Annual Performance Presentation

In Situ Oil Sands Schemes
9673 / 10147 / 10423 / 10787

April 2017

Premium Value | Defined Growth | Independent

Canadian Natural
Agenda

- Current Approvals
- Geological Overview
- Drilling, Completions, and Artificial Lift
- Field Performance and Surveillance
- Cap Rock Integrity & Monitoring
- Future Development Plans
- Facilities
- Measuring & Reporting
- Facility Future Plans
- Water Use, Conservation & Disposal
- AER Compliance
- Conclusions
Brintnell Location

The map shows the Brintnell location in Alberta, highlighting specific sections within Twp. 79 to 82 and R20 to R23.
Oil Sands Royalties (OSR 101, OSR 006)
Primary and Enhanced Approval Regions

Enhanced Recovery Schemes
- 10147
- 9673
- 10787
- 10423

Primary Recovery Schemes
- 6619
- 9466
- 9884
Wabiskaw ‘A’ Net Pay Map
Produced Oil Viscosity Map
The cap rock comprises the Clearwater Shales, Wabiskaw Marker and the Wabiskaw zone (which ranges in thickness from 80 to 95 meters) and overlies the Wabiskaw A Sand. Contained within this isopach are numerous tight streaks ranging from 1.5 - 4 meters in thickness throughout this interval; they are found in both the Clearwater shale interval the Wabiskaw marker interval, as illustrated in the accompanying log.
Brintnell Regional Reservoir Properties

- **Upper Wabiskaw Sand**
  - Depth of 300-425m TVD
  - Net Pay Range 1 – 9m
  - Porosity 28 – 32%
  - Permeability 300 – 3000md
  - Temperature 13-17 deg. C
  - Water Saturation 30 – 40%
  - Oil Viscosity (dead oil) 800 – 80,000cp @ 15 deg. C
  - Initial Reservoir Pressure 1900 – 2600kpa
Drilling, Completions, and Artificial Lift
• CNRL lands the intermediate casing within the Wabiskaw formation.
Typical Well Configurations

- **Producer**

  - Downhole Schematic (Heavy Oil) CNRES-TLPS BRENTNELL 15-04-01-22

- **Injector**

  - Downhole Schematic (Heavy Oil) CNRES-BF2 BRENTNELL 6-21-01-22

*Intermediate Casing landed in Wabiskaw sand (producers and injectors).*
EOR History and Current Approvals
Polymer Flood Development

Polymer Pilot started May 2005

Polymer Flood Start Dates
- 2006
- 2007
- 2008
- 2009
- 2010
- 2011
- 2012
- 2013
- 2014
The areas highlighted in blue for the map below started on waterflood (WF) prior to being converted to polymer flood (PF). All CNRL Pelican Lake water flood schemes have now been converted to polymer flood. Since 2007, all new enhanced recovery schemes are converted directly to polymer flooding.
Field Overview

Approximately 63% of the approved EOR scheme areas are currently developed and under flood as of the end of 2016.
Field Performance and Surveillance
Approval 10147 Production Update

Started Polymer Injection

Cum oil: 2,565 E3m3  Cum water: 1,860 E3m3  Cum injection: 5,222 E3m3
Approval 10147 Discussion

- Contains the most mature polymer flood patterns including the original pilot area which began flooding in 2005.
- First Polymer Response in April 2006 from the HTL6 Pilot area.
- Peak production occurred from mid 2007 to early 2010 at 650 m³/d oil.
- Injection returned to normal in 2014-2015 following a significant reduction in 2013 for offset drilling.
- Increased water cut was observed in 2016 due to the maturity of the flood.
- Water cut averaged roughly 65% during 2016.
- Oil viscosity ranges from 1,300 cp to 2,800 cP.
Approval 10423
Approval 10423 Production Update

Cum oil: 18,366 E3m3
Cum water: 18,315 E3m3
Cum injection: 39,891 E3m3

On Stream: 01/15/1981

Started Polymer Injection
Polymerflood started in 2006 covering roughly 5% of the approval area split between 3 small groups. The flood was expanded every year up to 2010. In 2012, small area from PRSA 9884 was added to the approval.

Currently 73% of the approval area is under flood.

Small portion of approval area under waterflood starting in 2003. This area was converted to polymer in 2008 and 2010.

First polymer response in July 2007 but due to the size and staged flood expansion, did not see a ramp up in oil volumes until early 2009.

Portions of the approval area are affected by higher in-situ water saturation and/or oil viscosity. Response in these regions has been more delayed and erratic when compared to other portions of the pool.

Oil viscosity ranges from 1,100 cp to 50,000 cp.

14 producers in WB 14 converted to injection in 2014. 6 producers in WB32 area converted to injection in 2015.

Average WCT in 2016 approximately 62%.
Approval 10787 Production Update

Cum oil: 8,835 E3m³
Cum water: 5,372 E3m³
Cum injection: 14,020 E3m³
• Polymer flood started in Dec 2007 covering roughly 4% of the approval area split into 2 small groups. There were no expansions until 2010, since then there has been an expansion completed in every year including 2013. Currently 45% of the approval area is under flood.

• First polymer response in Nov 2008 but due to the size and staged flood expansion, did not see a ramp up in oil volumes until mid 2012.

• Oil production increased in the late part of 2013 and early 2014, mostly due to new well activations.

• Polymer injection was commenced in the Peerless and Sandy Lake portions of the area in 2013, with the majority of wells exhibiting some form or polymer flood response.

• The BP 23-24 area has demonstrated reduced formation water production after 8 years of flooding.

• WCT increased slightly in 2016 to average roughly 55%.

• Oil viscosity ranges from 1,100 cp to 14,400 cp.
In May 2012, the 03/16-36-079-22W4 well intersected the 00/01-24-079-22W4 wellbore while drilling.

Numerous attempts were made to repair the 00/01-24 well but ultimately the wellbore could not be returned to service. A non-routine abandonment was conducted on 00/01-24 in March 2013. The 04/01-24-079-22W4 observation well was drilled in September 2013 to monitor the polymer flood near the 00/01-24 offset following consultations with the AER (Approval 10787K).

04/01-24-079-22W4 Monitoring Program:

- Produced water has been monitored continuously since Q4 2013. Through 2016, the well has not produced enough water to obtain a representative water analysis.
- The bottomhole reservoir pressure was measure quarterly in 2013/2014 and yearly in 2015/2016.
- The pressure was measured in November 2016 to be 548 kPa; this is comparable to measurements taken in previous years and in line with expectations for the Wabiskaw reservoir under primary depletion.
- CNRL will continue to monitor the produced watercut and take yearly pressure measurements on this well.
All injection is now polymer

Cum oil: 7,307 E3m3
Cum water: 11,463 E3m3
Cum Injection: 28,773 E3m3
Originally approved for waterflood in 2004; waterflood was expanded in 2005/2006 to cover roughly 40% of the current approval area.

Waterflood peak production occurred from late 2007 to early 2009 at 1850 m³/d oil.

Polymerflood began in Sept 2008 covering 6% of approval area. Existing waterflood patterns remained unchanged at this time.

In 2009 all waterflood areas were converted to polymer and a small expansion area from primary was added; additional small expansions from primary were conducted in each year from 2010 to 2012. Currently 70% of the approval area is under flood.

