Christina Lake in-situ oil sands scheme

This presentation contains information in compliance with:

AER Directive 054 – Performance Presentations, Auditing and Surveillance of In Situ Oil Sands Schemes

Section 3.1.1 Subsurface Issues Related to Resource Evaluation and Recovery
Advisory

This document contains forward-looking information prepared and submitted pursuant to Alberta regulatory requirements and is not intended to be relied upon for the purpose of making investment decisions, including without limitation, to purchase, hold or sell any securities of Cenovus Energy Inc. The resources estimates contained herein are not reported in accordance with National Instrument 51-101 and are provided solely for the purpose of complying with Alberta regulatory requirements.

Additional information regarding Cenovus Energy Inc. is available at www.cenovus.com
## Strong integrated oil portfolio

### TSX, NYSE | CVE

<table>
<thead>
<tr>
<th>Metric</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enterprise value</td>
<td>C$31 billion</td>
</tr>
<tr>
<td>Shares outstanding</td>
<td>757 MM</td>
</tr>
<tr>
<td>2014F production</td>
<td></td>
</tr>
<tr>
<td>Oil &amp; NGLs</td>
<td>199 Mbbls/d</td>
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<tr>
<td>Natural gas</td>
<td>470 MMcf/d</td>
</tr>
<tr>
<td>2013 proved &amp; probable reserves</td>
<td>3.2 BBOE</td>
</tr>
<tr>
<td>Bitumen</td>
<td></td>
</tr>
<tr>
<td>Economic contingent resources*</td>
<td>9.8 Bbbls</td>
</tr>
<tr>
<td>Discovered bitumen initially in place*</td>
<td>93 Bbbls</td>
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<tr>
<td>Lease rights**</td>
<td>1.5 MM net acres</td>
</tr>
<tr>
<td>P&amp;NG rights</td>
<td>5.9 MM net acres</td>
</tr>
<tr>
<td>Refining capacity</td>
<td>230 Mbbls/d</td>
</tr>
</tbody>
</table>

*See advisory. **Includes an additional 0.5 million net acres of exclusive lease rights to lease on our behalf and our assignee’s behalf.
Subsection 3.1.1 – 1) Brief Background

Chris Buchanan
Sr. Staff Development Planner, Christina Lake

committed. thoughtful. approachable. conscientious. agile. open-minded. creative. spirited. collaborative.
Major Scheme/Project Updates

- Q1 2000  EUB project approval
- Q2 2002  First steam of phase A pilot
- Q4 2005  Approval of phase B expansion
- Q2 2008  Phase B expansion first steam
- Q3 2008  Approval of phase C/D amendment
- Q1 2010  Approval of large gas cap air re-pressurization
- Q2 2011  Approval of phase E/F/G EIA application
- Q2 2011  Phase C expansion first steam
- Q2 2012  Phase D expansion first steam
- Q4 2012  Approval of phase F and G amendment
- Q4 2012  Filing of CDE 2nd Stage OTSG application
- Q1 2013  Filing Phase H and Eastern Expansion EIA
- Q3 2013  Approval of Development Area Expansion
- Q1 2014  Receipt of Phase H SIR Round 1
Recovery Process

- The Christina Lake Thermal Project uses the dual-horizontal well SAGD (steam-assisted gravity drainage) process to recover bitumen from the McMurray formation.
- Two horizontal wells one above the other approximately 5 m apart.
- Steam injected into upper well heat the bitumen and allows gravity to drain.
- Oil and water emulsion pumped to the surface and treated.
Scheme Map

AER Approved Project Area

- Well pair drilled but not producing
- Well pair currently on production
- Well* currently on production
- Well* drilled but not producing

*Well using Wedge Well™ technology
Source and Disposal Wells as of March 31, 2014

- **RD 1**
  - 15-35-76-4W4 (6 well pad)
- **RD 2**
  - 13-34-76-3W4 (7 wells drilled)
- **RD 3**
  - 13-03-77-3W4 (1 observation well)

**Local McMurray Disposal (3 wells)**

- **CW 1**
  - 10-34-75-6W4 (3 well pad)
- **CW 2**
  - 10-3-75-6W4 (2 well pad)
- **CW 3**
  - 10-27-75-6W4 (3 well pad)
- **CW 4**
  - 11-36-75-6W4 (3 well pad – drilled awaiting tie-in)

**Quaternary Fresh water source (2 wells @ 9-17-76-6W4)**

**Local McM Source (1 well)**

**Source Water Well**

**Water Disposal Well**

**Future Water Disposal Well**
Subsection 3.1.1 – 2) Geology and Geoscience

Joel Christiansen
Geologist
Reservoir Properties (Project Area)

- Reservoir Depth: 350m TVD
- Original Reservoir Pressure: 2500 kPa
- Original Reservoir Temperature: 12°C
- Average Permeability: 4.0 Darcies
- Average SAGD Pay: 21 meters
- Average Porosity (Ø): 33%
- Average Oil Saturation: 80%
- Rock Volume: $1,928 \times 10^6$ m$^3$
- SOIP = $0.509 \times 10^6$ m$^3$

Note: Cenovus Volumetric Estimates, not IQRE estimates
SOIP = Rock Volume in Project area x phi (.33) x So (.80)
Stratigraphic Wells within PA: 532
(-Cenovus 484/48 Others)- 2014
- 2D seismic - 155 km
- 3D seismic - 80 km²
(entire project area now covered by 3D)

- 2013 4D - 10.31 km²
- 2013 – 7 Strat wells, 10 Obs wells

- 2014 4D - 11.86 km²
- 2014 – 13 Strat Wells, 27 Obs Wells
Christina Lake Core Analysis (McMurray)

- Total cored wells within PA - 193
- 2014 cored wells within PA - 10
- 2013 cored wells within PA - 6
- Total steam chamber cores - 8

PA = Project Area

Analysis:
- Routine core analysis
- Photos

- Strat and strat/ccored wells are generally abandoned
- Some strat and strat/ccored wells are cased if they are further used for SAGD observation wells
- All abandoned and cased wells are examined for integrity by the completions department prior to SAGD startup
SAGD Pay Isopach  (Thickness in Meters)
SAGD Base Structure (SSTVD)
SAGD Top Structure (SSTVD)
Paleozoic Structure (SSTVD)
McMurray Isopach (thickness in meters)
McMurray Structure (SSTVD)
SAGD Gas Isopach (thickness in meters)
Composite Type Log: Phase B

- Pervasive basal mud layer often separates bitumen and McMurray water
- Basal mud is discontinuous and ranges from 0-4 meters in thickness
- Provides a good marker during SAGD operations

Location:

![Location Image]
• Pervasive basal mud layer often separates bitumen and McMurray water

• Basal mud is discontinuous and ranges from 0-4 meters in thickness

• Provides a good marker during SAGD operations

Location:
Representative Cross Sections
Cross Section A-A’ (Saturation)
Cross Section A-A' (Lithology)
Cross Section B-B’ (Saturation)
SAGDable vs. Producible OIP (SOIP vs. POIP)

We are presenting two tables
- SAGDable OIP and Producible OIP

We define SAGDable OIP as:
- \((\text{Planned Length}) \times (\text{Spacing}) \times (\text{Net SAGD Pay: Base to Top SAGD}) \times (S_o) \times (\Phi)\)
- Used during the planning phase
- Doesn’t change after well pair plans finalized
- Used to plan additional wells (Wedge Well™ technology, bypassed pay producers, re-drills, new pairs)
- We aim to drill the full planned length (typically 800m), and drill the producer well as low as possible in relation to Base SAGD

We define Producible OIP as:
- \((\text{Effective Length}) \times (\text{Spacing}) \times (\text{Effective Pay: Producer to Top SAGD}) \times (S_o) \times (\Phi)\)
- An “after-drilling” OOIP, based on well pair potential
- Changes with time and interpretation (obs. wells, 4D seismic, MWD error, etc.)
- Used to plan blowdown strategy
- This reflects actual well pair performance
  - Incorporates actual overlapping slotted liner lengths initially (including blank sections <100m)
  - Incorporates actual elevation of the producing well
  - Incorporates lithology

Producible OIP is always < SAGDable OIP
### SOIP & POIP per Pad *(Cenovus SOIP and POIP estimates, not IQRE)*

#### SAGDable Oil in Place (SOIP) and % Recovery

<table>
<thead>
<tr>
<th>Pad</th>
<th>Net SAGD Pay (m)</th>
<th>Drilled Length (m)</th>
<th>Spacing (m)</th>
<th>Average (ø)</th>
<th>Average (So)</th>
<th>Cumulative Oil Production (e³m³)*</th>
<th>SOIP (e³m³)</th>
<th>% Recovery</th>
</tr>
</thead>
<tbody>
<tr>
<td>A01</td>
<td>31.13</td>
<td>696.73</td>
<td>115</td>
<td>0.34</td>
<td>0.79</td>
<td>2,107</td>
<td>3,979</td>
<td>53.0%</td>
</tr>
<tr>
<td>A02</td>
<td>28.61</td>
<td>636.70</td>
<td>99</td>
<td>0.34</td>
<td>0.84</td>
<td>309</td>
<td>475</td>
<td>65.0%</td>
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<tr>
<td>B01</td>
<td>34.80</td>
<td>835.63</td>
<td>100</td>
<td>0.34</td>
<td>0.85</td>
<td>2,424</td>
<td>5,377</td>
<td>45.1%</td>
</tr>
<tr>
<td>B02</td>
<td>35.11</td>
<td>834.35</td>
<td>100</td>
<td>0.33</td>
<td>0.85</td>
<td>1,697</td>
<td>3,089</td>
<td>54.9%</td>
</tr>
<tr>
<td>B03</td>
<td>41.94</td>
<td>792.13</td>
<td>100</td>
<td>0.33</td>
<td>0.84</td>
<td>2,240</td>
<td>7,015</td>
<td>31.9%</td>
</tr>
<tr>
<td>B04</td>
<td>42.14</td>
<td>795.38</td>
<td>100</td>
<td>0.33</td>
<td>0.82</td>
<td>2,360</td>
<td>7,079</td>
<td>33.3%</td>
</tr>
<tr>
<td>B05</td>
<td>43.17</td>
<td>795.67</td>
<td>100</td>
<td>0.33</td>
<td>0.82</td>
<td>1,509</td>
<td>8,161</td>
<td>18.5%</td>
</tr>
<tr>
<td>B06</td>
<td>43.16</td>
<td>747.13</td>
<td>100</td>
<td>0.33</td>
<td>0.81</td>
<td>1,018</td>
<td>5,584</td>
<td>18.2%</td>
</tr>
<tr>
<td>B07</td>
<td>40.89</td>
<td>806.13</td>
<td>100</td>
<td>0.32</td>
<td>0.82</td>
<td>1,530</td>
<td>6,960</td>
<td>22.0%</td>
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<td>B02C</td>
<td>28.54</td>
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<td>272</td>
<td>2,243</td>
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<td>B08</td>
<td>40.29</td>
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<td>270</td>
<td>4,659</td>
<td>5.8%</td>
</tr>
<tr>
<td>B11</td>
<td>37.93</td>
<td>749.75</td>
<td>70</td>
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<td>0.80</td>
<td>426</td>
<td>5,998</td>
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<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>16,162</td>
<td>60,617</td>
<td>26.7%</td>
</tr>
</tbody>
</table>

#### Productive Oil in Place (POIP) and % Recovery

<table>
<thead>
<tr>
<th>Pad</th>
<th>Net SAGD Pay (m)</th>
<th>Effective Length (m)</th>
<th>Spacing (m)</th>
<th>Average (ø)</th>
<th>Average (So)</th>
<th>Cumulative Oil Production (e³m³)*</th>
<th>POIP (e³m³)</th>
<th>% Recovery</th>
</tr>
</thead>
<tbody>
<tr>
<td>A01</td>
<td>25.94</td>
<td>618.17</td>
<td>115</td>
<td>0.35</td>
<td>0.79</td>
<td>2,107</td>
<td>2,965</td>
<td>71.1%</td>
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<tr>
<td>A02</td>
<td>29.54</td>
<td>582.35</td>
<td>99</td>
<td>0.34</td>
<td>0.84</td>
<td>309</td>
<td>401</td>
<td>77.1%</td>
</tr>
<tr>
<td>B01</td>
<td>27.85</td>
<td>790.28</td>
<td>100</td>
<td>0.34</td>
<td>0.85</td>
<td>2,424</td>
<td>4,083</td>
<td>59.4%</td>
</tr>
<tr>
<td>B02</td>
<td>29.73</td>
<td>778.28</td>
<td>100</td>
<td>0.33</td>
<td>0.85</td>
<td>1,697</td>
<td>2,453</td>
<td>69.2%</td>
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<tr>
<td>B03</td>
<td>32.27</td>
<td>766.50</td>
<td>100</td>
<td>0.33</td>
<td>0.84</td>
<td>2,240</td>
<td>5,223</td>
<td>42.9%</td>
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<tr>
<td>B04</td>
<td>35.12</td>
<td>767.38</td>
<td>100</td>
<td>0.33</td>
<td>0.82</td>
<td>2,360</td>
<td>5,701</td>
<td>41.4%</td>
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<tr>
<td>B05</td>
<td>35.67</td>
<td>768.00</td>
<td>100</td>
<td>0.33</td>
<td>0.82</td>
<td>1,509</td>
<td>6,509</td>
<td>23.2%</td>
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<tr>
<td>B06</td>
<td>27.57</td>
<td>722.50</td>
<td>100</td>
<td>0.32</td>
<td>0.81</td>
<td>1,018</td>
<td>4,241</td>
<td>24.0%</td>
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<tr>
<td>B07</td>
<td>35.04</td>
<td>774.00</td>
<td>100</td>
<td>0.32</td>
<td>0.82</td>
<td>1,530</td>
<td>5,728</td>
<td>26.7%</td>
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<tr>
<td>B02C</td>
<td>22.26</td>
<td>972.00</td>
<td>100</td>
<td>0.35</td>
<td>0.83</td>
<td>272</td>
<td>1,712</td>
<td>15.9%</td>
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<tr>
<td>B08</td>
<td>30.45</td>
<td>812.33</td>
<td>67</td>
<td>0.40</td>
<td>0.96</td>
<td>270</td>
<td>3,410</td>
<td>7.9%</td>
</tr>
<tr>
<td>B11</td>
<td>31.01</td>
<td>672.81</td>
<td>70</td>
<td>0.33</td>
<td>0.80</td>
<td>426</td>
<td>4,493</td>
<td>9.5%</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>16,162</td>
<td>46,919</td>
<td>34.4%</td>
</tr>
</tbody>
</table>
Geomechanical and Surface Heave

- Integrated InSAR (Synthetic Aperture Radar) Land Deformation Monitoring took place between March-October 2013 by MDA Geospatial Services Inc
- The measurements were successfully made on 62 active corner reflector (CR) locations installed since April 2008
- In addition to the corner reflectors, the deformation profiles at 4304 point targets were estimated (Coherent Target Monitoring-CTM). The location of these points coincides in general with pad, pipeline and plant structures
Corner Reflector (CR) Locations:

Current Corner Reflectors: 62
Current Reference Corner Reflectors: 9
Cumulative Vertical Deformation:
July 2, 2008 to October 28, 2013 (~64 months)
Cumulative Vertical Deformation: Phase A
July 2 2008 to October 28, 2013 (~64 months)

- Little to no deformation on CR 8 & 23
- 7 Corner Reflectors removed due to expanding infrastructure
Cumulative Vertical Deformation: Phase B
July 2 2008 to October 28, 2013 (~64 months)

Reference CRs:
CR 19
CR R6

Measured CRs:
CR 10
CR 11
CR 12*
CR 13
CR 14
CR 15
CR 16
CR 20
CR 21

Vertical Deformation (mm)
-150  0  +150

CR 12*
~ 45 mm
156 mm cum. uplift
~ 2 year
There are no obvious geological reasons for the increased heave in the CR# 12/13 area.

