Suncor MacKay River Project
2015 AER Performance Presentation: Subsurface Commercial Scheme Approval No. 8668

December 17, 2015
Reporting Period September 1, 2014 – August 31, 2015
The Suncor Strategy

To provide greater reliability and flexibility to our feedstock supplies, we produce bitumen through mining and in-situ recovery technologies and supplement that supply through third party agreements.

We produce natural gas as a natural price hedge against the cost of energy consumption at Suncor’s oil sands operation.

International and offshore assets are a source of steady cash flow to fund our oil sands growth.

A staged approach to increasing crude oil production capacity allows Suncor to better manage capital costs and incorporate new ideas and new technologies into our facilities.

Suncor takes an active role in connecting supply to consumer demand with a diverse portfolio of products, downstream assets and markets.

Our investments in renewable wind energy and biofuels are a key part of Suncor’s climate change action plan.
Suncor has high quality leases in close proximity
AER Directive 054
2015 Performance Presentation

Section 3.1.1 – Subsurface Issues Related to Resource Evaluation and Recovery
Table of Contents

• Introduction
• Geoscience
• Well Operations
• Scheme Performance
• Caprock Integrity
• Future Plans
MacKay River Project Overview

• Company’s first operated SAGD facility - located 60 km NW of Ft. McMurray
• Current Approved Bitumen Production Rate 11,600 m³/d (73 kbpd)
• Adjacent to Suncor Dover (UTF/AOSTRA) Project
• Horizontal production wells are placed in the McMurray Formation at a depth of 98 – 145m from surface
• No extensive underlying water or gas over bitumen issues in current development areas
• Initial development had 25 well pairs with first steam in September 2002 and first production in November 2002 (Phase 1)
• 112 well pairs have been subsequently added (137 well pairs in total)
  – 95 producing well pairs
  – 40 non-producing well pairs
  – 2 Abandoned/Planned for Abandonment well pairs
Project Area and Project Site

- Current Project Area (PA) approximately 24 ½ sections
Wellpads and Subsurface Patterns

- 95 producing well pairs at MacKay River (up to Phase 5DF)

Drilling
- 3 Sidetracks, 1 Infill
- 824 -2 well pairs were drilled April 2015
MacKay River Project Overview

<table>
<thead>
<tr>
<th>Pad</th>
<th>Pattern</th>
<th>Phase</th>
<th># Well Pairs</th>
<th>Well Pairs</th>
<th>Spacing</th>
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<td>6</td>
<td>NN11-16</td>
<td>75</td>
<td>Jun-14</td>
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</table>

- Optimal well spacing is evaluated for each new development and is sensitive to geology. Generally, higher quality thicker pay intervals allow for wider spacing with negligible impact to resource recovery.
- Observation well data shows small terminal chamber angles even at 100m spacing.
- Suncor has drilled 3 infill wells in Phase 1 targeting cellar oil and is evaluating additional infill wells pending the results of those infills.
Current Approval Amendments

• Historical approval amendments in Appendices

• Amendment 8668Z
  • Pad 828 change from 3 well pairs to 2 wells pairs and correction of well UWIs on Pad 21
    Chemical Injection Test (D-Pattern Injectors) approval issued December 10, 2014

• Amendment 8668AA
  • Phase 1 NCG design amendment approval issued December 19, 2014

• Amendment 8668BB
  • Phase 2 and Phase 3 Chemical Co-Injection (E, F and G Patterns) approval issued January 1, 2015

• Amendment 8668CC
  • Approval for E1P Sidetrack well issued January 27, 2015

• Amendment 8668DD
  • Approval for NN6P Sidetrack well issued February 3, 2015

• Amendment 8668EE
  • Approval for VX™ multiphase meter on Pad 824 issued February 19, 2015

• Amendment 8668FF
  • Approval for NCG Test at OOSI well on pad 24 issued March 17, 2015
Current Approval Amendments

- **Amendment 8668GG**
  - Approval to conduct CO₂ Co-Injection at the OO9 well pair on Pad 24 issued April 13, 2015

- **Amendment 8668HH**
  - CO₂ Co-Injection amendment to change to OO8 well pair on Pad 24 issued

- **Amendment 8668II**
  - Pad 824 Thermal Compatibility Assessment approval issued July 14, 2015

- **Amendment 8668JJ**
  - Approval for NCG Test at OO7I issued July 29, 2015
Current Amendments / Applications

• **Application No. 1835073**: MOP Strategy Trial at QQ5 – QQ16 submitted July 24, 2015 and approved October 9, 2015 (8668KK)

• **Application No. 1838202**: C2IPB Sidetrack and well conversion application submitted September 2, 2015 and approved October 13, 2015 (8668LL)
MacKay River Stratigraphy

Log Corr
GR (gAPI)
0.0 150.0
SP (mV)
-130.0 0.0

T 92  T 93
R13  R12W4

2015 MacKay Bitumen Pay
Contour Interval = 5m

Upper Clearwater
Clearwater Shale
Wabiskaw A Shale
Wabiskaw C Sand
Wabiskaw D

McMurray Formation
Beaverhill Lake

1AA130409312W400

3.1.1 2 c, e) i ii iii
2014-15 Activities – Vertical & SAGD Drilling

- 11 vertical wells and 1 slant well drilled in the PA
  - 6 Delineation Wells
  - 3 McMurray/WabC monitoring wells
  - 1 Wabiskaw C monitoring well (slant)
  - 2 McMurray OB wells

- Horizontal Wells
  - Pad 824 well pairs
  - 3 sidetracks
  - 1 infill well

- Special core analyses conducted in PA:
  - Geochemistry
  - High core (2 wells)
Bitumen Pay Isopach

10 Weight Percent Bitumen cutoff

Legend

- Approved PA Boundary
  Contour Interval = 5m

- 2015 MacKay Bitumen Pay
  Contour Interval = 5m
3.1.1 2 d)

Base of Pay Structure Map

Legend
- Approved PA Boundary
  Contour Interval = 5m

2015 MacKay Base of Pay
Contour Interval = 5m
Top of Pay Structure Map

Legend

- Approved PA Boundary

Contour Interval = 5m

3.1.1 2 d)
Oil Sands Facies and Gross Bitumen Pay

**Facies:**
Defined by visual mud index (VMI)

**Cutoffs:**
F1 (Sandstone) = 0-5% VMI
F2 (Sandy IHS*) = 5-15% VMI
F3 (IHS*) = 15-30% VMI
F4 (Muddy IHS*) = 30-70% VMI
F5 (Mudstone) = 70-100% VMI
F10 (Breccia) = variable

* IHS = inclined, interbedded, sand and shale

**Pay:**
Includes Facies F1, F2, and F10
Can include F3-F5, if < 2m thick

Weight percent bitumen > 10%

Generally > 30% Porosity
- PA averages 31.1% in clean sands

Permeability = 1 to 5 Darcie's

> 15m for OBIP volumetric
Pattern OBIP Calculation

**Gross Rock Volume (GRV)** = total rock volume derived from Continuous Pay map

**Net Rock Volume (NRV)** = product of Continuous Pay gross rock volume multiplied by the average Net Sand Ratio for each area

**Net Sand Ratio (NSR)** = a net-to-gross adjustment used to account for pay mapping being done on a continuous (gross) basis