First polymer response occurred in Sept 2009 but due to declining production from the waterflood areas, have only recently started to see a ramp up in oil volumes from the polymer flood.
• The conversion from water to polymer has had a dramatic effect on the conformance of the flood. Within two years of conversion for most areas, watercuts declined.
• In 2016 watercut averaged about 58%.
• Oil viscosity ranges from 600 cp to 13,000 cp.
Results from polymer flood after waterflood areas vary by pattern but do show substantial polymer flood response on both oil and WCU. The range of performance is similar to that experienced in polymer after primary.
Estimated Ultimate Recovery Factors for Flooded Areas (excludes primary areas)

**Approval 9673**
- Total area OBIP 97.4 E^6m^3
- OBIP under flood: 78.4 E^6m^3
- Primary RF: 3%
- RF to date: 9%
- Estimated ultimate recovery factors: 17-22%

**Approval 10787**
- Total area OBIP 205.2 E^6m^3
- OBIP under flood: 81.4 E^6m^3
- Primary RF: 5%
- RF to date: 10%
- Estimated ultimate recovery factors: 23-30%

**Approval 10147**
- Total area OBIP 8.98 E^6m^3
- OBIP under flood: 8.98 E^6m^3
- Primary RF: 5%
- RF to date: 28%
- Estimated ultimate recovery factors: 32-38%

**Approval 10423**
- Total area OBIP 229.0 E^6m^3
- OBIP under flood: 163.8 E^6m^3
- Primary RF: 6%
- RF to date: 11%
- Estimated ultimate recovery factors: 24-30%

*RF to-date represents the RF from the polymer flooding areas only. Estimated RF range represents RF from areas recognized for EOR reserves by reserve auditor.*
Good Performance – HTL4 (Approval 10147)

- **HTL4 100/14-33 Pattern**
  - **Well list and allocation factors:**
    - **Injectors**
      - 100/14-33-081-22W4/0 (100%)
    - **Producers**
      - 102/14-33-081-22W4/0 (50%)
      - 103/13-33-081-22W4/0 (50%)
Good Performance – HTL4 (Approval 10147)
Average Performance – BP6 (Approval 10787)

- BP6 100/6-20 Pattern
  - Well List and allocation factors:
    - Injectors
      - 100/06-20-081-22W4/0 (100%)
    - Producers:
      - 100/03-20-081-22W4/0 (50%)
      - 102/06-20-081-22W4/0 (50%)

Approval 10787
Average Performance – BP6 (Approval 10787)

BPF#06_00/06-20-081-22W4/0
Polymer flood after Primary

Graph showing trends over time for Liquid Rate, Oil Rate, Water Cut, Water Flow, and Water Injection Pressure.
Below Average Performance – SB 29 (Approval 10423)

• SB 29 102/08-13 Pattern
  ▪ Well List and allocation factors:
    Injector
      ➢ 102/08-13-080-22W4/0 (100%)
    Producers
      ➢ 100/01-13-080-22W4/0 (50%)
      ➢ 100/08-13-080-22W4/0 (50%)
Below Average Performance – SB 29 (Approval 10423)

SBP#29_02/08-13-080-22W4/0
Polymer flood after Primary

- Liquid Rate (m³/d)
- CI Rate (m³/d)

- Water Cut (%)

- Water Injection (m³/d)
- Water Injection Pressure (psi)

Date

- 2001  02  03  04  05  06  07  08  09  10  11  12  13  14  15  16  17

- 0  20  40  60  80  100

- 0  20  40  60  80  100

- 0  200  400  600  800  1000

- 0  1500  3000  4500  6000  7500
Summary of Good/Average/Poor Areas

Plot showing Recovery Factor (RF) versus Pore Volume (PF) Injected. Indicates effectiveness and performance of the flood.
High Viscosity Performance – SB 41 (Approval 10423)

• SB 41 102/01-13 Pattern
  ▪ Well list and allocation factors:
    Injectors
      ➢ 102/01-13-080-22W4/0 (100%)
    Producers
      ➢ 100/01-13-080-22W4/0 (50%)
      ➢ 102/16-12-080-22W4/0 (50%)
High Viscosity Performance – SB 41 (Approval 10423)

SBP#41_02/01-13-080-22W4/0
Polymer flood after Primary

Liquid Rate (m3/d)
Oil Rate (m3/d)
Water influx (m3/d)

Date

Date

0 20 40 60 80 100

0 20 40 60 80 100

0 200 400 600 800 1000 1200 1400 1600 1800 2000

0 20 40 60 80 100

2009 10 11 12 13 14 15 16 17 18 19 20
Experience with higher viscosity flooding has been varied but indications are that response is to be expected but is harder to predict

- In the example total production from pattern has doubled in response to polymer flooding
- Water cut response has been muted compared to lower viscosity examples

Lower injection rates and slower response characteristic of polymer flooding higher viscosity oil.
Cap Rock Integrity
## Cap Rock Integrity

- **2016 Anomalies (7 in total)**

<table>
<thead>
<tr>
<th>Date of Event</th>
<th>Location</th>
<th>Cause of Alarm</th>
<th>Operations Review of Injection Well</th>
<th>Initial Injection Pressure</th>
<th>Anomalous Pressure</th>
<th>Initial Injection Rate</th>
<th>Anomalous Rate</th>
<th>Cause of Anomaly</th>
</tr>
</thead>
<tbody>
<tr>
<td>June 26, 2016</td>
<td>NBP 9: 00/14-35-08-21W4/0</td>
<td>Drop in injection pressure/injection rate increase</td>
<td>Surface facilities and instrumentation checked and found to be working properly</td>
<td>4850</td>
<td>4240</td>
<td>43</td>
<td>53</td>
<td>Breakthrough to offsetting production wells</td>
</tr>
<tr>
<td>Sept 18th, 2016</td>
<td>NBP 9: 00/14-35-08-21W4/0</td>
<td>Drop in injection pressure</td>
<td>Surface facilities and instrumentation checked and found to be working properly</td>
<td>4610</td>
<td>3365</td>
<td>39</td>
<td>39</td>
<td>Breakthrough to offsetting production wells</td>
</tr>
<tr>
<td>Sept 19th, 2016</td>
<td>BP 19: 02/06-03-081-22W4/0</td>
<td>Drop in injection pressure/injection rate increase</td>
<td>Surface facilities and instrumentation checked and found to be working properly</td>
<td>4817</td>
<td>3955</td>
<td>94</td>
<td>147</td>
<td>Flood accessing new higher permeability reservoir</td>
</tr>
<tr>
<td>October 1, 2016</td>
<td>NBP 8: 00/13-35-08-21W4/2</td>
<td>Drop in injection pressure/injection rate increase</td>
<td>Surface facilities and instrumentation checked and found to be working properly</td>
<td>5423</td>
<td>4668</td>
<td>57</td>
<td>78</td>
<td>Flood accessing new higher permeability reservoir</td>
</tr>
<tr>
<td>October 4, 2016</td>
<td>NBP28 100/16-36-082-20W4/0</td>
<td>Drop in injection pressure</td>
<td>Surface facilities and instrumentation checked and found to be working properly</td>
<td>4914</td>
<td>3708</td>
<td>27</td>
<td>27</td>
<td>Breakthrough to offsetting production wells</td>
</tr>
<tr>
<td>October 29, 2016</td>
<td>BP 25: W0/05-10-081-22W4/0</td>
<td>Drop in injection pressure/injection rate increase</td>
<td>Surface facilities and instrumentation checked and found to be working properly</td>
<td>5181</td>
<td>4387</td>
<td>67</td>
<td>78</td>
<td>Flood accessing new higher permeability reservoir</td>
</tr>
<tr>
<td>November 20, 2016</td>
<td>BP 17: 00/15-16-081-22W4/0</td>
<td>Drop in injection pressure/injection rate increase</td>
<td>Surface facilities and instrumentation checked and found to be working properly</td>
<td>5006</td>
<td>4493</td>
<td>60</td>
<td>99</td>
<td>Flood accessing new higher permeability reservoir</td>
</tr>
</tbody>
</table>

- **5 anomalies in 2015, 7 anomalies in 2014, 4 anomalies in 2013, 9 anomalies in 2012; 18 anomalies in 2011**

All seven 2016 anomalies were fully investigated. All injectors are back on-stream under normal operating conditions and have regained pressure following the event.
Injection rate was lowered immediately after anomaly. Injection rate remained stable with injection pressure climbing higher than pre-anomaly level within several weeks.