Operationally this pad has been subjected to extended gas lift prior to ESP conversion.

Due to the maturity of this pad and the extended gas lift its likely the pad has experienced more thermal expansion than other producing pads to date.

Overall the heave relatively is minor.
Cumulative Vertical Deformation: Phase C/D
March 31, 2012 to October 28, 2013 (~19 months)

• Greatest uplift observed over the B03, B04, and B05 pads was as high as 74mm (CR#51)

• Vertical deformation over B03, B04, and B05 ranged between 37mm-74mm

• Vertical deformation over B06 ranged between 12mm-35mm
Cumulative Vertical Deformation:
May 13, 2013 to October 28, 2013 (~6 months)
Cumulative Vertical Deformation: CTM
July 2, 2008 to October 28, 2013

-150 0 +150

Vertical Deformation (mm)

CTM Points  Lateral Wells

Reference CRs

© MDA Geospatial Services Inc. (2013) - All Rights Reserved
Optical Imagery Provided by Cenovus (2011)
Geomechanical and Surface Heave (coherent targets)

Cumulative Vertical Deformation: CTM
May 13, 2013 to October 28, 2013

-50 0 +50
CTM Points
Lateral Wells
Reference CRs
Wabiskaw Pressure at Christina Lake

• Upon retrieving a steam core from the well 107/06-15-076-06W4/00 an over pressured zone within the sandy tidal flat interval of the Wabiskaw (~10m above the reservoir top and ~12m below the base of cap rock) was encountered causing bitumen to flow back through the well bore to surface

• The over pressured zone is a result of conductive heating from the underlying steam chamber. The original pressure within the zone increased from 2000 kPa to 6500 kPa

• Due to the encounter, the coring operations were halted and the well was cased, and completed in order to produce the well and depressurize the zone.

• Further to that, Cenovus recompleted an existing observation well (100/11-15) to the north in order to monitor pressures within the zone. Cenovus also drilled two more observation wells to the west (108/6-15) and south (109/6-15) in order to better understand the pool and its boundaries through pressure and temperature data.

• Based on monitoring data to date, the pool boundary does not extend westwards but does appear to be further in extent to the north and south.

• Cenovus will continue to monitor the wells as 107/06-15-076-06W4/00 continues to produce, and take necessary action by either recompleting proximal wells to produce, and/or drill more observation wells for monitoring purposes.
Zone Of Interest: Wabiskaw

Location:

Over-pressured Wabiskaw first identified in April 2013 while attempting to drill a steam chamber core on the 107/06-15-76-6W4/00 well.

Conductive heating of bitumen in low perm Wabiskaw from underlying steam chamber created an increase in reservoir pressure from ~2000 kPa to ~6500 kPa
Wabiskaw Observation Wells (Mitigation Strategy):

100/11-15-76-6W4
Recompleted with hanging wire piezometer

108/06-15-76-6W4
Drilled and installed temperature and pressure monitoring in Fall 2013

107/06-15-76-6W4
Producing well

109/06-15-76-6W4
Drilled and installed temperature and pressure monitoring in April 2014

Legend
Wabiskaw Sand Isopach (m)
Over-pressured zones as imaged on 3D Seismic
Wabiskaw Observation Well Data:

100/11-15-76-6W4
5090 kPag

108/06-15-76-6W4
Range from 2633 kPag to 3929 kPag, Temp 28 to 38°C

107/06-15-76-6W4
Producer well BHP 3400 kPag (flowing), BHT 120°C

109/06-15-76-6W4
BHP 6200 kPag, BHT 46°C

Legend
Wabiskaw Sand Isopach (m)
Over-pressured zones as imaged on 3D Seismic
Existing Observation Wells Within Operating Area

Legend
- Cased Observation Well
- Wabiskaw Sand Isopach (m)
- Over-pressured zones as imaged on 3D Seismic
Cum Prod to May 22\textsuperscript{nd} 2014: \(~4200\ m^3\)
Subsection 3.1.1 – 3) Drilling and Completions

Karen Montemurro
Production Engineer

committed. thoughtful. approachable. conscientious. agile. open-minded. creative. spirited. collaborative.
Sample Circulation and Gas Lift Completion

**Outer tubing**
- Historical size was 5.5” tubing
- Phase C, D, E tubing was increased to 7.0” tubing

**Inner tubing**
- Historical size was 2 7/8” tubing
- Phase C, D, E tubing was increased to 3.5” tubing

**Intermediate Casing**
- 9 5/8”

**Slotted Liner**
- 7” slotted liner

**6 Pt Thermocouple**
- 1.25” coil tubing string to toe
339.7 mm 71.4 kg/m
H-40 ST&C Surface Casing

244.5 mm 59.5 kg/m
L-80 QB2 Production casing

Production Tubing:
114.3 mm tubing

Bubble Tube and Thermocouple:
48.3 mm IJ tbg

Tail Pipe

ESP

Liner Hanger
Sample ESP Producer Completion With-out Tailpipe

339.7 mm 71.4 kg/m  
H-40 ST&C Surface Casing

244.5 mm 59.5 kg/m  
L-80 QB2 Production casing

Production Tubing:  
114.3 mm tubing

Bubble Tube and Thermocouple:  
48.3 mm IJ tbg

ESP

Liner Hanger
Sample Injector Completion

Intermediate Casing
-9 5/8”

Outer tubing
-5.5” to 4.5” in horizontal with 2 to 5 steam subs and open toe

Slotted Liner
-7” slotted liner
Subsection 3.1.1 – 4) Artificial Lift

Karen Montemurro
Production Engineer

committed. thoughtful. approachable. conscientious. agile. open-minded. creative. spirited. collaborative.
## Review of Artificial Lift by Well

<table>
<thead>
<tr>
<th>Pad</th>
<th>Start Date</th>
<th>Total Producers</th>
<th>Total Gas Lift Producer Wells</th>
<th>Total ESP Producer Wells</th>
<th>Total wells using Wedge Well™ technology and ESP</th>
</tr>
</thead>
<tbody>
<tr>
<td>A Pad</td>
<td>2002</td>
<td>10</td>
<td>0</td>
<td>7</td>
<td>3</td>
</tr>
<tr>
<td>A02 Pad</td>
<td>2008</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>B01 Pad</td>
<td>2008</td>
<td>10</td>
<td>0</td>
<td>7</td>
<td>3</td>
</tr>
<tr>
<td>B02 Pad</td>
<td>2006</td>
<td>8</td>
<td>0</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>B02C Pad*</td>
<td>2013</td>
<td>6</td>
<td>0</td>
<td>6</td>
<td>0</td>
</tr>
<tr>
<td>B03 Pad</td>
<td>2011</td>
<td>8</td>
<td>0</td>
<td>8</td>
<td>0</td>
</tr>
<tr>
<td>B04 Pad</td>
<td>2011</td>
<td>8</td>
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<td>8</td>
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<td>0</td>
<td>9</td>
<td>0</td>
</tr>
<tr>
<td>B06 Pad</td>
<td>2012</td>
<td>8</td>
<td>0</td>
<td>8</td>
<td>0</td>
</tr>
<tr>
<td>B07 Pad</td>
<td>2012</td>
<td>8</td>
<td>0</td>
<td>8</td>
<td>0</td>
</tr>
<tr>
<td>B08 Pad</td>
<td>2013</td>
<td>10</td>
<td>0</td>
<td>10</td>
<td>0</td>
</tr>
<tr>
<td>B11 Pad</td>
<td>2013</td>
<td>12</td>
<td>0</td>
<td>12</td>
<td>0</td>
</tr>
</tbody>
</table>

*Note: B02C refers to the 6 well pairs on the north side of the B02 Pad Approved Drainage Box, which were drilled at a 50m lateral downhole spacing*
Artificial Lift Performance

Gas lift (0 current wells):
- Typical operating pressure 4,000 – 5,000 kPag
- No temperature limitations, go as hot as ~263°C
- Average emulsion flow rate ~ 600-1600 m³/d

ESP (98 current wells):
- Majority of wells were converted to ESP after a gas lift phase
- ESP conversion occurs when thief zone intersected or other optimization purposes
- Typical operating pressure 1,800 – 4,000 kPag
- No temperature limitations, go as hot as ~250°C
- Average emulsion flow rate ~ 200-1600 m³/d
Subsection 3.1.1 – 5)
Instrumentation

Karen Montemurro
Production Engineer

committed. thoughtful. approachable. conscientious. agile. open-minded. creative. spirited. collaborative.
Instrumentation in Observation Wells – Typical Completions

Hanging Wire Piezometer

Temperature Observation

Cemented Casing Piezometers
Map of Observation Wells

Thermocouple well
Piezometer well

76-6-W4

www.cenovus.com
Requirements under subsection 3.1.1 5c) and d) are located in Appendices 1 & 2
Subsection 3.1.1 – 6) 4D Seismic

Sam Quiroga
Geophysicist

committed. thoughtful. approachable. conscientious. agile. open-minded. creative. spirited. collaborative.
PHASE CD 2013 4D Seismic Steam Chamber Top (TVDSS)

Structure

High

Low

RST

Thermocouples
Subsection 3.1.1 – 7) Scheme Performance

Chris Elliott
Principal Reservoir Engineer
SAGD Summary to Date

Well pair drilled but not producing
Well pair currently on production
Well using Wedge Well™ Technology currently on production
Well, expecting to use Wedge Well™ Technology drilled but not producing

www.cenovus.com
SAGD Summary to Date

98 total production wells in operation to date:

- 87 standard well pairs
  - All on ESP, no Gas Lift
- 1 offset toe producer well
  - ESP
  - Increase recovery from A01-3 well pair
- 10 wedge wells using patented Wedge Well™ technology
  - All on ESP
  - 3 located in A01 pad
  - 1 in between B01 and B02 pad
  - 3 located in B01 pad
  - 3 located in B02 pad
Christina Lake Performance

- Phase A Startup
- Phase B Startup
- Phase C Startup
- Phase D Startup
- Phase E Startup

Graph showing the performance of Christina Lake with various rates and SOR.
Christina Lake Performance

- Oil Rate (m3/d)
- Water Rate (m3/d)
- Steam Inj Rate (m3/d)
- Inst SOR
- Cum SOR
- Produced Gas Rate (e5m3/d)
- Gas Co-Injection Rate (e5m3/d)
- Turnaround

**Phase E Startup**

**B02-05-B02-10 Startup**

**Pad B11 Startup**

**Pad B08 Startup**

**Y-axis**
- Rate (m3/day)
- Gas Rate (e5m3/d)

**X-axis**
- Jan/13 to Mar/14

www.cenovus.com
Christina Lake
Cumulative % Recovery Based on CVE SAGDable OOIP (SOIP)

Note: For A02 pad, recovery based on 100m spacing drainage box
Christina Lake
Cumulative % Recovery Based on CVE Producible OOIP (POIP)

Note: For A02 pad, recovery based on 100m spacing drainage box
Varying Reservoir Quality Pad Patterns

Two example well pairs provided in Subsection 3.1.1 – 7b) illustrate:

- **B05-6**: High Reservoir Quality
  - Phase B Area
  - Cross-bedded sands
  - Medium to fine grained
  - $\sim 7D K_{\text{max}}$
  - 32% Porosity
  - $K_v/K_h \sim 0.5-0.75$

- **B02-1**: Medium Reservoir Quality
  - Phase C Area
  - Massive sands
  - Coarse grained
  - $\sim 10D K_{\text{max}}$
  - 34% Porosity
  - $K_v/K_h \sim 1.0$

- Expect the same ultimate recovery long-term
Christina Lake
Cumulative % Recovery  B02-1 & B05-6

![Graph showing cumulative recovery over years for B02-1 and B05-6](image-url)
B05-6 Well Pair

- Well pair drilled but not producing
- Well pair currently on production
- Well using Wedge Well™ Technology currently on production
- Well, expecting to use Wedge Well™ Technology drilled but not producing
Circulation

Conversion to Low Pressure ESP Operations

Gas Lift operations

ESP operations
B02-1 Well Pair

76-6-W4

B02

B02-1
B02-1 Well Pair Performance

Conversion to Low Pressure ESP Operations

Circulation

Gas Lift operations

ESP operations

Date

Jan/06 Jul/06 Jan/07 Jul/07 Jan/08 Jul/08 Jan/09 Jul/09 Jan/10 Jul/10 Jan/11 Jul/11 Jan/12 Jul/12 Jan/13 Jul/13 Jan/14

www.cenovus.com
B02-1 Well Pair – Observation Well 103/05-15

<table>
<thead>
<tr>
<th>Correlation</th>
<th>FACL</th>
<th>Depth</th>
<th>Resistivity</th>
<th>RST SO</th>
<th>RST SG</th>
<th>Temperature</th>
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<tr>
<td>GR</td>
<td>0 AFI 150</td>
<td>0.2</td>
<td>OHMM 2000</td>
<td>OIL</td>
<td>0.2</td>
<td>OHMM 2000</td>
</tr>
<tr>
<td>TVDSS</td>
<td>0.2</td>
<td>OHMM 2000</td>
<td>OIL</td>
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<td>OIL</td>
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**GP-5 (B0201 MID) 103051507606W400**
### CVE POIP, % Recovery, and Ultimate Recovery by Pad

