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
Oil Sands Royalties (OSR 101, OSR 006)

OSR 006

OSR 101
Primary and Enhanced Approval Regions

Enhanced Recovery Schemes
- 10147
- 9673
- 10787
- 10423

Primary Recovery Schemes
- 6619
- 9466
- 9884
Wabiskaw ‘A’ Net Pay Map
Wabiskaw Structure Map
Produced Oil Viscosity Map
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
Typical Drilling Configuration

- CNRL lands the intermediate casing within the Wabiskaw formation.
Typical Well Configurations

- **Producer**

  - 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

Cum. oil: 37,099 E3m3

Approximately 63% of the approved EOR scheme areas are currently developed and under flood as of the end of 2015.
Field Performance and Surveillance
Approval 10147 Production Update

Cum oil: 2,336 E3m3  Cum water: 1,563 E3m3  Cum injection: 4,781 E3m3

Approval 10147
On Stream: 01/01/1997

Started Polymer Injection

Cum oil: 2,336 E3m3  Cum water: 1,563 E3m3  Cum injection: 4,781 E3m3
• 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.
• Water cut averaged just above 60% during 2015.
• Producer cleanouts executed since 2013 have helped recent production. Cleanouts are mechanical and executed using standard reverse circulation methods.
• Oil viscosity ranges from 1,300 cp to 2,800 cP.
Approval 10423
Approval 10423 Production Update

Cum oil: 17,873 E3m3  Cum water: 16,832 E3m3  Cum injection: 37,120 E3m3
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.
2015 Activity

- 6 producers drilled in 2014 were converted to injection in WB32 area.
- Oil production continued to ramp up in WB14 area in the early part of the year following the conversion of 12 producers to injectors in 2014.
- Some areas experiencing increased water cut, average water cut was about 60% during 2015.
Approval 10787
Approval 10787 Production Update

Cum oil: 8,678 E3m3  Cum water: 4,809 E3m3  Cum injection: 12,517 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 some wells responding in 2015.

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

Altogether, this has resulted in reducing WCT from 58% to 50% during 2015.

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:

- Reservoir pressure and produced water was monitored quarterly for Q4 2013 and the first three quarters of 2014. A reservoir pressure taken third quarter of 2015 confirmed these results.
- The reservoir pressure declined in each observation indicating normal primary decline and no communication from outside the Wabiskaw.
- Due to low produced water volumes, could not obtain a sufficient volume of water to analyze.
- CNRL will continue to monitor the produced watercut and take yearly pressure measurements on this well.
Approval 9673

Approval Areas
Scale 1:250,000

9673
Approval 9673 Production Update

Cum oil: 7,097 E3m3  Cum water: 11,456 E3m3  Cum Injection: 28,544 E3m3

On Stream: 01/01/1998

- All injection is now polymer
- Polymer injection begins

Cumulative oil and water injection data are shown. The graph displays the change in water cut and the number of wells on water injection and oil production over time. The polymer injection began in early 2008, and all injection is now polymer.
• 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 2015 watercut averaged about 55%.
- Oil viscosity ranges from 600 cp to 13,000 cp.
Estimated Ultimate Recovery Factors for Flooded Areas (excludes primary areas)

**Approval 9673**  
Total area OBIP 97.4 $E^6 m^3$  
OBIP under flood: 78.4 $E^6 m^3$  
RF to date: 8%  
Estimated ultimate recovery factors: 16-20%

**Approval 10787**  
Total area OBIP 205.2 $E^6 m^3$  
OBIP under flood: 81.4 $E^6 m^3$  
RF to date: 7%  
Estimated ultimate recovery factors: 21-28%

**Approval 10147**  
Total area OBIP 8.98 $E^6 m^3$  
OBIP under flood: 8.98 $E^6 m^3$  
RF to date: 26%  
Estimated ultimate recovery factors: 32-38%