- Offsetting production wells monitored post anomaly with no change if offsetting WCT observed.
- Injection pressure exceeded pre-anomaly levels within several weeks.
- Cause of anomaly determined a function of reservoir heterogeneity and flood accessing higher permeability reservoir as no change in offsetting WCT observed and pressure built above pre-anomaly levels.

**BP 25: W0/05-10-081-22W4/0 Injection History**

- **Injection Anomaly**: 5194 kPa
- **Injection Pressure**: 5638 kPa
- **Daily Rate**: 67m3/d
  - **Injection Rate**: 78m3/d
  - **Injection Pressure**: 5638 kPa

**W0/05-10-081-22W4/0**: Injection rate was lowered immediately after anomaly. Injection rate remained stable with injection pressure climbing higher than pre-anomaly level within several weeks.
Hall plots are reviewed regularly to investigate potential cap rock breaches. A sudden change in the Hall Plot slope may indicate a potential issue.
Future Development Plans
Future Development Plans

- Canadian Natural plans to continue with the expansion of the polymer flood at Brintnell over the next several years. Expansion will push the flood to the southeastern and western edges of the pool.
- The focus of this year’s capital program will be infill drilling and polymer flood optimization of existing well patterns. Optimization will be achieved through continuous flood management to ensure balance and optimal recovery factor.
- CNRL received approval in 2012 to implement a surfactant pilot in the field. CNRL is not pursuing surfactant flooding at the present time.
Facilities
Brintnell Batteries

- South Brintnell Battery
- North Brintnell Battery
- Central 1-36 Brintnell Battery
Facility: NB 07-27-82-21W4 Battery Plot Plan

Refer to Appendix A
Facility: CB 01-36-80-22W4 Battery Plot Plan

Refer to Appendix A
Facility: Typical Brintnell Battery PFD

Refer to Appendix B
### Brintnell Power Consumption

#### Table: Power Consumption - KWH

<table>
<thead>
<tr>
<th></th>
<th>Jan-16</th>
<th>Feb-16</th>
<th>Mar-16</th>
<th>Apr-16</th>
<th>May-16</th>
<th>Jun-16</th>
<th>Jul-16</th>
<th>Aug-16</th>
<th>Sep-16</th>
<th>Oct-16</th>
<th>Nov-16</th>
<th>Dec-16</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Central</td>
<td>5,880,640</td>
<td>5,226,063</td>
<td>5,458,563</td>
<td>5,090,711</td>
<td>4,717,776</td>
<td>4,221,819</td>
<td>4,126,621</td>
<td>3,940,437</td>
<td>3,784,130</td>
<td>4,764,569</td>
<td>5,667,146</td>
<td>6,044,215</td>
<td>58,922,690</td>
</tr>
<tr>
<td>South</td>
<td>8,221,987</td>
<td>7,301,424</td>
<td>7,890,070</td>
<td>7,187,245</td>
<td>5,950,432</td>
<td>5,098,711</td>
<td>5,010,761</td>
<td>4,830,538</td>
<td>5,125,216</td>
<td>6,755,010</td>
<td>7,747,347</td>
<td>8,816,008</td>
<td>79,934,749</td>
</tr>
<tr>
<td></td>
<td>19,787,344</td>
<td>17,553,004</td>
<td>18,576,803</td>
<td>17,006,727</td>
<td>14,452,102</td>
<td>12,614,321</td>
<td>12,143,319</td>
<td>11,604,640</td>
<td>12,025,655</td>
<td>16,166,055</td>
<td>18,484,199</td>
<td>20,748,537</td>
<td>191,162,706</td>
</tr>
</tbody>
</table>

#### Graph: Brintnell Power Consumption (KWH)

- **Central Brintnell Power**
- **South Brintnell Power**
- **North Brintnell Power**
Facility Modifications

• Reasons for Modifications:

  ▪ **Oil Treating:**
    – Heat integration: Installing indirect heating projects to reduce OPEX. Currently investigating other opportunities.
    – Optimizing battery process

  ▪ **Integrity:**
    – Implementing plan to rebuild existing flood areas; future flood areas to be rebuilt as the flood is expanded
    – Construction and routine monitoring ongoing. Working towards 2019 compliance.
    – All high risk sour pipelines have been lined as of Feb, 2014

  ▪ **Improve Water Quality:**
    – De-oiling and Filtration
## Battery Performance

<table>
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<tr>
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</tr>
</thead>
<tbody>
<tr>
<td><strong>North Brintnell 7-27</strong></td>
<td></td>
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<td></td>
<td></td>
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</tr>
<tr>
<td>Oil Produced (m³)</td>
<td>705,917</td>
<td>809,627</td>
<td>959,335</td>
<td>988,448</td>
<td>957,855</td>
<td>835,263</td>
<td>1,075,836</td>
<td>1,027,258</td>
<td>937,154</td>
<td>900,340</td>
<td>644,768</td>
</tr>
<tr>
<td>Produced Water (m³)</td>
<td>1,374,731</td>
<td>1,775,300</td>
<td>2,096,258</td>
<td>2,292,879</td>
<td>2,386,085</td>
<td>1,484,277</td>
<td>1,795,440</td>
<td>1,567,398</td>
<td>1,772,860</td>
<td>1,618,804</td>
<td>1,325,432</td>
</tr>
<tr>
<td>Recycle Rates (m³)</td>
<td>1,220,482</td>
<td>1,779,160</td>
<td>2,057,161</td>
<td>2,238,740</td>
<td>2,330,418</td>
<td>1,453,711</td>
<td>1,786,316</td>
<td>1,559,325</td>
<td>1,772,860</td>
<td>1,618,804</td>
<td>1,325,432</td>
</tr>
<tr>
<td>Produce Recycle</td>
<td>88.8%</td>
<td>100.2%</td>
<td>98.1%</td>
<td>97.6%</td>
<td>97.7%</td>
<td>97.9%</td>
<td>99.8%</td>
<td>99.8%</td>
<td>100.0%</td>
<td>100.0%</td>
<td>100.0%</td>
</tr>
<tr>
<td>Average Daily Recycle (m³/d)</td>
<td>3,344</td>
<td>4,874</td>
<td>5,621</td>
<td>6,134</td>
<td>6,385</td>
<td>3,982</td>
<td>4,881</td>
<td>4,272</td>
<td>4,857</td>
<td>4,435</td>
<td>3,621</td>
</tr>
<tr>
<td>Average Disposal Rates (m³/d)</td>
<td>423</td>
<td>-11</td>
<td>107</td>
<td>148</td>
<td>153</td>
<td>85</td>
<td>25</td>
<td>22</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