<table>
<thead>
<tr>
<th>Pad</th>
<th>% Recovery to date*</th>
<th>POIP (e3m³)</th>
<th>Ultimate Recovery (e3m³)</th>
<th>Ultimate % Recovery</th>
<th>Potential Ultimate Recovery including Wedge Well™ technology (e3m³)*</th>
<th>Potential Ultimate % Recovery including Wedge Well™ technology</th>
</tr>
</thead>
<tbody>
<tr>
<td>A01</td>
<td>71.1</td>
<td>2,965</td>
<td>2,076</td>
<td>70</td>
<td>~2,372</td>
<td>~75-80</td>
</tr>
<tr>
<td>A02</td>
<td>77.1</td>
<td>401</td>
<td>281</td>
<td>70</td>
<td>~321</td>
<td>~75-80</td>
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<tr>
<td>B01</td>
<td>59.4</td>
<td>4,083</td>
<td>2,858</td>
<td>70</td>
<td>~3,266</td>
<td>~75-80</td>
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<tr>
<td>B02</td>
<td>69.2</td>
<td>2,453</td>
<td>1,717</td>
<td>70</td>
<td>~1,962</td>
<td>~75-80</td>
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<tr>
<td>B02C</td>
<td>15.9</td>
<td>1,712</td>
<td>1,198</td>
<td>70</td>
<td>~1370</td>
<td>~75-80</td>
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<tr>
<td>B03</td>
<td>42.9</td>
<td>5,223</td>
<td>3,656</td>
<td>70</td>
<td>~4,178</td>
<td>~75-80</td>
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<tr>
<td>B04</td>
<td>41.4</td>
<td>5,701</td>
<td>3,991</td>
<td>70</td>
<td>~4,561</td>
<td>~75-80</td>
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<td>B05</td>
<td>23.2</td>
<td>6,509</td>
<td>4,556</td>
<td>70</td>
<td>~5,207</td>
<td>~75-80</td>
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<tr>
<td>B06</td>
<td>24.0</td>
<td>4,241</td>
<td>2,969</td>
<td>70</td>
<td>~3,393</td>
<td>~75-80</td>
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<tr>
<td>B07</td>
<td>26.7</td>
<td>5,728</td>
<td>4,010</td>
<td>70</td>
<td>~4,582</td>
<td>~75-80</td>
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<tr>
<td>B08 (downspaced)</td>
<td>7.9</td>
<td>3,410</td>
<td>2,728</td>
<td>~75-80</td>
<td>2,728 (no ww)</td>
<td>~75-80</td>
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<tr>
<td>B11 (downspaced)</td>
<td>9.5</td>
<td>4,493</td>
<td>3,594</td>
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<td>3,594 (no ww)</td>
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<td>Total</td>
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<td>46,919</td>
<td>33,634</td>
<td>~72</td>
<td>~37,534</td>
<td>~75-80</td>
</tr>
</tbody>
</table>

*Volumes are based on ultimate recovery factor of 80% using Wedge Well™ Technology*  
* up to March 31, 2014
## CVE SOIP, % Recovery, and Ultimate Recovery by Pad

<table>
<thead>
<tr>
<th>Pad</th>
<th>% Recovery to date*</th>
<th>SOIP (e3m3)</th>
<th>Ultimate Recovery (e3m3)</th>
<th>Ultimate % Recovery</th>
<th>Potential Ultimate Recovery including Wedge Well™ Technology (e3m3)*</th>
<th>Potential Ultimate % Recovery including Wedge Well™ Technology</th>
</tr>
</thead>
<tbody>
<tr>
<td>A01</td>
<td>53.0</td>
<td>3,979</td>
<td>2,076</td>
<td>52</td>
<td>~2,372</td>
<td>60</td>
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<tr>
<td>A02</td>
<td>65.0</td>
<td>475</td>
<td>281</td>
<td>59</td>
<td>~321</td>
<td>68</td>
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<tr>
<td>B01</td>
<td>45.1</td>
<td>5,377</td>
<td>2,858</td>
<td>53</td>
<td>~3,266</td>
<td>61</td>
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<tr>
<td>B02</td>
<td>54.9</td>
<td>3,089</td>
<td>1,717</td>
<td>56</td>
<td>~1,962</td>
<td>64</td>
</tr>
<tr>
<td>B02C</td>
<td>12.1</td>
<td>2,243</td>
<td>1,198</td>
<td>53</td>
<td>~1,370</td>
<td>60</td>
</tr>
<tr>
<td>B03</td>
<td>31.9</td>
<td>7,015</td>
<td>3,656</td>
<td>52</td>
<td>~4,178</td>
<td>60</td>
</tr>
<tr>
<td>B04</td>
<td>33.3</td>
<td>7,079</td>
<td>3,991</td>
<td>56</td>
<td>~4,561</td>
<td>64</td>
</tr>
<tr>
<td>B05</td>
<td>18.5</td>
<td>8,161</td>
<td>4,556</td>
<td>56</td>
<td>~5,207</td>
<td>64</td>
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<tr>
<td>B06</td>
<td>18.2</td>
<td>5,584</td>
<td>2,969</td>
<td>53</td>
<td>~3,393</td>
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<td>B07</td>
<td>22.0</td>
<td>6,960</td>
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<td>58</td>
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<td>66</td>
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<tr>
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<td>2,728</td>
<td>58</td>
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<tr>
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<td>3,594</td>
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<tr>
<td>Total</td>
<td>26.7</td>
<td>60,617</td>
<td>33,634</td>
<td>55</td>
<td>~37,535</td>
<td>62</td>
</tr>
</tbody>
</table>

* Volumes are based on ultimate recovery factor of 80% using Wedge Well™ Technology * up to March 31, 2014
Scheme Performance Prediction

• Predict well pair performance based on modified Butler’s equation

• Predict well pair CSOR using published CSOR correlations (Edmunds & Chhina 2002)

• Generate overall scheme production performance by adding individual well forecasts over time to honor predicted plant steam capacity
Wellhead Steam Quality

- Current steam quality injected into all pads is calculated to be greater than 95%.

- Currently steam head pressure is operated at 8.5 MPag with a corresponding steam temperature of 300°C.
There are no anticipated pad abandonments for any of the Christina Lake wells at this time.
Subsection 3.1.1 – 7c) Steam Chamber Pressures

Chris Elliott
Principal Reservoir Engineer

committed. thoughtful. approachable. conscientious. agile. open-minded. creative. spirited. collaborative.
A01 Pad

- Pressures are Monthly Averages
• Pressures are Monthly Averages
B01 Pad

- Pressures are Monthly Averages
B02 Pad

Pressures are Monthly Averages
• Pressures are Monthly Averages
B04 Pad

- Pressures are Monthly Averages
B05 Pad

Pressures are Monthly Averages
B06 Pad

- Pressures are Monthly Averages
B07 Pad

- Pressures are Monthly Averages
Pressures are Monthly Averages
B11 Pad

- Pressures are Monthly Averages
B02C Pad

- Pressures are Monthly Averages
Subsection 3.1.1 – 7e) Operating SAGD with Top Gas, Bottom Water

Chris Elliott
Principal Reservoir Engineer

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Operations at Christina Lake

- Thief zones:
  - B01 to B07 pad are operating under a gas cap
  - A01, B01 to B07, B08 and B11 Pads have areas where Regional Bottom Water (BW) present with no shale break separating oil and BW

- Well performance of these two situations will be discussed:
  - Gas cap communication only
  - Bottom water and Gas Cap communication
High Pressure Operations

• For high pressure operations, the SAGD chamber has to be isolated from other zones
  • No gas cap or bottom water contact
Gas Cap at Christina Lake

Section 15 Gas Cap (Currently being repressured with air)

Section 11-14 Gas Cap (repressured with air)
B03-6: Gas Cap Communication

B03-6 Well Pair Performance

High Pressure gas lift
Circulation
Low Pressure ESP operations
• **Blue** = bottom water
• **Grey/Black/Orange** = mud barrier (isolates oil & water zones)
• Anywhere with blue and no grey: Oil in direct contact with water
B06 Pad: Operating with Bottom Water

- Ideally, we would like to operate in perfect pressure balance with the bottom water
B06 Pad Produced Water to Steam Ratio (PWSR)

Cumulative PWSR: B06 Pad (Christina Lake)

- Operating the Pad To Avoid Bottom Water Influx
Subsection 3.1.1 – 7a)ii) Patented Wedge Well™ Technology

Chris Elliott
Principal Reservoir Engineer
Patented Wedge Well™ Technology Locations

- Well pair drilled but not producing
- Well pair currently on production
- Well using Wedge Well™ Technology currently on production
- Well, expecting to use Wedge Well™ Technology drilled but not producing

Locations:
- B02W01
- B02W02
- B02W03
- B02W04
- B02W05
- A01W01
- B02W06
- B02W07
- B02W08
- B01W01
- B01W02
- B01W03
# Patented Wedge Well™ Technology Background

<table>
<thead>
<tr>
<th>Pad Location</th>
<th>Well Name</th>
<th>Start Date</th>
<th>Average Oil Rate (m³/d)</th>
<th>Average Water Cut (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A01 Pad Wells using Wedge Well™ Technology</td>
<td>A01W01</td>
<td>March, 2010</td>
<td>11</td>
<td>93%</td>
</tr>
<tr>
<td></td>
<td>B02W04</td>
<td>July, 2011</td>
<td>41</td>
<td>89%</td>
</tr>
<tr>
<td></td>
<td>B02W05</td>
<td>July, 2011</td>
<td>37</td>
<td>89%</td>
</tr>
<tr>
<td>B02 Pad Wells using Wedge Well™ Technology</td>
<td>B02W03</td>
<td>September, 2011</td>
<td>108</td>
<td>64%</td>
</tr>
<tr>
<td></td>
<td>B02W06</td>
<td>June, 2013</td>
<td>138</td>
<td>49%</td>
</tr>
<tr>
<td></td>
<td>B02W07</td>
<td>June, 2013</td>
<td>85</td>
<td>61%</td>
</tr>
<tr>
<td></td>
<td>B02W08</td>
<td>June, 2013</td>
<td>126</td>
<td>56%</td>
</tr>
<tr>
<td>B01 Pad Wells using Wedge Well™ Technology</td>
<td>B01W01</td>
<td>November, 2012</td>
<td>146</td>
<td>55%</td>
</tr>
<tr>
<td></td>
<td>B01W02</td>
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<td>124</td>
<td>58%</td>
</tr>
<tr>
<td></td>
<td>B01W03</td>
<td>November, 2012</td>
<td>109</td>
<td>63%</td>
</tr>
</tbody>
</table>
B01 Pad Neighboring Wells and Patented Wedge Well™ Technology Performance

- Steam (m³/d)
- Neighboring Wells Oil rate (m³/d)
- Wells Using Wedge Well™ Technology and Neighboring Wells Total Oil rate (m³/d)
- Neighboring Wells Cum Oil (km³)
- Wells Using Wedge Well™ Technology and Neighboring Wells Total Cum Oil (km³)
- 30 per. Mov. Avg. (Neighboring Wells Oil rate (m³/d))
- 30 per. Mov. Avg. (Wells Using Wedge Well™ Technology and Neighboring Wells Total Oil rate (m³/d))
B02 Pad Neighboring Wells and Patented Wedge Well™ Technology Performance

![B02 Pad Wells Using Wedge Well™ Technology]

- **Steam (m³/d)**
- **Neighboring Wells Oil rate (m³/d)**
- **Wells Using Wedge Well™ Technology and Neighboring Wells Total Oil rate (m³/d)**
- **Neighboring Wells Cum Oil (km³)**
- **Wells Using Wedge Well™ Technology and Neighboring Wells Total Oil rate (m³/d)**
- **30 per. Mov. Avg. (Neighboring Wells Oil rate (m³/d))**
- **30 per. Mov. Avg. (Wells Using Wedge Well™ Technology and Neighboring Wells Total Oil rate (m³/d))**

---

Subsection 3.1.1 – 7a)ii)
A01 Pad Neighboring Wells and Patented Wedge Well™ Technology Performance

![Graph showing oil rate and steam rate from 01 Sept 10 to 14 Dec 14 with various data points and trend lines for different categories such as neighboring wells, wedge wells, and steam supply.]

**Legend:**
- Red line: Steam (m^3/d)
- Blue dots: Neighboring Wells Oil rate (m^3/d)
- Green dots: Wells Using Wedge Well™ Technology and Neighboring Wells Total Oil rate (m^3/d)
- Gray line: Neighboring Wells Cum Oil (km^3)
- Black line: Wells Using Wedge Well™ Technology and Neighboring Wells Total Cum Oil (km^3)
- Yellow lines: 30 per. Mov. Avg. (Neighboring Wells Oil rate (m^3/d))
- Green lines: 30 per. Mov. Avg. (Wells Using Wedge Well™ Technology and Neighboring Wells Total Oil rate (m^3/d))
Follow-up from 2013 - 7g) Bottom Water Depressurization

Karen Montemurro
Production Engineer
Bottom Water Pressure Influence

- 2002-2006: Historical disposal into the local bottom water aquifer caused an increase to bottom water pressure
  - Moved disposal to remote location (15-35-076-06W4, 28 km from CPF) and saw immediate and significant drop in aquifer pressure
- 2010-2013: Regional activity from neighboring operators caused an increase to bottom water pressure
  - Reversed 1F5/3-16-076-06W4 local disposal well to a water production well
  - Developing an integrated strategy with regional partners to manage bottom water pressure
Reversal of 3-16 Disposal Well

282,263 m³ produced of the 5,236,500 m³ originally disposed

TDS (mg/L), Daily Volume (m³/d), and BHP (kPag)
Information requested from AER (May 13, 2014) – Application 1773237 follow up and B02-2 bottom water influx

Karen Montemurro
Production Engineer

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B02-2 Bottom Water Influx

- Bottom water influx into B02 pad due to regionally elevated bottom water pressure

- Risk of flooding B01, B02 chambers, similar to challenges on A01 Pad

- Large developed steam chamber; therefore, repressurization with steam would not be efficient

- Able to inject natural gas into the gas cap to support chamber pressures and bring us in balance with bottom water pressure
B02-2 Chamber Cooling

OB-3 (B0202 Heel)

Temperature (°C)

Depth (m)

- Gas/Bitumen Contact
- Injector
- Producer

14-May-14
15-Mar-14
14-Jan-14
15-Nov-13
16-Sep-13
18-Jul-13
19-May-13
20-Mar-13
19-Jan-13
20-Nov-12
21-Sep-12
6-15 Natural Gas Injection
6-15 Natural Gas Injection Update

- 6-15 natural gas injection began on December 17, 2013
- Currently injecting at a rate of ~115 e3m3/d
- Have increased gas cap pressure by ~240 kPa
- Current B01/B02 gas cap pressure: 2,422 kPag
- Bottom water pressure: 2,695 kPag
- Increasing gas cap pressure by ~ 1.7 kPa/d
- 273 kPa remaining
  - ~5 months at current injection rates
Section 15 Gas Cap - Injection Rates and BHP
Path Forward

• Continue to inject natural gas into the gas cap until bottom water pressure reached

• Applied to AER to switch to air injection

• Once 2,700 kPag is reached, transition to rampdown / blowdown phase on B02-1 through B02-4, and B01-1 through B01-4
  o Inject air into Section 15 gas cap to support pressure
Subsection 3.1.1 – 7e) Co-Injection at A01 Pad

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Principal Reservoir Engineer

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agile. open-minded. creative. spirited. collaborative.
Methane Co-injection Experience

- Co-injection of methane with steam in SAGD has been demonstrated in the field to improve SOR.

