Annual Surmont SAGD Performance Review
Approvals 9426, 11596, and 9460

April 6, 2016
Calgary, Alberta, Canada
Introduction, Overview and Highlights

Subsection 3.1.1 (1)
Ownership and Approvals

Ownership

- The Surmont In Situ Oil Sands Project is a 50/50 joint venture between ConocoPhillips Canada Resources Corp. and TOTAL E&P Canada Ltd; Operated by ConocoPhillips Canada.

Project History

- 1997 - First steam at pilot project
- 2007 - First steam at Phase 1
- 2010 - Construction start at Phase 2
- 2015 - Start-up of Phase 2, solvent soak on well pairs 7&8 on pad 103
- 2016 - Start-up of liquid scavenging system

Approval Update - AER Approval No. 9426

- Amendment 9426DD – February 26, 2015
  - Sustaining Pad 268
- Amendment 9426EE – March 25, 2015
  - Inclusion of well pairs from Well Pad 103 in solvent soak trial at Well Pad 101
- Amendment 9426FF – April 10, 2015
  - Replace SulFerox® unit (not yet operating) with liquid scavenging equipment (Phase 2)
- Amendment 9426GG – May 13, 2015
  - Surmont 2 Debottleneck Project
- Amendment 9426HH – October 22, 2015
  - Add well 12 well pairs at Pad 267 and develop subsurface DA 267-3 (Phase 2)
- Amendment 9426II – February 12, 2016
  - Outboard wells at Well Pads 265 and 266 (Phase 2)
- Amendment 9426JJ – February 24, 2016
  - Non-condensable gas injection at Well Pad 102 (Phase 1)
Surmont Overview

Phase 1 is focused on improving production and start-up of 103.

Phase 2 is focused on starting facility and 7 well pads.

Moving to a “One Surmont” philosophy

Surmont combined approved capacity is 29,964 m³/cd (188,700 bbl/cd)*
*(where cd is calendar day on an annual average basis)
2015 Highlights

Phase 1 production recovery
- Increased OTSG fouling and economizer box replacement.
- Steam allocation constraints from start up of 103.
- Treating constraints after chemical well treatments.
- Extra steam from Phase 2.

Phase 2 start-up
- First steam May 2015 (using interconnect to send steam to pad 103).
- Bitumen treating started August 2015 (using interconnect to send S1 emulsion to S2),
- First sales oil shipped September 2015.
- Start up of 7 pads.

Sustaining pads
- Pad 101-24/25/26 deferred to 2017 – reassessing economics.
- Pad 103 start-up April 2015.
- Outboard wells at pads 265 and 266 deferred – reassessing economics.

Additional steam (from debottlenecking) deferred to 2018
- Commodity Price response defers steam expansions.
Surmont Performance

Historical Steam Injection and Bitumen Production

- MBPD: MBPD (MB/Day)
  - Steam (cwebpd)
  - Oil (boepd)

- 2007-2008: Unstable Ramp-Up
  - Key Issues:
    - Commissioning
    - Manpower
    - Off-spec product
    - Freezing
    - Plant Instability
    - Minimum Turndown

- 2009: Steam Gen Issues
  - Key Issues:
    - OTSG integrity
    - Front-end treatment
    - 1st turnaround
    - Well Constraints

- 2010-2012: Stable operations reaching “capacity”
  - Key Issues:
    - ESP installations/repair
    - OTSG maintenance
    - 2011 Turnaround
    - Well Constraints

- 2013+: Continuous Improvement
  - Key Issues:
    - ESP installations/repair
    - OTSG maintenance
    - 2014 Turnaround
    - Well & Facility Optimization

- 2015: S2 Ramp begins
  - Key Issues:
    - OTSG fouling
    - Front-end treatment
    - Pressure drop from 2014 T/A
    - Steam constraints (PAD 103 accelerated S/U)

- 2016 Key Issues:
  - Slotted liner Ramp-up performance
  - Horizontal liner deformation
  - Increased performance on S1 base due to re-pressurization

Average Steam Uptime

- Last Half 2009:
  - 85%

- 2010-2015:
  - 91% - 97%

SOR and WOR

- S1 2015 SOR = 2.88

Subsection 3.1.1 (1)
2015 Loss Production Summary

Facilities/Other 32% of losses

- Unplanned maintenance (pigging, economizer replacement, ...): 24%
- Production impact associated with extended steam reduction: 24%
- Planned maintenance for equipment (pigging, equipment maintenance): 24%
- Power outage due to lightning/thunder storms: 5%
- Pad 103 Repairs: 3%
- Process Control and Safety System: 1%
- Third party power supply failure: 1%
- Pump: 2%
- Third party power supply failure: 1%
- Production impact associated with extended steam reduction: 24%

Wells 68% of losses

- Troubleshooting low production: 31%
- Sensitive Subcool: 16%
- Caustic Stimulation (102-12,101-17): 9%
- Optimization / Troubleshooting (pump inefficiency, blockages, ...): 4%
- Sensitive Subcool: 16%
- ESP Failure, PCP Upsize: 9%
- Masking Effect/Hot Spot Issues: 4%
- Power outage due to lightning/thunder storms: 5%
- Pad 103 Repairs: 3%
- Process Control and Safety System: 1%
- Third party power supply failure: 1%

Average Performance

- Oil Production (bbl/d): 25,701
- Oil Loss (bbl/d): 3,241
- DOE: 89%
- ASC (bbl/d): 28,925
- Steam Uptime: 95.7%
Subsurface Resource Evaluation and Recovery

Geology and Geophysics
Subsection 3.1.1 (2)
2015-2016 Delineation Campaign and Well Density

Subsection 3.1.1 (2f)

1454 existing wells – 80 new

80 new vertical wells (as of Mar 1, 2016)

Phase 1 and Phase 2
Development Area

Drainage Areas

Surmont leases
Focus on Surmont Phase 1 sustaining pad locations as well as delineation of Phase 3
(only wells that penetrate the McMurray)

- Existing wells
- New vertical wells (as of Mar 1, 2016)

- Phase 1 and Phase 2 Development Area
- Drainage Areas
- Surmont leases
2015-2016 Delineation Campaign and Core Density

McMurray Cored Wells - Surmont Lease

1454 wells total
537 existing core wells
22 new core wells (as of Mar 1, 2016)

Phase 1 and Phase 2 Development Area
Drainage Areas
Surmont leases
2015-2016 Delineation Campaign and Core Density

Subsection 3.1.1 (2f)
100% Coverage of FMI/CMI Data in 2015/2016 program

- Important for breccia identification

- 1454 wells total
- 1073 existing FMI/CMI wells
- 80 new FMI/CMI wells (as of Mar 1, 2016)

Phase 1 and Phase 2 Development Area

Drainage Areas

Surmont leases
100% Coverage of FMI/CMI Data in 2015/2016 program
- Important for breccia identification
- Geomechanical Modeling

- Existing wells
- Existing FMI wells
- New FMI wells (as of Mar 1, 2016)
- Phase 1 and Phase 2 Development Area
- Drainage Areas
- Surmont leases
Delineation across Phase 1, 2, and 3

Delineation Well Density Map - Jan 2015

Delineation Well Density Map - Mar 2016

Density Map Difference

McMurray penetrated wells only

2015-2016 Delineation Campaign and Well Density
2015-2016 Delineation Campaign and Well Density

Increased core density with latest drilling

Cored Wells Density Map - Jan 2015

Cored Wells Density Map - Mar 2016

Cored Density Map Difference

Subsection 3.1.1 (2f)
Increased Formation Micro Imaging density with latest drilling

FMI Well Log Density Map – Jan 2015

FMI Well Log Density Map – Mar 2016

FMI Density Map Difference

McMurray penetrated wells only

Subsection 3.1.1 (2f)
## Reservoir Characteristics

### Properties

<table>
<thead>
<tr>
<th>Properties</th>
<th>Depth (masl)</th>
<th>Phie in NCB</th>
<th>So in NCB</th>
<th>KH in NCB</th>
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<th>Initial Pressure (KPa)</th>
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McMurray Gross Isopach

2015/2016 Delineation Campaign Update
- December 2015 – minor changes due to:
  - Re-evaluated/uniﬁed geologic picks
  - Revised Seismic Interpretation
McMurray Net Gas Isopach

Net Top Gas thickness = sands have deep resistivity ≥10 Ω-m and Vsh <65%

2015/2016 Delineation Campaign Update
- December 2015 – minor changes due to:
  - Re-evaluated/unified geologic picks
  - Revised Seismic Interpretation
McMurray Net Top Water Isopach

Net Top Water thickness = sands have deep resistivity <10 Ω·m and Vsh <45%

3D seismic areas used for mapping (all 12 volumes)

Surmont leases

Phase 1 & 2 Development Area
Phase 1 & 2 Drainage Areas

2015/2016 Delineation Campaign Update
• December 2015 – minor changes due to:
  • Re-evaluated/unified geologic picks
  • Revised Seismic Interpretation
McMurray Top Continuous Bitumen Structure

3D seismic areas used for mapping (all 12 volumes)
Surmont leases

Phase 1 & 2 Development Area
Phase 1 & 2 Drainage Areas

TCB = The uppermost limit of good reservoir, bitumen-bearing sands.

2015/2016 Delineation Campaign Update
- December 2015 – minor changes due to:
  - Re-evaluated/unified geologic picks
  - Revised Seismic Interpretation

Top Continuous Bitumen Structure

Subsection 3.1.1 (2d)
McMurray Base Continuous Bitumen Structure

BCB = First occurrence of good reservoir, bitumen-bearing sands.

3D seismic areas used for mapping (all 12 volumes)

Surmont leases

Phase 1 & 2 Development Area
Phase 1 & 2 Drainage Areas

2015/2016 Delineation Campaign Update
- December 2015 – minor changes due to:
  - Re-evaluated/unified geologic picks
  - Revised Seismic Interpretation
Net continuous bitumen thickness criteria:
- Sands with deep resistivity > 40 Ohm-m and Vsh < 33%,
- No shale greater than 3 m thick.

**2015/2016 Delineation Campaign Update**
- December 2015 – minor changes due to:
  - Re-evaluated/unified geologic picks
  - Revised Seismic Interpretation
**Surmont Leases OBIP**

**Surmont Development Area OBIP**

- **Properties**
  - NCB Thickness Range: 0 to Greater than 30 m
  - Phie in NCB: 32.42%
  - So in NCB: 78.84%
  - OOIP in NCB > 18m: 3507.27 MMbbls Deterministic

**Development Area**
- **Surmont leasing**
- **3D seismic areas used for mapping (all 12 volumes)**
- **Phase 1 & 2 Development Area**
- **Phase 1 & 2 Drainage Areas**
- **Previous Dev Area**

**OBIP = Thickness x Phie x So x Area**
Phase 1 Type Log Well Pad 101

Example Log 100161408307w400

- McMurray
- Continuous Bitumen
- High Sw

Phase 1 Area

Subsection 3.1.1 (2e)
Phase 2 Type Log – Well Pad 264-2

Example Log 100162208306w400

- **McMurray**
  - Top Gas
  - High Sw

- **Continuous Bitumen**

- **Devonian**

Phase 2 Area

Subsection 3.1.1 (2e)
Objectives:

- Characterize vertical and lateral variance in viscosity at different temperatures.
- Model the variance in bitumen properties and its implications for bitumen production rates during SAGD.
- Characterize relationship between viscosity, density and geochemical composition.

Viscosity increases with depth in the McMurray Formation.

- 52 existing viscosity sample wells
- Delineated Wells - Surmont

2015 – 2016 Delineation
Subsection 3.1.1 (2f)

Viscosity Gradient

Height above base of bitumen (m)

Dead oil Viscosity (cP)
Representative Structural Cross Section
The presence of basal water becomes a potential impact on production performance on Well Pad 262-1.