| **Central Brintnell 12-09** |               |           |           |           |           |           |           |           |           |           |           |
| Oil Produced (m³) | 568,076   | 603,657   | 569,149   | 533,178   | 528,267   | 492,495   | 546,580   | 237,914   | 1,080,977 | 1,055,952 | 1,298,572 |
| Produced Water (m³) | 167,755   | 193,349   | 267,607   | 378,988   | 323,086   | 402,772   | 402,822   | 143,284   | 638,159   | 615,263   | 1,908,506 |
| Recycle Rates (m³) | 0         | 26,826    | 159,288   | 346,418   | 301,720   | 357,025   | 329,781   | 104,583   | 565,099   | 1,615,263 | 2,150,738 |
| Produce Recycle | 0.0%      | 13.9%     | 59.5%     | 91.4%     | 93.4%     | 88.6%     | 81.9%     | 73.0%     | 88.6%     | 83.0%     | 83.7%     |
| Average Daily Recycle (m³/d) | 0 | 73 | 435 | 949 | 827 | 978 | 901 | 775 |
| Average Disposal Rates (m³/d) | 460 | 456 | 296 | 89 | 59 | 125 | 200 | 106 |

| **Central Brintnell 01-36** |                           |           |           |           |           |           |           |           |           |           |           |
| Oil Produced (m³) | 441,942   | 575,306   | 620,631   | 602,897   | 645,053   | 782,847   | 1,080,977 | 1,055,952 | 1,220,367 | 1,100,589 | 840,998   |
| Produced Water (m³) | 341,034   | 413,480   | 501,318   | 544,390   | 776,095   | 1,014,789 | 1,505,539 | 1,494,985 | 1,205,459 | 1,278,060 | 1,438,774 |
| Recycle Rates (m³) | 0         | 22,465    | 173,011   | 204,727   | 173,120   | 823,109   | 1,412,965 | 1,384,546 | 1,172,557 | 1,173,748 |
| Produce Recycle | 0.0%      | 5.4%      | 34.5%     | 37.6%     | 34.5%     | 93.9%     | 92.6%     | 90.5%     | 91.7%     | 91.7%     | 91.7%     |
| Average Daily Recycle (m³/d) | 0 | 62 | 473 | 561 | 474 | 2,255 | 3,861 | 3,793 | 2,990 | 3,212 | 3,207 |
| Average Disposal Rates (m³/d) | 318 | 907 | 1,204 | 1,146 |

| **South Brintnell 9-02** |                             |           |           |           |           |           |           |           |           |           |           |
| Oil Produced (m³) | 1,715,934 | 1,988,589 | 2,149,115 | 2,124,523 | 2,131,175 | 2,110,605 | 2,703,393 | 2,905,421 | 2,957,339 | 2,957,339 | 2,957,339 |
| Produced Water (m³) | 1,883,520 | 2,382,129 | 2,865,183 | 3,216,258 | 3,485,267 | 2,901,838 | 3,703,800 | 3,843,826 | 4,924,563 | 5,244,736 | 5,334,455 |
| Recycle Rates (m³) | 1,220,482 | 1,828,451 | 2,389,460 | 2,789,885 | 2,805,257 | 2,633,505 | 3,529,061 | 4,194,985 | 1,205,459 | 1,278,060 | 1,438,774 |
| Fresh Water (m³) | 512,766   | 1,026,684 | 1,493,264 | 1,433,242 | 1,553,045 | 1,479,780 | 1,876,840 | 2,041,938 | 2,028,731 | 1,937,567 | 1,916,943 |
| Brackish Water (m³) | 1,438,110 | 1,661,989 | 764,664   | 2,963,684 | 3,999,848 | 6,274,361 | 4,780,011 | 3,800,437 | 3,666,120 | 3,133,047 | 2,276,529 |
| Total Produce Recycle (%) | 64.8%      | 76.8%     | 83.4%     | 86.7%     | 80.5%     | 90.8%     | 95.3%     | 94.0%     | 91.0%     | 89.6%     | 87.2%     |
| Average Daily Recycle (m³/d) | 3,344 | 5,009 | 6,529 | 7,644 | 7,686 | 7,215 | 9,642 | 9,900 | 12,273 | 12,876 | 12,705 |
| Average Daily Disposal (m³/d) | 1,817 | 1,517 | 1,300 | 1,168 | 1,863 | 735 | 477 | 748 | 1,219 | 1,493 | 1,870 |
Measuring and Reporting
Measurement and Reporting

• Methods of Measurement:
  ▪ Oil and Water: flow meters and test tanks (Primary only)
  ▪ Solution Gas: orifice meters/GOR Testing

• Typical Well Testing:
  ▪ Frequency and duration: well testing as per Directive 17.
  ▪ Meter installations have replaced test tanks (high volume and flood producers).
    – Part of all new pad expansions and rebuilds.

• 2016 Field Proration Factors:
  ▪ Meets directive 17 requirements (Oil: 0.85, Water: 1.08)
• Optimization:
  - Remove test tanks and install flow meters on pads/wells
    - Increase testing frequency and duration
    - Perform testing inline
    - Eliminates gas venting from tanks
    - Reduces fuel gas consumption
    - Reduces potential for spill
  - Standardize testing equipment across field
    - Reduce downtime and maintenance
    - Increase reliability in calibration
    - Improve & revise BS&W testing procedures for better accuracy
### Brintnell Gas Volumes - Update

#### Gas Volumes (e3m³)

<table>
<thead>
<tr>
<th></th>
<th>Jan-16</th>
<th>Feb-16</th>
<th>Mar-16</th>
<th>Apr-16</th>
<th>May-16</th>
<th>Jun-16</th>
<th>Jul-16</th>
<th>Aug-16</th>
<th>Sep-16</th>
<th>Oct-16</th>
<th>Nov-16</th>
<th>Dec-16</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>DISP</td>
<td>4,874</td>
<td>4,549</td>
<td>4,927</td>
<td>4,710</td>
<td>4,858</td>
<td>4,329</td>
<td>4,418</td>
<td>4,282</td>
<td>4,440</td>
<td>4,612</td>
<td>4,289</td>
<td>4,088</td>
<td>54,376</td>
</tr>
<tr>
<td>FLARE</td>
<td>121</td>
<td>67</td>
<td>66</td>
<td>69</td>
<td>85</td>
<td>117</td>
<td>182</td>
<td>162</td>
<td>80</td>
<td>88</td>
<td>83</td>
<td>238</td>
<td>1,357</td>
</tr>
<tr>
<td>PROD</td>
<td>5,601</td>
<td>5,150</td>
<td>5,537</td>
<td>5,062</td>
<td>5,437</td>
<td>4,846</td>
<td>4,927</td>
<td>4,689</td>
<td>4,819</td>
<td>5,001</td>
<td>4,724</td>
<td>4,597</td>
<td>60,391</td>
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<tr>
<td>PUREDISP</td>
<td>64</td>
<td>85</td>
<td>89</td>
<td>95</td>
<td>60</td>
<td>76</td>
<td></td>
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<td>469</td>
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<td>PURREC</td>
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<td>85</td>
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<td>95</td>
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<td>76</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>469</td>
</tr>
<tr>
<td>VENT</td>
<td>356</td>
<td>266</td>
<td>261</td>
<td>270</td>
<td>265</td>
<td>283</td>
<td>304</td>
<td>304</td>
<td>317</td>
<td>314</td>
<td>395</td>
<td>380</td>
<td>3,713</td>
</tr>
</tbody>
</table>