- High percentage of injected methane appears to get produced preventing excessive accumulation in the steam chamber.

- Good understanding of how gas behaves in reservoir:
  - Allow for increased understanding of drainage from I.H.S.
Co-injection of Methane at A01 Pad

- Natural gas is currently co-injected with steam into A01-1 thru A01-6
  - The composition of this gas is ~99% pure methane as it is delivered to the wells from our main gas pipeline

- Average concentration for Jan 2013 – March 2014
  - Cumulative C1 (m3)/ Cumulative steam (m3)(C.W.E.) = 8.0

- Average current operating conditions
  - 8.0 e³m³/d natural gas, 1000 m³/d steam for the entire pad
    - Due to facility restriction on handling produced gas, co-injection gas rates were lower than approval
  - Operating pressure ~ 2200 kPag
# A01 Pad General Co-injection Performance

## A01 Pad phases of operation

<table>
<thead>
<tr>
<th>Period</th>
<th>RF (%) (SOIP)</th>
<th>RF (%) (POIP)</th>
<th>CSOR (v/v)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dec ’05 – Dec ’06</td>
<td>20.7 – 29.4 (0.73%/mo)</td>
<td>27.8 – 39.5 (0.98%/mo)</td>
<td>2.47 – 2.37</td>
</tr>
<tr>
<td>(co-inj – 12 mo.)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dec ’06 – Dec ’07</td>
<td>29.4 – 34.2 (0.40%/mo)</td>
<td>39.5 – 45.9 (0.53%/mo)</td>
<td>2.37 – 2.36</td>
</tr>
<tr>
<td>(SAGD – 12 mo.)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dec ’07 – Mar ’14</td>
<td>34.2 – 53.0 (0.25%/mo)</td>
<td>45.9 – 71.1 (0.34%/mo)</td>
<td>2.36 – 2.39</td>
</tr>
<tr>
<td>(co-inj – 75 mo.)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Co-injection Experience to Date

• To date, co-injection has not demonstrated a negative impact on production or recovery

• Elevation regional bottom water pressure caused influx of water into A01 pad
  • Impacting oil rates and recovery negatively

• After first phase of co-injection (shut-in on Dec 2006), steam-only SAGD operations resumed with no negative impacts
Co-injection Experience to Date

- Second phase of co-injection is proceeding

- Required to inject 600 m$^3$/d of steam into A01 pad
  - CSOR has increased from 2.37 in Jan 2013 to 2.49 in March 2014
  - ISOR as of March 2014 is > 7.00
  - Need to consider full blowdown of pad (Target 2015)
    - Increased gas rates will help reduce bottom water influx issues
  - Rate of recovery is about 0.20% POIP per month (0.15% SOIP per month) for the pad

Shay Dodds (AER) suggested that CVE should set up a meeting with the AER to discuss to stop steam injection (600 m$^3$/d) at Pad A01 as this steam volume is not contributing to any oil recovery. The AER doesn’t want CVE to inject Steam if it’s not recovery any oil. Shay Dodds, Anna Pranjic-Ross and Andrew McPherson from the AER would be involved in this discussion. – Amanda follow-up on this.
Subsection 3.1.1 – 7e) Rampdown/Blowdown Test at B01/B02 Pad

Chris Elliott
Principal Reservoir Engineer
Rampdown/Blowdown Test: B01 and B02 Pad Location
Rampdown/Blowdown Test: Setup

Strategy: Top down blowdown
Will start injecting air in 6-15 to support gas cap pressure (as required)
Rampdown/Blowdown Test: Plan

• **Conduct a temporary wind-down test on B01 and B02 pads**
  - Timeframe: 6 months – 1 year
  - Well pairs: B02-1 to B02-4 ; B01-1 to B01-4
  - Steam will be brought back on after test is complete

• **B01-1 to B01-4: Blowdown test (6 month test)**
  - Shut-in steam on all four wells
    - Using gas cap (top down blowdown) to maintain pressure
  - Current RF: 65% POIP

• **B02-1 to B02-4: Steam ramp-down test (1 year test)**
  - Cut steam by 25% every 3 months (75%, 50%, 25%, 0%)
  - Current RF: 62% POIP

• **Planned start date: Oct 2014**
  - Repressuring gas cap to ~2700-2750 kPag to be in balance with bottom water
  - Once repressured, steady SAGD operations for 1 month before wind-down test started
Subsection 3.1.1 – 7f) Enhanced Start-up

Chris Elliott
Principal Reservoir Engineer
Solvent

- **Objective:** increase mobility in inter-well region.

- **Hypothesized Benefit:** shorter circulation time leading to accelerated production and improved steam conformance.

![Diagram showing communication between an injector well and a producer well, with a distance of approximately 5 meters.]
Solvent

- Solvent – Xylene
- 25 m$^3$/well
  - B08 Pad – I06
  - B11 Pad – I03, I06 & I08

Key Learning

- Average reduction in circulation time did not justify the expense associated with using xylene.
Steam Dilation

- Create an increased **porosity and permeability dilation zone** between the SAGD wells via **controlled high-pressure injection**.
- The injection is managed so that **NO excessive propagation is caused** except between the wells.
  - Not the same as fracturing (no propants injected)
- Dilated wells:

<table>
<thead>
<tr>
<th>Pad</th>
<th>Dilated wells</th>
<th>Pad</th>
<th>Dilated wells</th>
</tr>
</thead>
<tbody>
<tr>
<td>B01</td>
<td>5; 6, 7 (water)</td>
<td>B05</td>
<td>3, 9</td>
</tr>
<tr>
<td>B02</td>
<td>8</td>
<td>B07</td>
<td>3, 4</td>
</tr>
<tr>
<td>B03</td>
<td>1, 2, 3, 7, 8</td>
<td>B08</td>
<td>3</td>
</tr>
<tr>
<td>B04</td>
<td>1, 2, 5, 6, 7</td>
<td>B11</td>
<td>3</td>
</tr>
</tbody>
</table>

**Promotes** and **Prevents**

![Diagram showing the process of steam dilation](image-url)
# B08 Pad Enhanced Start-up Summary

<table>
<thead>
<tr>
<th>Well</th>
<th>Start-up Method</th>
<th>Soak Time (Days)</th>
<th>Net Injection (m³)</th>
<th>Max BHP (MPag)</th>
</tr>
</thead>
<tbody>
<tr>
<td>B08-1</td>
<td>Circulation</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>B08-2</td>
<td>Circulation</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
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<tr>
<td>B08-3</td>
<td>Dilation &amp; Circulation</td>
<td>N/A</td>
<td>139</td>
<td>7.39</td>
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<td>B08-4</td>
<td>Circulation</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
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<tr>
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<td>N/A</td>
<td>N/A</td>
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<tr>
<td>B08-6</td>
<td>Solvent &amp; Circulation</td>
<td>202</td>
<td>N/A</td>
<td>N/A</td>
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<td>B08-7</td>
<td>Circulation</td>
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<td>N/A</td>
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<td>B08-8</td>
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<td>B08-9</td>
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<td>B08-10</td>
<td>Circulation</td>
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## B11 Pad Enhanced Start-up Summary

<table>
<thead>
<tr>
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<th>Net Injection (m³)</th>
<th>Max BHP (MPag)</th>
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<tbody>
<tr>
<td>B11-1</td>
<td>Circulation</td>
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<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>B11-2</td>
<td>Circulation</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
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<tr>
<td>B11-3</td>
<td>Solvent, Circulation &amp; Dilation</td>
<td>155</td>
<td>298</td>
<td>7.25</td>
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<tr>
<td>B11-4</td>
<td>Circulation</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>B11-5</td>
<td>Circulation</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>B11-6</td>
<td>Solvent &amp; Circulation</td>
<td>155</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>B11-7</td>
<td>Circulation</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
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<tr>
<td>B11-8</td>
<td>Solvent &amp; Circulation</td>
<td>155</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>B11-9</td>
<td>Circulation</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>B11-10</td>
<td>Circulation</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>B11-11</td>
<td>Circulation</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>B11-12</td>
<td>Circulation</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
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</tbody>
</table>
B11-3 Dilation Results

![Graph showing dilation results with various data points and lines representing different metrics such as rates (m3/d), pressures (kPag), and dates from October 2004 to October 2006.](image-url)
CL CondenSAP pilot

CondenSAP

- Using condensate mix as solvent

B01-7 CondenSAP

- Well pair currently operating on ESP
- Solvent injection: December 2012 to December 2013
- Currently bringing pressure in balance with gas cap

<table>
<thead>
<tr>
<th>Result</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cum. wt% solvent injected</td>
<td>5% Solvent injection limited by vapour handling capacity and treating upsets in central processing facility (CPF).</td>
</tr>
<tr>
<td>Cum. solvent recovery (%)</td>
<td>14% Solvent production limited by losses to top gas zone.</td>
</tr>
</tbody>
</table>
Subsection 3.1.1 – 7e)
B05-8 Rise Rate Control Test Update

Karen Montemurro
Production Engineer

committed. thoughtful. approachable. conscientious.
agile. open-minded. creative. spirited. collaborative.
CL Rise Rate Pilot

- Location of Rise rate pilot was moved to B05-8
- Modifications to the design were required in order to make the compressor system operational
- Construction expected to be complete by Q3 2014
- Intent of pilot was to inject air and steam during the chamber rise phase:
  - Monitor if/how the shape of the chamber differs from regular SAGD as it grows vertically
  - Monitor changes in the rate of steam rise
- B05-8 steam chamber has connected to gas cap under regular SAGD ops
  - Rise rate control opportunity missed on B05-8
  - Will look for another location in the future
Subsection 3.1.1 – 7e) Cenovus A02-2 SAP Project Update

Christian Canas
Production Engineer

committed. thoughtful. approachable. conscientious.
agile. open-minded. creative. spirited. collaborative.
A02-2 Isolated SAP Test:

- Inject solvent along with steam
  - Solvents aid in reducing the viscosity of the oil

- Benefits of SAP:
  - Reduced CSOR
  - Improved oil recovery
  - Improved oil quality
  - Possibility of wider well spacing

- Solvent is produced from production well and can be recycled and re-injected

- Several SAP pilots have been tested by Cenovus
Christina Lake SAP pilots

Current A02 - 2 Pilot

Future A02-1 Pilot

A01-1  A01-6

76-6-W4
A02-2 Isolated SAP Project Layout

- SAP recovery facility
- SAP well pair - A02-2
- Butane storage
A02 Pad

SAGDable Oil in Place (SOIP)

<table>
<thead>
<tr>
<th>Well</th>
<th>Net SAGD Pay (m)</th>
<th>Drilled Length (m)</th>
<th>Spacing (m)</th>
<th>Average (ø)</th>
<th>Average (So)</th>
<th>Cumulative Oil Production (e³m³)*</th>
<th>SOIP (e³m³)</th>
<th>% Recovery</th>
</tr>
</thead>
<tbody>
<tr>
<td>A02-2 (SAP)</td>
<td>28.51</td>
<td>636.70</td>
<td>100</td>
<td>0.34</td>
<td>0.84</td>
<td>308.6</td>
<td>475.0</td>
<td>65.0</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>308.6</td>
<td>475.0</td>
<td>65.0%</td>
</tr>
</tbody>
</table>

Producible Oil in Place (POIP)

<table>
<thead>
<tr>
<th>Well</th>
<th>Net SAGD Pay (m)</th>
<th>Drilled Length (m)</th>
<th>Spacing (m)</th>
<th>Average (ø)</th>
<th>Average (So)</th>
<th>Cumulative Oil Production (e³m³)*</th>
<th>POIP (e³m³)</th>
<th>% Recovery</th>
</tr>
</thead>
<tbody>
<tr>
<td>A02-2 (SAP)</td>
<td>25.54</td>
<td>592.35</td>
<td>100</td>
<td>0.34</td>
<td>0.84</td>
<td>308.6</td>
<td>400.5</td>
<td>77.1</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>308.6</td>
<td>400.5</td>
<td>77.1%</td>
</tr>
</tbody>
</table>

* up to March 31, 2014

Note: Recovery based on 100m spacing drainage box
A02-2 Isolated SAP Performance Highlights

Low Pressure ESP Mode (October 2009 – September 2011)
• P=2500Kpa
• 7% uplift in oil rate
• 27% reduction in ISOR
• 66% cumulative solvent recovered

High Pressure ESP Mode (October 2011 – October 2012)
• P=2900Kpa
• 17% uplift in oil rate
• 31% increase in ISOR (due to raising chamber pressure)
• 63% cumulative solvent recovered

Low Pressure ESP Mode (November 2012 – March 31, 2014)
• P=2200Kpa
• Avg oil rate 1172 bbl/d (49% uplift in oil. SAGD baseline is 785bbl/d)
• Avg ISOR= 0.97 (59% reduction in ISOR. SAGD baseline is 2.37)
• 63% cumulative solvent recovered
A02-2 Performance

SAP A02 Well
Cumulative Steam-to-Oil Ratio (CSOR)