A well at 4-3-84-6 W4M intersected a raised bitumen/water contact, the contact is ~ 12 m higher than the nearest offset.

The well also intersected a small gas pool under the bitumen.

The well also intersected a raised bitumen/water contact, the contact is ~ 12 m higher than the nearest offset.

The presence of basal water becomes a potential impact on production performance on Well Pad 262-1.
INSAR Surface Deformation Monitoring

- Interferometric Synthetic Aperture Radar Images:
  - Data is collected every 24 days
- Data acquisition initiated after first steam in 2008:
  - Data used for Geomechanical Model Calibration
  - CRs 1 to 20 installed March 2008
  - CRs 21 to 47 installed March 2010
  - CRs 48 to 136 installed March 2012
  - CRs 137 to 244 installed March 2014
  - CRs 246 to 249 & CRs 251-252 installed December 2015

- CRs 20 and 49 were replaced in March 2015

Location Map of CR Points (Surmont 1)

Location Map of CR Points (Surmont 2)
Deformation currently in line with expectations
Maximum deformation seen in CRs 13, 244,14b over pad 101S.
INSAR Update for CN Rail

- Overall, cumulative deformation is around ± 5 mm, and none of the corner reflectors show deformation values close to the 25 mm disclosure limit defined by CN Rail.
- Annual report will be provided to CN Rail containing:
  - Map of Railway Corner Reflectors and horizontal wells
  - Table of data containing the Railway CRs

Figure 1: InSAR Corner Reflector points along the railway—Township 083, Range 06, W4M
• 12 cap rock cores in 2015 and 2016, three of which were used for rock mechanics testing.
• 1 caprock core was used for rock mechanics testing in 2014.
• Cap rock interval investigation included:
  • Core description and analyses
  • Log interpretation and correlation
  • Seismic interpretation and correlation
• Analytical methods included:
  • Rock mechanics testing
  • Visual core examination
  • Reflected light microscopy
  • Laser particle size analysis
  • Biostratigraphic analyses
  • X-ray diffraction for clay species
  • QEMSCAN (quantitative mineralogy)
  • Chemostratigraphy (bulk geochemistry)
  • MICP (mercury injection capillary pressure) analyses to determine seal capacity

Conclusions from the study:
• The best seals within the cap rock interval are the deeper water deposits occurring on maximum flooding surfaces.
• These muds can be over 80% clay and are correlated throughout and beyond the Surmont leases.
• The mechanical properties of the caprock allow for providing a continuous seal over the steam chamber.
Three mini-fracs were conducted in 2011, one in 2012, four in 2015 and two in 2016. Structurally complex areas as well as new developments were targeted.

Wellbore image log and other open-hole logs were analyzed in detail for stress analysis and natural fractures characterization.

The results suggest while the previously used value of 18.4 kPa/m is valid, the minimum horizontal stress is higher in several drainage areas.

ConocoPhillips Canada is going to submit an application in the near future, recommending higher Maximum Operating Pressure in select drainage areas.

Conclusions from the study:
- The results suggest that in many parts of Surmont the caprock minimum horizontal stress is above the used value of 18.4 kPa/m in the MOP calculation.
- While the recommended 15 kPa/m MOP gradient is verified and valid, higher MOP gradient will be requested for select drainage areas.
Based on the cap rock integrity studies, ConocoPhillips Canada proposed a maximum pressure of 15kpa/m in 2011. This MOP is going to be revised for select drainage areas, where the caprock can withstand higher MOP with the same safety factor. Applications related to revised MOP will be submitted to the AER in a near future.

- Circulation optimization including dilation is an area of ongoing study.
- Pace of pressure drops will be largely driven by:
  - Specific, local reservoir properties
  - Thief zone interactions
  - Economics
  - ESP installations
  - Plant capacity
  - Global steam optimization

ConocoPhillips Canada continues to propose a flexible tapered strategy envelope bound by the cap rock integrity study and the associated MOP on one side and economic achievable pressures on the low side.
Drilling and Completions

Subsection 3.1.1 (3)
One Surmont - Well Summary

Surmont 1

Surmont 2

Subsection 3.1.1 (3a)
Well Pad 101 South
Producer and Injector Vertical Offset

Pad 101S

Subsection 3.1.1 (3a)
Well Pad 102 North
Producer and Injector Vertical Offset

Pad 102N

Subsection 3.1.1 (3a)
Well Pad 102 South
Producer and Injector Vertical Offset

Pad 102S

Subsection 3.1.1 (3a)
Well Pad 103
Producer and Injector Vertical Offset

Subsection 3.1.1 (3a)
Well Pad 261-3
Producer and Injector Vertical Offset

Pad 261-3

Subsection 3.1.1 (3a)
Well Pad 262-1
Producer and Injector Vertical Offset

Pad 262-1

Offset (m)

Depth (m MD KB)

Subsection 3.1.1 (3a)
Subsection 3.1.1 (3a)
Well Pad 263-1
Producer and Injector Vertical Offset

Pad 263-1

Subsection 3.1.1 (3a)
Subsection 3.1.1 (3a)
Subsection 3.1.1 (3a)
Well Pad 264-1-11 Fishbones
Producer and Injector Vertical Offset

Injector has 3 legs while producer has 7 legs. 3 vertical offsets.
Well Pad 264-2
Producer and Injector Vertical Offset

Subsection 3.1.1 (3a)
Well Pad 264-3
Producer and Injector Vertical Offset

Subsection 3.1.1 (3a)
Well Pad 265-2
Producer and Injector Vertical Offset

Subsection 3.1.1 (3a)
Well Pad 266-2
Producer and Injector Vertical Offset

Subsection 3.1.1 (3a)
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Jacobs S2 Pad Design

Drawing Applicable for:
- Pad 261-3
- Pad 266-2

Subsection 3.1.1 (3a)
Bantrel S2 Pad Design

Drawing Applicable for:
- Pad 262-1
- Pad 262-2
- Pad 262-3
- Pad 263-1
- Pad 263-2
- Pad 264-1
- Pad 264-2
- Pad 264-3
- Pad 265-2

MODULE LIST - 2023

WELL PAD C-4

- 263-W-3001 4 WELL PAD MODULE 6m x 39m
- 263-W-3002 4 WELL PAD MODULE 6m x 39m
- 263-W-3003 3 WELL PAD MODULE 6m x 39m
- 263-W-3004 GROUP TEST SHOT MODULE 6m x 39m
- 263-W-3005 TRANSFER PUMP MODULE 6m x 29m
- 263-W-3006 TRANSFER PUMP MODULE 6m x 29m
- 263-W-3007 ROCK MODULE 5m x 29m
- 263-W-3008 ROCK MODULE 5m x 29m
- 263-W-3009 ROCK MODULE 5m x 29m

BUILDING LIST

- 263-BG-3001 TRANSFER PUMP BUILDING 5m x 5m

SCHEDULE
1. 2020.000 is EQUAL TO 0.20000475
2. 2.000000 is EQUAL TO 0.0000000

MARKS
1. Inside piping and equipment are not finalized.
2. Equipment and building numbers.
3. Field and mains.

Subsection 3.1.1 (3a)
## Pad 101, 102 & 103 Well Completions

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<th>Producer Completion</th>
<th>Injector Completion</th>
<th>Well Identifier - Surface</th>
<th>Producer Completion (no concentric or parallel producing strings)</th>
<th>Injector Completion</th>
<th>Well Identifier - Surface (no concentric or parallel producing strings)</th>
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Subsection 3.1.1 (3b)
## Pad 262-3 & 265-2 Well Completions

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## Pad 263-1 & 263-2 Well Completions

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## Pad 264-1, 264-2 & 264-3 Well Completions

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*Fishbone well which will be started at a later date
Typical Concentric Injector

- 16” Surface Casing
- 11 ¾” Intermediate Casing
- 7” Heel Tubing String
- Liner Hanger
- 4 ½” Toe String
- 8 5/8” Slotted Liner
Typical Parallel Injector

- 16” Surface Casing
- 11 ¾” Intermediate Casing
- 4 ½” Heel Tubing String
- Liner Hanger
- 2 7/8” Toe String
- 8 5/8” Slotted Liner

Subsection 3.1.1 (3c)
1. Install a heel gas coil (5/8”) to lift heel production, no more blanket gas lifting.

2. Heel lift gas coil set 10 – 15m TVD above lateral.
1. Heel tubing string set 10 – 15m TVD above lateral.

2. One perforated joint on the bottom of heel tubing string with an additional 1-2 casing joints attached below.
9 5/8” Intermediate casing

13 3/8” Surface Casing

1” Toe Lift Gas Coil Tubing
Inside Toe Tubing

5/8” Heel Lift Gas Coil Tubing
Clamped to outside of Toe Tubing

4 ½” x 3 ½” VIT L80:

7” Heel Tubing String

9 5/8” Intermediate casing

FCD’s with Screens

Emulsion

1.25” Thermocouples (8pt)
Clamped to outside of Toe Tubing

4 ½” Toe String

Non Slotted liner 7”

Subsection 3.1.1 (3c)

Typical Flow Control Device (FCD) Completion

Total Wells with FCDs

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<th>Pad</th>
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<tr>
<td>264-3</td>
<td>6</td>
</tr>
<tr>
<td>266-2</td>
<td>10</td>
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* Injector wells don’t have instrumentation
Typical ESP Producer

13 3/8” Surface Casing

ESP Power Cable + 3/8” Bubble Tube + 2x 3/8” encapsulated F.O. P/T Instrumentation Cables (Intake/Discharge) (Clamp to outside of ESP Production Tubing)

3 ½” Production Tubing String

ESP (landed at Well Tangent)

Liner Hanger

9 5/8” Intermediate Casing

2 1/16” Guide String

P/T Sensor clamped to 2-3/8” pup joint

40pt Fiber Optic LxData 1 ¼” Coil (Inside of Guide Sting & FCD Tubing)

Slotted liner 7”

Subsection 3.1.1 (4a)
Typical PCP Producer

- **13 3/8” Surface Casing**
- **3 1/2” Production Tubing String**
- **2 1/16” Guide String**
- **ESP Power Cable + 3/8” Bubble Tube + 2x 1/4” encapsulated F.O. P/T Instrumentation Cables (Intake) (Clamp to outside of ESP Production Tubing)**
- **Sucker Rod/ CoRod**
- **PCP (Progressive Cavity Pump)**
- **Liner Hanger**
- **9 5/8” Intermediate Casing**
- **40pt Fiber Optic LxData 1 3/8” Coil (Inside of Guide Sting & FCD Tubing)**
- **Slotted liner 7”**

Subsection 3.1.1 (4a)
**Fishbone Completion Pad 101-P21 & P22**

**101-P21 (10INF) Completion**
- Rod String: Sucker Rods with ConocoPhillips Canada tested spin through centralizers.
- Lined to toe with sidetrack to “hook” towards P01 (10) taking-off at 1404MD.
- Guide/steam injection string: 2 3/8” by 3½” to toe.
- Instrumentation consisting of: Intake/Discharge P/T + 40 pts Lxdata + Toe P/T gauge.

**101-P22 (11INF) Completion**
- Rod String: Continuous Rod.
- Lined and ‘hooked” towards P02 (11) at toe.
- Guide/steam injection string: 2 3/8” by 3 ½” to toe.
- Instrumentation consisting of: Intake/Discharge P/T + 40 pts Lxdata + Toe P/T gauge.
DA 266-2, the 266-1 Outboards (OB), and the 266-2 Buffer Zone (BZ) well to be drilled from 266 pad

Three “fishbone” wells were planned as a component of DA 266-2 but replaced with conventional SAGD well pairs prior to spud in Q4 2015. Fishbone trial deferred pending additional results from 102P21,22 producers.

The 266-2 OB and BZ wells were built together as a single project for execution, with a single 4-well surface module.