- Produced gas is captured, processed and used throughout the field as consumable fuel gas.
- Venting only occurs at the well leases when D-60 requirements have been approved by the AER. No sour gas vented.
- Year over year reductions in vented and flared gas volumes
Future Facility Plans
Facility Future Plans

• Major Activities:
  ▪ Pad Rebuilds
  ▪ Future Polymer Expansions
  ▪ Water Management Plan
Water Use
Non-Saline Water Use

- Canadian Natural currently has license 00249595-00-00 with Alberta Energy Regulator for the annual diversion of up to 2,151,310 m3 of non-saline water for injection with an expiry date of 2019-01-25.
  - CNRL received a renewal of this license in early 2014.
- Canadian Natural has not increased the amount of licensed non-saline water since 2006, yet has significantly increased the amount of area under flood as seen in the polymer flood section of this presentation.
- Working to optimize the use of fresh water for polymer hydration to maximize its benefit
- Significant investment has been made in infrastructure and increased operating cost in order to continue to expand the polymer flood without the use of additional non-saline water to our current license.
- In Compliance with Alberta Environment and Water regarding monthly reporting, observation well monitoring, and all other terms of the License.
Brintnell Total Injection

2016 Brintnell Total Injection

- Non-Saline Make-Up Water
- Saline Make-Up Water
- PW to Injection
## 2016 Injection Water Summary

### 2016 Polymer Injection Volumes (m³)

<table>
<thead>
<tr>
<th></th>
<th>Jan</th>
<th>Feb</th>
<th>Mar</th>
<th>Apr</th>
<th>May</th>
<th>Jun</th>
<th>Jul</th>
<th>Aug</th>
<th>Sep</th>
<th>Oct</th>
<th>Nov</th>
<th>Dec</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Produced Water to Injection</strong></td>
<td>361,568</td>
<td>320,192</td>
<td>368,792</td>
<td>348,762</td>
<td>358,408</td>
<td>342,411</td>
<td>366,221</td>
<td>388,012</td>
<td>403,739</td>
<td>388,431</td>
<td>416,131</td>
<td>444,370</td>
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<tr>
<td><strong>Fresh Make-Up Water</strong></td>
<td>165,864</td>
<td>152,842</td>
<td>169,033</td>
<td>151,731</td>
<td>153,981</td>
<td>157,362</td>
<td>159,819</td>
<td>159,857</td>
<td>157,942</td>
<td>166,232</td>
<td>157,629</td>
<td>164,651</td>
</tr>
<tr>
<td><strong>Saline Make-Up Water</strong></td>
<td>178,470</td>
<td>151,138</td>
<td>185,998</td>
<td>176,611</td>
<td>180,006</td>
<td>187,861</td>
<td>205,805</td>
<td>202,106</td>
<td>222,768</td>
<td>218,065</td>
<td>185,436</td>
<td>182,266</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>705,902</td>
<td>624,171</td>
<td>723,823</td>
<td>677,104</td>
<td>692,395</td>
<td>687,634</td>
<td>731,845</td>
<td>749,975</td>
<td>784,449</td>
<td>772,728</td>
<td>759,196</td>
<td>791,286</td>
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</tbody>
</table>

### Total Injection Volumes (m³)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Produced Water to Injection</strong></td>
<td>2,382,129</td>
<td>2,865,183</td>
<td>3,216,258</td>
<td>3,485,267</td>
<td>3,888,006</td>
<td>3,522,671</td>
<td>3,380,618</td>
<td>4,617,604</td>
<td>4,507,036</td>
<td>52%</td>
</tr>
<tr>
<td><strong>Fresh Make-Up Water</strong></td>
<td>1,026,684</td>
<td>1,493,264</td>
<td>1,433,242</td>
<td>1,553,045</td>
<td>1,479,780</td>
<td>1,876,840</td>
<td>2,041,938</td>
<td>1,937,567</td>
<td>1,916,943</td>
<td>22%</td>
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<tr>
<td><strong>Saline Make-Up Water</strong></td>
<td>1,661,989</td>
<td>764,664</td>
<td>2,963,684</td>
<td>3,999,848</td>
<td>6,274,361</td>
<td>4,780,011</td>
<td>3,666,120</td>
<td>3,133,047</td>
<td>2,276,529</td>
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<td><strong>Total</strong></td>
<td>5,070,802</td>
<td>5,123,111</td>
<td>7,613,184</td>
<td>9,038,160</td>
<td>10,655,979</td>
<td>10,044,856</td>
<td>9,365,047</td>
<td>10,085,470</td>
<td>9,688,218</td>
<td>8,700,507</td>
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Non-Saline Well Locations
## Non-Saline Water Make up Wells

<table>
<thead>
<tr>
<th>Well Name</th>
<th>UWI</th>
<th>Production Interval</th>
<th>Maximum Rate of Diversion (m³/d)</th>
<th>Maximum Annual Diversion Volume (m³/d)</th>
<th>2016 Average Diversion Volumes (m³/d)</th>
<th>2016 Total Non-Saline Water</th>
</tr>
</thead>
<tbody>
<tr>
<td>WSW BP25 - QUAT</td>
<td>100/08-04-081-22W4/00</td>
<td>53.3-65.2</td>
<td>818</td>
<td>247,470</td>
<td>525</td>
<td></td>
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<tr>
<td>WSW BP11 - QUAT</td>
<td>1F2/13-04-081-22W4/00</td>
<td>34.3-38.8</td>
<td>1200</td>
<td>153,300</td>
<td>410</td>
<td></td>
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<tr>
<td>WSW BP2 - GR</td>
<td>1AA/12-16-081-22W4/02</td>
<td>270.6-317.6</td>
<td>1200</td>
<td>778</td>
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<td></td>
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<tr>
<td>WSW BP11 - GR</td>
<td>1F1/13-04-081-22W4/00</td>
<td>258.5-315.9</td>
<td>812</td>
<td>725</td>
<td></td>
<td></td>
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<tr>
<td>WSW HTP2 - GR</td>
<td>1F1/13-29-081-22W4/00</td>
<td>265.8-326.8</td>
<td>2250</td>
<td>1,354</td>
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<tr>
<td>WSW HTP6 - GR</td>
<td>1F1/15-27-081-22W4/00</td>
<td>264.8-317.8</td>
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<td>394</td>
<td></td>
<td></td>
</tr>
<tr>
<td>WSW NHTP16 - GR</td>
<td>1F1/01-17-082-23W4/00</td>
<td>253.0-310.0</td>
<td>933</td>
<td>507</td>
<td></td>
<td></td>
</tr>
<tr>
<td>WSW WBP30 - GR</td>
<td>100/15-20-081-22W4/00</td>
<td>260-315</td>
<td>750</td>
<td>182</td>
<td></td>
<td></td>
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<tr>
<td>WSW NHP13 - GR</td>
<td>100/07-05-082-23W4/00</td>
<td>232-302</td>
<td>325</td>
<td>256</td>
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</tr>
<tr>
<td>WSW NHP15 - GR</td>
<td>100/08-08-082-23W4/00</td>
<td>243-305</td>
<td>225</td>
<td>106</td>
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</tbody>
</table>