Beginning of SAP

<table>
<thead>
<tr>
<th>CSOR</th>
<th>Oil Rate (m3/d)</th>
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</thead>
<tbody>
<tr>
<td>3.4</td>
<td>800</td>
</tr>
<tr>
<td>3.0</td>
<td>700</td>
</tr>
<tr>
<td>2.6</td>
<td>600</td>
</tr>
<tr>
<td>2.2</td>
<td>500</td>
</tr>
<tr>
<td>1.8</td>
<td>400</td>
</tr>
<tr>
<td>1.4</td>
<td>300</td>
</tr>
<tr>
<td>1.0</td>
<td>200</td>
</tr>
<tr>
<td>0.6</td>
<td>100</td>
</tr>
<tr>
<td>0.2</td>
<td>0</td>
</tr>
</tbody>
</table>

- Cum. SOR
- Start of Butane Inj. >
- Avg SOR Pre-SAP
- Avg SOR SAP
- Avg Oil Pre-SAP
- Avg Oil SAP
- Oil Production
- Water Production
- Steam Injection

- Oil Pre-SAP 125 m3/d
- SOR Pre-SAP = 2.37
- Oil After SAP = 151 m3/d
- SOR After SAP = 1.59

Time:
- Jan/09
- Jun/09
- Nov/09
- Apr/10
- Sep/10
- Feb/11
- Jul/11
- Dec/11
- May/12
- Oct/12
- Mar/13
- Aug/13
- Jan/14
- May/14
A02-2 Butane Recovery

SAP A02 Well
Cumulative Injected & Produced Butane

Liquid volumes reported at 101.3 kPa and -0.5 °C
A02-1 SAP Pilot

Pilot Project Plan

A02-1 will focus on early injection of butane in the reservoir and its main objectives are:

- Demonstrate the benefits of injecting butane during rise phase
- Monitor butane injection and recovery profile
- Evaluate SAP performance with different solvent concentrations after rise phase
- Monitor gas and oil production rates, rise rate, SOR, chamber conformance

SCHEDULE

- Drilled October 2013
- Completed Jan 2014
- Currently in Engineering stage
- Handover to Operations October 2014
Subsection 3.1.1 – 7e) Surfactant Steam Process (SSP) pilot update

Christian Canas
Production Engineer

committed. thoughtful. approachable. conscientious. agile. open-minded. creative. spirited. collaborative.
SSP Pilot Description

- Surfactant Steam Process (SSP)
- Co-inject surfactant at <0.30 wt% of steam rate
SSP Well Operation Overview

- B11 pad drilled at ~67m well spacing

- Timeline:
  - Mid July, 2013 – Well pair circulation starts
  - Mid Aug, 2013 – SAGD starts
  - Jan 19, 2014 – Surfactant co-injection started (B11-10 & B11-11 well pairs)

- The pilot needs to be operated for longer period in order to have a more meaningful evaluation of the SSP process
Subsection 3.1.1 – 7f) Summary of Key Learnings

Chris Elliott
Principal Reservoir Engineer

committed. thoughtful. approachable. conscientious. agile. open-minded. creative. spirited. collaborative.
Key Learnings at Christina Lake for 2013

• Phase ABCDE nameplate oil (138,800 bbls/d cumulative capacity):
  • Achieved Q1 2014 (after 6-9 months of oil production)
  • Fast ramp-up achieved due to successful start-up strategy, optimized steam injection design, and superior reservoir quality

• Start-up technology:
  • Still evaluating the different technologies
  • Start-up technology used on a pad will be determined on a pad-by-pad basis
    o Areas with bottom water will revert to circulation or solvent soak in injectors

• Early conversion from high pressure operations to low pressure operations:
  • Has been successful in the field
  • SOR improves
    o Some wells have CSOR close to 2 after less than 1 year of operation
Key Learnings at Christina Lake for 2013 (cont’d)

- **Performance of Wells using Wedge Well™ Technology:**
  - Results from B01 and B02 Wedge Well Technology™ promising (300 - 1000 bbl/day production)

- **A01 Pad:**
  - Injecting 600 m$^3$/d steam with ISOR of ~7
  - A01 pad recovery to date ~ 72% POIP
  - Consider blowdown operations in 2015 for more efficient steam usage

- **Wabiskaw:**
  - Encountered high pressure (~6500 kPag) in the Wabiskaw Mbr that had been conductively heated by the underlying steam chamber.
  - Currently producing from the Wabiskaw Mbr in order to reduce the pressure below the approved MOP of 5400 kPag.
Follow-up from Previous Presentations

There are no outstanding issues to follow up from any previous AER presentation
Pad Production Plots

Requirements under subsection 3.1.1 7h) are located in Appendix 4
Subsection 3.1.1 – 8) Future Plans

Chris Buchanan
Sr. Staff Development Planner, Christina Lake

committed. thoughtful. approachable. conscientious. agile. open-minded. creative. spirited. collaborative.
Resource Recovery Strategy

• Well/Pad placement:
  • 2014/2015 well pairs will be drilled as per the existing (or future) applications and approvals
  • Well spacing/trajectories planned to be submitted for approval up to 1 year prior to construction/drilling

• No changes in the overall resource recovery strategy (operating pressure, composition of injected fluid)

• Any deviations will be applied for as future amendments
## Filed Applications

<table>
<thead>
<tr>
<th>Category</th>
<th>Application</th>
<th>Date Filed</th>
</tr>
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<tbody>
<tr>
<td>3</td>
<td>Phase H and Eastern Expansion</td>
<td>March, 2013</td>
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<tr>
<td>2</td>
<td>R&amp;D Casing Gas Reinjection</td>
<td>March, 2014</td>
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<td>N/A</td>
<td>RD2 Disposal D51/D65</td>
<td>December, 2013</td>
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## Potential Future Applications

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<tr>
<td>2</td>
<td>B10 Bypassed Pay Well(s)</td>
<td>Q2 2014</td>
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<tr>
<td>2</td>
<td>Amendment to Project Pads: L03, L05, L05b, B11b, H07, H09, J05, J09, L01b, and H01</td>
<td>Q2 2014</td>
</tr>
<tr>
<td>2</td>
<td>Propane SAP</td>
<td>Q4 2014</td>
</tr>
<tr>
<td>2</td>
<td>Pad CondenSAP</td>
<td>2015</td>
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## Drilling Plans – 2014

<table>
<thead>
<tr>
<th>Pad</th>
<th>Pad Type</th>
<th>Well Count</th>
<th>Timing</th>
</tr>
</thead>
<tbody>
<tr>
<td>B03</td>
<td>Production</td>
<td>8 Wells*</td>
<td>Q1 2014 (Rig Release)</td>
</tr>
<tr>
<td>B05</td>
<td>Production</td>
<td>9 Wells*</td>
<td>Q1 2014 (Rig Release)</td>
</tr>
<tr>
<td>B07B</td>
<td>Production</td>
<td>11 Well Pairs</td>
<td>Q1 2014 (Spud, In Progress)</td>
</tr>
<tr>
<td>H03</td>
<td>Production</td>
<td>12 Well Pairs</td>
<td>Q2 2014 (Spud, In Progress)</td>
</tr>
<tr>
<td>B10</td>
<td>Production</td>
<td>10 Well Pairs</td>
<td>Q2 2014 (Spud)</td>
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<tr>
<td>H01</td>
<td>Production</td>
<td>12 Well Pairs</td>
<td>Q3 2014 (Spud)</td>
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<tr>
<td>J03</td>
<td>Production</td>
<td>11 Well Pairs</td>
<td>Q4 2014</td>
</tr>
<tr>
<td>L03</td>
<td>Production</td>
<td>7 Well Pairs and 2 Wells*</td>
<td>Q4 2014</td>
</tr>
<tr>
<td>B06</td>
<td>Production</td>
<td>9 Wells*</td>
<td>Q4 2014</td>
</tr>
</tbody>
</table>

*Wells using Wedge Well™ technology*
SAGD Drilling Plans 2014F

- L03 Pad: 7 Well Pairs and 2 Wells*
- H01 Pad: 12 Well Pairs
- H03 Pad: (currently drilling) 12 Well Pairs
- J03 Pad: 11 Well Pairs
- B07B Pad: (currently drilling) 11 Well Pairs
- B10 Pad: 10 Well Pairs
- B05 Pad: 9 Wells* (rig released Q1)
- B03 Pad: 8 Wells* (rig released Q1)
- B06 Pad: 9 Wells*

*Wells using Wedge Well™ technology
Drilling Plans - 2015

<table>
<thead>
<tr>
<th>Pad</th>
<th>Pad Type</th>
<th>Well Count</th>
<th>Timing</th>
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<td>B07</td>
<td>Production</td>
<td>8 Wells*</td>
<td>Q3 2015</td>
</tr>
<tr>
<td>L05/L05b¹</td>
<td>Production</td>
<td>18 Well Pairs and 2 Wells*</td>
<td>Q2 2015</td>
</tr>
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<td>J01</td>
<td>Production</td>
<td>11 Well Pairs</td>
<td>Q2 2015</td>
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<td>Production</td>
<td>12 Well Pairs</td>
<td>Q2 2015</td>
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<tr>
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*Wells using Wedge Well™ technology

1: Single surface pad. Accesses 2 sub-surface drainage boxes.
SAGD Drilling Plans 2015F

- L05 Pad: 7 Well Pairs and 2 Wells*
- L05b Pad: 11 Well Pairs
- B07 Pad: 8 Wells*
- B13 Pad: 12 Well Pairs
- J01 Pad: 11 Well Pairs
- J07 Pad: 12 Well Pairs
- J09 Pad: 12 Well Pairs
- H09 Pad: 11 Well Pairs and 1 Well*

*Wells using Wedge Well™ technology
MW1 McMurray Source Pad 3 Wells

MW4 McMurray Source Pad 3 Wells

RD2 McMurray Disposal Pad 3 Additional Wells (currently 7 on pad)

1: Pending AER Approval
Steam Strategy 2014

- Dry steam capacity at CL Phases A-E = 39,523 m$^3$/d.
- The following pads are planned to start up for sustaining production: B09, B01*, B04*, B03*, F01
  - Total of 23 Well Pairs and 19 Wells*
- Methane co-injection to continue at A01 pad
- Rampdown/Blowdown pilot test at B01-1 to B01-4 and B02-1 to B02-4
- No steam shortages expected on existing pads
- No planned changes to steam capacity

*Wells using Wedge Well™ technology
Steam Strategy 2015

- Phase CDE 2nd Stage OTSG adding 6,695 m$^3$/d incremental capacity, bringing total capacity to 46,218 m$^3$/d
- 1 additional pad starting up with Phase CDE 2nd Stage OTSG: B07B (11 Well Pairs)
- The following pads are planned to start up for sustaining production: B05*, H03 (potential early start-up prior to Phase F steam)
  - Total of 12 Well Pairs and 9 Wells*
- Methane co-injection continues at A01 pad
- Rampdown/Blowdown pilot test continues at B01-1 to B01-4 and B02-1 to B02-4
- No steam shortages expected on existing pads

*Wells using Wedge Well™ technology
APPENDIX 1 Subsection 3.1.1 5d) Peizometer Data
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## Thermocouples in observation wells

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Piezometer data
Piezometer data
Piezometer data
Piezometer data

02/06-12-75-05W4M

P (kPa)

Piezometer data

![Piezometer data graph]

**100/13-12-76-06W4M**

- 380 m kPa
- 360 m kPa
- 546.5 m kPa
- 331.5 m kPa

**Axes:**
- **Y-axis:** Pressure (kPa)
- **X-axis:** Time (Jan-13 to Mar-14)

---

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Page 188
Piezometer data

![Piezometer data graph](image-url)
Piezometer data

![Piezometer data graph](graph.png)
Piezometer data

100/01-14-76-06W4M

- 402.0 mKPa
- 372.0 mKPa
- 355.0 mKPa
- 345.0 mKPa
- 323.5 mKPa

P [KPa]

Piezometer data

102/11-14-76-06W4M

[Graph showing piezometer data with pressure (p) in kPa and time from January 2013 to March 2014, with different lines for various pressure levels (385.0 mKb, 360.0 mKb, 345.0 mKb, 332.0 mKb, 322.0 mKb).]
Piezometer data
Piezometer data

100/04-15-76-6W4M

P (psi)

Piezometer data

100/05-15-76-06W4M

Pressure (kPa)

Piezometer data
Piezometer data

![Piezometer data graph](image-url)
Piezometer data
Piezometer data

02-23-076-04W4

P (kPa)

Piezometer data
APPENDIX 2
Subsection 3.1.1 5d) RST and Observation Temperature Data
OB-5 (B0103 HEEL) 102051507606W400

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WABISKAW
T11 MCM
E10
SAGD PAY TOP
340
320
315
310
300
265
250
225
200
175
150
125
100
75
50
25
### OB-4 (B0103 TOE) 102061507606W400

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- **310WABISKAW**
- **315**
- **320**
- **325**
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- **340**
- **345**
- **SAGD PAY TOP**
- **350**
- **355**
- **360**
- **365**
- **370**
- **375**
- **380**
- **385**
- **SAGD Base**
- **390**
- **395**
- **PALEO**

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## OB-6 (B0104 MID 104061507606W400)

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**Diagram:**
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- **SAGD PAY TOP**
- **T11**
- **SAGD Base**
- **PALEO**

[Diagram Image]
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![Graph and Table](image-url)

WABISKAW
T11
MCM
E10
SAGD PAY TOP
370
Injector

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- Oil
- RST_SG

![Graph and Diagram]
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- **325**
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- **415** PALEO
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**Diagram:**

- **WABISKAW**
- **T11 MCM**
- **E10**
- **SAGD PAY TOR**
- **Injector**
- **Producer**
- **SAGD Base**
- **OWC**
- **PALEO**
B32H (B0302 HEEL) 102101107606W400

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TVDSS

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<th>Resistivity</th>
<th>Temperature</th>
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<tr>
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<td>GAPI</td>
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<td>T_Jan12</td>
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<tr>
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<th>FACI</th>
<th>Depth</th>
<th>Resistivity</th>
<th>Temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>GR (GRGM)</td>
<td>GAPI</td>
<td>&lt;MD</td>
<td>AHT0 (RILM)</td>
<td>T_Jan11</td>
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<td>150</td>
<td>20000</td>
<td>0</td>
<td>UNKNOWN 300</td>
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320 WABISKAW
325
330
333
340
345
350
355
360
365
370
375
380
385
390
SAGD PAY TOP
395
400 PALEO