The OB/BZ project, due to drill in Q3 2016, has been deferred.
Artificial Lift

Subsection 3.1.1 (4)
## Artificial Lift Current Pad Overview

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<th>Well Pairs Completed</th>
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<th>ESP Producing Wells</th>
<th>PCP Producing Wells</th>
<th>Total Wells with FCDs</th>
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</tbody>
</table>

*264-1 WP 11: Complete but no steam, Cold well  
**262-2, 266-2: Pad’s currently under construction
Artificial Lift Types

- **Gas Lift**
  - Gas lift is effective with bottom hole flowing pressures >2,700 kPa with Pwh approx. 1000 kPa.
  - Lifting from heel and toe with gas assist at start of vertical section.
  - Current production rates range from 100 m$^3$/d to 700 m$^3$/d of emulsion targeting 3,500 kPa.

- **Electric Submersible Pump (ESP)**
  - ESP for thermal SAGD applications can be sized to meet the specific deliverability of the well.
  - Operating temperatures typically below 215°C.
  - Typically Series 500 installed, and Series 400 pumps installed due to casing restrictions.

- **Progressive Cavity Pumps (PCP)**
  - Generally PCPs have been used for low deliverability wells and where potential solids may be produced.*
  - Installation of metal to metal pumps.

* ConocoPhillips Canada initial strategy for PCPs was to use them on low deliverability wells where the current ESP designs were deemed less appropriate. However, installation of larger PCPs are being considered for wells that may produce relatively “cold” viscous fluid for some time.
ESP Run Life Definitions

- **MTTF:** This run-life measure is calculated as the total exposure time of all systems (running, pulled and failed) divided by the number of failed systems.

- **Average Runtime:** This run-life measure is calculated as the total exposure time of all systems (running, pulled and failed) divided by the number of systems (running, pulled and failed).

- **Average run life running ESP:** This run-life measure is calculated as the total exposure time of running systems divided by the number of running systems.

- **Window:** Window time allows for changes in average run-life to be more apparent, as they are less obscured by previous data.
ESP Performance

KPI’s

Population: 39 ESP’s**
Cumulative MTTF: 30.1 months
Windowed* MTTF: 41.0 months
Average Runtime: 17.1 months
Windowed Runtime: 20.5 months
Average run life running ESP: 18.0 months

2015: 12 ESP failures
2016: 1 ESP failure

*(730 day window)
**2 ESP failures from December 2015 were started back up in January 2016

ESP Distribution by Company

- 47% Schlumberger
- 45% Baker Hughes
- 8% GE

MTTF

Average Runtime
The artificial lift mode selection is reliant on the pressure strategy for any given well, or drainage area (DA).

- Phase 2 wells currently utilize Gas Lift (GL) and then will be converted to ESP when the flowing bottom hole pressure is below the effective GL operating point.
- Four wells in Pad 103 will be ESP day 1. This means that following the circulation time the well will be converted directly to ESP. 266-2 will be an ESP Day 1 pad.

2015 Key Decisions:
- Removal of all single point pump pressure and temperature measurement from design due to cost and reliability.
Instrumentation in Wells

Subsection 3.1.1 (5)
SAGD Well Instrumentation

- All wells on pads contain 40 point fiber optics strings in the producers unless otherwise noted.
All wells on pads currently online contain 8 thermocouples in the producers.

Pads online as of Feb. 2016:
- 262-3
- 263-1
- 263-2
- 264-1
- 264-2
- 264-3
- 265-2
Typical Observation Well Measurement

- Example thermocouple and piezometer (101-P07-OBA).
- Typically 30TC (Surmont 1), 40 TC (Surmont 2).
- 0-10 piezometers placed at varying intervals.

Soft cable Thermocouple (TC) strings were replaced by hard cable TC strings for improved well integrity.

![Diagram showing well measurements and piezometer information.]

**COP 101-P07-OBA**

<table>
<thead>
<tr>
<th>Zone</th>
<th>Depth (mKB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bitumen</td>
<td>362.5</td>
</tr>
<tr>
<td>Bitumen</td>
<td>376.2</td>
</tr>
<tr>
<td>Bitumen</td>
<td>388.1</td>
</tr>
</tbody>
</table>

- Piezo 1: 256.1 mASL
- Piezo 2: 241.4 mASL
- Piezo 3: 231.5 mASL

TC bottom @ 390.6 m GL  
TC Top@ 347.1 m GL  
39 points TC and 1.5 m spacing out

TD: 414.5m  
Production casing

Prod 227 mASL  
Inj 232 mASL  
West of prod 21 m

Subsection 3.1.1 (5b)
Typical Injector Well Configuration

16” Surface Casing

11 3/4” Intermediate Casing

Liner Hanger

7” Heel Tubing String

Toe String
Typical ESP Well Configuration

13-3/8” Surface Casing

1/4” Bubble Tube Coil (in power cable)
3/8” Instrumentation for motor Temp gauge (clamped)
1/4” encapsulated instrumentation line for LxData P/T sensor (clamped)

40 point LxData Instrumentation (S1)
8 point Thermocouple Instrumentation (S2)

9-5/8” Intermediate Casing

Production String 3 1/2”

P/T Sensor clamped to 2-3/8” pup joint

Liner hanger top

7.0” Slotted Liner or 6-5/8” Equalizer Liner

Guide String

1/4” Instrumentation for ESP P/T sensor (clamped)
1. Heel tubing string set 10 – 15m TVD above lateral.

2. One perforated joint on the bottom of heel tubing string with an additional 1-2 casing joints attached below.
1. Install a heel gas coil (5/8”) to lift heel production, no more blanket gas lifting.

2. Heel lift gas coil set 10 – 15m TVD above lateral.
4D Seismic

Subsection 3.1.1 (6)
4D Seismic Location Map

Phase 1 Area

Pilot
- Buried analog single component geophones
- Cased dynamite shots (1/4 Kg) @ 9 m
- 14\textsuperscript{th} monitor acquired in September 2015

Pad 101N
- Buried analog single component geophones
- Cased dynamite shots (1/8 Kg) @ 6 m
- 8\textsuperscript{th} monitor acquired in March 2015

Pad 101S
- Buried analog single component geophones
- Cased dynamite shots (1/8 Kg) @ 6 m
- 9\textsuperscript{th} monitor acquired in March 2015

Pad 102N
- Buried analog single component geophones
- Cased dynamite shots (1/8 Kg) @ 6 m
- 9\textsuperscript{th} monitor acquired in April 2015

Pad 102S
- Buried analog single component geophones
- Cased dynamite shots (1/8 Kg) @ 6 m
- 5\textsuperscript{th} monitor acquired in April 2014

Pads 103 and 104
- Buried analog single component geophones
- Cased dynamite shots (1/8 Kg) @ 6 m
- Baseline acquired in April 2012
### Phase 1 4D Seismic Program

<table>
<thead>
<tr>
<th>PAD</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
<th>2015</th>
</tr>
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<tr>
<td></td>
<td>Spring</td>
<td>Fall</td>
<td>Spring</td>
<td>Fall</td>
</tr>
<tr>
<td>101N</td>
<td>M</td>
<td>M</td>
<td>M</td>
<td>M</td>
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<td>101S</td>
<td>M</td>
<td>M</td>
<td>M</td>
<td>M</td>
</tr>
<tr>
<td>102N</td>
<td>M</td>
<td>M</td>
<td>M</td>
<td>M</td>
</tr>
<tr>
<td>102S</td>
<td>M</td>
<td></td>
<td>M</td>
<td>M</td>
</tr>
<tr>
<td>Pilot</td>
<td>M</td>
<td>M</td>
<td>M</td>
<td>M</td>
</tr>
<tr>
<td>103</td>
<td>B</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>104</td>
<td>B</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Legend:**
- **B** Baseline
- **M** Monitor
4D Seismic Workflow

- Cross-plot of 4D anomaly volumes versus allocated SAGD oil production volumes from select Phase 1 well pairs.

- Because of seismic resolution there are some discrepancies between the total oil produced and the volume of 4D anomalies.
2015 4D Seismic Results Pad 101

- Well Pad 07/08/09, without a true baseline.
- 4D anomaly volume have increased for the remaining well pairs.
- Good conformance, especially at the heel.
- Well Pads 02/03 are E-SAGD pilot.

- 4D anomaly volumes have increased.
- Continued conformance improvement along Well Pad 10, 11, 16, 17.
- Infill wells drilled between Well Pads 10, 11, 12, 16, 17 and 18 to optimize production in a geological more complex zone.
2014 4D Seismic Results Pad 102

- 4D anomaly volumes have increased. Improved conformance along well pairs 1 to 9.

- 4D anomaly volume have increased. Improved conformance along well pairs 10 to 18.

= 4D anomaly
~60 deg C Isotherm
2015 4D Seismic Results Pilot

- Poor SAGD conformance in middle of well pair “C”.
- Coalescence between well pair B/A and C.

Subsection 3.1.1 (6b)
Seismic Examples: 101-P16 Conformance (Toe)

Problem:
• Well pair 101-P16 lacking good conformance along well pair.

Action:
• Increase pressure of steam injection at toe.

Results:
• Conformance improved at toe.
Seismic Examples: 102-04 OBA Baffle Breakthrough (Heel)

- 2009 RST and 4D surveys confirmed recovery above mudstone.
- Operating pressure reduced to manage thief zone interactions.
- Objectives - Top water and gas thief zone interaction.
- Poor SAGD conformance in middle of well pair C.
- Coalescence between WP B/A and C.
• 4D seismic has proven very useful in monitoring and optimizing conformance and pressure strategy.

• 4D correlates with observation well data.

• Continuing to optimize heel/toe production/injection splits using 4D results.

• Ongoing efforts to history match reservoir models using 4D seismic.
Scheme Performance

Subsection 3.1.1 (7)
Surmont: Pilot Performance Plot

Well Count

- Prod. Well Pairs
- Standing
- Total

Surmont: Pilot Volumes

- Volumes (Jan, 2015 – Feb, 2016, E3M3) – Oil: 24.3; Steam: 218.5; Water: 116.1

Surmont: Pilot SOR

- Top water influx into the steam chamber is evident as seen in the increase in water production.

Ratio (Jan, 2015 – Feb, 2016) – SOR: 4.8; WOR: 9.0

Subsection 3.1.1 (7a i)
Surmont: Pad 101 Performance Plots

**Well Count**

- Prod. Well Pairs: 17
- Prod. Infill Well Pairs: 2
- Prod. Infill Well: 2
- On Circulation: 1
- Standing Well Pairs: 3
- Total: 25

**Surmont Phase 1: Pad 101: Volumes**

Volumes (Jan, 2015 – Feb, 2016, E3M³)
- Oil: 909.8
- Steam: 2543.7
- Water: 2451.0

**Surmont Phase 1: Pad 101 SOR**

- **SOR**
  - Jan-15: 2.00
  - Feb-15: 2.25
  - Mar-15: 2.50
  - Apr-15: 2.75
  - May-15: 3.00
  - Jun-15: 3.25
  - Jul-15: 3.50

**Notes:**

- 101-24/25/26 have been deferred
- 101-07(18) on circulation

**Increased steam injection has resulted in incremental bitumen production as the iSOR has remained flat or decreased**

- Refer to section Subsection 3.1.1 (7g)

**Ratio (Jan, 2015 – Feb, 2016) – SOR: 2.8; WOR: 2.7**

Subsection 3.1.1 (7a i)
**Surmont: Pad 102 Performance Plots**

**Well Count**

- **Prod. Well Pairs**: 18
- **Fishbone Infill Wells**: 2
- **Total**: 20

**Surmont Phase 1: Pad 102 Volumes**

- **Volumes (Jan 2015 – Feb, 2016, E3M3)**
  - Bitumen: 798.2
  - Steam: 2421.0
  - Water: 2124.5

**SURMONT PHASE 1: Pad 102 SOR**

- **Ratio (Jan, 2015 – Feb, 2016)**: SOR: 3.0; WOR: 2.7

**Notes**

- **Steam stimulating fishbone well 102-21**
  - Evaluation is ongoing

- **Fishbone well 102-22 remains standing**

- **iSOR continues to climb as expected with increased steam injection** – marginal gains in bitumen production but upward trend expected to continue in 2016
  - Refer to section Subsection 3.1.1 (7g)
Surmont: Pad 103 Performance Plots

**Well Count**
- Prod. Well Pairs: 11
- On Circulation: 1
- Total: 12

**Surmont Phase 1: Pad 103 Volumes**
- Bitumen
- Steam
- Water

**Surmont Phase 1: Pad 103 SOR**

- **Initial production performance in line with forecasted expectations.**
- **ISOR continues to decline as expected with a new pad startup.**

**Volumes (Jan, 2015 – Feb, 2016, E3M3) – Oil: 106.9; Steam: 585.9; Water: 545.7**

Subsection 3.1.1 (7a i)
Surmont: Historical Pilot Performance Plot

**Surmont: Pilot Volumes**

- Graph showing daily volumes from January 1997 to January 2017 for Bitumen, Steam, and Water.