### 2016 Total Non-Saline Water

![Graph showing 2016 Total Non-Saline Water](chart.png)
## Water Chemistry

### Non-Saline Water Source Wells

<table>
<thead>
<tr>
<th>Monitoring Well</th>
<th>Sample Date</th>
<th>Lab pH</th>
<th>Lab EC µS/cm</th>
<th>Ca mg/L</th>
<th>Mg mg/L</th>
<th>Na mg/L</th>
<th>K mg/L</th>
<th>T-Alkalinity mg/L</th>
<th>HCO₃⁻ mg/L</th>
<th>CO₃²⁻ mg/L</th>
<th>NO₂⁻ mg/L</th>
<th>NO₃⁻ mg/L</th>
<th>NO₂⁻+NO₃⁻ mg/L</th>
<th>Hardness mg/L</th>
<th>TDS mg/L</th>
</tr>
</thead>
<tbody>
<tr>
<td>WSW HTP 2 - GR</td>
<td>25-Jul-15</td>
<td>8.95</td>
<td>2600</td>
<td>2.05</td>
<td>1.41</td>
<td>608</td>
<td>3.64</td>
<td>82.6</td>
<td>1270</td>
<td>1340</td>
<td>&lt;0.60</td>
<td>&lt;0.020</td>
<td>&lt;0.045</td>
<td>10.9</td>
<td>1460</td>
</tr>
<tr>
<td>WSW HTP 6 - GR</td>
<td>25-Jul-15</td>
<td>8.95</td>
<td>2580</td>
<td>1.95</td>
<td>1.34</td>
<td>602</td>
<td>3.58</td>
<td>91.3</td>
<td>1250</td>
<td>1320</td>
<td>&lt;0.60</td>
<td>&lt;0.020</td>
<td>&lt;0.045</td>
<td>10.4</td>
<td>1450</td>
</tr>
<tr>
<td>WSW NHTP 13 - GR</td>
<td>26-Jul-15</td>
<td>8.65</td>
<td>2570</td>
<td>2.35</td>
<td>1.56</td>
<td>603</td>
<td>4.17</td>
<td>94.8</td>
<td>1260</td>
<td>1400</td>
<td>&lt;0.60</td>
<td>&lt;0.020</td>
<td>&lt;0.045</td>
<td>12.3</td>
<td>1470</td>
</tr>
<tr>
<td>WSW NHTP 15 - GR</td>
<td>26-Jul-15</td>
<td>8.96</td>
<td>2560</td>
<td>1.88</td>
<td>1.52</td>
<td>610</td>
<td>3.71</td>
<td>99.8</td>
<td>1230</td>
<td>1300</td>
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<td>&lt;0.020</td>
<td>&lt;0.045</td>
<td>11</td>
<td>1460</td>
</tr>
<tr>
<td>WSW NHTP 16 - GR</td>
<td>26-Jul-15</td>
<td>8.93</td>
<td>2670</td>
<td>1.99</td>
<td>1.71</td>
<td>637</td>
<td>3.99</td>
<td>93.2</td>
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<td>1430</td>
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<td>&lt;0.050</td>
<td>&lt;0.10</td>
<td>&lt;0.11</td>
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<tr>
<td>WSW BP 2 - GR</td>
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<td>8.94</td>
<td>2470</td>
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<td>1.23</td>
<td>609</td>
<td>3.57</td>
<td>89</td>
<td>1210</td>
<td>1270</td>
<td>&lt;0.60</td>
<td>&lt;0.020</td>
<td>&lt;0.045</td>
<td>9.7</td>
<td>1430</td>
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<tr>
<td>WSW BP 11 - GR</td>
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<td>2390</td>
<td>1.74</td>
<td>1.17</td>
<td>595</td>
<td>3.53</td>
<td>76</td>
<td>1210</td>
<td>1280</td>
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<td>&lt;0.020</td>
<td>&lt;0.045</td>
<td>9.2</td>
<td>1410</td>
</tr>
<tr>
<td>WSW BP 11 - Quat</td>
<td>25-Jul-15</td>
<td>8.54</td>
<td>740</td>
<td>88</td>
<td>24.1</td>
<td>53.8</td>
<td>4.9</td>
<td>0.73</td>
<td>329</td>
<td>369</td>
<td>16.2</td>
<td>73.8</td>
<td>0.010</td>
<td>0.062</td>
<td>319</td>
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<tr>
<td>WSW BP 25 - Quat</td>
<td>19-Jan-16</td>
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<td>1600</td>
<td>129</td>
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<td>487</td>
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<td>WB30 - GR</td>
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<td>9.01</td>
<td>2610</td>
<td>2.22</td>
<td>1.37</td>
<td>631</td>
<td>3.74</td>
<td>98.3</td>
<td>1330</td>
<td>1380</td>
<td>&lt;0.60</td>
<td>&lt;0.020</td>
<td>&lt;0.045</td>
<td>11.2</td>
<td>1540</td>
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</tbody>
</table>

### Saline Water Source Wells – Grosmont

- **Typical TDS range – 22,000-35,000 mg/L**
Saline Water Source Map
### 2016 Saline Water Source Well Diversion Volumes (m³)

<table>
<thead>
<tr>
<th>Non-Saline Wells</th>
<th>Jan-16</th>
<th>Feb-16</th>
<th>Mar-16</th>
<th>Apr-16</th>
<th>May-16</th>
<th>Jun-16</th>
<th>Jul-16</th>
<th>Aug-16</th>
<th>Sep-16</th>
<th>Oct-16</th>
<th>Nov-16</th>
<th>Dec-16</th>
<th>Totals</th>
</tr>
</thead>
<tbody>
<tr>
<td>1F1/01-36-080-22W4/00</td>
<td>58,502</td>
<td>52,120</td>
<td>58,871</td>
<td>60,327</td>
<td>63,188</td>
<td>62,001</td>
<td>58,853</td>
<td>59,414</td>
<td>65,057</td>
<td>63,402</td>
<td>57,681</td>
<td>61,669</td>
<td>721,085</td>
</tr>
<tr>
<td>1F1/02-32-080-22W4/00</td>
<td>40,974</td>
<td>43,048</td>
<td>38,919</td>
<td>33,485</td>
<td>33,073</td>
<td>29,408</td>
<td>42,662</td>
<td>55,107</td>
<td>58,749</td>
<td>38,798</td>
<td>30,496</td>
<td></td>
<td>478,320</td>
</tr>
<tr>
<td>1F1/08-08-081-22W4/00</td>
<td>11,050</td>
<td>17,507</td>
<td>14,626</td>
<td>4,200</td>
<td>3,417</td>
<td>16,937</td>
<td>30,795</td>
<td>23,490</td>
<td>10,232</td>
<td>0</td>
<td>594</td>
<td>2,940</td>
<td>135,788</td>
</tr>
<tr>
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<td>13,755</td>
<td>23,428</td>
<td>24,752</td>
<td>27,382</td>
<td>26,706</td>
<td>23,231</td>
<td>29,106</td>
<td>34,655</td>
<td>20,089</td>
<td>41,034</td>
<td>38,747</td>
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<td>760</td>
<td>707</td>
<td>302</td>
<td>366</td>
<td>4,176</td>
<td>1,733</td>
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<td>31,674</td>
<td>24,500</td>
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<td>48,250</td>
<td>59,342</td>
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<td>45,356</td>
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<td>8,781</td>
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<td>1F1/12-14-080-22W4/00</td>
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<tr>
<td>1F1/11-26-082-20W4/00</td>
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<tr>
<td>1F1/12-27-082-21W4/00</td>
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<tr>
<td>1F1/06-02-082-22W4/00</td>
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</tr>
<tr>
<td>1F2/14-11-082-22W4/00</td>
<td></td>
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</tr>
</tbody>
</table>

| TOTAL SALINE                | 178,470 | 151,138 | 185,998 | 176,611 | 180,006 | 187,861 | 205,805 | 202,106 | 222,768 | 218,065 | 185,436 | 182,266 | 2,276,529 |

- Inactive wells above have been suspended and could be reactivated for future use.
Water Usage and Disposal

- Continued to focus on maintaining high water recycling ratios.
  - **2016 recycle at 87.2%.**
- CNRL continues to be in compliance with AENV water diversion license.