NEOM

Injector
Producer

www.cenovus.com
<table>
<thead>
<tr>
<th>Correlation</th>
<th>FAC1</th>
<th>Depth</th>
<th>Resistivity</th>
<th>Temperature</th>
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<tbody>
<tr>
<td>B42T (B042 TOE) 100021407606W400</td>
<td>MD</td>
<td>0.2</td>
<td>CHMM 2000</td>
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</table>

![Diagram of well log data with depth and resistivity measurements.](image-url)
<table>
<thead>
<tr>
<th>Correlation</th>
<th>FACI</th>
<th>Depth</th>
<th>Resistivity</th>
<th>Temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>GR(GRGM)</td>
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<td>AHT90(RILD)</td>
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<td>OHMM</td>
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<tr>
<td>0</td>
<td>GAPI</td>
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<td>0.2</td>
<td>OHMM</td>
</tr>
<tr>
<td>TVDSS&gt;</td>
<td>3</td>
<td>AHT90(KILM)</td>
<td>0.2</td>
<td>OHMM</td>
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The diagram shows a section of the reservoir with layers labeled WABISKAW, T11, and SAGD PAY TOP. The depth intervals are marked with varying colors representing different facies and geological features. The chart also indicates the presence of oil and water zones.
No thermo data or RST after 2012
<table>
<thead>
<tr>
<th>Correlation</th>
<th>FACI</th>
<th>Depth</th>
<th>Resistivity</th>
<th>Temperature</th>
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<td>TVDSS</td>
<td></td>
<td>0.2</td>
<td>OHMM</td>
<td>2000</td>
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The diagram illustrates various geological layers, including WABISKAW, T11, and SAGD PAY TOP, with annotations for oil production and injection points.
B58H (B058 HEEL) 100141107606W400
B62T (B062 TOE) 103061207606W400

<table>
<thead>
<tr>
<th>Correlation</th>
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<td>TVDSS&gt;</td>
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<td>T FEB12</td>
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**Diagram:**
- *WABISKAW* 335 to 340
- *T11* 345 to 350
- *NEON* 355 to 360
- *SAGD PAY TOP* 365 to 370
- *375 SAGD PAY TOP* 380
- *385 Injector* 390
- *395 Producer* 395
- *400 SAGD Base* 405
- *410 PALEO* 415

*Oil* markers are indicated on the diagram.
<table>
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<td>OHMM</td>
<td>TVDSS</td>
<td>AHT80</td>
<td>WC</td>
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</tbody>
</table>

---

**Diagram:**

- **SAGD Base:** 410
- **PALEO:** 175
- **SAGD PAY TOP:** 370
- **NEWM:** 350
- **T11:** 340
- **NEWM:** 335
- **WABISKAW:** 330

**Legend:**
- **Oil:**
- **WC:**
### B66T (B06_6 Toe) 102051207606W400

<table>
<thead>
<tr>
<th>Correlation</th>
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<td>AHT60(RILM)</td>
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<td>SG 2011</td>
<td>T Mar13</td>
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<td>0.2 OHMM</td>
<td>20000</td>
<td>unitless</td>
<td>10</td>
</tr>
</tbody>
</table>

![Graphical representation of the data](image)

- **WABISKAW**: 320-325
- **T11**: 330-335
- **NEON**: 340-345
- **SAGD PAY TOP**: 360-365
- **Injacker**: 390
- **Producer**: 395
Subsection 3.1.1 7h) pad production data
Additional Slides (as requested by AER July 2014)

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List of Re-drills/Re-entry Wells in 2013-2014

- The list of re-drill/re-entry wells in 2013-2014 is summarized in table below:

<table>
<thead>
<tr>
<th>UWI</th>
<th>WELLNAME</th>
<th>RE-DRILL/RE-ENTRY REASON</th>
</tr>
</thead>
<tbody>
<tr>
<td>102/09-11-076-06W4/00</td>
<td>CVE FCCL B03W04 LEISMER 9-11-76-6</td>
<td>Upon drilling out of ICP, cuttings were low in oil saturation indicating a possible bottom water zone. The well was whipstocked and drilled ~2m higher in oil saturated sand.</td>
</tr>
<tr>
<td>112/16-11-076-06W4/02</td>
<td>CVE FCCL B03W04 LEISMER 16-11-76-6 S01</td>
<td></td>
</tr>
</tbody>
</table>
Summary of Well Spacing in Existing Pads

- The well spacing in existing pads is summarized in table below:

<table>
<thead>
<tr>
<th>SAGD Pad</th>
<th>Inter Well Pair Spacing [m]</th>
</tr>
</thead>
<tbody>
<tr>
<td>A01</td>
<td>110</td>
</tr>
<tr>
<td>A02</td>
<td>100</td>
</tr>
<tr>
<td>B01</td>
<td>100</td>
</tr>
<tr>
<td>B02</td>
<td>100</td>
</tr>
<tr>
<td>B03</td>
<td>100</td>
</tr>
<tr>
<td>B04</td>
<td>100</td>
</tr>
<tr>
<td>B05</td>
<td>100</td>
</tr>
<tr>
<td>B06</td>
<td>100</td>
</tr>
<tr>
<td>B07</td>
<td>100</td>
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<tr>
<td>B08</td>
<td>70</td>
</tr>
<tr>
<td>B11</td>
<td>67</td>
</tr>
<tr>
<td>B09</td>
<td>64</td>
</tr>
</tbody>
</table>
Criteria to determine standoff from bottom water

- Cenovus optimizes the well position from the base of the reservoir and bottom water
  - To maximize resource recovery and operational efficiency

- Wells are targeted to land at ~50% oil saturation
  - Excluding other factors such as potential barriers
  - Planned trajectories are ~2m higher than this due to the drilling error that is consistently observed
Christina Lake in-situ oil sands scheme

This presentation contains information in compliance with:

AER *Directive 054* - Performance Presentations, Auditing, and Surveillance of In Situ Oil Sands Schemes

Section 3.1.2 Surface Operations, Compliance, and Issues Not Related to Resource Evaluation and Recovery
Advisory

This document contains forward-looking information prepared and submitted pursuant to Alberta regulatory requirements and is not intended to be relied upon for the purpose of making investment decisions, including without limitation, to purchase, hold or sell any securities of Cenovus Energy Inc. Certain resources estimates contained herein are not reported in accordance with National Instrument 51-101 and are provided solely for the purpose of complying with Alberta regulatory requirements.

Additional information regarding Cenovus Energy Inc. is available at cenovus.com
Oil & gas information

The estimates of reserves and contingent resources, with the exception of internal SOIP and POIP estimates disclosed for regulatory purposes (the “Additional Estimates”) were prepared effective December 31, 2013 and the estimates of bitumen initially-in-place were prepared effective December 31, 2012. All estimates other than the Additional Estimates were prepared by independent qualified reserves evaluators, based on definitions contained in the Canadian Oil and Gas Evaluation Handbook and in accordance with National Instrument 51-101. Additional information with respect to the significant factors relevant to the resources estimates, the specific contingencies which prevent the classification of the contingent resources as reserves, pricing and additional reserves and other oil and gas information, including the material risks and uncertainties associated with reserves and resources estimates, is contained in our AIF and Form 40-F for the year ended December 31, 2013, available on SEDAR at www.sedar.com, EDGAR at www.sec.gov and on our website at cenovus.com.

There is no certainty that it will be commercially viable to produce any portion of the contingent resources. There is no certainty that any portion of the prospective resources will be discovered. If discovered, there is no certainty that it will be commercially viable to produce any portion of those resources. Actual resources may be greater than or less than the estimates provided.

Total bitumen initially-in-place (BIIP) estimates, and all subcategories thereof, including the definitions associated with the categories and estimates, are disclosed and discussed in our July 24, 2013 news release, available on SEDAR at sedan.com and at cenovus.com. BIIP estimates include unrecoverable volumes and are not an estimate of the volume of the substances that will ultimately be recovered. Cumulative production, reserves and contingent resources are disclosed on a before royalties basis. All estimates are best estimate, billion barrels (Bbbls). Total BIIP (143 Bbbls); discovered BIIP (93 Bbbls); commercial discovered BIIP equals the cumulative production (0.1 Bbbls) plus reserves (2.4 Bbbls); sub-commercial discovered BIIP equals economic contingent resources (9.6 Bbbls) plus the unrecoverable portion of discovered BIIP (81 Bbbls); undiscovered BIIP (50 Bbbls); prospective resources (8.5 Bbbls); unrecoverable portion of undiscovered BIIP (42 Bbbls). Any contingent resources as at December 31, 2012 that are sub-economic or that are classified as being subject to technology under development have been grouped into the unrecoverable portion of discovered BIIP.

Certain natural gas volumes have been converted to barrels of oil equivalent (BOE) on the basis of one barrel (bbl) to six thousand cubic feet (Mcf). BOE may be misleading, particularly if used in isolation. A conversion ratio of one bbl to six Mcf is based on an energy equivalency conversion method primarily applicable at the burner tip and does not represent value equivalency at the well head.

TM denotes a trademark of Cenovus Energy Inc.
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## Strong integrated oil portfolio

<table>
<thead>
<tr>
<th>TSX, NYSE</th>
<th>CVE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enterprise value</td>
<td>C$31 billion</td>
</tr>
<tr>
<td>Shares outstanding</td>
<td>757 MM</td>
</tr>
<tr>
<td><strong>2014F production</strong></td>
<td></td>
</tr>
<tr>
<td>Oil &amp; NGLs</td>
<td>199 Mmbls/d</td>
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<tr>
<td>Natural gas</td>
<td>470 MMcf/d</td>
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<tr>
<td><strong>2013 proved &amp; probable reserves</strong></td>
<td>3.2 BBOE</td>
</tr>
<tr>
<td>Bitumen</td>
<td></td>
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<tr>
<td>Economic contingent resources*</td>
<td>9.8 Bbbls</td>
</tr>
<tr>
<td>Discovered bitumen initially in place*</td>
<td>93 Bbbls</td>
</tr>
<tr>
<td>Lease rights**</td>
<td>1.5 MM net acres</td>
</tr>
<tr>
<td>P&amp;NG rights</td>
<td>5.9 MM net acres</td>
</tr>
<tr>
<td>Refining capacity</td>
<td>230 Mmbls/d</td>
</tr>
</tbody>
</table>


*See advisory. **Includes an additional 0.5 million net acres of exclusive lease rights to lease on our behalf and our assignee’s behalf.
Subsection 3.1.2 – 1)
Facilities

Karen Montemurro
Production Engineer

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Facility summary

Phase E was brought online in 2013

- First steam was June 2013
- First oil was July 2013

Phase E had excellent operational success

- Ramped up to nameplate capacity in 6 to 9 months
- No major commissioning/start up problems

Phase E success attributed to:

- High plant availability and consistent steam delivery
- Experienced operations
- Intelligent drilling, completion and start up practices
Subsection 3.1.2 – 1a)
Detailed Plot Plan – Phase A/B and C/D/E Water Treatment

Subsection 3.1.2 – 1a)
Process Schematic – Phase C/D/E

NOTE: Templated parallel treating train added for Phase E
Process Schematic – Phase C/D/E

Subsection 3.1.2 – 1b)
Facility Modifications – Addition of Phase E

- No major modifications made to Phase A/B/C/D
- Phase E added an incremental 40,000 bbls/d of oil capacity
  - First oil in July 2013
  - Additional FWKO and 2 treaters
- Phase E added an incremental 11,392 t/d of steam capacity
  - First steam in June 2013
  - 4 x 250 MMBTU steam generators added
- Phase E added an incremental 16,382 t/d of deoiling capacity
  - First throughput July 2013
  - Additional Skim tank, IGF and ORFs added
- Phase E added an incremental 16,382 t/d of produced water treatment capacity
  - First throughput November 2013
  - Additional WLS, Afterfilters, and IX (WAC-WAC) added
Subsection 3.1.2 – 2) Facility Performance

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Production Engineer

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Plant Performance

**Exceeded design performance:**

- Steam plant has achieved higher rates than nameplate design
  (105%, 41,334 t/d vs nameplate 39,523 t/d)
- Water treatment (de-oiling) has achieved nameplate design through each individual train, but have not exceeded total capacity as has not been required
  (90%, 44,155 t/d vs nameplate 49,146 t/d)
- Oil treating has achieved higher rates than nameplate design
  (103%, 143,091 bbls/d vs 138,800 bbls/d)

**Issues:**

- Emulsion chemical treating program required optimization
Bitumen Treatment

Bitumen treatment:

- Capacity of 138,800 bopd
- Have consistently achieved rates of 138,800 bopd (high of 143,091 bbls or 103% of design achieved)
- Have reduced issues with treating and water quality due to:
  - Optimizing chemical treating
  - Improving operating procedures
Water Treatment

De-Oiling

- Capacity of 49,146 t/d of water
- Flowed up to 44,155 t/d of water
- Issues in de-oiling are:
  - Water cooling at high flow rates
  - Fouling of heat exchangers
  - Flaring due to high oil carryover from treating (resolved)

Water treatment

- Produced Water treatment – commissioning completed in November 2013
- Brackish Water treatment – Phase E provided additional capacity to treat McMurray source water
- Blowdown recycle into the produced water treatment trains and BFW tank with no adverse impacts
- No major issues to report
Slop Treatment - Hydrocyclone
Slop Treatment - Hydrocyclone

- Hydrocyclone equipment installed to concentrate high BS&W slop oil feed to crude flash unit; water phase recycled to skim tank

- Commercial installation not tested due to feedstock availability, however pilot demonstration showed concentration of BS&W from 80% to 50%
Steam Generation

Steam generation via 15 OTSGs

- Design capacity of 39,523 m$^3$/d CWE dry steam
- Have achieved rates in excess of 41,300 m$^3$/d CWE dry steam
- Typical operation: 80 to 85% quality, but have tested a single unit at >90% qualities
  - Working with OTSG vendor to prove high quality operation with no increased scaling and no loss of tube wall wetting
  - No significant scaling increase or increased tube wall temperature noted to date
  - Rigorous monitoring program including NDT, DT, and continuous boiler performance monitoring in place
*Note – Plot represents monthly power imports. No operating power generation facilities at Christina Lake
Gas Usage

Subsection 3.1.2 – 2e)
Gas Flared

March 2013: Process Upset, Plant Trip - Electrical Issue, and Commissioning event
May 2013: Flaring during plant shutdown prior to turnaround
June 2013: Flaring during plant startup after turnaround, Power bump
September 2013: Plant trip, Internal Power Failure, Commissioning, Tank Management, SRF contactors plugged, AB plant shutdown

Subsection 3.1.2 –2e)
Greenhouse Gas Emissions

Greenhouse gas emissions are reported to AENV on a yearly basis for review.