**Approval 10423**  
Total area OBIP 229.0 $E^6 m^3$  
OBIP under flood: 163.8 $E^6 m^3$  
RF to date: 10%  
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 – HTL1 (Approval 10147)

- HTL1 Pad
  - Well list and allocation factors:
    - Injectors
      - 100/14-31-081-22W4/0 (50%)
      - 100/15-31-081-22W4/0 (100%)
    - Producers
      - 102/15-31-081-22W4/0 (50%)
      - 102/14-31-081-22W4/0 (100%)
Good Performance – HTL1 (Approval 10147)

HTLP1
Polymer flood after Primary

Liquid Rate (m³/d)  Oil Rate (m³/d)

Water Cut (%)

Water Inj (m³/d)  Water Injection Pressure (kPa)

Polymer flood after Primary HTLP1
NHT Pad 10 subgroup

Well List and allocation factors:

Injectors:
- 100/02-02-082-23W4/0 (50%)
- 100/01-02-082-23W4/0 (100%)

Producers:
- 102/01-02-082-23W4/0 (100%)
- 102/04-01-082-23W4/0 (50%)
Average Performance – NHTP10 (Approval 10423)

NHTP10
Polymer flood after Primary

Date

Oil Rate (m³/d)

Liquid Rate (m³/d)

Water Cut (%)

Water Inj (m³/d)

Water Injection Pressure (kPa)

Polymer flood after Primary
Below Average Performance – SB 26 (Approval 10423)

- SB 26 103/10-24 Pattern
  - Well List and allocation factors:
    - Injector
      - 103/10-24-080-22W4/2 (100%)
    - Producers
      - 102/11-24-080-22W4/0 (50%)
      - 104/07-24-080-22W4/0 (50%)

Approval 10423
Plot showing Recovery Factor (RF) versus Pore Volume (PF) Injected. Indicates effectiveness and performance of the flood.
Cap Rock Integrity
## Cap Rock Integrity

### 2015 Anomalies (5 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>May 18, 2015</td>
<td>NBP 8 03/04-23-082-21W4/0</td>
<td>Drop in injection pressure/injection rate increase</td>
<td>Everything working operationally.</td>
<td>5300</td>
<td>4000</td>
<td>48</td>
<td>75</td>
<td>Flood accessing new higher permeability reservoir</td>
</tr>
<tr>
<td>August 2, 2015</td>
<td>BP 19 00/16-10-081-22W4/0</td>
<td>Drop in injection pressure/injection rate increase</td>
<td>Everything working operationally.</td>
<td>5999</td>
<td>5434</td>
<td>50</td>
<td>223</td>
<td>Flood accessing new higher permeability reservoir</td>
</tr>
<tr>
<td>August 21, 2015</td>
<td>NBP 8 03/04-23-082-21W4/0</td>
<td>Drop in injection pressure/injection rate increase</td>
<td>Everything working operationally.</td>
<td>5500</td>
<td>4211</td>
<td>55</td>
<td>108</td>
<td>Flood accessing new higher permeability reservoir</td>
</tr>
<tr>
<td>August 30, 2015</td>
<td>BP 18 00/01-15-081-22W4/0</td>
<td>Drop in injection pressure/injection rate increase</td>
<td>Everything working operationally.</td>
<td>5962</td>
<td>4980</td>
<td>34</td>
<td>165</td>
<td>Breakthrough to offsetting production wells</td>
</tr>
<tr>
<td>October 12, 2015</td>
<td>NBP 8 03/04-23-082-21W4/0</td>
<td>Drop in injection pressure/injection rate increase</td>
<td>Everything working operationally.</td>
<td>5479</td>
<td>4065</td>
<td>63</td>
<td>104</td>
<td>Flood accessing new higher permeability reservoir</td>
</tr>
</tbody>
</table>