<table>
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<tbody>
<tr>
<td>Produced Water for Injection (m3)</td>
<td>2,382,129</td>
<td>2,865,183</td>
<td>3,216,258</td>
<td>3,485,267</td>
<td>2,901,838</td>
<td>3,703,800</td>
<td>3,522,671</td>
<td>4,390,618</td>
<td>4,617,604</td>
<td>4,507,036</td>
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<tr>
<td>Fresh Water (m3)</td>
<td>1,026,684</td>
<td>1,493,264</td>
<td>1,433,242</td>
<td>1,553,045</td>
<td>1,479,780</td>
<td>1,876,840</td>
<td>2,041,938</td>
<td>2,028,731</td>
<td>1,937,567</td>
<td>1,916,943</td>
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<tr>
<td>Brackish Water (m3) - Grosmont</td>
<td>1,661,989</td>
<td>764,664</td>
<td>2,963,684</td>
<td>3,999,848</td>
<td>6,274,361</td>
<td>4,780,011</td>
<td>3,800,437</td>
<td>3,666,120</td>
<td>3,133,047</td>
<td>2,276,529</td>
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<tr>
<td>Disposal Volume (m3)</td>
<td>553,678</td>
<td>475,723</td>
<td>426,373</td>
<td>680,010</td>
<td>268,333</td>
<td>174,739</td>
<td>222,200</td>
<td>464,554</td>
<td>544,868</td>
<td>684,537</td>
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<tr>
<td>Total Produce Recycle (%)</td>
<td>76.80%</td>
<td>83.40%</td>
<td>86.70%</td>
<td>80.50%</td>
<td>90.80%</td>
<td>95.30%</td>
<td>94.00%</td>
<td>91.0%</td>
<td>89.6%</td>
<td><strong>87.2%</strong></td>
</tr>
<tr>
<td>Average Daily Recycle (m3/d)</td>
<td>5,009</td>
<td>6,529</td>
<td>7,644</td>
<td>7,686</td>
<td>7,215</td>
<td>9,642</td>
<td>9,900</td>
<td>12,273</td>
<td>12,876</td>
<td>12,740</td>
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</table>
## Pelican Lake Water Information

### 2006-2016

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<th></th>
<th></th>
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</thead>
<tbody>
<tr>
<td>Fresh Water (m³/day) - Quaternary and Grand Rapids</td>
<td>1405</td>
<td>2813</td>
<td>4091</td>
<td>3927</td>
<td>4255</td>
<td>4054</td>
<td>5142</td>
<td>5594</td>
<td>5558</td>
<td>5308</td>
<td>5252</td>
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<tr>
<td>Brackish Water (m³/day) - Grosmont</td>
<td>3940</td>
<td>4553</td>
<td>2095</td>
<td>8120</td>
<td>10958</td>
<td>17190</td>
<td>13096</td>
<td>10412</td>
<td>10044</td>
<td>8584</td>
<td>6237</td>
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<td>Total Source Water (m³/day)</td>
<td>5345</td>
<td>7366</td>
<td>6186</td>
<td>12046</td>
<td>15213</td>
<td>21244</td>
<td>18238</td>
<td>16007</td>
<td>15602</td>
<td>13892</td>
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<td>Total Source Water per barrel of oil</td>
<td>1.1</td>
<td>1.4</td>
<td>1.1</td>
<td>2.1</td>
<td>2.6</td>
<td>3.7</td>
<td>3.0</td>
<td>2.3</td>
<td>2.0</td>
<td>1.7</td>
<td>1.5</td>
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<td>Brackish Water per barrel of oil</td>
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<td>0.8</td>
<td>0.4</td>
<td>1.4</td>
<td>1.9</td>
<td>3.0</td>
<td>2.1</td>
<td>1.5</td>
<td>1.3</td>
<td>1.1</td>
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<tr>
<td>Fresh Water per barrel of oil</td>
<td>0.3</td>
<td>0.5</td>
<td>0.7</td>
<td>0.7</td>
<td>0.7</td>
<td>0.7</td>
<td>0.8</td>
<td>0.8</td>
<td>0.7</td>
<td>0.7</td>
<td>0.7</td>
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<tr>
<td>Produced Water Recycle (m³/day)</td>
<td>3344</td>
<td>5009</td>
<td>6546</td>
<td>7644</td>
<td>7686</td>
<td>715</td>
<td>5699</td>
<td>9900</td>
<td>12273</td>
<td>12876</td>
<td>12740</td>
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<tr>
<td>Recycle Rates</td>
<td>64.8%</td>
<td>76.8%</td>
<td>83.4%</td>
<td>86.7%</td>
<td>80.5%</td>
<td>90.8%</td>
<td>95.3%</td>
<td>94.0%</td>
<td>91.0%</td>
<td>89.6%</td>
<td>87.2%</td>
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<tr>
<td>Oil Produced (bbl/day)</td>
<td>29570</td>
<td>34269</td>
<td>37035</td>
<td>36612</td>
<td>36726</td>
<td>3637</td>
<td>3865</td>
<td>42934</td>
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<td>50877</td>
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### 2016 Monthly