- 15% VMI (visual mud index) cutoff plus the sand component of breccia intervals

**Original Bitumen in Place** = product of the Net Pay volume multiplied by the average Porosity, and the average Oil Saturation

\[
\text{OBIP} = \text{GRV} \times \text{NSR} \times \text{So} \times \text{Por}
\]

New net-to-gross adjustment using Net Sand Ratio map allows for consistent application of a mudstone cutoff while: a) avoiding adjustments based on pattern averages, and b) allowing the differential treatment of sand- versus mud-rich breccia's.
## Reservoir Properties and Base Case OBIP

<table>
<thead>
<tr>
<th>Pattern</th>
<th>Net Sand Ratio</th>
<th>So</th>
<th>Phi</th>
<th>So-Phi</th>
<th>OBIP(e³m³)</th>
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<tbody>
<tr>
<td>A</td>
<td>91%</td>
<td>82%</td>
<td>31%</td>
<td>26%</td>
<td>2,389</td>
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<tr>
<td>B</td>
<td>95%</td>
<td>86%</td>
<td>32%</td>
<td>27%</td>
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<tr>
<td>C</td>
<td>95%</td>
<td>89%</td>
<td>32%</td>
<td>29%</td>
<td>4,238</td>
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<tr>
<td>D</td>
<td>96%</td>
<td>91%</td>
<td>31%</td>
<td>29%</td>
<td>4,238</td>
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<tr>
<td>E</td>
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<td>84%</td>
<td>31%</td>
<td>26%</td>
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<td>F</td>
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<td>89%</td>
<td>32%</td>
<td>28%</td>
<td>3,616</td>
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<td>G</td>
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<td>86%</td>
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<td>H</td>
<td>94%</td>
<td>84%</td>
<td>31%</td>
<td>26%</td>
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<td>NN (Phase 4/5)</td>
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<td>85%</td>
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<td>27%</td>
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<td>OO (Phase 4/5)</td>
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<td>84%</td>
<td>31%</td>
<td>26%</td>
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<td>QQ (Phase 4/5)</td>
<td>87%</td>
<td>84%</td>
<td>31%</td>
<td>26%</td>
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**Subtotal** | 43,784

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<tr>
<th>Pattern</th>
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<th>So</th>
<th>Phi</th>
<th>So-Phi</th>
<th>OBIP(e³m³)</th>
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<tr>
<td>Total PA</td>
<td>93%</td>
<td>86%</td>
<td>31%</td>
<td>27%</td>
<td>171,479</td>
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</table>

Average Reservoir Depth = 109 m TVD, Pi = 400 kPa, Ti = 6-7 °C, $K_{max} = 1.7$-8.5 D, $K_{min} = 1.1$-6.5 D
Phases 2, 3 and 4
Phase 5

Pad 24

Pad 25

Clearwater
Wabiskaw C
Wabiskaw D

Top of Pay

Devonian
Beaverhill Lake

NN Pattern

OO Pattern

QQ Pattern
Pattern 824

Clearwater
Wabiskaw C
Wabiskaw D
Top of Pay
Devonian
Beaverhill Lake

Pad 24

OO Pattern  NN Pattern  824 Pattern
MacKay Steam Chamber Edge as Defined by April 2013 3D Seismic

- 2013 3D first full seismic survey over project area
- Aided in estimating steam chamber growth in current operating areas
- 2014 4D seismic survey used to establish steam chamber growth in SE direction
- Seismic interpretations throughout operating area are complete
MacKay River Performance Presentation

Well Operations
Typical Well Completions – Phase 1 Type

**Injector**

- 329.7 mm conductor @ 60.0 mKB
- 114.9 mm x 79 mm crossover @ mKB
- 73 mm log @ mKB
- TD @ 1100 mKB
- (116.8 mTVD)
- HS-HT packer set at 395.5 mKB
- 1.0% slotted area from 393.0 - 1101.3 mKB
- 244.5 mm cag @ 394.5 mKB

**Producer**

- 339.7 mm conductor @ 77.5 mKB
- 19.1 mm gas lift @ mKB
- 88.9 mm log @ mKB
- 25.4 mm coil @ mKB
- 88.9 mm log @ mKB
- 88.9 mm x 79 mm crossover @ mKB
- TD @ 1172.0 mKB
- (126.0 mTVD)
- HS-HT packer set at 389.0 mKB
- 1.0% slotted area from 415.9 - 1167.4 mKB
- 244.5 mm cag @ 405.0 mKB
- 177.6 mm Slotted Liner landed @ 1167.6 mKB
Typical Well Completions – Phase 5 Type
Well Downhole Instrumentation

- **Phase 1 (25 well pairs)**
  - Temperature optic fibre in 4 producers have been replaced and are functional today (A5, B2, C1, and C2)
- **Phase 2 (14 well pairs)**
  - Temperature fibre optic installed in G6P
  - P/T gauge installed in G6I
- **Phase 3 (7 well pairs)**
  - No instrumentation
- **Phase 4 (10 well pairs)**
  - No instrumentation except temperature fibre optics in OO3 I & P
  - Temperature fibre optic installed in NN1P
- **Phase 5A (6 well pairs)**
  - Pressure - bubble tube to the toe in every producer
  - Two producers equipped with 6 point thermocouple bundle to the toe (QQ5, NN5)
- **Phase 5B-1 (6 well pairs)**
  - Pressure - bubble tube to the toe in every producer except OO5
  - All producers equipped with 6 point thermocouple bundle to the toe except OO5 and OO9 which have temperature fibre optic
Well Downhole Instrumentation

- Phase 5B-2 (10 well pairs)
  - Pressure - bubble tube to the toe in every producer
  - All producers equipped with 6 point thermocouple bundle to the toe

- Phase 5D&F (18 well pairs)
  - Pressure - bubble tube to the toe in every producer except OO well pairs which have pressure gauges
  - All producers equipped with fibre optic to the toe
Artificial Lift

• All existing SAGD production wells designed for gas lift
  • Low cost completion
  • Recover gas
  • No downhole moving parts
• Producing wells with downhole pumps:
  • F1P, ESP since February 2009, current pump installed March 2011
  • OO3P, ESP since October 2009, current pump installed March 2012
Key Learnings: Wellbore Integrity Management

- **Wellbore integrity management** is a high priority focused on wellbore containment over a well's full life cycle
  
  - **Monitoring and repair of SCVF’s**
    - Monitoring using Vent Nanny assembly to monitor pressure, rate & H₂S concentration
    - Gas migration rates continue to decline indicating remediation work may have been successful
  
  - **Wellbore integrity workovers (liner patches, sidetracks etc.)**
    - Patches determined to be not an effective long term strategy for remediation
    - FCD’s used in 3 wells instead of liner patches with successful results to date
Key Learnings: Well Enhancement Repairs

• **Flow Control Devices**
  
  – Used to repair steam break through (SBT) condition, achieve higher and consistent flow rate, reduce risk of future new SBT and potential liner failure
  
  – FCD completions utilized in new, mature and sidetracked wells using various vendor devices
    
    • Early results look promising
      
      – Example of well limited due to hot spots Pre-FCD’s (blue) now capable of full drawdown for increased peak production (orange)
Observation Wells
Observation Well Overview