- **Q1 2014 total direct emissions by gas type**
  - CO₂ – 472,504 tonnes CO₂e
  - CH₄ – 386 tonnes CO₂e
  - N₂O – 750 tonnes CO₂e

- **2013 total direct emissions by gas type**
  - CO₂ – 1,405,303 tonnes CO₂e
  - CH₄ – 3,605 tonnes CO₂e
  - N₂O – 2,420 tonnes CO₂e

*Note – For Specified Gas Emitters Regulation (SGER), as directed by the regulator, we reported using the old GHG potentials of 21 and 310 for 2013. Going forward the new numbers of 25 and 298 will be used. As a note on this slide as well; only the 2013 GHGs have been verified and submitted, the 2014 numbers are still preliminary.*
Subsection 3.1.2 – 3) Measurement and Reporting (MARP)

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Production Engineer

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Phase A-G MARP approved Feb 2013

- No SIRs received in 2013
- Yearly update submitted in February 2014

MARP modifications:

- Updated lists to reflect current information
- Request for modifications received and will be complete by June 2014 deadline
- Addressed SIRs received in February 2014
  - Provided an update on PG to flare meter
  - Updated formulas to reflect the layout of the sample MARP
Simplified MARP schematic

- Fresh Source from Wells
- Saline Source from Wells
- SAGD Production
- Lease Fuel
- P/L Fuel

Domestic use
Steam to Field
Blow Down to Disp.
PW & Waste to Disp.

Cavern (future)
Gas
Oil
Water

Subsection 3.1.2 – 3)
Injection Volumes

Steam injection

- Steam to wells measured by nozzles or V-cone (>95% quality)
- Prorate well steam to plant steam (metered by flow nozzle off steam seps, checked by BFW-BD)
Production and Injection Volumes

Measured plant bitumen

- Blend (API 12.3) and bitumen inventory and trucking
- Incorporated diluent loss/bitumen gain in to production calculation
- Estimate by well tests (2 phase test separators with BSW%)
  - 8-12 wells per separator (maximum 12 wells per separator)
  - ~10 hour cycles + purges
  - 1 hour of testing for every 20 hours of well operations, or about 4 x 10 hour tests per month

Gas production

- Plant measurement by balance
- Measuring well GOR based off well test and prorate to plant measurement
- Co-Injected gas monitored and reported on a well basis

Subsections 3.1.2 – 3a,c)
Proration Factors

Overall water balance closure monitored on a monthly basis (< 5%)

Oil proration
- Typically 10%
- Some months have higher proration error due to facility turnaround, process upsets and phase ramp up

Water proration
- Typically < 10%
- Some months have higher proration error due to facility turnaround, process upsets

Gas proration
- Variable and sometimes greater than 50%
- Variable due to:
  - Proration based from individual well tests (not facility GOR)

Steam proration
- Typically < 8%
- Some higher proration error occurred after start-up/commissioning and during plant upsets
Proration Factors

Oil Proration Factor

- Subsections 3.1.2 – 3b)
Proration Factors

Water Proration Factor

Subsections 3.1.2 – 3b)
Proration Factors

Gas Proration Factor

Subsections 3.1.2 – 3b)
Proration Factors

Steam Proration Factor

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<thead>
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<th>Proration Factor</th>
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<tr>
<td>Jan-2014</td>
<td>1.06</td>
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<tr>
<td>Feb-2014</td>
<td>1.00</td>
</tr>
<tr>
<td>Mar-2014</td>
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<tr>
<td>2014 YTD Average</td>
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</tbody>
</table>

Subsections 3.1.2 – 3b)
Cenovus continually focuses on evaluating new meter technologies

Water cut meters:

- Delta C installed on B04 pad (February 2012), B02 pad (September 2012) – Installing data logger and sampling system on B04 pad to collect raw data for improved calibration.

Multi Phase flow meters:

  - Still plan on using test separator for well testing. Reviewing MPFM technology for future trials and where it could be applicable in well testing.
Subsection 3.1.2 – 4) Water Production, Injection and Uses

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Production Engineer

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Fresh and Brackish Sources

Fresh wells:
- Two Quaternary wells (Empress Formation) at 09-17-076-06W4M
- ESRD - Licensed for up to 5,000 m³/day
- TDS = 500-600 mg/L

Brackish water source wells:
- Historical
  - 10-34A 1F1/13-35-075-06W4/00: TDS= 7,400 mg/L
  - 10-34B 1F1/13-34-075-06W4/00: TDS= 7,200 mg/L
  - 10-34C 1F1/15-27-075-06W4/00: TDS= 7,200 mg/L
  - 10-3A 1F1/16-03-076-06W4/00: TDS= 4,600 mg/L
  - 10-3B 1F1/02-03-076-06W4/00: TDS= 5,700 mg/L
  - 10-27A 100/04-35-075-06W4/00: TDS= 11,600 mg/L
  - 10-27B 100/13-27-075-06W4/00: TDS= 8,700 mg/L
  - 10-27C 100/02-27-075-06W4/00: TDS= 12,100 mg/L
- Disposal reversal well
  - 3-16 1F5/03-16-076-06W4/00 TDS= 2,300 mg/L
- New in 2013
  - CW4-A 1F1/01-35-075-06W4 TDS= 13,400 mg/L
  - CW4-B 1F1/06-01-076-06W4 TDS= 9,400 mg/L
Uses:

- Includes camp and domestic use, utilities, seal flushes, etc. All attempts are made to minimize fresh water usage.
- Was used for make-up water for steam during commissioning and start up
Fresh Water Intensity

- FW/Oil Produced

↓15% from 2012

Subsection 3.1.2 – 4b)
Brackish Water Use

Uses:
- Make-up water for steam generation
- Softened water used for slurry make-up, seal flushes etc.

Subsection 3.1.2 – 4b)
Brackish Water Intensity

Uses:
- Make-up water for steam generation
- Softened water used for slurry make-up, seal flushes etc.

Subsection 3.1.2 – 4b)
Produced Water Volumes

Subsection 3.1.2 4c)
3-16 Well Reversal

282,263 m³ produced of the 5,236,500 m³ originally disposed
Steam Volumes

Average Monthly Rate (m^3/d)

Jan-2013: 25,000.00
Feb-2013: 25,000.00
Mar-2013: 25,000.00
Apr-2013: 25,000.00
May-2013: 25,000.00
Jun-2013: 15,000.00
Jul-2013: 30,000.00
Aug-2013: 35,000.00
Sep-2013: 35,000.00
Oct-2013: 35,000.00
Nov-2013: 35,000.00
Dec-2013: 35,000.00
2013 YTD AVG: 28,865
Jan-2014: 39,549
Feb-2014: 39,549
Mar-2014: 39,549
2014 YTD AVG: 39,549

Subsection 3.1.2 4d)
Water Recycle Ratio

Average Monthly Recycle Rate (%)

Directive 081 Disposal Limit

Subsection 3.1.2 4e)
Produced Water to Steam Ratio

Subsection 3.1.2 4e)
Blowdown Recycle

Average Monthly Blowdown Recycle (%)

<table>
<thead>
<tr>
<th>Month</th>
<th>Average Recycle Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jan-2013</td>
<td></td>
</tr>
<tr>
<td>Feb-2013</td>
<td></td>
</tr>
<tr>
<td>Mar-2013</td>
<td></td>
</tr>
<tr>
<td>Apr-2013</td>
<td></td>
</tr>
<tr>
<td>May-2013</td>
<td></td>
</tr>
<tr>
<td>Jun-2013</td>
<td></td>
</tr>
<tr>
<td>Jul-2013</td>
<td></td>
</tr>
<tr>
<td>Aug-2013</td>
<td></td>
</tr>
<tr>
<td>Sep-2013</td>
<td></td>
</tr>
<tr>
<td>Oct-2013</td>
<td></td>
</tr>
<tr>
<td>Nov-2013</td>
<td></td>
</tr>
<tr>
<td>Dec-2013</td>
<td></td>
</tr>
<tr>
<td>2013 YTD AVG</td>
<td>33%</td>
</tr>
<tr>
<td>Jan-2014</td>
<td></td>
</tr>
<tr>
<td>Feb-2014</td>
<td></td>
</tr>
<tr>
<td>Mar-2014</td>
<td>46%</td>
</tr>
<tr>
<td>2014 YTD AVG</td>
<td></td>
</tr>
</tbody>
</table>

NOTE: BD Recycle volumes very dependent of PW: Steam ratio

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Water Disposal Operations

- Continue to inject into McMurray water sands at 15-35
- Approval No. 9712 and 10627 (Class 1b Disposal)
- Nine disposal wells (all Class 1b)
  - Three disposal wells located near the facility (3-16);
  - One well located near the facility (3-16) has been converted for disposal reversal
  - Six disposal wells in service located at 15-35
- 15-35 disposal is main disposal location with local wells used as back-up
McMurray Water Disposal Wells

Existing Water Disposal
100/04-16-76-6W4
100/03-16-76-6W4
102/07-16-76-6W4

Converted to water prod well
1F5/03-16-76-6W4

Existing Water Disposal
102/15-35-76-4W4
103/15-35-76-4W4
104/15-35-76-4W4
105/15-35-76-4W4
106/15-35-76-4W4
107/15-35-76-4W4

*All disposal streams always attempted to be minimized
*Disposal temperatures at remote locations is less than 55 °C.
*Disposal temperature at plant site is higher as there is less pipeline cooling

Subsection 3.1.2 – 4g)
Total Disposal Volumes (PW, RW, BD)

Notes:

- All disposal stream always attempted to be minimized. Specifically, blowdown recycle, regeneration optimization, and minimizing brackish makeup requirements to ensure the maximum amount of produced water can be used.
Disposal Well Head Pressures

- Remote disposal temperature <55 °C
- Local disposal temperature slightly higher due to lack of pipeline cooling

Disposal WH Limit = 5,000 kPag

Subsection 3.1.2 – 4h
Disposal Injection Volumes

Disposal Injection Volumes

Injection Volume (m³/d)

- B 15 (102/15-35-076-04W4/00) m³/d
- C15 (104/15-35-076-04W4/00) m³/d
- A15 (103/15-35-076-04W4/00) m³/d
- 2D15 (105/15-35-076-04W4/00) m³/d
- D15 (106/15-35-076-04W4/00) m³/d
- 2C15 (107/15-35-076-04W4/00) m³/d
- 7-16 (102/07-16-076-06W4/00) m³/d
- 4-16 (100/04-16-076-06W4/00) m³/d
- 3-16 (100/03-16-076-06W4/00) m³/d

Page 54
Water Disposal Operations

Bottom Water Pressure

Disposal Volumes move to 15-35 disposal site

Pressure (kPa)

Mar-01 Jul-02 Dec-03 Apr-05 Sep-06 Jan-08 Jun-09 Oct-10 Feb-12 Jul-13

100/05-15-076-06W4
AA/06-02-076-06W4M
AA/15-15-076-06W4M
100/06-16-076-06W4M
100/09-13-076-06W4
102/03-08-076-06W4M
Water Disposal Operations cont’d

Subsection 3.1.2 – 4h)
Waste Disposal Volumes

- Increased slop oil and lime sludge due to increased production; slop oil increase due to treating issues

<table>
<thead>
<tr>
<th></th>
<th>2013</th>
<th>2012</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slop Oil (m$^3$)</td>
<td>152,589</td>
<td>85,571</td>
</tr>
<tr>
<td>Drilling Waste (m$^3$)</td>
<td>53,221</td>
<td>28,108</td>
</tr>
<tr>
<td>Lime Sludge (m$^3$)</td>
<td>24,071</td>
<td>11,923</td>
</tr>
<tr>
<td>Contaminated Soils (m$^3$)</td>
<td>358</td>
<td>1,517</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>230,239</strong></td>
<td><strong>127,119</strong></td>
</tr>
</tbody>
</table>
## Waste Disposal Sites

<table>
<thead>
<tr>
<th>Facility</th>
<th>Total (t or m$^3$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Absolute Env. Class Ia Disposal Well</td>
<td>2,411</td>
</tr>
<tr>
<td>Cancen New Sarepta Disposal Well</td>
<td>479</td>
</tr>
<tr>
<td>Newalta Elk Point</td>
<td>93,164</td>
</tr>
<tr>
<td>Newalta Hughenden</td>
<td>1,355</td>
</tr>
<tr>
<td>Newalta Niton Junction</td>
<td>20</td>
</tr>
<tr>
<td>Newalta Redwater</td>
<td>6</td>
</tr>
<tr>
<td>R.B.W. Edmonton</td>
<td>1,096</td>
</tr>
<tr>
<td>Tervita Big Valley</td>
<td>1,768</td>
</tr>
<tr>
<td>Tervita Bonnyville Landfill</td>
<td>4,422</td>
</tr>
<tr>
<td>Tervita Buck Creek</td>
<td>6</td>
</tr>
<tr>
<td>Tervita Janvier Landfill</td>
<td>46,589</td>
</tr>
<tr>
<td>Tervita Judy Creek</td>
<td>289</td>
</tr>
<tr>
<td>Tervita Lindbergh Cavern</td>
<td>92,452</td>
</tr>
<tr>
<td>Tervita Mitsue</td>
<td>63</td>
</tr>
<tr>
<td>Tervita Normcan Standard</td>
<td>1</td>
</tr>
<tr>
<td>Tervita Unity, SK Cavern</td>
<td>85</td>
</tr>
<tr>
<td><strong>TOTAL (t or m$^3$)</strong></td>
<td><strong>244,204</strong></td>
</tr>
</tbody>
</table>

Cenovus Christina Lake trucks all disposal waste to licensed third party facilities.
Subsection 3.1.2 – 5) Sulphur Production

Karen Montemurro
Production Engineer

committed. thoughtful. approachable. conscientious.
agile. open-minded. creative. spirited. collaborative.
Scavenger Uptime Details

- Scavenger unit was offline in May / June 2013 for Turn Around
- Plugging issues due to chemical carry over blocking downstream valve, unit offline for cleaning
- Scavenger offline to replace trim in valve that had been plugging
- Lower gas rates while ramping up after Turn Around, only one train was online
- One train taken offline for cleaning

Subsection 3.1.2 – 5a)ii)
Sulphur Recovery Challenges

Plugging issues

- High temperature excursions during ramp up caused fouling of chemical in contactor and inlet distributor
- Spent chemical carry over condensed at downstream pressure control valve and caused plugging issues

Preventative Measures

- Chemical injection was switched to counter current injection October 2013 to prevent fouling of internal distributor
- Three additional produced gas aerial coolers were added in May 2013 to maintain inlet air temp < 40ºC
- Downstream valve trim upsized to prevent condensation / fouling of spent chemical in valve
- Each train is on a 6 month PM to be cleaned (contactor, internal distributor, outlet separator demister inspected)
SO\textsubscript{2} Emissions

Phase E Commissioning

SO\textsubscript{2} Emissions, t/d

Actual Daily SO\textsubscript{2} t/d
Quarterly Average SO\textsubscript{2} t/d
AENV EPEA Approval Limit t/d

Subsection 3.1.2 – 5c)
Passive Exposure Monitoring

- As per the Approval (Table 3.3), prior to commencing operation of Phase E, Christina Lake was required to maintain a network of four passive monitoring exposure stations to obtain monthly static exposures of H2S and SO2. After Phase E commenced operation, i.e., in June 2013, 12 passive monitoring exposure stations must be maintained.
- Passive exposure monitoring was conducted for SO2 and H2S at the AESRD approved passive monitoring locations from January through December, 2013.
- The passive monitoring results in 2013 did not identify any significant air quality issues related to Plant operations.