### 7 anomalies in 2014, 4 anomalies in 2013, 9 anomalies in 2012; 18 anomalies in 2011

All five 2015 anomalies were fully investigated and reported. All injectors are back on-stream under normal operating conditions and have regained pressure following the event.
100/16-10-081-22W4/0: Well was shut in for 1 week as a precaution. Rates and pressures returned to normal upon restarting injection.
Hall plots are reviewed regularly to investigate potential cap rock breaches. A sudden change in the Hall Plot slope may indicate a potential issue.
Hall Plot for NBP 8 03/04-23

103/04-23-082-21W4/0: 3 of the 5 events were at this well. The first event initiated a Hall plot slope change. At the same time, pattern fluid production increased and WCT decreased.
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 optimization of the existing well patterns. No drilling is planned for 2016.
• CNRL received approval in 2012 to implement a surfactant pilot in the field. CNRL is not pursuing surfactant flooding at the present time.
Facilities
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

### Power Consumption - KWH

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</tr>
</thead>
<tbody>
<tr>
<td>Central</td>
<td>6,076,710</td>
<td>5,507,612</td>
<td>5,733,240</td>
<td>5,438,419</td>
<td>5,015,062</td>
<td>4,023,750</td>
<td>3,927,186</td>
<td>3,648,464</td>
<td>3,909,748</td>
<td>4,523,816</td>
<td>4,976,577</td>
<td>5,727,228</td>
<td>58,507,813</td>
</tr>
<tr>
<td>South</td>
<td>8,795,731</td>
<td>7,933,840</td>
<td>8,207,432</td>
<td>7,328,913</td>
<td>6,106,494</td>
<td>5,165,585</td>
<td>5,186,158</td>
<td>5,246,982</td>
<td>5,311,794</td>
<td>6,214,601</td>
<td>7,366,027</td>
<td>8,314,751</td>
<td>81,178,306</td>
</tr>
<tr>
<td>North</td>
<td>6,244,432</td>
<td>5,631,054</td>
<td>5,707,856</td>
<td>5,101,786</td>
<td>4,540,890</td>
<td>3,355,819</td>
<td>3,228,355</td>
<td>3,062,986</td>
<td>3,444,674</td>
<td>4,404,159</td>
<td>5,033,560</td>
<td>5,505,633</td>
<td>55,261,203</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>21,116,873</td>
<td>19,072,506</td>
<td>19,648,528</td>
<td>17,869,118</td>
<td>15,662,445</td>
<td>12,545,155</td>
<td>12,341,699</td>
<td>11,958,432</td>
<td>12,666,216</td>
<td>15,142,575</td>
<td>17,376,163</td>
<td>19,547,613</td>
<td>194,947,323</td>
</tr>
</tbody>
</table>

### Brintnell Power Consumption (KWH)

- **Central Brintnell Power (KWH)**
- **South Brintnell Power (KWH)**
- **North Brintnell Power (KWH)**
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
    – All high risk sour pipelines have been lined as of Feb, 2014

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

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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>
<td></td>
<td></td>
<td></td>
</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>
</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>
</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>1,453,371</td>
<td>1,786,316</td>
<td>1,559,325</td>
<td>1,772,860</td>
<td>1,618,804</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>99.5%</td>
<td>99.5%</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>
</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>
</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| 104,583| 360,704|
| Produced Water (m³)  | 167,755| 193,349| 267,607| 378,988| 323,086| 402,772| 402,822| 143,284| 129,710| 101,937|
| Recycle Rates (m³)  | 0| 26,826| 159,288| 346,418| 301,720| 357,025| 329,781| 104,583| 129,710| 129,710|
| Produce Recycle (%)  | 0%| 13.9%| 59.5%| 91.4%| 93.4%| 88.6%| 81.9%| 73.0%| 73.0%| 73.0%|
| Average Daily Recycle (m³/d) | 0| 73| 435| 949| 827| 978| 901| 775| 775| 775|
| Average Disposal Rates (m³/d) | 460| 456| 296| 89| 59| 125| 200| 106| 106| 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|
| Produced Water (m³)  | 341,034| 413,480| 501,318| 544,390| 776,095| 1,014,789| 1,505,539| 1,494,858| 1,205,459| 1,278,060|
| Recycle Rates (m³)  | 0| 22,465| 173,011| 204,727| 173,120| 832,109| 1,412,965| 1,384,546| 1,091,455| 1,172,557|
| Produce Recycle (%)  | 0%| 5.4%| 34.5%| 37.6%| 22.3%| 81.1%| 93.9%| 92.6%| 90.5%| 91.7%|
| Average Daily Recycle (m³/d) | 0| 62| 473| 561| 474| 2,255| 3,861| 3,793| 2,990| 3,212|
| Average Disposal Rates (m³/d) | 318| 907| 1,204| 525| 752| 493| 1,004| 1,204| 1,204| 1,204|