**Surmont: Pilot SOR**

- Graph showing SOR (Serious Oil Recovery) from January 1997 to January 2017 for iSOR and cSOR.

**Aggregate Volumes (E3M3)**
- Oil: 638.6; Steam: 2129.7; Water: 2491.4

**Aggregate Ratios**
- cSOR: 3.3; cWOR: 3.9

**Top Water Influx into Steam Chamber**
- Pilot performance impacted by thief zone (top water).
- Resulted in reduced thermal efficiency.

Subsection 3.1.1 (7a ii)
**Surmont: Phase 1 Historical Performance Plots**

**MATURING BASE – PADS 101 / 102**

**Surmont Phase 1: Pad 101/102 Volumes**

- Phase 1 continues to regain production post 2014 turnaround - refer to Subsection 3.1.1 (7g).
- Focus remains on sustaining and optimizing base production.

**AGGREGATE VOLUMES (E6M3) - OIL: 10.2; STEAM: 26.6; WATER: 25.3**

**Surmont Phase 1: Pad 101/102 Ratios**

- Recent increase due to incremental steam injection - refer to Subsection 3.1.1 (7g).
- iSOR remains within expectations.

**AGGREGATE RATIOS – cSOR: 2.6; cWOR: 2.5**

Subsection 3.1.1 (7a ii, 7h)
Surmont: Phase 1 Historical Performance Plots

**SUSTAINING PAD(S) – PAD 103**

**Surmont Phase 1: Pad 103 Volumes**

- Pad 103 brought online in April, 2015.
- FCD completion outperforms slotted liner.
  - Refer to Subsection 3.1.1 7(g)
- Initial production performance in-line with forecasted expectations.

**Surmont Phase 1: Pad 103 SOR**

- iSOR continues to decline as expected with a new pad startup.

**AGGREGATE VOLUMES (E3M3) - OIL: 106.9; STEAM: 585.9; WATER: 545.7**

**AGGREGATE RATIOS- cSOR: 5.69; cWOR: 5.28**

Subsection 3.1.1 (7a ii)
Temperature and pressure development; No significant changes.
Surmont: Obs Wells Temp & GR – 101-P07-OBA, 101-P08-OBC

- Temperature and pressure development; No significant changes.
Temperature and pressure development; No significant changes.
Temperature and pressure development; No significant changes.

**103-P02-OBA** 100/08-22-083-07W4 / 20.7m offset

**103-P12-OBA** 105/14-14-083-07W4 / 41.3m offset
Temperature and pressure development; No significant changes.
Surmont: Pilot – OBIP and RF

OBIP = (BV)(Φ)(So)

- OBIP: 597 – 1215 E3M3
- Current RF: 7% - 48%

- Porosity: 33%
- Oil saturation: 82% - 84%

- Pilot Well C remains shut in
Subsection 3.1.1 (7c i & ii)

**Surmont: Phase 1 - OBIP and RF**

- **OBIP:** 6,998 – 10,176 E3m3
- **Current RF:** 1% - 44%

<table>
<thead>
<tr>
<th>DA</th>
<th>Cumulative Prod E3m3</th>
<th>OBIP E3m3</th>
<th>Expected RF</th>
<th>Current RF</th>
<th>Avg Phi</th>
<th>Avg So</th>
</tr>
</thead>
<tbody>
<tr>
<td>101N</td>
<td>1878</td>
<td>7,817</td>
<td>50%</td>
<td>24.0%</td>
<td>32.5%</td>
<td>82.2%</td>
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<tr>
<td>101S</td>
<td>2874</td>
<td>8,842</td>
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<td>33.4%</td>
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<td>102N</td>
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<td>6,998</td>
<td>50%</td>
<td>30.2%</td>
<td>32.7%</td>
<td>80.7%</td>
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<tr>
<td>102S</td>
<td>3299</td>
<td>7,481</td>
<td>50%</td>
<td>44.1%</td>
<td>31.4%</td>
<td>74.4%</td>
</tr>
<tr>
<td>103</td>
<td>108</td>
<td>10,176</td>
<td>50%</td>
<td>1.1%</td>
<td>32.2%</td>
<td>84.1%</td>
</tr>
</tbody>
</table>

- **Porosity:** 31% - 33%
- **Oil saturation:** 82% - 84%

**Cumulative volumes and recoveries align with internal forecasts. Blowdown timing will determine final EUR/RF.**
Surmont: Low, Medium, High Recovery

- **Low Recovery: 101-13(06)**
- **Medium Recovery: 101-11(04)**
- **High Recovery 101-02(11)**

**101 North 8th monitor - March 2015**

- Low ceiling in the middle.
- Poor geology a significant driver behind overall well performance.
- Injector toe tubing landed in the middle.

**101 South 9th monitor - March 2015**

- Low quality at the producer toe.
- Good steam chamber development along wellbore.

**101-13(06)**

- Very good steam chamber development along wellbore.
- Clean I/P.

Subsection 3.1.1 (7c iii)
**Surmont: Low, Medium, High Recovery**

- Low Recovery: 101-13(06)
- Medium Recovery: 101-11(04)
- High Recovery: 101-02(11)

**Pad 101: Relative Production Performance**

- **Bitumen (m3/d)**
  - Low
  - Medium
  - High

**Steam (m3/d)**

- Low
- Medium
- High

- **Sustained / increased bitumen production from subject wells.**

- **Effective steam management improved performance of 101-06.**

Subsection 3.1.1 (7c iii)
Surmont: Low, Medium, High Recovery

- **Low Recovery: 102-03**
  - Limited steam chamber development
  - Poor geology a significant driver behind overall well performance
  - I/P landed in muddy sands

- **Medium Recovery: 102-08**
  - Significant steam chamber development
  - I/P landed in marginal geology

- **High Recovery: 102-11**
  - Significant steam chamber development
  - I/P landed in good geology
  - Toe impacted by low muddy ceiling

Subsection 3.1.1 (7c iii)
Surmont: Low, Medium, High Recovery

- Low Recovery (102-03)
- Medium Recovery (102-08)
- High Recovery (102-11)

- **Pad 102: Production Performance**
  - Optimized steam injection to maximize bitumen production from 102-11.
  - Sustained / increased bitumen production from subject wells.

- **Pad 102: Steam Injection**
  - Optimized steam injection to maximize bitumen production from 102-11.
Solvent Soak – AER request

Provide a list of wells that had solvent soaking with name of solvent, duration of soaking, volume of soaking and temperature of solvent. Also, include any learnings achieved.

<table>
<thead>
<tr>
<th>Solvent Type</th>
<th>101-I24</th>
<th>101-P24</th>
<th>101-I26</th>
<th>101-P26</th>
<th>103-I07</th>
<th>103-P07</th>
<th>103-I08</th>
<th>103-P08</th>
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<tbody>
<tr>
<td>Soak Period (days)</td>
<td>Xylene</td>
<td>Xylene</td>
<td>Xylene</td>
<td>N/A</td>
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</tr>
<tr>
<td>Volume (m³)</td>
<td>40</td>
<td>40</td>
<td>40</td>
<td>N/A</td>
<td>71</td>
<td>37</td>
<td>34.5</td>
<td>36</td>
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<tr>
<td>Temperature (°C)</td>
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<td>Ambient</td>
<td>Ambient</td>
<td>N/A</td>
<td>Ambient</td>
<td>Ambient</td>
<td>Ambient</td>
<td>Ambient</td>
</tr>
</tbody>
</table>

NOTES:
• Could not spot solvent in 101-P26 due to downhole plugging.
• Wells pairs 101-24 and 101-26 will not be tied in. There is no applicable soak period for these wells
• Solvent was not pre-heated prior to being injected.

LEARNINGS:
• N/A for well pair 101-24 and 101-I26
• No additional benefit was observed at Pad 103
  • Small sample size
  • No measurable improvement in number of circulation days during startup
• Pad 101 and pad 102 continue to benefit from incremental steam / reservoir pressurization.

• Reservoir performance on trend with pre-turnaround baseline.
• Have been able to successfully produce bitumen through continued steam stimulation trials.

• Able to establish a second hot spot/communication point at the top of the steam chamber.

• Early indications of additional fluid displacement to the adjacent 102-01 well pair.

• Continue with steam stimulation trials until able to establish steady state production.

• Apply learnings to Pad 102-22.
Pilot Scheme Steam Injection Trial

**Objective:** mitigate top water influx into steam chamber; improve/stabilize WCUT & bitumen rate

### Actions Taken For Thief Zone

- **Mitigations/learnings:**
  - Bigger pump for both well pairs:
    - A: replaced Dec 2014
    - B: replaced May 2015
  - Increased steam injection by 50% (May 2015)
  - Operation issues during first 2 months of trial (pump issues)
  - Increase in iSOR and injection BHP (50-100 kPa)

- **Learnings from trial:**
  - Stabilized bitumen production
  - Improvement in water cut started
  - Improvement in iWSR
  - Increase in iSOR
Surmont: Pad 103 Technology Trials

**TECH TRIALS INCLUDED FCDS AND SOLVENT SOAKS**

- Initial assessment are that FCDs are beneficial.

**LIMITED EVALUATION PERIOD**

- Continuing to assess solvent soak treatments.

**WELLS OPERATE NEAR 0°C SUBCOOL TARGET**

- FCD wells outperforming slotted liners.

**PAD GEOLOGY CONSIDERED TO BE UNIFORM**

- Continue to evaluate performance of Pad 103.
Surmont 1 – Key Learnings

• Incremental steam continues to optimize performance at Phase 1 through pressure support and subsequent rate recovery.

• Planned optimization has and will continue to improve performance of mature wells:
  • Steam injection optimization
  • ESP upsizing
  • Subcool management
  • Caustic jobs
  • Possible changes in tubing landing depths

• Technology trials for FCDs, initially, are proving to be beneficial.
  • Continuing to assess how solvent soak impacted start up.
Surmont 1 Well Pad Rates and SOR

Subsection 3.1.1 (7h)
Surmont Phase 2 Aggregate Performance Plots

- Surmont 2 started circulation of wells on August 2015.
- Seven pads were started as of February 29, 2016.
- A total of 45 well pairs were converted to SAGD as of February 29, 2016.
- Ramp-up ongoing.
Performance / Chamber Development Challenges – Pad 264-1

- 264-1 has been operating at a pressure of 3,400 kPa with a recent increase to 3,550 kPa.
- 8/12 wells converted to SAGD.
- 3 circulating wells with communication issues
- 1 cold well.

- Too early on SAGD to define performance issues.
Some wells start to see temperature increase, however far from chamber temperature.
• 264-2 has been operating at a pressure of 3,300 kPa with a recent increase to 3,450 kPa.
• 8/11 wells converted to SAGD.
• 3 horizontal liner deformations (1 back on circulation after workover).