- Total of 145 licensed observation wells at MacKay River
- Observation wells at MacKay River serve three main purposes:
  1. Reservoir optimization (steam chamber monitoring)
     - 37 wells with fibre optic cable from surface to TD
     - 12 wells with fibre optic cable and pressure sensors
     - 36 wells with thermocouple bundles and pressure sensors
  2. Wabiskaw C pressure monitoring
     - 51 wells with a single pressure / temperature sensor
  3. Subsurface Monitoring (outside of producing area)
     - 5 wells with thermocouple bundles and pressure sensors
     - 2 wells with a single pressure / temperature sensor
     - 5 piezometer wells
- Current observation well design incorporates thermocouple measurement as this provides sufficient resolution for steam chamber monitoring and is preferred for remote well locations.
Typical Observation Well Instrumentation

**McMurray Observation Well (Type 1):**
- Capillary line loop cemented outside casing
- Fibre optic cable pumped into capillary line loop to provide temperature profile along entire vertical well depth
- Allows for close monitoring of steam chamber development

**McMurray Observation Well (Type 2):**
- Coiled tubing instrument string containing 14 thermocouples and 1 P/T gauge run inside 114 mm intermediate casing
- Perforated near the top of the McMurray oil sands zone
- Pressure / temp gauge positioned at MPP
- 14 point thermocouple bundle collects temperature data across the McMurray
Typical Observation Well Design

Wabiskaw C Observation Well:

- Open hole into Wabiskaw C sand
- Wellbore does not penetrate Wabiskaw D mudstone or McMurray sand
- Pressure / temp gauge landed inside tubing
- WBC-40 intermediate casing leak discovered and planned for repair by March 31, 2016
- WBC-29 – anomalous pressure data at from April 2015 to August 2015
  - Investigation confirmed measurements were inaccurate and not representative of formation pressure
MacKay River Performance Presentation

SAGD Scheme Performance
### Summary of Operating Wells

<table>
<thead>
<tr>
<th>Pad</th>
<th>Pattern</th>
<th>Phase</th>
<th># Well pairs</th>
<th>First steam to Pad</th>
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<td>Sept 2002</td>
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<td>D</td>
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<td>May 2014</td>
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<td>NN</td>
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<td>Dec 2008</td>
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<td>Jun - Jul 2011</td>
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<td></td>
<td>5DF</td>
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<td>June 2014</td>
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Fluid Rates
Producin Well Count

Phase 1

Phase 2

Phase 3

Phase 4

Phase 5A

Phase 5B-1

Phase 5B-2

Phase 5DF

Well Pair Count

Oil Rate [m³/d]

Well Count

Oil Rate
Cumulative Fluid Volumes

As of August 2015
Cum Oil 17.9 million m³
Cum Steam 43.4 million m³
Cum Water 43.8 million m³
CSOR 2.4
Average Oil Rate per Pattern

Oil Rate (m³/d/well pair)

Months Since Start-up

- A
- B
- C
- D
- E
- F
- G
- H
- NN
- OO
- QQ
**CSOR by Pattern**

**As of August 2014**

- QQ wells have the lowest CSOR
- NN wells have a mid range CSOR
- A Pattern has the highest CSOR
## Performance Summary by Pattern

<table>
<thead>
<tr>
<th>Pattern</th>
<th>OBIP [e³ m³]</th>
<th>Cum. Oil [e³ m³]</th>
<th>Recovery up to August 2015 [%]</th>
<th>CSOR [m³/m³]</th>
<th>ISOR (Aug. 2015) [m³/m³]</th>
<th>Ultimate Recovery [%]</th>
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<td>2,389</td>
<td>1,000</td>
<td>43.0</td>
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<td>2,627</td>
<td>72.4</td>
<td>2.2</td>
<td>4.6</td>
<td>82</td>
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<td>Pattern C</td>
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## Pattern Examples Based on Recovery

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<th>CSOR [m³/m³]</th>
<th>Cum Oil [10⁶ m³]</th>
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<td>Low Recovery</td>
<td>4.4</td>
<td>6.9</td>
<td>1000</td>
<td>73-149</td>
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<td>• Producing for more than 13 years</td>
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<tr>
<td><strong>E Pattern</strong></td>
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<td>125-235</td>
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<td>• Medium quality geology</td>
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<td>• 55% recovery to date (ultimate RF: 70%)</td>
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<td></td>
<td>• Producing for about 9 years</td>
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<tr>
<td><strong>C Pattern</strong></td>
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<td>High Recovery</td>
<td>3.0</td>
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<td>3370</td>
<td>179-299</td>
<td>10-145</td>
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<td>• 76% recovery to date (ultimate RF: 89%)</td>
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<td></td>
<td></td>
<td>• Producing for more than 13 years</td>
</tr>
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</table>
A Pattern – Low Recovery

![Diagram showing oil rate, steam rate, water rate, ISOR, and CSOR over time from Sep-02 to Mar-15. The graph plots rate (m³/d) against time (Sep-02 to Mar-15) on the x-axis, with SOR (m³/m³) on the y-axis.]
E Pattern – Medium Recovery

- Increased steam demand in March 2015 was due to the planned cogeneration outage that occurred in late March-early April. Due to large chamber size, low MOP and communication with D pattern, it took several months at higher steam injection rates to re-pressurize the chambers back to pre-outage levels.
C Pattern – High Recovery

3.1.17 c) iii

- Rate (m$^3$/d)
- SOR (m$^3$/m$^3$)

- Oil Rate
- Steam Rate
- Water Rate
- ISOR
- CSOR
Steam Chamber Growth: OB O1-1 Observation Well

- After 4 years of stunted steam chamber growth, steam has been able to surpass geological layers of resistance
  - OB O1-1 observation well shows that chamber can grow through IHS in certain areas
  - ~15m vertical growth in steam chamber in 4 years
  - ~5m vertical growth in 1 year
Steam Chamber Development: Surface Heave Monitoring

- 431 monuments exist over MacKay River for heave measurement and monitoring
- Installed 59 monuments in 750/751
- Survey History
  - 1st: Fall 2002
  - 2nd: Dec 2006
  - 3rd: Fall/Winter 2007/08
  - 4th: Nov 2008
  - 5th: Jan/Feb 2010
  - 6th: Nov. 2010
  - 7th: Dec. 2011
  - 9th: Oct 2013
  - 10th: Oct 2014
2D Surface Heave: Change from Baseline to October 2014

Survey strategy
- Heave surveys are performed at different frequencies depending on well vintage
  - Oct 2014 heave survey for total producing area

Heave monitoring application:
- Field performance monitoring coupled with seismic
Key Learnings: Flow Control Devices at Suncor

- Suncor has installed flow control devices (FCDs) in 16 well pairs at MacKay River:
- FCDs in H2 have demonstrated considerable success. This well had poor conformance resulting
  in steam coning, which the FCDs have been successful in managing.
- FCDs in E4 have yet to demonstrate success. Cooler sections of the well are now heating up
  and conformance is improving. This well is expected to demonstrate success given more time.
Key Learnings: Validation of Seismic Data

- Infill temperature log validates 2013 seismic data
- Temperature log indicated:
  - ~180°C at heel area of well
  - Cooler temperature in mid well section
Steam Injection Conditions