Continuous Air Quality Monitoring

- CLSF is required in the Approval (Table 3.3) to maintain one continuous ambient air monitoring station 12 months per year to measure ambient levels of SO2, H2S, and NO2 concentrations in addition to wind speed and wind direction. The 12 month monitoring requirement is a change implemented in the most recent Approval amendment; the previous requirement was for six months monitoring. Given the date of the amendment, i.e., December 2012, Cenovus was permitted to follow the previous requirement, i.e., six months of monitoring, for the 2013 year.
- In 2013, continuous air quality monitoring was conducted from July 1 to December 31 by Maxxam Analytics. The continuous ambient air monitoring station is located approximately at 03-16-076-06-W4M. This location is the same as the passive monitoring station C10. Parameters measured were SO2, H2S, NO2, wind speed and direction.
- There were no operational issues relating to the ambient air monitoring equipment during the monitoring period.
- The continuous ambient air quality monitoring in 2013 did not identify any significant air quality issues related to Plant operations.

No criteria exceedances were noted in either monitoring program.
### Ambient Monitoring Trailer for 2013 Monthly Summary Results

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Maximum Reading for 2013 (ppbv)</th>
<th>Date of Maximum Reading in 2013</th>
<th>Limit (ppbv)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SO₂</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 hr average</td>
<td>20</td>
<td>July 2</td>
<td>172</td>
</tr>
<tr>
<td>24 hr average</td>
<td>6.5</td>
<td>July 2</td>
<td>48</td>
</tr>
<tr>
<td>H₂S</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 hr average</td>
<td>4</td>
<td>Sept 24, Oct 8</td>
<td>10</td>
</tr>
<tr>
<td>24 hr average</td>
<td>0.8</td>
<td>Sept 21</td>
<td>3</td>
</tr>
<tr>
<td>NO₂</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 hr average</td>
<td>36</td>
<td>Dec 11</td>
<td>159</td>
</tr>
</tbody>
</table>

- As was noted for the period 2009 to 2012, in 2013, there were no ambient NO₅, SO₂ or H₂S readings above the Alberta Ambient Air Quality Objective (AAAQO).
- Maximum 1 hour and 24 hour average values for SO₂, H₂S, and NO₂ for 2013 are listed above.
Subsection 3.1.2 – 6) Environmental Issues

Chris Farrer
Sr. Environmental Advisor

committed. thoughtful. approachable. conscientious.
agile. open-minded. creative. spirited. collaborative.
2013 Compliance - AESRD

• EPEA Approval (48522-01-00)
  - In Compliance

• December 2012 – Amended (48522-01-03)
  - Adjusted air emission limits to address SSP, FG Amendment and additional glycol heaters
  - Addition of new industrial runoff control system

• January 2014 – Amended (48522-01-04)
  - Adjusted air emission limits and monitoring of sources
EPEA Approval (298224-00-00) – In Compliance
  • Construction, operation, and reclamation of domestic wastewater system for the CLTP Elk Point and Martin’s Point Camp

Water Act Approval (265924-00-00) – In Compliance
  • Fenceline Water Act Approval

Water Act Licence (293633-00-00) – In Compliance
  • Permanent Surface Water Sources (authorized March 2013)

Water Act Licence (82524-00-00 (as amended)) – In Compliance
  • Industrial use (injection)

Water Act Licences (226094-00-00, 266708-00-00, 267616-00-00 and 343057-00-00) (as amended)) – In Compliance
  • Camp supply wells
2013 Compliance - Other

ESRD – In Compliance
  • ASRD disposition requirement

DFO – In Compliance
  • Pipelines, bridges etc.

Transport Canada – In Compliance
  • Monday Creek bridge construction
  • RD2 bridge across Winefred River
Seven Amendments in 2013:

1. June 2013 (Z)
   - Adjustment of Trajectories of 7 wedge wells.
   - Removal of Condition 23

2. July 2013 (AA)
   - Wabiskaw Pressure Reduction

3. July 2013 (BB)
   - Project Area Expansion – add 6 sections

4. August 2013 (CC)
   - Butane injection (experimental scheme 11305A) rolled into 8591
Seven Amendments in 2013:

5. September 2013 (DD)
   - Phase CDE Optimization-Addition of 2\textsuperscript{nd} stage OTSG’s
   - Temporary Brine Storage at 3-16

6. October 2013 (EE)
   - Natural Gas Injection at section 15

7. November 2013 (FF)
   - Pads H01, H03, J01, J03, B07b, J05, H09 Well Pattern Layout
   - Emulsion Circulation During Unscheduled Plant Shutdown

8. April 2014 (GG)
   - B01/B02 Rampdown/Blowdown Pilot
Environmental Monitoring Programs

Wildlife

- Wildlife Mitigation Program – In Compliance
  - Authorized in December 2011
- Wildlife Monitoring Program – In Compliance
  - Authorized in September 2012
- Caribou Mitigation and Monitoring Program – In Compliance
  - Authorized in March 2013

Key Changes to the Monitoring Programs

- Logical framework and measurable indicators (clear objectives, metrics and targets)
- Alignment with COMS (Cenovus Operations Management System)
- Objectives align with impacts identified in EIA
- Furbearer monitoring completed in Winter 2013/14
Environmental Monitoring Programs

Soil

- Soil Monitoring Program completed in 2008 – no industrial impacts
  - Soil Monitoring Proposal due to ESRD January 2014
- Soil Monitoring Proposal completed and accepted by ESRD in 2014
  - Soil Monitoring Program to be implemented in the summer of 2014

Groundwater

- Annual groundwater monitoring – no material changes
- Thermal mobilization of naturally occurring metals in shallow groundwater systems
  - Initial monitoring wells installed in 2013
  - Maintenance and well clean out scheduled for 2014
Environmental Monitoring Programs

Wetlands

- Wetland Monitoring Program proposal was approved June 2013
  - Wetland Monitoring Program was initiated
  - New Wetland Monitoring Plots established in 2013
Environmental Monitoring Programs

Reclamation

- Annual Conservation and Reclamation Report
  - Commercial footprint 2013: 661.9 ha
  - Area of temporary reclamation is 142 ha
  - Focus on reuse of existing disturbances and reduced footprint

- Wetland Reclamation Trial Program
  - In October 2013 AESRD authorized the extension of the program to “when a candidate site becomes available”

- Reclamation Monitoring Program
  - No reclamation opportunities available
  - Extension authorized until December 2014

- Project Level Conservation, Reclamation and Closure Plan
  - Extension authorized until December 2016
Other Environmental Initiatives

Christina Lake Regional Groundwater Management Committee

- Collaboration between Cenovus, Devon and MEG
  - Share hydrogeology information
  - Arrive at one regional hydrogeology model

Participation in Regional Initiatives

- Canada’s Oil Sands Innovation Alliance (COSIA)
- Lower Athabasca Regional Plan (LARP)
- Southern Athabasca Oil Sands Producers (SAOP)
- Sustainable Ecosystems Working Group (SEWG)
- Alberta Chamber of Resources (ARC)
- Alberta Biodiversity Monitoring Institute (ABMI)
- Cumulative Environmental Management Association (CEMA)
- Wood Buffalo Environmental Association (WBEA)
- Regional Aquatics Monitoring Program (RAMP)
- Ecological Monitoring Committee (EMCLA)
Subsection 3.1.2 – 7) Statement of Compliance

Chris Farrer
Sr. Environmental Advisor

committed. thoughtful. approachable. conscientious.
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2013 Compliance Status

- Maintain and track compliance
  - Incident Management System (IMS)
  - Centrac Database for commitment management
  - Internal Regulatory Compliance Audit Team
  - Dedicated onsite Environmental Monitoring and Stewardship Advisors
  - Routine inspections and audits
  - Raise awareness through training
  - Establish consistent management processes

- Cenovus FCCL Ltd. believes existing CLTP operations are in compliance with AER approvals and regulatory requirements (i.e. measurement, storage, flaring/venting, well placement).
Subsection 3.1.2 – 8) Statement of Non-Compliance

Chris Farrer
Sr. Environmental Advisor

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<table>
<thead>
<tr>
<th>Date</th>
<th>Self-Disclosure</th>
<th>Follow-up</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013-09-23</td>
<td>B011 Maximum Injection Well Head Pressure of 9,000 kPag Exceeded</td>
<td>Self Disclosure was submitted to AER Nov 14, 2013</td>
</tr>
<tr>
<td>2013-06-05</td>
<td>Elevated Pressure Encountered in the Wabiskaw Member (B01/B02 Drainage Area)</td>
<td>Self Disclosure was submitted to the AER Jun 5, 2013</td>
</tr>
<tr>
<td>2013-10-08</td>
<td>Flue Gas Recirculation (FGR) Equipment and Trial - Application # 1750498</td>
<td>Event Reported</td>
</tr>
<tr>
<td>2013-09-12</td>
<td>Drilling beyond the 15m over hole</td>
<td>Event Reported and procedures reviewed</td>
</tr>
<tr>
<td>2013-04-30</td>
<td>Non-compliant storage of drilling waste on B06 Pad @ 05/12-76-6W4</td>
<td>Drilling waste storage rectified and Compliance Achieved June 18, 2013</td>
</tr>
<tr>
<td>2013</td>
<td>5 Reportable Spills</td>
<td>Corrective action completed on all releases.</td>
</tr>
<tr>
<td>Q1 2014</td>
<td>6 Reportable Releases</td>
<td>Corrective action completed on all releases.</td>
</tr>
</tbody>
</table>
Subsection 3.1.2 – 9)
Future Plans

Chris Buchanan
Sr. Staff Development Planner, Christina Lake

committed. thoughtful. approachable. conscientious.
agele. open-minded. creative. spirited. collaborative.
### Major Activities and Target Dates

<table>
<thead>
<tr>
<th>Phase</th>
<th>Regulatory</th>
<th>Production Capacity (bbl/d)</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Filing</td>
<td>Incremental</td>
</tr>
<tr>
<td>A</td>
<td>Q1 1998</td>
<td>Q1 2000</td>
</tr>
<tr>
<td></td>
<td>Q2 2002</td>
<td>10,000</td>
</tr>
<tr>
<td>B</td>
<td>Q2 2005</td>
<td>Q4 2005</td>
</tr>
<tr>
<td></td>
<td>Q2 2008</td>
<td>18,800</td>
</tr>
<tr>
<td>C</td>
<td>Q3 2007</td>
<td>Q2 2008</td>
</tr>
<tr>
<td></td>
<td>Q2 2011</td>
<td>58,800</td>
</tr>
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<td>D</td>
<td>Q3 2007</td>
<td>Q2 2008</td>
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<tr>
<td></td>
<td>Q2 2012</td>
<td>98,800</td>
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<td>E</td>
<td>Q3 2009</td>
<td>Q2 2011</td>
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<td></td>
<td>Q3 2013</td>
<td>138,800</td>
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<td>F</td>
<td>Q3 2009</td>
<td>Q2 2011</td>
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<tr>
<td></td>
<td>2016</td>
<td>178,800</td>
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<tr>
<td>G</td>
<td>Q3 2009</td>
<td>Q2 2011</td>
</tr>
<tr>
<td></td>
<td>2017</td>
<td>218,800</td>
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<tr>
<td>FG Amendment</td>
<td>Q4 2012</td>
<td>Q4 2012</td>
</tr>
<tr>
<td>H</td>
<td>Q1 2013</td>
<td>2014F</td>
</tr>
<tr>
<td></td>
<td>2019</td>
<td>310,000</td>
</tr>
<tr>
<td>CDE 2nd Stage OTSG</td>
<td>Q4 2012</td>
<td>2013</td>
</tr>
</tbody>
</table>

Note: Filing is the date of formal submission, Approval is the date of regulatory approval, First Steam is the date of initial production, Incremental is the additional production capacity, and Total is the cumulative production capacity.
<table>
<thead>
<tr>
<th>Category</th>
<th>Application</th>
<th>Date Filed</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>Phase H and Eastern Expansion</td>
<td>March, 2013</td>
</tr>
<tr>
<td>2</td>
<td>R&amp;D Casing Gas Reinjection</td>
<td>March, 2014</td>
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<tr>
<td>N/A</td>
<td>RD2 Disposal D51/D65</td>
<td>December, 2013</td>
</tr>
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</table>
## Potential Future Applications

<table>
<thead>
<tr>
<th>Category</th>
<th>Application</th>
<th>Planned Filing Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>B10 Bypassed Pay Well(s)</td>
<td>Q2 2014</td>
</tr>
<tr>
<td>2</td>
<td>Amendment to Project Pads: L03, L05, L05b, B11b, H07, H09, J05, J09, L01b, and H01</td>
<td>Q2 2014</td>
</tr>
<tr>
<td>2</td>
<td>Propane SAP</td>
<td>Q4 2014</td>
</tr>
<tr>
<td>2</td>
<td>Pad CondenSAP</td>
<td>2015</td>
</tr>
</tbody>
</table>
Changes to Plant Design or Water Treatment Strategy

• Current plans are consistent with existing approvals

• Any future changes will be communicated via notifications or amendments as required

• Phases F and G amendment incorporates “cogeneration” into the CLTP.
  • Power generated will supply onsite operations

• The following applications will have the potential to improve CLTP current water metrics
  • CDE 2nd Stage OTSGs project
  • Phase H project application