• Too early on SAGD to define performance issues.
Obs Wells Temp & GR - 264-2-P07-OBA, 264-2-P04-OBB

- Temperature response slower on this Pad.

Subsection 3.1.1 (7b)
263-2 has been operating at a pressure of 3,300 kPa with a recent increase to 3,450 kPa.
9/11 wells converted to SAGD.
1 horizontal liner deformation.

Too early on SAGD to define performance issues.
Some wells start to see temperature increase, however far from chamber temperature.
### SOIP & Recovery Per Pad

<table>
<thead>
<tr>
<th>DA</th>
<th>SOIP* (E3M3)</th>
<th>CUM OIL (E3M3)</th>
<th>RF</th>
</tr>
</thead>
<tbody>
<tr>
<td>263-1</td>
<td>9,146</td>
<td>103.4</td>
<td>1.1%</td>
</tr>
<tr>
<td>263-2</td>
<td>8,954</td>
<td>42.0</td>
<td>0.5%</td>
</tr>
<tr>
<td>264-1</td>
<td>7,573</td>
<td>42.4</td>
<td>0.6%</td>
</tr>
<tr>
<td>264-2</td>
<td>9,845</td>
<td>30.1</td>
<td>0.3%</td>
</tr>
<tr>
<td>264-3</td>
<td>10,122</td>
<td>45.7</td>
<td>0.5%</td>
</tr>
<tr>
<td>265-2</td>
<td>6,839</td>
<td>12.6</td>
<td>0.2%</td>
</tr>
<tr>
<td>262-3</td>
<td>9,552</td>
<td>5.7</td>
<td>0.1%</td>
</tr>
</tbody>
</table>

*SOIP: SAGDable Oil in Place

### Cumulative Bitumen Production by Subsurface Pad (m³)

- Pads ramping-up. Oil allocated during circulation accounted for RF.
• Well Performance exceeds expectations.
• Very good injectivity translating into fast ramp-up and good production rate.
• Good temperature conformance along the well for a 1,400m horizontal.
Well performance in line with expectations.
Stable iSOR of <3.
Hot spot developing near the Toe currently controlling well’s subcool.
• Well performance under expectations.
• Very good iSOR of <2, indicates the wells has injectivity challenges similar to neighboring wells in this Pad.
Surmont 2 – Pressure Operating Strategy

- S2 base case Operating Strategy follows a declining pressure profile, which is influenced by the efficiency of artificial lift, SOR, thief zone (TZ) interaction, etc.
- Some DA’s have been identified at risk based on top water TZ interaction.
- Strategy for these DA’s account for a more aggressive pressure drop to minimize steam loss into the TZ, but still keeping an overbalanced condition to avoid water influx into the chambers.
- Timing of pressure drop is dependent on each DA’s condition. Chamber growth monitoring (Obs Wells, 4D, etc.) will aid in tailoring the strategy per Pad.

Learnings from Surmont Pilot TZ
- Pilot shows that water influx will occur if the steam chamber pressure is allowed to drop below the thief zone pressure
- The consequence of this is not a catastrophic loss of the steam chamber but an increase in water cut
- Raising pressure by increasing steam injection may mitigate thief zone invasion
• Current performance difference between Pads and wells drilled in same Pads are under ongoing evaluation, due to the early stage of most wells.

• Some wells have been challenged with injectivity issues, which translates into a slower ramp-up. Analysis of different parameters (geology, operating pressure, operating strategy) is work in progress.
Pad 262-3 Rates & SOR

Subsection 3.1.1 (7h)
Subsection 3.1.1 (7h)
Pad 264-1 Rates & SOR

Subsection 3.1.1 (7h)
Pad 264-2 Rates & SOR

Subsection 3.1.1 (7h)
Pad 264-3 Rates & SOR

### Rates (m³/d)

- **Steam Rate** (Red line)
- **Oil Rate** (Green line)
- **Water Rate** (Blue line)

### ISOR / cSOR (sm³/sm³)

- **ISOR** (Red line)
- **cSOR** (Black line)

**Subsection 3.1.1 (7h)**
ConocoPhillips implemented eSAGD pilot in 2013 at Surmont 1

- Pilot area includes:
  - 2 eSAGD well pairs (101-08(02), 101-10(03))
  - 2 adjacent well pairs (101-09(01), 101-11(04))
  - 8 observation wells
  - Spacing 125 meters

- Cumulative Solvent recovery up until end of February 2016 is 50%

2015 Learnings:
- eSAGD had no impact to ESP conversions on well pairs 101-08(02) and 101-10 (03)

<table>
<thead>
<tr>
<th>Well pairs</th>
<th>Start of production</th>
<th>Start of solvent co-injection</th>
<th>End of solvent co-injection</th>
</tr>
</thead>
</table>
Future Plans

Subsection 3.1.1 (8)
Future Plans – Surmont

Phase 1
• 102-21/22 fish bone infill wells in 102N remained cold on startup. Steam squeezed 102-21 and placed on production. Preparing for a second steam squeeze.
• Phase 1 Infill Program: 101-24/25/26 alternative start-ups have been delayed. Work remains to tie in wells.
• NCG co-injection for 3 wells on 102S.

Phase 2
• Start-up 4 remaining pads ramp-up.
• CPF Debottleneck including one OTSG addition was deferred.
• Plan to start 3rd steam train March 2016.
• Well completions ongoing with only 266-2 remaining.
• Apply for an increase in MOP for two drainage areas (261-3, 262-3).
Well pads 261-3, 262-2, 262-1 and 266-2 brought online before end of 2016.

- Continue to convert wells to SAGD when ready.
- The well start up base plan is primarily based on a conventional circulation pre-heat period of 90 days. Actual performance has taken longer.
Planned 2016 4D campaign

• Spring Acquisition
  • Pad 103:
    • Regulatory requirement - Well 10-23
    • First DAS Monitor (WP 05 & 06 FCD)
    • 101N Chamber
  • Pad 263-2:
    • Possible thief zone issue on well pair 4 (Winter access only)

• Fall Acquisition
  • Pad 263-1 / 264-1
    • Well on SAGD > 9 months
    • Regulatory requirement – Well 10-28 (263-1)
    • Thief Zone Risk
  • Pads 265-2 / 264-3
    • Should be on SAGD ~ 6 months
    • High to Moderate risk of Thief Zone
Future Pad Developments

• Outboard wells on pads 265 and 266 deferred.
• 267 is first in the queue.
• 268 being reviewed for impact of regional bottom water.
• 104 development is 2\textsuperscript{nd} in the queue.
Surface Operations and Compliance
Surmont Project
Approval 9426

Facilities
Subsection 3.1.2 (1)
• No Major Modifications at Phase 1 CPF in 2015.
Phase 1 Plot Plan: Pad 101

- No ESP Conversions or Major Modifications at Pad 101.
Phase 1 Plot Plan: Pad 102

- No ESP Conversions or Major Modifications at Pad 102

Subsection 3.1.2 (1a)
Phase 1 Plot Plan: Pad 103

- Pad 103 ESP Conversions added 3 ESPs in Feb 2016
Phase 1 Plot Plan: Pad 103 Gathering Line

- Completion and Start-up of Pad 103

Subsection 3.1.2 (1a)
5 Chemical Tanks, Equipment Buildings, and Pipe Rack

Focus on Start-up of Phase 2
Phase 2 Plot Plan: Distribution Pipeline & Pads

- Focus on Start-up and Process Optimization
Plant Schematic: Phase 1

Pad 103 start-up

Emulsion to Phase 2 via interconnect

Steam from Phase 2 via interconnect
Currently not blending Naphtha to produce Dilbit.

*Operating philosophy changes. No mechanical design changes were implemented.
2015 Surmont Operations

2015 – Capital Projects:

- Steam Condensate Pump: Addition of pump and extension to condensate building as part of the Pad 103 project.
- Emulsion Breaker (EB) Injection Facility: Consists of an injection skid, metering skid, electrical building, and 2 storage tanks. Installed to improve operating conditions and reduce use of the EB chemical.
- Mercaptan Project: The original SulFerox system was not designed to handle mercaptans. Installed 5 chemical tanks, equipment buildings, and pipe rack so as to implement liquid scavenger technology in place of SulFerox.
- Completion and start-up of Pad 103. Three wells were converted from gas lift ESP as per Pad 103 Ramp-up and operating strategy.
- Start-up of Phase 2 facility and wells.

2015 – Optimization Focus Overview:

- Successful steam quality control trial completed on SG-531 C.
- Next step is to progress to Surmont wide steam quality improvement.
- Began water treatment injection trials.
- Completion of Heat Integration study at Phase 1; next step is implementation.
Facility Performance

Subsection 3.1.2 (2)
Facility Performance: Bitumen Treatment

Measured Emulsion Flow [AM3/hr]

CPF 1 Train 1 [02.FI.3002.PV.RAW]  CPF 1 Train 2 [02.FI.4002.PV.RAW]
CPF 2 Train 1 [202FC01001.PV.RAW]  CPF 2 Train 2 [202FC02001.PV.RAW]
CPF 2 Train 3 [202FC03001.PV.RAW]
Facility Performance: Phase 1 Water Treatment

- Phase 1 water treatment plant continues to operate as per design.

- Multiple chemical trials have been conducted which impact water treatment performance. Well stimulation trials in 2015 negatively impacted performance. Ongoing water treatment chemical trials are positively impacting water quality performance.

### Boiler Feed Water Quality (Feb 1, 2015 to Feb 29, 2016)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>BFW Specification</th>
<th>Avg. Value</th>
<th>% of time on Spec</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hardness (Dissolved), mg/L</td>
<td>&lt;0.3</td>
<td>0.13</td>
<td>95.7*</td>
</tr>
<tr>
<td>Silica, as SiO2, mg/L</td>
<td>&lt;50</td>
<td>19.1</td>
<td>99.2</td>
</tr>
<tr>
<td>Bitumen in Water, ppm</td>
<td>&lt;0.5</td>
<td>0.34</td>
<td>98.8</td>
</tr>
<tr>
<td>Turbidity, NTU</td>
<td>&lt;3.5</td>
<td>1.51</td>
<td>98.5</td>
</tr>
</tbody>
</table>

* 99.8% excluding chemical trials
Facility Performance: Phase 2 Water Treatment

- Phase 2 water treatment plant successfully started up in 2015.
- Train 1 operating at near design capacity. Train 2 startup ongoing.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>BFW Specification</th>
<th>Avg. Value</th>
<th>% of time on Spec</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hardness (Dissolved), mg/L</td>
<td>&lt;0.3</td>
<td>0.17</td>
<td>96.7</td>
</tr>
<tr>
<td>Silica, as SiO2, mg/L</td>
<td>&lt;50</td>
<td>24.9</td>
<td>100</td>
</tr>
<tr>
<td>Bitumen in Water, ppm</td>
<td>&lt;0.5</td>
<td>0.28</td>
<td>97.3</td>
</tr>
<tr>
<td>Turbidity, NTU</td>
<td>&lt;3.5</td>
<td>0.84</td>
<td>99.1</td>
</tr>
</tbody>
</table>

* Phase 2 water treatment plant started up in July 2015
### Plant Performance Steam Generation Phase 1

#### 2014:
- Operating BDR @ 25%
- Max rate: 73,100 bpd
- Average: 62,600 bpd

#### 2015:
- Operating BDR @ 25%
- Max rate: 74,700 bpd
- Average: 66,300 bpd

#### Graph:
- SG-531 D economizer replacement

#### Table:

<table>
<thead>
<tr>
<th>Date</th>
<th>Steam Injection (cwe bpd)</th>
<th>Quality (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-Jan-14</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2-Mar-14</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1-May-14</td>
<td></td>
<td></td>
</tr>
<tr>
<td>30-Jun-14</td>
<td></td>
<td></td>
</tr>
<tr>
<td>29-Aug-14</td>
<td></td>
<td></td>
</tr>
<tr>
<td>28-Oct-14</td>
<td></td>
<td></td>
</tr>
<tr>
<td>27-Dec-14</td>
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<td></td>
</tr>
<tr>
<td>25-Feb-15</td>
<td></td>
<td></td>
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<tr>
<td>26-Apr-15</td>
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</tr>
<tr>
<td>25-Jun-15</td>
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<td></td>
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<tr>
<td>24-Aug-15</td>
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<td></td>
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<tr>
<td>23-Oct-15</td>
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<td></td>
</tr>
<tr>
<td>22-Dec-15</td>
<td></td>
<td></td>
</tr>
<tr>
<td>20-Feb-16</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Legend:
- **Steam output**
- **Steam quality**
Phase 2 steam generators started commissioning on April - May 2015.
Train 1 and 2 (steam generators 1-12) were started in 2015.
Steam interconnect between Phase 2 and Phase 1 was commissioned in 2015, so any excess of steam from Phase 2 steam generators can be directed to Phase 1 well pads.
Number of pigging events increased during 2015 due to water quality challenges at the end of 2014 and throughout 2015.