<table>
<thead>
<tr>
<th>Pattern</th>
<th>Wells</th>
<th>Maximum Operating Pressure*</th>
</tr>
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<tbody>
<tr>
<td></td>
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<td>Surface (kPag)</td>
</tr>
<tr>
<td>A</td>
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<tr>
<td>B</td>
<td>B1-7</td>
<td>1810</td>
</tr>
<tr>
<td>C</td>
<td>C1-6</td>
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<tr>
<td>D</td>
<td>D1-5</td>
<td>1400</td>
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<tr>
<td>E (S)</td>
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<td>E (N)</td>
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<td>1430</td>
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<tr>
<td>F</td>
<td>F1-7</td>
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<tr>
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<tr>
<td>QQ</td>
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<td>QQ</td>
<td>QQ11-16</td>
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</table>

*Commercial Scheme Approval No. 8668U

- Approved MOPs based on the methodology detailed in Application 1724610
- New approved Bottomhole MOP at 80% of the fracture closure pressure
- MOPs are set by shallowest point in each pattern to allow for intra-pattern communication
- Steam injection pressure limits are enforced at wellhead on tubing and annulus via pressure transmitters. Phase 1 wells are monitored via manual pressure measurement at the wellhead every second day
- Steam injection pressure is reduced as required to maintain estimated bottomhole pressure below MOP for neighbouring patterns in communication
Stewardship to maximum bottomhole operating pressure

- All of the Mackay wells in SAGD are currently operating at pressures below the new approved 80% maximum bottomhole operating pressure.
- Alarm systems are in place to ensure the approved maximum bottomhole operating pressures are not exceeded.
- Steam injection pressure is reduced as required to maintain estimated bottomhole pressure below maximum bottomhole operating pressure.

### Impact
- Lower production rates in low MOP areas
- Slower ramp-up post planned outage’s
- Impacts new well conversions in low MOP areas
- Small impact to mature wells performance

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Stewardship to maximum bottomhole operating pressure

- For SAGD wells with no downhole instrumentation, Step-down Tests (SDT) and Low Rate Tests (LRT) are performed and used to calculate estimated chamber pressure to ensure that the Maximum Bottomhole Injection Pressure (MBHIP) is not exceeded.

- **SDTs** are conducted by lowering the steam injection rate in steps and allowing pressures to stabilize between steps.

- **LRTs** are conducted on wells that do not have reliable SDT correlations by reducing the steam injection rates low enough to estimate the chamber pressure.

- **SDT** is the preferred method for chamber pressure estimation as it allows for real time chamber pressure monitoring based on changing injection rates.
Pad Abandonment Outlook

- The strategy for future well and pad (including surface equipment) abandonments is under development
- Do not anticipate abandonment of operating Pads during the next 5 years
  - Pads 20 and 21 (A/C and B/D patterns) are the most mature and are expected to be under pressure maintenance within 5 years.
  - Individual wells may be suspended or abandoned as required
- Pad 40 expected to be abandoned within the next 5 years
  - Three of four wells on pad abandoned (NP, NI and SP).
  - Considerations for surface equipment are under review.
SAGD NCG Co-Injection Strategy

**Pilot**
- NCG co-injection into B pattern commenced October 2011
- Pilot infrastructure left in place until Stage 1 is operational
- Injection currently based on steam availability

**Stage 1**
- NCG co-injection to A, B, C, D patterns currently approved
- Expect First NCG Co-Injection Q2 2016

**Stage 2**
- NCG co-injection into E, F, G, H, NN (4/5A), OO (4/5A), QQ (4/5A) patterns work in progress
- Planning First NCG Co-Injection Q3 2017
New Technology Projects – Near Term

- NCG Co-Injection Expansion (A/B/C/D)
  - First injection planned for Q2 2016

- Surfactant Chemical Pilot (D2/D4/D5)
  - First injection February 2015
  - Early stages of performance evaluation
  - Final injection planned for Q1 2016

- Surfactant Co-Injection Pilot Expansion (F)
  - First Injection planned for Q2 2016

- CO2 Co-Injection Pilot Well (OO8)
  - Pilot of DCSG technology
  - First injection planned for Q1 2016
MacKay River Coupled Geo-Mechanics/Reservoir Workflow

1 - Data Gathering
- Well Operations (Rate/Pressure)
- Pressure (Piezometer)
- Temperature (Thermocouple/Fiber)
- Stress (mini-fracs)
- Geo-mechanical (core tests)
- Surface Heave (monuments)
- Dilation (Extensometers)

2 – Data Interpretation
Reservoir Physics
- Well performance
- Vertical Pressure Leak-off
- Lateral Pressure Leak-off
- Vertical heat conduction
Geo-Science
- Initial stress state
- Material behavior
  - shear strength
  - dilation
  - perm enhancement
  - fractures
- Surface Heave
- Reservoir level deformations

3 - Coupled Reservoir Geo-Mechanics
- Update material properties
- Update pressures and stress state
- Recalibrate field history match
- Truth test model
- Forecast/Design for all developments

4 - Learnings
- Sensitize key variables within uncertainty range
- Quantify geo-mechanical risks
- Verify and update MOP
- Recommend further measurements
- Design lab tests

Geo-Mechanical analysis for safe optimal MacKay River operations
Dataset for Characterization of Natural Fractures

2005/06:
- Image logs for 15 wells

2007/09:
- Cores and/or image logs for 17 wells

2010/11:
- 17 wells with cores and image logs,
- 10 wells with only image logs

2011/12:
- Cored 6 wells
- FMI logs for 27 wells

2012/13:
- No wells were drilled

2013/14:
- Cored 3 wells
- FMI logs for 3 wells.

2014/15:
- Cored 2 wells
- FMI Logs for 11 wells
Geology - Observations of Natural Fractures

Dataset
- Over 800 individual fracture observations have been assessed, measured, and classified
- Fracture analysis up to 2013/14 cores and FMI data complete.
  - Caprock core logging and fracture identification of high cores
  - Analysis and integration of new image logs into MacKay River caprock dataset

Fracture Frequency
- Fracture frequency higher for the lower part of the Clearwater Shale and the Wabiskaw A Shale than for the Wabiskaw D Mudstone.
- No observed correlation between natural fracture frequency and proximity to SAGD operations

Fracture Orientations
- Orientations continue to be random in azimuth based on image log analysis
Monitoring: Wab C Pressure & Temperature

Average pressure decrease of 7 kPa from August 2014 to August 2015

- Pressures are below hydrostatic and well below fracture pressures

10 Wabiskaw C wells with elevated temperatures directly above mature SAGD operations

- 2 wells between 90°C and 120°C - 8 wells between 30°C and 90°C
- Elevated temperatures are within the expected range as depicted by heat conduction calculations
- Ongoing analysis and simulation efforts are continuing to further understand underlying mechanisms
Monitoring: Wab C Alarms

• Observation well data is reviewed bi-weekly and automated alarms initiate proactive, more detailed daily review of data. The following alarm settings are used for the automated alarms:
  - High pressure – set to alarm at 90% of hydrostatic pressure in the OB well
  - Rising pressure – set to alarm if the pressure increase is >25 kPa/day
  - High temperature – set to alarm if the temperature is above its normal operating temperature range
  - Rising temperature – set to alarm if temperature increase is > 5 °C/day
  - The set point for the proactive alarms result in daily alarms if set conditions are exceeded; however, review of current alarms has resulted in no safety concerns
Monitoring: Wab C Response