| **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| 2,938,034| 2,952,339|
| 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|
| Recycle Rates (m³)  | 1,220,482| 1,828,451| 2,389,460| 2,789,885| 2,805,257| 2,633,505| 3,529,061| 3,613,553| 4,479,577| 4,699,867|
| 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|
| Brackish Water (m³) - Grosmont | 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|
| Disposal Volume (m³) | 663,038| 553,678| 475,723| 426,373| 680,010| 268,333| 174,739| 222,200| 464,554| 544,868|
| Total Produce Recycle (%) | 64.8%| 76.8%| 83.4%| 86.7%| 80.5%| 90.8%| 95.3%| 94.0%| 91.0%| 89.6%|
| 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|
| Average Daily Disposal (m³/d) | 1,817| 1,517| 1,300| 1,168| 1,863| 735| 477| 748| 1,219| 1,493|
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.

• 2015 Field Proration Factors:
  ▪ Meets directive 17 requirements (Oil: 0.859, Water: 1.13)
Measurement and Reporting – Continued

- **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

- 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.
- 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.
### 2015 Injection Water Summary

**2015 Polymer Injection Volumes (m³)**

<table>
<thead>
<tr>
<th></th>
<th>Jan</th>
<th>Feb</th>
<th>Mar</th>
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<th>May</th>
<th>Jun</th>
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<th>Sep</th>
<th>Oct</th>
<th>Nov</th>
<th>Dec</th>
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<tbody>
<tr>
<td><strong>Produced Water to Injection</strong></td>
<td>390,190</td>
<td>361,511</td>
<td>394,294</td>
<td>384,333</td>
<td>390,510</td>
<td>354,874</td>
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<tr>
<td><strong>Fresh Make-Up Water</strong></td>
<td>175,502</td>
<td>154,073</td>
<td>177,850</td>
<td>167,178</td>
<td>170,969</td>
<td>164,929</td>
<td>160,841</td>
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<td>147,385</td>
<td>144,058</td>
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<td>166,169</td>
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<td><strong>Saline Make-Up Water</strong></td>
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<td>298,900</td>
<td>291,836</td>
<td>289,709</td>
<td>237,233</td>
<td>246,732</td>
<td>278,302</td>
<td>266,916</td>
<td>242,341</td>
<td>212,603</td>
<td>187,433</td>
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<td><strong>Total</strong></td>
<td>873,408</td>
<td>788,911</td>
<td>871,044</td>
<td>853,347</td>
<td>851,188</td>
<td>757,036</td>
<td>803,600</td>
<td>818,309</td>
<td>813,195</td>
<td>802,786</td>
<td>731,758</td>
<td>735,635</td>
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**Total Injection Volumes (m³)**

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<td>1,479,780</td>
<td>1,876,840</td>
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Non-Saline Well Locations
### Non-Saline Water Make up Wells

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<th>UWI</th>
<th>Production Interval</th>
<th>Maximum Rate of Diversion (m³/day)</th>
<th>Maximum Annual Diversion Volume (m³)</th>
<th>2015 Average Diversion Volumes (m³/day)</th>
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<td>WSW BP25 - QUAT</td>
<td>100/08-04-081-22W4/00</td>
<td>53.3 - 65.2</td>
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<td>153,300</td>
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<td>WSW BP2 - GR</td>
<td>1AA/12-16-081-22W4/02</td>
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<td>WSW HTP2 - GR</td>
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<td>1F1/15-27-081-22W4/00</td>
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<td>WSW WBP30 - GR</td>
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#### 2015 Total Fresh Water