Well stimulation during October 2015 impacted water quality and pigging frequency.

Surmont 2 generators were not pigged since being started in 2015.
S1 Steam Quality Improvement Trial  Background

- **2009-13 Background**
  - 2009 & 2012 – OTSG failures, RCA
  - 2012-2013 – CFD & New box design
  - 2013 – BD Reduction trial
  - 2012-2013 – SG & WT improvement

- **2014 Due Diligence & Trial Plan**
  - 2014 – Due diligence and trial Plan
  - 2014 TA – Preparing OTSGs for trial
  - 2014 – Approval for trials on Charlie

Subsection 3.1.2 (2c)
Phase 1 Steam Quality Improvement Trial 2015 Goal

2015 OS Goal: Safely & successfully delivered 85% SQ trial at Phase 1 Charlie gen Q4, 2015

<table>
<thead>
<tr>
<th>Base - 100%</th>
<th>Step 1 - 105%</th>
<th>Step 2 - 107%</th>
<th>Step 3 - 110%</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Steam Quality</strong></td>
<td>蒸汽质量</td>
<td>蒸汽质量</td>
<td>蒸汽质量</td>
</tr>
<tr>
<td>80%</td>
<td>80%</td>
<td>80%</td>
<td>85%</td>
</tr>
<tr>
<td><strong>BFW rate</strong></td>
<td>给水率</td>
<td>给水率</td>
<td>给水率</td>
</tr>
<tr>
<td>m³/hr</td>
<td>m³/hr</td>
<td>m³/hr</td>
<td>m³/hr</td>
</tr>
<tr>
<td>140</td>
<td>147</td>
<td>147</td>
<td>148</td>
</tr>
<tr>
<td><strong>Steam Output</strong></td>
<td>蒸汽产量</td>
<td>蒸汽产量</td>
<td>蒸汽产量</td>
</tr>
<tr>
<td>m³/hr</td>
<td>m³/hr</td>
<td>m³/hr</td>
<td>m³/hr</td>
</tr>
<tr>
<td>112</td>
<td>117</td>
<td>117</td>
<td>122</td>
</tr>
<tr>
<td><strong>Time Line</strong></td>
<td>时间线</td>
<td>时间线</td>
<td>时间线</td>
</tr>
</tbody>
</table>

Risk mitigation strategy:

- Conduct trials on Charlie OTSG with upgraded box design, material and redundant TCs.
- Conduct trials in three incremental steps, inspect OTSG to ensure no deterioration.
Conducted Step 3 trial for 10 continuous weeks on Charlie OTSG:
- Achieved Target steam quality ~ 85% and steam output of ~ 126 m3/h.
- No increase in the fouling rate observed with ~110% burner firing vs. base case.

Enablers to generate ~85% SQ and 110% steam output:
- OTSG retrofitted with a new box - upgraded design and upgraded materials.
- On-spec BFW quality (Target KPIs: Hardness < 0.2 ppm & Turbidity < 2.5 NTU).
- No significant excursions in WTP and/or Front-end.
- Upsized FD fan motor 400 HP (to supply more combustion air for >107% firing).
- Continuous monitoring of ΔT rise on bottom rows of shock tubes and low finned tubes.
- BFW temp over ~150 °C (Higher BFW temp → more steam output).
- Timely pigging/smart pigging of OTSGs using the pigging predictive tool.

Operation of Delta steam gen at 83% SQ at 107% firing is able to achieve:
- Target steam quality ~ 83% and steam output of ~ 123 m3/h (7% incremental).
- Upsized FD fan motor is required for 110% firing to achieve 85% SQ.
Phase 1 Fouling Lessons Learned Transferred to Phase 2

- Transition to hardness measurement via Inductively Coupled Plasma Mass Spectrometry (ICP-MS).
- Conducted on a minimum once per day frequency, in addition to the current practice of measuring dissolved hardness via the Hach titration methodology (once per six hours).
- Hach methodology used to detect short term process upsets that may otherwise be missed by ICP-MS.

- Measure dissolved and total hardness via ICP-MS to determine the quantity of particulate hardness present and consider this parameter in determining the fouling potential of BFW.
- Use total hardness instead of dissolved as the primary metric for BFW quality in terms of fouling potential.
Phase 1 Fouling Lessons Learned Transferred to Phase 2

- Based on analytical data, the dissolved hardness measurements recorded through ICP-MS correlated well with those measured on site using the Hach titration method.
- Total hardness measurements by ICP-MS, and in particular the differential between total and dissolved hardness, was found to correlate relatively well with the distinct operation modes / high and low fouling periods observed during 2014 and 2015.
- Individual cation (Ca and Mg) total and dissolved concentrations along with the total and dissolved hardness concentrations aligning with a qualitative indication of the OTSG fouling rates observed during each period of the steam quality trial on Steam gen Charlie.
- Large difference seen between total and dissolved hardness measurements is due primarily to magnesium, present as fine particulate material.
Electricity consumption at S1 is constant while production has climbed.
Facility Performance: Electricity Consumption Surmont 2

Electricity consumption at S2 is climbing as is production – system not at steady state

Subsection 3.1.2 (2d)
## Facility Performance: Gas Usage

<table>
<thead>
<tr>
<th></th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
<th>2015 Phase 1 Phase 2</th>
<th>to 2016-04</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total Gas Imports (TCPL)</strong></td>
<td>42,999</td>
<td>160,095</td>
<td>183,933</td>
<td>223,447</td>
<td>228,344</td>
<td>250,412</td>
<td>254,883</td>
<td>241,276</td>
<td>433,640</td>
<td>297,462</td>
<td>10^3 m^3</td>
</tr>
<tr>
<td><strong>Solution Gas</strong></td>
<td>2,534</td>
<td>5,273</td>
<td>10,052</td>
<td>12,703</td>
<td>13,869</td>
<td>15,193</td>
<td>17,005</td>
<td>14,246</td>
<td>18,749</td>
<td>9,284</td>
<td>10^3 m^3</td>
</tr>
<tr>
<td><strong>Total Gas Flared</strong></td>
<td>4,640.6</td>
<td>6,438.7</td>
<td>3,962.0</td>
<td>705.0</td>
<td>624.8</td>
<td>217.6</td>
<td>117.3</td>
<td>277.3</td>
<td>S1-194.9 S2-280.8 475.7</td>
<td>84.1</td>
<td>10^3 m^3</td>
</tr>
<tr>
<td><strong>Solution Gas Recovery</strong></td>
<td>60.6</td>
<td>94.5</td>
<td>95.5</td>
<td>98.6</td>
<td>99.3</td>
<td>98.1</td>
<td>97.5</td>
<td>99.1</td>
<td>%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Subsection 3.1.2 (2e)
Facility Performance: Gas Consumption

Surmont Gas Consumption 2015 and 2016 YTD

- Produced Gas
- Purchased Gas

Phase 2 Train 1 and 2 Ramp-up
Facility Performance: Greenhouse Gas

- Exceeded Specified Gas Emitters Regulation intensity reduction target of 10% for 2015 at S1, and of 10% direct fee on total emissions at S2.
- 162kt CO2e overage, $2.4M payment was issued by Mar 31st 2016. 2015 absolute CO2e emitted is 905kt.

- Turn-Around: Flaring emissions over very minimal production create a brief high intensity moment, when data is aggregated monthly.
Measurement and Reporting

Subsection 3.1.2 (3)
MARP and Well Testing

- One-Surmont MARP approved by AER in 2015.
  - AER site-visit to Phase 2 in October 2015.

- Phase 1 Pad 103 and seven Phase 2 Well Pads started in 2015.

- Intensive efforts to resolve challenges with:
  - Test separator performance
  - Calibration of water-cut meters during circulation phase
  - Data handling across multiple software systems
Well Allocated Oil Production

**Well Allocation Oil Production** = Estimated Monthly Well Oil Production x Oil Proration Factor

*Where:*

- **Estimated Production** = \( \frac{\text{Accepted well test}}{\text{duration of test}} \times \text{on-stream hours} \)
- **Oil Proration Factor** = \( \frac{\text{Actual battery production}}{\text{estimated battery production}} \)
- **Actual Battery Production** = \( \text{Dispositions + Tank Inventory - Receipts + Shrinkage + External Shipments} \)
  + (Load Oil to Wells inventories)

*Where:*

- **Dispositions** = Sales Oil shipped to Enbridge + Diluent send to Surmont Pilot
- **Tank Inventory** = Sales Oil tanks volume changes + Diluent tank volume changes
  + Slop tank oil inventory + Skim tank oil inventory
- **Receipts** = Sales Oil received from Surmont Pilot + Diluent received from Enbridge
- **Shrinkage** = Shrinkage adjustment
- **External Shipment** = Oil from slop trucked out to external facility

*Surmont design allows for the production and sale of the 2 different blends: Synbit and Dilbit. Current Operation only blends Synbit*
Well Allocation Water Production = Estimated Monthly Well Water Production x Water Proration Factor

Where:

Estimated Water Production = Accepted well test / duration of test * on-stream hours
Water Proration Factor = Produced water (PW) volume / estimated water production
PW Volume = Dispositions + PW_{tanks} – Receipts + Load Water (LW) Inventory

Where:

Dispositions: Battery PW Disposition to Injection Facility + Pilot Plant + Other
PW_{tanks}: Battery PW Inventory, including net water content in oil storage tanks
Receipts: PW received from other sources, including Injection Facility
LW Inventory: Battery LW Inventory
Well Allocated Gas Production

**Well Allocation Gas Production** = Well Allocated Oil Production x Calculated Gas-Oil Ratio

*Where:*

Calculated Gas-Oil Ratio (GOR) = Gas Production / Battery Bitumen Production
Gas Production = Dispositions – Receipts

*Where:*

Dispositions = Metered Flared Gas + Metered Steam Gen Fuel Gas + Utilities Fuel Gas + Purge Gas
Receipts = Fuel Gas Receipts from TCPL
Well Allocated Steam Injection

**Estimated Volume of Injected Steam** = Sum of Injected Steam to Wells x Steam Proration Factor

Where:

Steam Proration Factor = Steam Produced / Steam Measured

Steam Produced: Total Steam Meter to Well Pads – Steam Condensate Dropped Out – Steam Recovered at Pipeline

Steam Measured: Steam Injection to Heel and Toe String of each well
• Produced Oil and Water Regulatory Compliance Maintained through Start-Up of S2 Well Pads

- Pads 101/102, 41 Wells in SAGD
- S2 80 Wells in CIRC
- Pad 103, 12 Wells in CIRC
- S2 45 Wells in SAGD
- Pad 103, 8 Wells in SAGD