• In the event that pressure or temperatures are nearing levels of concern Suncor will:
  • Confirm the alarm pressure or temperature, and if accurate
  • Decrease injection pressure in the offsetting injection wells as appropriate
  • Monitor the response and adjust operations as required

• WBC-29 had resulted in above actions to be performed
  • Investigation confirmed measurements were inaccurate and not representative of formation pressure
Geo-Mechanics: Mini-frac Test

- No mini-frac tests conducted since last reporting period
- Fracture gradient within operating area still holds at or above 21 kPag/m
  - Fracture gradient measured (kPag/m) from mini-frac test

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<td>CW</td>
<td>22.3</td>
<td>24.1</td>
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Geo-Mechanics: Geo-mechanical Simulation Studies

Continued Calibration to Field Data, Pad specific modeling
• Re-calibrated the MacKay River geo-mechanical model
  – Utilizing pressure measurements in the WabC and McMurray
• Performed pad specific coupled geomechanical modeling for subsurface risk reviews
  – Based on current MOP design calculation
  – Verified sufficient factor of safety to tensile and shear failure in the caprock

Results
• Model predictions supported by field measurements; indicates good characterization of geomechanical model
• MOP design calculation continues to provide sufficient factor of safety to tensile and shear failure in the caprock

Geo-mechanical model inputs
• Lab tests to understand Wab A + McM geomechanical properties delayed
  – Performed scanning of various core to screen for lab testing in 2014
MacKay River Performance Presentation

Future Plans
Pad 824

- Required to provide sustaining production for the existing MR1 central processing facility (CPF)
- 2 well pairs located between Pad 750 and the UTF
  - Wells drilled from north of Pad 24
    - Drilling completed April 2015
    - Wells tied in to Pad 24 facilities
- Wells completed May 2015
  - ESPs installed in producers
    - Startup will involve steaming past the pump during circulation
- Approval received to use VX meter for well testing
- First steam expected in October 2015
Future Development: Pads 750/751

- Pad 750/751 is a future area of development within the MacKay River PA
  - To provide sustaining production for the existing MR1 central processing facility (CPF)
- Approval received August 7, 2012
  - 35 well pairs and 2 single producers
- Drilling completed June 2014
- First Steam for Pad 750 expected in September 2016

- To maintain maximum MR1 CPF capacity:
  - Pad 751 and remaining Pad 750 completions will occur in 2018/2019
  - First Steam for Pad 751 expected in 2020
Future Development: Pad 819

- Pad 819 is a future area of development within the MacKay River PA
  - To provide sustaining production for the existing MR1 central processing facility (CPF)
- Directive 078 amendment approval received in January 2014
  - 9 well pairs located south of existing infrastructure
- Drilling planned to be completed in 2020
- First steam expected in 2022
MacKay River Performance Presentation

Appendices
Historical Approval Amendments

- **Amendment 8668A**
  - Changed annual average volume to 33,000 bpd (5,250 m³/d)
- **Amendment 8668B**
  - Increase to project area
- **Amendment 8668C**
  - Additional project area
  - Approval to inject non-condensable gas
- **Amendment 8668D**
  - Additions to project area
  - Increase to annual average volume to 72,964 bpd (11,600 m³/d)
- **Amendment 8668E**
  - Approval to drill four well pairs
- **Amendment 8668F**
  - Approval to change approval holder from Petro-Canada to Suncor
- **Amendment 8668G**
  - Approval to undertake amendments & modifications to CPF systems
  - Approval tie-in 6 well pairs to well testing facilities
- **Amendment 8668H**
  - Approval to conduct non-condensable gas injection test on Pad 21 wells
- **Amendment 8668I**
  - Approval to conduct non-condensable gas injection at the Section 16 Test Project
- **Amendment 8668J**
  - Approval to transfer portions of the Dover project area into the MacKay River project area
- **Amendment 8668K**
  - Approval to tie-in 16 well pairs to well testing facilities
- **Amendment 8668L**
  - Approval to the remove the limiting factor of a mole percent restriction for the B Pattern non-condensable gas injection test on Pad 21
- **Amendment 8668M**
  - Approval to inject chemical into Pad 22 wells
- **Amendment 8668N**
  - Approval to abandon 3 wells and suspend 1 well on Pad 20
- **Amendment 8668O**
  - Approval to change Phase 5F well trajectories
- **Amendment 8668P**
  - Approval to develop Pads 750/751/28 and add 2 sections to project area
- **Amendment 8668Q**
  - Approval to conduct a pilot of water treatment technologies
- **Amendment 8668R**
  - Approval to abandon well G1I
- **Amendment 8668S**
  - Approval to conduct chemical injection test on Pad 21 (D-Pattern Injectors)
Historical Approval Amendments

- Amendment 8668T
  - Pad 819 Approval
- Amendment 8668U
  - Maximum Operating Pressure Approval
- Amendment 8668V
  - NCG Expansion Project and Phase 5D/F Chemical Injection Approval
- Amendment 8668W
  - MR CPF Expansion Project and Directive 081 Waiver Approval
- Amendment 8668X
  - Administrative reissue approval
- Amendment 8668Y
  - WHIP for Phases 5B2, 5D and 5F Patterns approval
MacKay River Project Overview

<table>
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<tr>
<th>Pad</th>
<th>Pattern</th>
<th>Phase</th>
<th># Well Pairs</th>
<th>Well Pairs</th>
<th>Spacing</th>
<th>First Steam</th>
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<td>100</td>
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<td>D1 - 5</td>
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<td>7</td>
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<td>100</td>
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<td>5DF</td>
<td>OO10-15</td>
<td>75</td>
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<td>25</td>
<td>H</td>
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<td>100</td>
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<td>4</td>
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<td>75</td>
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<td>5A</td>
<td>QQ4-5</td>
<td>75</td>
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<td>5B-2</td>
<td>QQ6-10</td>
<td>75</td>
<td>Jan - May 2013</td>
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<td>QQ11-16</td>
<td>75</td>
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<td>75</td>
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<td>Jan - Feb 2013</td>
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<td>5DF</td>
<td>NN11-16</td>
<td>75</td>
<td>Jun-14</td>
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<td>2</td>
<td>S16 1-2</td>
<td>120</td>
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</table>

- Optimal well spacing is evaluated for each new development
- Currently evaluating feasibility / safety for infill wells
AER Directive 054
2015 Performance Presentation

Section 3.1.2 – Surface Operations, Compliance, and Issues not related to Resource Evaluation and Recovery
Table of Contents

• Introduction
• Facilities
• Central Processing Facilities (CPF) Performance
• Measurement and Reporting
• Water Production, Injection and Use
• Sulphur Production
• Environmental Performance
• Future Plans
MacKay River Performance Presentation
Facilities
MacKay River Project Site
Simplified CPF Process Block Diagram

- Fluids From Wells
  - Pad Separation
  - Plant Separation
  - Produced Emulsion
  - Produced Vapours
- Fuel Gas System
  - Pipeline Gas
  - Fuel Gas to Steam Generators
- Pipeline to Market
- Produced Water
- Makeup Water
  - Water Treatment
  - Boiler Feed Water
  - Recovered Water
- Steam Generation
  - Steam to Injection Wells
  - Blowdown Water
- Zero Liquid Discharge
  - Salt Cake to On-Site Landfill
  - Solids to On-Site Landfill
CPF Performance (September 2014 - 2015 YTD)

MR CPF has been remained very reliable:
• Strong performance in water treatment plant operation
• Implemented initiatives to enhance OTSG/HRSG online time

Major challenges:
• Minor plant upset in water treatment plant during March.