![Graph showing total fresh water from 2015](image)

- Red line: CUM
- Green line: Cum License
- Blue line: % Variance

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<td>3/1/2015</td>
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<td>4/1/2015</td>
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<td>6/1/2015</td>
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<td>7/1/2015</td>
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<td>8/1/2015</td>
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<td>9/1/2015</td>
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<td>11/1/2015</td>
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<td>12/1/2015</td>
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### Water Chemistry

#### Non-Saline Water Source Wells

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<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>CO₃ mg/L</th>
<th>SO₄ mg/L</th>
<th>NO₂-N mg/L</th>
<th>NO₃-N mg/L</th>
<th>NO₂-N+NO₃-N mg/L</th>
<th>Hardness mg/L</th>
<th>TDS mg/L</th>
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<tbody>
<tr>
<td>WSW HTP 2 - GR</td>
<td>25-Jul-15</td>
<td>8.95</td>
<td>2600</td>
<td>2.05</td>
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<td>608</td>
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<td>&lt;0.020</td>
<td>&lt;0.040</td>
<td>&lt;0.045</td>
<td>10.9</td>
<td>1460</td>
</tr>
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<td>WSW BP 11 - Quat</td>
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<td>740</td>
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<td>53.8</td>
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#### Saline Water Source Wells – Grosmont

- **Typical TDS range – 22,000-35,000 mg/L**
Saline Water Source Map
### 2015 Saline Water Source Well Diversion Volumes (m³)

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</thead>
<tbody>
<tr>
<td>1F1/01-36-080-22W4/00</td>
<td>99,770</td>
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<td>99,908</td>
<td>94,693</td>
<td>89,170</td>
<td>81,814</td>
<td>76,562</td>
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<td>69,962</td>
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<td>52,844</td>
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<td><strong>237,233</strong></td>
<td><strong>248,732</strong></td>
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<td><strong>212,603</strong></td>
<td><strong>187,433</strong></td>
<td><strong>3,133,047</strong></td>
</tr>
</tbody>
</table>

- 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.
  - **2015 recycle at 89.6%**.
- CNRL continues to be in compliance with AENV water diversion license.
# Pelican Lake Water Information

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<th>Fresh Water (m³/day) - Quaternary and Grand Rapids</th>
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<th>2012</th>
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<td>5558</td>
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<td>Brackish Water (m³/day) - Grosmont</td>
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<td>10958</td>
<td>17190</td>
<td>13096</td>
<td>10412</td>
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<tr>
<td>Total Source Water (m³/day)</td>
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<td>6186</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>
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<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>
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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>7215</td>
<td>9669</td>
<td>9900</td>
<td>12273</td>
<td>12876</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>
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<td>89.6%</td>
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<td>Oil Produced (bbl/day)</td>
<td>29570</td>
<td>34269</td>
<td>37035</td>
<td>36612</td>
<td>36726</td>
<td>38656</td>
<td>42934</td>
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### Pelican Lake Water Information