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<th>Mar</th>
<th>Apr</th>
<th>May</th>
<th>Jun</th>
<th>Jul</th>
<th>Aug</th>
<th>Sep</th>
<th>Oct</th>
<th>Nov</th>
<th>Dec</th>
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</thead>
<tbody>
<tr>
<td>Fresh Water (m³/day) - Quaternary and Grand Rapids</td>
<td>5,438</td>
<td>5,011</td>
<td>5,542</td>
<td>4,975</td>
<td>5,049</td>
<td>5,159</td>
<td>5,240</td>
<td>5,241</td>
<td>5,178</td>
<td>5,450</td>
<td>5,168</td>
<td>5,398</td>
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<td>Brackish Water (m³/day) - Grosmont</td>
<td>5,851</td>
<td>4,955</td>
<td>6,098</td>
<td>5,791</td>
<td>5,902</td>
<td>6,159</td>
<td>6,748</td>
<td>6,626</td>
<td>7,304</td>
<td>7,150</td>
<td>6,080</td>
<td>5,976</td>
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<tr>
<td>Total Makeup Water (m³/day)</td>
<td>11,290</td>
<td>9,967</td>
<td>11,640</td>
<td>10,765</td>
<td>10,950</td>
<td>11,319</td>
<td>11,988</td>
<td>11,868</td>
<td>12,482</td>
<td>12,600</td>
<td>11,248</td>
<td>11,374</td>
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<td>Total Makeup Water per barrel of oil</td>
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<td>1.4</td>
<td>1.5</td>
<td>1.4</td>
<td>1.5</td>
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<tr>
<td>Brackish Water per barrel of oil</td>
<td>0.8</td>
<td>0.7</td>
<td>0.8</td>
<td>0.8</td>
<td>0.8</td>
<td>0.8</td>
<td>0.9</td>
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<td>0.9</td>
<td>0.9</td>
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<tr>
<td>Fresh Water per barrel of oil</td>
<td>0.7</td>
<td>0.7</td>
<td>0.7</td>
<td>0.7</td>
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<td>0.7</td>
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<td>0.7</td>
<td>0.7</td>
<td>0.7</td>
<td>0.8</td>
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<tr>
<td>Produced Water Recycle (m³/day)</td>
<td>12220</td>
<td>10903</td>
<td>12464</td>
<td>11841</td>
<td>12249</td>
<td>12126</td>
<td>12641</td>
<td>13095</td>
<td>13564</td>
<td>13115</td>
<td>14047</td>
<td>14693</td>
</tr>
<tr>
<td>Recycle Rates</td>
<td>87.27%</td>
<td>88.27%</td>
<td>88.19%</td>
<td>87.60%</td>
<td>87.78%</td>
<td>87.33%</td>
<td>85.99%</td>
<td>86.18%</td>
<td>86.25%</td>
<td>86.20%</td>
<td>86.54%</td>
<td>88.71%</td>
</tr>
<tr>
<td>Oil Produced (bbl/day)</td>
<td>48,345</td>
<td>44,932</td>
<td>49,620</td>
<td>48,017</td>
<td>48,199</td>
<td>47,157</td>
<td>49,030</td>
<td>48,423</td>
<td>46,731</td>
<td>48,491</td>
<td>47,697</td>
<td>47,503</td>
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</table>
• Striving to improve field performance by increasing throughput through injectivity improvements
• Optimize polymer loading with the use of existing fresh water volumes
• Additional water treatment processes previously piloted but not implemented – economics and operating limitations posed challenges
• 2015 – Small water treatment pilot to investigate new technologies to improve produced water quality.
• Additional Grosmont Source/Disposal options are being investigated as we plan the long-term Water Sourcing options.
  ▪ 2017 Approval for additional disposal at 1F1/13-28 which was converted from Grosmont source to disposal.
<table>
<thead>
<tr>
<th>Unique Well Identifiers</th>
<th>Disposal Zone</th>
<th>Top of Injection Interval (Measured depth - metres KB)</th>
<th>Depth of Production Packer (Measured depth - metres KB)</th>
<th>Maximum Wellhead Injection Pressure (kilopascals gauge)</th>
</tr>
</thead>
<tbody>
<tr>
<td>00/12-09-081-22W4/0</td>
<td>Nisku</td>
<td>487.5</td>
<td>478.9</td>
<td>6000</td>
</tr>
<tr>
<td>02/12-09-081-22W4/0</td>
<td>Grosmont</td>
<td>536.0</td>
<td>526.7</td>
<td>4325</td>
</tr>
<tr>
<td>† 00/05-02-081-23W4/3</td>
<td>Nisku</td>
<td>513.0</td>
<td>508.2</td>
<td>3300</td>
</tr>
<tr>
<td>00/04-12-081-23W4/3</td>
<td>Nisku</td>
<td>508.0</td>
<td>506.0</td>
<td>3450</td>
</tr>
<tr>
<td>† 00/02-35-080-22W4/0\</td>
<td>Nisku</td>
<td>475.0</td>
<td>473.0</td>
<td>3200</td>
</tr>
<tr>
<td>† 00/01-36-080-22W4/0</td>
<td>Nisku</td>
<td>458.1</td>
<td>454.0</td>
<td>3200</td>
</tr>
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</table>
# CNRL Brintnell Disposal Wells

## Table 1

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<th>4</th>
<th>5</th>
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<tbody>
<tr>
<td><strong>Unique Well Identifiers</strong></td>
<td><strong>Disposal Zone</strong></td>
<td><strong>Top of Injection Interval</strong>&lt;br&gt;(Measured depth - metres KB)</td>
<td><strong>Depth of Production Packer</strong>&lt;br&gt;(Measured depth - metres KB)</td>
<td><strong>Maximum Wellhead Injection Pressure</strong>&lt;br&gt;(kilopascals gauge)</td>
</tr>
<tr>
<td>02/07-27-082-21W4/2¹</td>
<td>Grosmont</td>
<td>555.0</td>
<td>545.1</td>
<td>3450</td>
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<tr>
<td>00/14-04-082-22W4/0</td>
<td>Nisku/Graminia/&lt;br&gt;Blue Ridge/Calmar</td>
<td>453.0</td>
<td>438.0</td>
<td>3500</td>
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</table>
Disposal Well Data

- 1-36-080-22W4/00
  - Rate (m3/d)
  - Disposal Pressure (kPa)
  - Volume
  - Injection Pressure

- 02-35-080-22W4/00
  - Rate (m3/d)
  - Disposal Pressure (kPa)
  - Volume
  - Injection Pressure

- 05-02-081-23W4/03
  - Rate (m3/d)
  - Disposal Pressure (kPa)
  - Volume
  - Injection Pressure

- 4-12-081-23W4/03
  - Rate (m3/d)
  - Disposal Pressure (kPa)
  - Volume
  - Injection Pressure
AER Compliance
Hydrogen Sulphide

- Souring of production to occur over time, Engineering and Construction, has and will continue to ensure compliance across the entire Field to handle sour production (<1% H2S).
- H2S produced at padsites and batteries is expected to be in low concentration and volume.
- CNRL collects solution gas at batteries and wellsites in a common solution gas gathering system.
- Gas to be sweetened in field and at major facility sites (emulsion batteries, compressor station).
CNRL continues to work with AER regarding injection well integrity:
- Formation/hydraulic isolation
- Cement bond
- Casing corrosion

Process of upgrading existing wellsite facilities to meet current regulations and codes for the expected service (higher WCT, higher TDS, less than 1% H2S). Timeline to be completed over next 2-3 years throughout field (existing facilities met regulations at time of original construction).
- Priority on areas where we have seen corrosion through inspections, and areas with high water cut
AER Compliance

- Canadian Natural Resources is not aware of any outstanding compliance issues regarding the current approvals.
- CNRL currently in compliance with other regulatory bodies (AER, AENV).
- Reclamation programs: Well and Pipeline abandonments as required by Directives 65 and 13.
- Inactive wells: currently compliant.
  - Long Term Inactives.
  - Review future flood areas to properly downhole suspend/abandon wells within a reasonable time of start of injection (some wells to be completed for flood monitoring).
Outstanding Applications

- Water Act Application: 001-00329572
  - Water Act File 00218314
Conclusion

• Canadian Natural continues to be committed to maximizing the value of the resource for both itself and the Province of Alberta through its Royalty Interest
  ▪ 2016 – Stable production in low commodity price environment

• Results from the polymer flood continue to be encouraging
  ▪ Continuing to evaluate the impacts of oil viscosity and water production on the ultimate performance and recovery under polymer flooding

• CNRL continues to optimize the operation of the flood and expand to new, more challenging areas
  ▪ Injection management is a balance of OPEX, power consumption and flood management

• CNRL is working on an injection plan to maximize field throughput and thus ultimate recovery of the field. Several options are being investigated over the next several years.

• Compliance with all AER regulations, including cap rock integrity monitoring, and communication with the AER remains a top priority for CNRL.
THE FUTURE CLEARLY DEFINED

Premium Value  |  Defined Growth  |  Independent