Average 98.5%
(September 2014 to August 2015)
Historical Production (January 2003 – 2015 YTD)
Production (2014)

Period Average: 4244.8 m³/d
Production (January 2015 to August 2015)

Period Average: 4966.7 m3/d
Water Treatment Technology

Warm Lime Softening (WLS) and Weak Acid Cation (WAC) softening for produced water

Zero Liquid Discharge (ZLD) System on blowdown slip stream:
- Evaporators: one steam and one mechanical driven
- Crystallizer: Steam driven
- Dryer: gas fired
- Filter press (2): back up for dryer
# Boiler Feed Water (BFW) Quality

<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>Temperature, °C</td>
<td>151.14</td>
<td>169.76</td>
<td>140 – 170</td>
</tr>
<tr>
<td>Hardness (Dissolved), mg/L</td>
<td>0.23</td>
<td>0.93</td>
<td>&lt; 1.0</td>
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<tr>
<td>Total Dissolved Solids, mg/L</td>
<td>6115.3</td>
<td>7682.9</td>
<td>&lt; 8000</td>
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<tr>
<td>Silica, as SiO2, mg/L</td>
<td>23.53</td>
<td>67.43</td>
<td>&lt; 50.0</td>
</tr>
</tbody>
</table>
Water Treatment Successes and Challenges

The WLS performance has been steady for 2015:

- Reliability is 98.6%
  - Consecutive days within spec: 148 days Parameters: temperature, hardness, total dissolved solids, pH, silica, oil, free oxygen, total dissolved iron
  - Reliability of water treatment system significantly enhanced due to a renewed focus on operational targets

Challenges:

- Lower Warm Lime Softener performance entering Q3 2015
  - Water quality was within operational targets
  - Problem within WLS rectified during turnaround activities
Steam Quality from Co-gen is maintained approximately 77% and OTSG is approximately 80%
Steam Generation (2015 YTD)

Steam Quality from Co-gen is maintained approximately 77% and OTSG is approximately 80%
Power Generation (2014)

Electricity Consumed (MwH)

January
February
March
April
May
June
July
August
September
October
November
December

0
1,000
2,000
3,000
4,000
5,000
6,000
7,000
8,000
9,000
10,000
11,000
12,000

Consumption
Imported
Power Generation (2015 YTD)
Gas Consumption (2014)
Gas Consumption (2015 YTD)

Steam Generated (kg)

Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec

Cogen | OTSG
Energy Intensity

Energy Intensity Formula

- Energy Intensity (GJ/m$^3$) = Total energy consumed by site / Sales bitumen volume

- Total energy consumed by site (GJ) = Energy used to make steam in Cogen + Natural Gas imported to site + Solution gas to Cogen + Electricity consumed by site – Mixed gas to Cogen duct firing
  - Note that the term “site” does not include Cogeneration

- Energy used to make steam in Cogen (GJ) = BFW Mass Flow Rate to Cogen x Hourly average difference in enthalpy between steam and BFW
Cogeneration Agreement with TransCanada Energy

Energy exchange: TransCanada Energy (TCE) provides steam and electricity to Suncor in exchange for BFW and a “fee”

- Fee calculated as GJ of fuel gas equivalent in compensation for steam and electricity (energy equivalent value based on contractual formula)

- Suncor provides on-spec BFW and fuel gas, maintains MacKay River facility within specified outage hours and takes a minimum steam requirement

- Mixed gas supplied by Suncor to TCE credited against total gas “fee” requirement

- TCE required to provide all other excess gas for the operation of the cogeneration facility

- TCE sells excess electric energy generated by the cogeneration facility to the market
Energy Intensity (2014)

MacKay River Energy Intensity for Year 2014

<table>
<thead>
<tr>
<th>Month</th>
<th>Energy Intensity (GJ/m³ Bitumen)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jan</td>
<td>8</td>
</tr>
<tr>
<td>Feb</td>
<td>8</td>
</tr>
<tr>
<td>Mar</td>
<td>6</td>
</tr>
<tr>
<td>Apr</td>
<td>6</td>
</tr>
<tr>
<td>May</td>
<td>8</td>
</tr>
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<td>Jun</td>
<td>8</td>
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<td>Jul</td>
<td>8</td>
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<td>Aug</td>
<td>8</td>
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<tr>
<td>Sep</td>
<td>8</td>
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<tr>
<td>Oct</td>
<td>8</td>
</tr>
<tr>
<td>Nov</td>
<td>8</td>
</tr>
<tr>
<td>Dec</td>
<td>8</td>
</tr>
</tbody>
</table>
MacKay River Energy Intensity for 2015 Year-to-Date
Measurement Accounting & Reporting Plan (MARP)

- MARP approved in April 2010
- MARP was updated on February 28, 2015
- MARP details all the required data in Directive 42
- MacKay River Report Codes:
  - Battery – AB BT 0067097
  - Injection Facility – AB IF 0009498
  - Meter Station – AB MS 0084090
Well Testing Strategy

Test Separators are used to test all wells for production allocation
Fully compliant with Directive 017

Pad 20 and Pad 21 Well Testing Strategy
• 12 active SAGD producers per pad, 4 hour tests (+ purge time)

Pads 22 Well Testing Strategy
• 23 active SAGD producers, 5.5 hour tests (+ purge time)
• No long grandfathered as a result of the Directive 017 update
• Phase 5A (NN2-5, QQ4-5) are tested via Pad 22 Test Separator

Pads 23/24 Well Testing Strategy
• 14 active SAGD producers, 7 hour tests (+ purge time)

Pad 25 Well Testing Strategy
• V-100 Test Separator
  • 10 active SAGD producers, 5 hour tests (+ purge time)
• V-1100 Test Separator – *Recalibrated May 2015 once substantial steady production achieved*
  • *12 active SAGD producers*, 5 hour tests (+ purge time)
• V-1150 Test Separator - *Recalibrated May 2015 once substantial steady production achieved*
  • *12 active SAGD producers*, 6 hours test (+ purge time)
**Proration of Oil and Water**

- Average for 2014: Oil Factor = 0.95 Water Factor = 1.1
- Average for 2015 YTD: Oil Factor = 0.95 Water Factor = 1.06
MacKay River Performance Presentation
Water Production, Injection and Use
CPF Water Traffic
Fresh Water

Source Water Wells
• Water Act Licence No. 00188229-02-00 (511,000 m3/y) Birch Channel Aquifer (Renewal issued September 2012)

  1. 13-05-093-12W4 (GD-SW-212-53; formerly WSW-1), max. rate 450 m3/day
  2. 04-08-093-12W4 (GD-SW-213-86; formerly WSW-2), max. rate 1368 m3/day
  3. 04-08-093-12W4 (GD-SW-215-91; formerly WSW-3), max. rate 1411 m3/day

Domestic Water Well
• Water Act Licence No. 00249470-01-00 (25,550 m3/y) Birch Channel Aquifer

  4. 12-05-093-12W4 (CWSW-SW-218-55), max. rate 123 m3/day

• Monthly reporting done through Water Use Reporting System (WURS)
## Raw Water Source Wells