<table>
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<tr>
<th>Pelican Lake Water Information</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>Fresh Water (m³/day) - Quaternary and Grand Rapids</td>
<td>5,754</td>
<td>5,052</td>
<td>5,831</td>
<td>5,481</td>
<td>5,606</td>
<td>5,408</td>
<td>5,273</td>
<td>5,002</td>
<td>4,832</td>
<td>4,723</td>
<td>5,116</td>
<td>5,448</td>
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<td>Brackish Water (m³/day) - Grosmont</td>
<td>10,089</td>
<td>8,896</td>
<td>9,800</td>
<td>9,568</td>
<td>9,499</td>
<td>7,778</td>
<td>8,155</td>
<td>9,125</td>
<td>8,751</td>
<td>7,946</td>
<td>6,971</td>
<td>6,145</td>
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<tr>
<td>Total Makeup Water (m³/day)</td>
<td>15,843</td>
<td>13,948</td>
<td>15,631</td>
<td>15,050</td>
<td>15,104</td>
<td>13,186</td>
<td>13,429</td>
<td>14,127</td>
<td>13,584</td>
<td>12,669</td>
<td>12,087</td>
<td>11,594</td>
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<td>Total Makeup Water per barrel of oil</td>
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<tr>
<td>Brackish Water per barrel of oil</td>
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<td>1.1</td>
<td>1.0</td>
<td>0.9</td>
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<tr>
<td>Fresh Water per barrel of oil</td>
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<td>0.7</td>
<td>0.7</td>
<td>0.7</td>
<td>0.7</td>
<td>0.6</td>
<td>0.6</td>
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<td>0.6</td>
<td>0.7</td>
<td>0.7</td>
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<tr>
<td>Produced Water Recycle (m³/day)</td>
<td>13026</td>
<td>12059</td>
<td>13307</td>
<td>12815</td>
<td>13001</td>
<td>11937</td>
<td>13289</td>
<td>12931</td>
<td>13303</td>
<td>13977</td>
<td>12145</td>
<td>12811</td>
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<tr>
<td>Recycle Rates</td>
<td>92.74%</td>
<td>93.13%</td>
<td>91.67%</td>
<td>87.33%</td>
<td>86.03%</td>
<td>86.04%</td>
<td>89.19%</td>
<td>88.96%</td>
<td>90.86%</td>
<td>91.62%</td>
<td>89.76%</td>
<td>88.41%</td>
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<tr>
<td>Oil Produced (bbl/day)</td>
<td>51,314</td>
<td>47,485</td>
<td>51,751</td>
<td>51,668</td>
<td>52,504</td>
<td>50,567</td>
<td>52,358</td>
<td>52,662</td>
<td>49,623</td>
<td>50,731</td>
<td>48,562</td>
<td>49,634</td>
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</tbody>
</table>
Pelican Water Management Plan

- 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.
## CNRL Brintnell Disposal Wells

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
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</thead>
<tbody>
<tr>
<td>Unique Well Identifiers <em>(Directive 051 satisfied)</em></td>
<td>Unique Well Identifiers <em>(Directive 051 not satisfied)</em></td>
<td>Disposal Zone</td>
<td>Top of Injection Interval (Measured depth - metres KB)</td>
<td>Depth of Production Packer (Measured depth - metres KB)</td>
<td>Maximum Wellhead Injection Pressure (kilopascals gauge)</td>
</tr>
<tr>
<td>00/12-09-081-22W4/0</td>
<td>Nisku</td>
<td>487.5</td>
<td>478.9</td>
<td>6000</td>
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<tr>
<td>02/12-09-081-22W4/0</td>
<td>Grosmont</td>
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<td>526.7</td>
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<tr>
<td>† 00/05-02-081-23W4/3</td>
<td>Nisku</td>
<td>513.0</td>
<td>508.2</td>
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<td>† 00/04-12-081-23W4/3</td>
<td>Nisku</td>
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<td>† 00/02-35-080-22W4/2 *</td>
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<td>480.0</td>
<td>3200</td>
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<td>Nisku</td>
<td>458.1¹</td>
<td>454.0</td>
<td>3200</td>
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</tbody>
</table>

*00/02-35-080-22W4/2

- re-perfed and acidized within the Nisku, March 28-April 4, 2015, to optimize disposal capacity
- D65 application has been approved and processed by the AER
Disposal Well Data

01-36-080-22W4/00

02-35-080-22W4/00

05-02-081-23W4/03

04-12-081-23W4/03
AER Compliance
Hydrogen Sulphide

- Sourcing 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

- No outstanding applications
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
  ▪ 2015 – Record production year from Pelican Lake

• 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

• 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