- Loss of steam injection affected Performance of Pad Water Cut Meter

Regulatory Compliance Limits
Subsection 3.1.2 (3b)

• Average Steam Proration for year 2015 = 1.03

- Regulatory Compliance Limits
Water Production, Injection, and Uses

Subsection 3.1.2 (4)
### Surmont Phase 1 Non-Saline Water Source Wells

<table>
<thead>
<tr>
<th>Source Well</th>
<th>Observation Well</th>
<th>Formation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1F1021808306W400</td>
<td>1F2021808306W400</td>
<td>Lower Grand Rapids</td>
</tr>
<tr>
<td>1F1041808306W400</td>
<td>102041808306W400</td>
<td>Lower Grand Rapids</td>
</tr>
<tr>
<td>1F1011908306W400</td>
<td>100011908306W400</td>
<td>Lower Grand Rapids</td>
</tr>
<tr>
<td>1F1032308307W400</td>
<td>100032308307W400</td>
<td>Lower Grand Rapids</td>
</tr>
</tbody>
</table>

The diagram shows the distribution of these wells across the region, with each well marked by a symbol that corresponds to the formation type. The map also includes a color legend indicating the different types of wells and sites such as Surmont Pilot, Surmont 1, and Surmont 2.
Surmont Phase 2 Non-Saline Water Source Wells

<table>
<thead>
<tr>
<th>Source Well</th>
<th>Observation Well</th>
<th>Formation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1F1022108306W400</td>
<td>100022108306W400</td>
<td>Lower Grand Rapids</td>
</tr>
<tr>
<td>1F1022608306W400</td>
<td>100022608306W400</td>
<td>Lower Grand Rapids</td>
</tr>
<tr>
<td>1F1052808306W400</td>
<td>100052808306W400</td>
<td>Lower Grand Rapids</td>
</tr>
<tr>
<td>1F1070308306W400</td>
<td>1F2070308306W400</td>
<td>Lower Grand Rapids</td>
</tr>
<tr>
<td>1F1101408306W400</td>
<td>1F1111408306W400</td>
<td>Lower Grand Rapids</td>
</tr>
<tr>
<td>1F1130508306W400</td>
<td>100130508306W400</td>
<td>Lower Grand Rapids</td>
</tr>
<tr>
<td>1F1153408307W400</td>
<td>1F2153408307W400</td>
<td>Lower Grand Rapids</td>
</tr>
</tbody>
</table>

Subsection 3.1.2 (4a)
Surmont Phase 2 Saline Water Source Wells

<table>
<thead>
<tr>
<th>Source Well</th>
<th>Formation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1F1020308404W400</td>
<td>Clearwater</td>
</tr>
<tr>
<td>1F1020608404W400</td>
<td>Clearwater</td>
</tr>
<tr>
<td>1F1033008304W400</td>
<td>Lower Grand Rapids</td>
</tr>
<tr>
<td>1F1042208305W400</td>
<td>Clearwater</td>
</tr>
<tr>
<td>1F1071308305W400</td>
<td>Clearwater</td>
</tr>
<tr>
<td>1F1081008305W400</td>
<td>Lower Grand Rapids</td>
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<tr>
<td>1F1101708404W400</td>
<td>Clearwater</td>
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<tr>
<td>1F1160908404W400</td>
<td>Clearwater</td>
</tr>
<tr>
<td>1F2091708404W400</td>
<td>Lower Grand Rapids</td>
</tr>
<tr>
<td>1F2141108404W400</td>
<td>Lower Grand Rapids</td>
</tr>
</tbody>
</table>
Surmont Non-Saline and Saline Water Source Wells Production Volumes

- **Surmont Phase 2 Saline** [4 Lower Grand Rapids, 6 Clearwater Wells]
- **Surmont Phase 2 Non-Saline** [7 Lower Grand Rapids Wells]
- **Surmont Phase 1 Non-Saline** [4 Lower Grand Rapids Wells]

**Graph Details:**
- **Y-axis:** Volume of Water Produced (m³) per Month
- **X-axis:** Months from Jan-13 to Jan-16

The graph illustrates the production volumes over time for different phases of Surmont wells, showing a significant increase in production volumes, particularly in the latter months, with a notable peak in Jan-16.
Continuous optimization and improvements:
- Steam quality trials;
- Water and energy balances;

Challenges
- Surmont 2 commissioning and startup

<table>
<thead>
<tr>
<th>Year</th>
<th>WRR, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012</td>
<td>81.9</td>
</tr>
<tr>
<td>2013</td>
<td>87.1</td>
</tr>
<tr>
<td>2014</td>
<td>88.2</td>
</tr>
<tr>
<td>2015</td>
<td>83.9</td>
</tr>
</tbody>
</table>

Surmont 1 Turnaround
Surmont 2 start up: facilities preparation, First steam, etc.

Water Recycle Rate (Bulletin 2006-11)

Bulletin 2006-11 recycle rate target of 90%
Surmont in compliance with *D-81* Injection Facility Water Imbalance since June 2014.

Challenging to keep metering imbalance within 5% when performing large maintenance/repair projects (Sept 2014).

Maintained compliance during Surmont 2 ramp up.

**Surmont 2 CPF mega-flush started November 2014 (high disposal volumes in March 2015)**
• Surmont achieved *Directive 81* disposal limit compliance in 2014 (9.1% actual vs. 9.2% disposal limit) after completing reduced blowdown recycle rate trials in 2013:
  • Average boiler blowdown recycle rate at Surmont 1 in 2014 was 53 - 58%

• Excess disposal in 2015 due to:
  • Surmont 2 ramp-up (Testing 12 out of 18 OTSGs)
  • Performed Surmont 2 CPF mega-flush
  • Significant repair work on Surmont 1 OTSG-D
  • Well caustic work causing significant water plant upset

• Saline water and blowdown evaporators at Surmont 2 will enable D-81 compliance in 2016.
## Surmont Phase 1 Water Disposal Wells

<table>
<thead>
<tr>
<th>Well</th>
<th>Zone Approved for Disposal</th>
<th>Maximum Wellhead Injection Pressure (kPa)</th>
<th>Well Status</th>
<th>AER Disposal Approval No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>100/01-16-083-05W4/0</td>
<td>McMurray</td>
<td>2700</td>
<td>Water Disposal</td>
<td>10044H</td>
</tr>
<tr>
<td>100/07-22-083-05W4/0</td>
<td>McMurray</td>
<td>2500</td>
<td>Water Disposal</td>
<td>10044H</td>
</tr>
<tr>
<td>100/08-10-083-05W4/0</td>
<td>McMurray</td>
<td>2300</td>
<td>Water Disposal</td>
<td>10044H</td>
</tr>
<tr>
<td>100/04-21-083-05W4/0</td>
<td>McMurray</td>
<td>2500</td>
<td>Water Disposal</td>
<td>10044H</td>
</tr>
<tr>
<td>100/01-11-083-05W4/0</td>
<td>McMurray</td>
<td>2500</td>
<td>Water Disposal</td>
<td>10044H</td>
</tr>
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</table>

Subsection 3.1.2 (4g)
### Surmont Phase 2 Water Disposal Wells

<table>
<thead>
<tr>
<th>Well</th>
<th>Zone Approved for Disposal</th>
<th>Maximum Wellhead Injection Pressure (kPa)</th>
<th>Well Status</th>
<th>AER Disposal Approval No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>100/01-09-083-05W4/0</td>
<td>McMurray</td>
<td>3400</td>
<td>Water Disposal</td>
<td>10044H</td>
</tr>
<tr>
<td>100/01-04-083-05W4/0</td>
<td>McMurray</td>
<td>2500</td>
<td>Water Disposal</td>
<td>10044H</td>
</tr>
<tr>
<td>102/08-21-083-05W4/0</td>
<td>McMurray</td>
<td>3400</td>
<td>Water Disposal</td>
<td>10044H</td>
</tr>
<tr>
<td>100/01-28-083-05W4/0</td>
<td>McMurray</td>
<td>3400</td>
<td>Water Disposal</td>
<td>10044H</td>
</tr>
<tr>
<td>100/10-15-083-05W4/0</td>
<td>McMurray</td>
<td>3400</td>
<td>Water Disposal</td>
<td>10044H</td>
</tr>
<tr>
<td>102/15-15-083-05W4/0</td>
<td>McMurray</td>
<td>3400</td>
<td>Water Disposal</td>
<td>10044H</td>
</tr>
<tr>
<td>100/08-27-083-05W4/0</td>
<td>McMurray</td>
<td>3400</td>
<td>Water Disposal</td>
<td>10044H</td>
</tr>
<tr>
<td>100/08-23-083-05W4/0</td>
<td>McMurray</td>
<td>3400</td>
<td>Water Disposal</td>
<td>10044H</td>
</tr>
<tr>
<td>100/16-24-083-05W4/0</td>
<td>McMurray</td>
<td>3400</td>
<td>Water Disposal</td>
<td>10044H</td>
</tr>
</tbody>
</table>

---

Subsection 3.1.2 (4g)
Surmont Water Disposal Wells Injection Rates (McMurray)

- **Surmont Phase 2** [9 Wells]
- **Surmont Phase 1** [5 Wells]

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
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<th></th>
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<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Volume</td>
<td>40,000</td>
<td>40,000</td>
<td>40,000</td>
<td>40,000</td>
<td>40,000</td>
<td>40,000</td>
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<td>40,000</td>
<td>40,000</td>
<td>40,000</td>
<td>40,000</td>
<td>40,000</td>
</tr>
</tbody>
</table>
### Waste Disposal

<table>
<thead>
<tr>
<th>Waste Description</th>
<th>Disposal Weight (Tonnes)</th>
<th>Disposal Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dangerous Oilfield Waste</td>
<td>3179</td>
<td></td>
</tr>
<tr>
<td>Hydrocarbon/Emulsion Sludge</td>
<td>586</td>
<td>Oilfield Waste Processing Facility</td>
</tr>
<tr>
<td>Crude Oil/Condensate Emulsions</td>
<td>185</td>
<td>Oilfield Waste Processing Facility</td>
</tr>
<tr>
<td>Various</td>
<td>2403</td>
<td>Landfill</td>
</tr>
<tr>
<td>Non-Dangerous Oilfield Waste</td>
<td>29867</td>
<td></td>
</tr>
<tr>
<td>Lime Sludge</td>
<td>862</td>
<td>Landfill</td>
</tr>
<tr>
<td>Various</td>
<td>23143</td>
<td>Landfill</td>
</tr>
<tr>
<td>Well Fluids</td>
<td>5862</td>
<td>Cavern</td>
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</table>
## Waste Recycling

<table>
<thead>
<tr>
<th>Waste Description</th>
<th>Disposal Weight (Tonnes)</th>
<th>Disposal Method</th>
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</thead>
<tbody>
<tr>
<td>Oil</td>
<td>38</td>
<td>Used Oil Recycler</td>
</tr>
<tr>
<td>Empty Containers</td>
<td>6</td>
<td>Recycling Facility</td>
</tr>
<tr>
<td>Fluorescent Light Tubes</td>
<td>0.5</td>
<td>Recycling Facility</td>
</tr>
<tr>
<td>Batteries</td>
<td>6</td>
<td>Recycling Facility</td>
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</tbody>
</table>
## Typical Water Analysis