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<tr>
<th>test</th>
<th>water analysis</th>
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<td><strong>physical</strong></td>
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<tr>
<td>EC (μS/cm)</td>
<td>864</td>
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<tr>
<td>pH (units)</td>
<td>8.21</td>
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<tr>
<td>Tot Hard as CaCO2 (mg/L)</td>
<td>416</td>
</tr>
<tr>
<td>Tot Alk as CaCO3 (mg/L)</td>
<td>402</td>
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<tr>
<td><strong>indicators</strong></td>
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<tr>
<td>Chloride:D (mg/L)</td>
<td>0.53</td>
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<tr>
<td>Sulphate:D (mg/L)</td>
<td>108</td>
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<tr>
<td>Iron:D (mg/L)</td>
<td>&lt;0.030</td>
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<td>Manganese:D (mg/L)</td>
<td>0.277</td>
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<td>TDS-calculated (mg/L)</td>
<td>535</td>
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<td><strong>cations, anions &amp; ion balance</strong></td>
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<td>Calcium:D (mg/L)</td>
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<td>Magnesium:D (mg/L)</td>
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<td>Potassium:D (mg/L)</td>
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<td>Sodium:D (mg/L)</td>
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<td>Bicarbonate:D (mg/L)</td>
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<td>Carbonate:D (mg/L)</td>
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<td>Hydroxide:D (mg/L)</td>
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<td>Fluoride:D (mg/L)</td>
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<td>Ion balance % (%)</td>
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<td><strong>nitrogen parameters</strong></td>
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<td>NO2 as N (mg/L)</td>
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<tr>
<td>NO3 as N (mg/L)</td>
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<td>NO2 + NO3 as N (mg/L)</td>
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<td>DKN (mg/L)</td>
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<tr>
<td>TKN (mg/L)</td>
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<tr>
<td>Tot Amm N (mg/L)</td>
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<tr>
<td><strong>phenols</strong></td>
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<tr>
<td>phenols (mg/L)</td>
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<tr>
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<tr>
<td>Naphthenic Acids (mg/L)</td>
<td>---</td>
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</table>

Typical water quality assessment parameters

Monitoring station GD-SW-212-53 (formerly WSW-1)
Cumulative Raw Water – Source Wells (2014)

- Regulatory allowable limit from Water Act Licence No. 188229 is 1.4e³ m³/day (511e³ m³ per year - black line shown on chart)
Cumulative Raw Water – Source Wells (2015 YTD)

- Regulatory allowable limit from Water Act Licence No. 188229 is 1.4e³m³/day (511e³m³ per year – black line shown on chart)

• Water well casing failure September 9, 2011; well was abandoned and a replacement well drilled July 2013. No water has been withdrawn (2015 YTD)
Water Balance

• Steam:
  
  • MARP approved methods:

    (1) HP steam ultrasonic meter pending resolution on foaming issue:

    • A new longer wave guide was installed in the ultrasonic meter during the 2012 September turnaround
    • A new annubar meter was installed off the new steam separator at the end of 2014
    • An additional new annubar steam meter (on the common steam header to the pads) was installed during the 2015 September turnaround

    (2) Steam Injected = Σ All Meters to injection wells
Water Balance Continued

3.1.2 4 c)

- HP BFW Pumps
- OTSGs
- Cogeneration
- HP Steam Separators 04-V-400A/B/C
- HP Steam to 01-E-100A~D
- LP Steam
- HP Steam Separators 04-V-400D
- 04-FI-600
- 04-FI-283
- 04-FI-1002
- Injection Wells
- XXWWW-FI-015/020
- 04-FI-162
- 04-FI-1001
- To LP Steam Separator
Water Balance Continued

- **Raw Water** = \( \Sigma \) Water Source wells (3 water source wells)

- **Produced Water:**
  - MARP approved method

- **Vapour losses are estimated:**
  - LP Steam vent losses
  - ZLD has vapour loss to atmosphere

- Details of measurement and reporting procedures may be found in the MARP

- Water from the crystallizer is metered at the crystallizer outlet before it goes to the dryer
  - Truck tickets capture the volume of water trucked off-site
  - Volumes reported in Petrinex
Water Balance (2014)
Water Balance (2015 YTD)

- Volume m³/month
- Steam Injected
- Produced Water
- Make-Up Water
Water Recycle (2014)

Produced Water Recycle* = (Produced Water – Disposal Water)*100/Produced Water

*New calculation based on Appendix H of Directive 081
Water Recycle (2015 YTD)
Low Pressure Blowdown Recycle (2014 & 2015 YTD)

Blowdown Recycle = 100%
- Blowdown treated in the Water Plant
  - YTD (August 2015): 54,710 m$^3$/month
    2014: 49,322 m$^3$/month
- Blowdown treated in the Zero Liquid Discharge (ZLD) Plant
  - YTD (August 2015): 42,371 m$^3$/month
    2014: 41,865 m$^3$/month

Trucked volumes from Diversion Lagoon:
- 55,816 m$^3$ (January 1, 2014 – December 31, 2014)
- 22,433 m$^3$ (January 1, 2015 – August 31, 2015)

Note: The diversion lagoon is filled by crystallizer concentrate during purges and by landfill leachate after periods of rain
MacKay River Landfill / Waste Management

AER Approval WM-072 Class II Oilfield Landfill

- Volumes of solids (salt/lime) to landfill
  - 2014: 23,808 m³
  - 2015 YTD: 20,011 m³ *

- Total volume of landfill fluids to facility
  - 2014: 20,753 m³
  - 2015 YTD: 14,472 m³ *

- Waste Surveys completed on October 8/9th, 2014 (Phase II), and February 6/8th, 2015 (Phase III)
  - Phase III: 27,447 m³
  - Phase II Cell (A&B): 74,270 m³ (approved for 86,000 m³)
  - Phase I of the MacKay River Landfill is closed and is in post-closure monitoring period

- Waste services contract in place
  - Addresses hazardous, scrap metal, domestic waste

- Waste Tracker software used to track and submit manifests to AER

*Volumes estimated in August 2015
**Off-Site Brine Water Disposal**

**Location of disposal site:**
- Tervita Lindbergh (WPF, SFC)
- 05-26-056-05 W4M
- Application No: 1652609
- Approval No: WM061 (Amendment I)

- Brine water is disposed of off-site when the diversion tank and diversion lagoon reach capacity and the ZLD system cannot process the boiler blowdown from Unit 400.

- Water sources in the diversion lagoon include: precipitation, leachate from the MacKay River Landfill and excess boiler blowdown water during upset conditions.
Off-Site Brine Water Disposal (2014)

- Volumes reported via Petrinex
Off-Site Brine Water Disposal (2015 YTD)

- Volumes reported via Petrinex
MacKay River Performance Presentation
Sulphur Production
Sulphur Production

- Currently there are no sulphur recovery facilities at the MacKay River Project
• $\text{SO}_2$ emissions are calculated from monthly produced gas samples
Sulphur Dioxide Emissions (2015 YTD)

- $\text{SO}_2$ emissions are calculated from monthly produced gas samples
H₂S Concentration (2014)

- H₂S concentrations are measured in semi-monthly produced gas samples.
H₂S Concentration (2015 YTD)

- H₂S concentrations are measured in monthly produced gas samples.
Solution Gas Flared (2014)

- **Solution Gas Flared**
- **(m³)**

- **Jan**: 500
- **Feb**: 1,200
- **Mar**: 0
- **Apr**: 0
- **May**: 0
- **Jun**: 0
- **Jul**: 0
- **Aug**: 200
- **Sep**: 400
- **Oct**: 0
- **Nov**: 100
- **Dec**: 50
Solution Gas Flared (2015 YTD)
Solution Gas Recovery (2014)
Solution Gas Recovery (2015 YTD)
MacKay River Performance Presentation
Environmental Performance
Greenhouse Gas Emissions (GHG)

Submitted the annual SGER report to Alberta Environment and Parks and NPRI GHG report to Environment Canada
  • GHG calculation methodology developed to improve transparency

Total direct emissions for 2014:
  • 228,984 tonnes of CO₂equiv
  • Total emissions have been reported to ESRD

Total direct emissions for 2015 (5+7 Forecast):
  • 313,057 tonnes of CO₂equiv*
  • Total emissions will be reported to ESRD

Approved baseline emissions intensity:
  • 0.1174 tCO₂e/m³ (Global Warming Potential Updated)

* 2015 5+7 forecast estimated. Numbers to be verified in 2016.
Ambient Air Monitoring

- 4 passive air monitoring stations at MacKay River

- Monthly ambient air quality monitoring performed by a site representative and sample analysis reports submitted to AER by Suncor site personnel for H₂S and SO₂

- Ambient air quality data available for viewing on WBEA website

- No air quality exceedances at MacKay River

- In 2014 average H₂S concentration was 0.09 ppb and SO₂ concentration was 0.6 ppb collected from the passive stations

- In 2015 (as of August 31) average H₂S concentration was 0.09 ppb and SO₂ was 0.5 ppb collected from the passive stations
Total Flared Gas (2014)

![Bar chart showing the total flared gas (in 10^3 m^3) for each month of 2014. The chart indicates that the highest flared gas was in January, with values decreasing for subsequent months.]
Total Flared Gas (2015 YTD)
Regulatory Compliance (2014 and 2015 YTD)

Environment Canada Site Visit
- May 14, 2014
  - Audit of bird deterrent systems on ponds

AER Site Visit
- May 13, 2015
  - Introduction of new inspector and discussion on transition of reporting from Bonnyville to the Fort McMurray Office.
Release Management – Reportable Releases

AER Reportable Releases for 2014
  • Twelve AER reportable releases

AER Reportable Releases for 2015 (YTD)
  • Five AER reportable releases

Environmental Awareness Training
  • Core training requirement
  • Highlights Spill Awareness, Waste Management, Flaring etc.
Current Approval Amendments

AER Approval No. 8668

- **Amendment 8668Z**
  - Pad 828 change from 3 well pairs to 2 wells pairs and correction of well UWIs on Pad 21
  - Chemical Injection Test (D-Pattern Injectors) approval issued December 10, 2014

- **Amendment 8668AA**
  - Phase 1 NCG design amendment approval issued December 19, 2014

- **Amendment 8668BB**
  - Phase 2 and Phase 3 Chemical Co-Injection (E, F and G Patterns) approval issued January 1, 2015

- **Amendment 8668CC**
  - Approval for E1P Sidetrack well issued January 27, 2015

- **Amendment 8668DD**
  - Approval for NN6P Sidetrack well issued February 3, 2015

- **Amendment 8668EE**
  - Approval for VX™ multiphase meter on Pad 824 issued February 19, 2015

- **Amendment 8668FF**
  - Approval for NCG Test at OO5I well on pad 24 issued March 17, 2015
Current Amendments Continued

• **Amendment 8668GG**
  - Approval to conduct CO₂ Co-Injection at the OO9 well pair on Pad 24 issued April 13, 2015

• **Amendment 8668HH**
  - CO₂ Co-Injection amendment to change to OO8 well pair on Pad 24 issued

• **Amendment 8668II**
  - Pad 824 Thermal Compatibility Assessment approval issued July 14, 2015

• **Amendment 8668JJ**
  - Approval for NCG Test at OO7I issued July 29, 2015
Current Amendments / Applications

AER Approval 8668

- Application No. 1835073: MOP Strategy Trial at QQ5 – QQ16 submitted July 24, 2015 and approved October 9, 2015 (8668KK)
- Application No. 1838202: C2IPB Sidetrack and well conversion application submitted September 2, 2015 and approved October 13, 2015 (8668LL)

AER Water Act Licences

- Licence No. 00289164-01-00 for MR2 diversion of water renewed June 26, 2015; expiry June 25, 2020;
- New Licence No. 00367341-00-00 for dust suppression on AOSTRA road issued July 20, 2015; expiry July 19, 2025
Current Amendments / Applications

EPEA Approval – no amendments within this reporting period

AEP

- New Wildlife Research Permit (56728) and Collection License (56219) issued on April 27, 2015
Environmental Initiatives

Suncor is an active member of:

- Cumulative Environmental Management Association (CEMA)
- Regional Aquatics Monitoring Program (RAMP)
- Wood Buffalo Environmental Association (WBEA)
- Alberta Biodiversity Monitoring Institute (ABMI)
- Alberta Water Council (Watershed Planning Advisory Council)
- Oil Sands Developers Group (OSDG)
- Canada’s Oil Sands Innovation Alliance (COSIA)
- Industrial Footprint Reduction Options Group (iFrog)
- Oil Sands Spill Coop Area Y

Suncor is in ongoing consultation with:

- Regional stakeholders
- Aboriginal Communities and the local Municipality
Reclamation

2014 Conservation & Reclamation report was submitted to AER in March 2015. No reclamation activities are underway at MacKay River.

- **Total area of land cleared in 2014 was 16.9 ha:**
  - MR2 Central Processing Facility – 2.4 ha
  - Soil Stockpile Area – 6.3 ha
  - Observation Wells – 8.2 ha

- **Estimated total area of land to be cleared in 2015 is 5.8 ha:**
  - Pad 824 – 2.5 ha
  - Borrow Pit – 3.3 ha

Note: Estimated numbers do not include exploration programs
Regulatory Compliance

• Suncor Energy Inc. is in compliance with all regulatory approvals, decisions, regulations and conditions as described in Decision Report 2000-50; specifically pertaining to:

  • Plant and waste management facility location,
  • Ground level ozone and VOC monitoring,
  • Groundwater monitoring wells,
  • Surface water quality monitoring, and
  • Participation in Regional Initiatives
Summary of Key Learnings (Operations)

- Implementation of Suncor Safety Task force initiatives driving and reinforcing correct behaviours
  - Primary focus on operational discipline and leadership
  - Secondary deployment of processes and tools

- Visual management of process variables delivers step change in CPF reliability
  - Record consecutive days without unplanned steam outage
  - Record consecutive days of on-spec boiler feed water

- Group transfer pump reliability gains from previous years have been maintained. Project to right size pumps funded late 2014 with fabrication underway.

- Focus on brine dryer operation has significantly reduced offsite disposal
MacKay River Performance Presentation

Future Plans
## Future Plans

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<thead>
<tr>
<th>Project Description</th>
<th>Comments</th>
<th>Status</th>
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<tr>
<td>MR1 Debottlenecking/Optimization</td>
<td>Series of equipment modifications/improvements building towards an increase in MR1 production capacity</td>
<td>Series of submissions over the next few years</td>
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