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Non-Saline Makeup Water (mg/L)</th>
<th>Saline Makeup Water (mg/L)</th>
<th>Produced Water (mg/L)</th>
<th>Disposal Water (mg/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td>8.5</td>
<td>8.2</td>
<td>7.5</td>
<td>11.8</td>
</tr>
<tr>
<td>Total Dissolved Solids (TDS)</td>
<td>1,400</td>
<td>8,000</td>
<td>1,800</td>
<td>23,000</td>
</tr>
<tr>
<td>Chloride</td>
<td>200</td>
<td>2,800</td>
<td>650</td>
<td>9,500</td>
</tr>
<tr>
<td>Hardness as CaCO₃</td>
<td>&lt;0.5</td>
<td>225</td>
<td>10</td>
<td>5</td>
</tr>
<tr>
<td>Alkalinity as CaCO₃</td>
<td>900</td>
<td>350</td>
<td>250</td>
<td>2,700</td>
</tr>
<tr>
<td>Silica</td>
<td>8</td>
<td>7</td>
<td>190</td>
<td>225</td>
</tr>
<tr>
<td>Total Boron</td>
<td>6</td>
<td>3.3</td>
<td>40</td>
<td>260</td>
</tr>
<tr>
<td>Total Organic Carbon</td>
<td>15</td>
<td>4</td>
<td>500</td>
<td>2,150</td>
</tr>
<tr>
<td>Oil Content</td>
<td>&lt;1</td>
<td>&lt;1</td>
<td>65</td>
<td>30</td>
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</table>
Sulphur Production

Subsection 3.1.2 (5)
Daily Sulphur Emissions

Subsection 3.1.2 (5a i)
Monthly Sulphur Emissions

Sulphur Emissions (tonnes/month)

- 02/2015
- 03/2015
- 04/2015
- 05/2015
- 06/2015
- 07/2015
- 08/2015
- 09/2015
- 10/2015
- 11/2015
- 12/2015
- 01/2016
- 02/2016
Daily SO$_2$ Emissions

![Graph of Daily SO$_2$ Emissions](image)

- **Average**
- **Peak Daily**
- **Limit (EPEA)**

Subsection 3.1.2 (5c)
Continuous ambient air monitoring - all Alberta Ambient Air Quality Objectives were met in 2015

NOx Passives added to Surmont Facility
January 2016
Environmental Compliance

Subsection 3.1.2 (6)
Environmental Approval Contraventions

• Reference # 295104 – February 26, 2015
  • The sample membrane of one Sulphur dioxide passive sample was lost at or before installation making the sample invalid. Thus only three samples were counted instead of the required four.

• Reference # 298932 – May 29, 2015
  • The results of the manual stack surveys showed that the glycol trim heaters were exceeding oxides of Nitrogen limit (2.2 kg/hr). Vendor came out to adjust burner settings to reduce emissions.

• Reference # 308062 – February 7, 2016
  • Failure to submit Certificate of Completion for the Phase 2 Storm water pond within 60 days of construction completion.
  • Certificate submitted March 31, 2016.
Environmental Monitoring

- Groundwater Monitoring Program
  - 2015 results within historical/background concentrations

- Integrated Wetlands Monitoring Program
  - 2015 results within historical/background concentrations

- Reclamation Programs
  - No final reclamation in 2015

- Wildlife Monitoring Program
  - Monitoring of above-ground pipeline completed in 2015
  - January 2016 Monitoring program expanded to include Surmont Phase 2
  - Monitoring avian productivity and survivorship (MAPS)

- Provided funding to AEMERA and provided technical input through COSIA monitoring working group and JOSM Biodiversity Component Biodiversity Committee in 2015.
- In 2015, CPC was required to contribute to CEMA, WBEA and ABMI.

• Groundwater and Integrated Wetland Monitoring Programs extended to Surmont 2
Compliance Confirmation and Non Compliances

Subsection 3.1.2 (7) + (8)
ConocoPhillips Canada is in regulatory compliance for 2015 with the exception of the following:

- A minor overpressure event at Pad 263-1 and Pad 265-2:
  - Caused by challenges with the bubble tube used to measure bottom hole pressure.

- Surmont Phase 1 Pond Primary Liner Leak:
  - Self Disclosed that there is a breach in the primary liner at Phase 1.
  - Corrective action plan has been developed and is being executed.

- Surmont Phase 2 Storm Water Pond Certificate of Completion:
  - Certificate of Completion was not submitted within 60 days of completion.
Future Plans

Subsection 3.1.2 (9)
Future Plans – Surmont

Phase 1
• Exploration of a heat integration project to improve facility efficiency and uplift steam production. Critical tie-ins planned to be executed during June Shutdown. Project still under evaluation.
• Full Implementation of alternative WLS coagulant program based on 2016 trial results.

Phase 2
• Execution of alternative WLS coagulant program pending success at Phase 1.
• Completion of detailed engineering to manage PSV lift challenges in steam plant.
• Kick off of detailed engineering for treater desand installations – pending
• Train 1 steam plant Condensate Induced Water Hammer Mitigation project – detailed engineering to begin 2Q, 2016.
## Upcoming Commissioning:

- **Gen 13** – 2/25/2016
- **Gen 14** – 3/04/2016
- **Gen 15** – 3/12/2016
- **Gen 16** – 3/20/2016
- **Gen 17** – 04/15/2016
- **Gen 18** – 4/22/2016

### Activity Name

<table>
<thead>
<tr>
<th>Activity Name</th>
<th>Finish</th>
</tr>
</thead>
<tbody>
<tr>
<td>Train 1 - Prepare and Test Steam Gen #1 (OTSG)</td>
<td>15-July-2015</td>
</tr>
<tr>
<td>Train 1 - Prepare and Test Steam Gen #2 (OTSG)</td>
<td>15-July-2015</td>
</tr>
<tr>
<td>Train 1 - Prepare and Test Steam Gen #3 (OTSG)</td>
<td>15-July-2015</td>
</tr>
<tr>
<td>Train 1 - Prepare and Test Steam Gen #4 (OTSG)</td>
<td>15-July-2015</td>
</tr>
<tr>
<td>Train 1 - Prepare and Test Steam Gen #5 (OTSG)</td>
<td>9-Aug-2015</td>
</tr>
<tr>
<td>Train 1 - Prepare and Test Steam Gen #6 (OTSG)</td>
<td>16-Aug-2015</td>
</tr>
<tr>
<td>Train 2 - Prepare and Test Steam Gen #7 (OTSG)</td>
<td>16-Oct-15 A</td>
</tr>
<tr>
<td>Train 2 - Prepare and Test Steam Gen #9 (OTSG)</td>
<td>21-Oct-15 A</td>
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<tr>
<td>Train 2 - Prepare and Test Steam Gen #11 (OTSG)</td>
<td>09-Nov-15 A</td>
</tr>
<tr>
<td>Train 2 - Prepare and Test Steam Gen #12 (OTSG)</td>
<td>30-Oct-15 A</td>
</tr>
<tr>
<td>Train 2 - Prepare and Test Steam Gen #10 (OTSG)</td>
<td>02-Nov-15 A</td>
</tr>
<tr>
<td>Train 2 - Prepare and Test Steam Gen #8 (OTSG)</td>
<td>07-Nov-15 A</td>
</tr>
</tbody>
</table>
• Outboard wells on pads 265 and 266 deferred.
• 267 is first in the queue.
• 268 being reviewed for impact of regional bottom water.
• 104 development is 2\textsuperscript{nd} in the queue.
Surface Operations and Compliance
Pilot Project Approval 9460

Facilities
Subsection 3.1.2 (1)
No significant facility modifications completed in 2015.
Facility Performance

Subsection 3.1.2 (2)
Deviation from capacity due to:

- Thief zone interaction limiting production
- P2 ESP unable to decrease to subcool target
- P3 pump failed shutting in production from this well in 2014
Subsection 3.1.2 (2b)

Produced Water (m³/day)

Deviation from capacity due to:

- HP BFW output limitations
- Reservoir strategy prior to high injection steam trial
- Steam quality sampling
Facility Performance: Electricity Consumption Surmont Pilot

Electricity consumption and intensity at pilot is constant.

Electrical Imports (MWh/month)

Electrical Intensity (kWh/BBL Bitumen)

Subsection 3.1.2 (2d)
# Pilot Plant Performance: Gas Usage

<table>
<thead>
<tr>
<th></th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
<th>2015</th>
<th>to 2016-04</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total Gas Imports (TCPL) (10³ m³)</strong></td>
<td>12,334</td>
<td>9,728</td>
<td>11,828</td>
<td>10,351</td>
<td>8,876</td>
<td>2,405</td>
</tr>
<tr>
<td><strong>Solution Gas (10³ m³)</strong></td>
<td>1,347</td>
<td>2,962</td>
<td>3,229</td>
<td>1,152</td>
<td>555</td>
<td>428</td>
</tr>
<tr>
<td><strong>Total Gas Flared (10³ m³)</strong></td>
<td>2.8</td>
<td>2.5</td>
<td>85.4</td>
<td>31.7</td>
<td>6.2</td>
<td>194.0</td>
</tr>
<tr>
<td><strong>Solution Gas Recovery (%)</strong></td>
<td>99.8</td>
<td>99.9</td>
<td>97.4</td>
<td>97.2</td>
<td>98.9</td>
<td>54.7</td>
</tr>
</tbody>
</table>
Pilot Plant Performance Produced Gas

Produced Gas

Produced Gas (10^3 m^3/month)


Subsection 3.1.2 (2e)
Pilot Plant Performance: Greenhouse Gas

GHG Emission Intensity

Subsection 3.1.2 (2f)
Measurement and Reporting

Subsection 3.1.2 (3)
Battery Actual Bitumen Production = [Closing Inventories – Opening Inventories (Oil portion of Sales and Slop)]/Shrinkage Factor – Diluent Received + [Closing Inventories – Opening Inventories (Diluent)] + [Closing – Opening (Injected Fluids into Producers)] + Sales Shipped to S1 and Trucked

Battery Estimated Bitumen Production = Well bitumen production is calculated from well tests (pro-rated battery)
Produced Water Measurement and Reporting

**Water Production** = \([\text{Closing inventories} - \text{Opening Inventories (Water portion of Sales, Slop, Flash, Skim and Produced Water)}] - \text{Water Content of Received Diluent or Oil} + [\text{Closing} - \text{Opening (Injected Fluids into Producers)}] + \text{Produced Water} + \text{Produced Water Truck Tickets} + \text{Water Content of Sales Oil}\)

**Battery Estimated Water Production** = Well water production is calculated from well tests (pro-rated battery)
Measurement and Reporting Methods

Production Gas
- Total battery gas production estimated from inlet of FKOD, Scrubber and P3 usage.
- Well gas production calculated from well oil production and GOR.
- GOR = battery gas production / battery bitumen production.
- Gas proration factor = total battery gas production / well test gas production.

Steam
- Steam injection metered individually at each well and allocated using the group steam injection meter.

Well Testing
- One well on test at a time.
- Target a minimum of two tests per well per month (24 hours in length).
- All well pairs tests regularly tested to meet minimum monthly target.

- No modifications in accounting formula
Water Production, Injection, and Uses

Subsection 3.1.2 (4)
### Surmont Pilot Non-Saline Water Source Wells

<table>
<thead>
<tr>
<th>Source Well</th>
<th>Observation Well</th>
<th>Formation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1F1082508307W400</td>
<td>1AJ082508307W400</td>
<td>Lower Grand Rapids</td>
</tr>
<tr>
<td>1F1072508307W400</td>
<td>100072508307W400</td>
<td>Clearwater</td>
</tr>
</tbody>
</table>

![Map of Surmont Pilot Non-Saline Water Source Wells](image_url)
Pilot Water Source Wells Production Volumes

Subsection 3.1.2 (4b)
### Surmont Pilot Water Disposal Well

<table>
<thead>
<tr>
<th>Well</th>
<th>Zone Approved for Disposal</th>
<th>Maximum Wellhead Injection Pressure (kPa)</th>
<th>Well Status</th>
<th>AER Disposal Approval No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>100/09-25-083-07W4/0</td>
<td>Keg River</td>
<td>6000</td>
<td>Water Disposal</td>
<td>9573C</td>
</tr>
</tbody>
</table>

---

Subsection 3.1.2 (4g)
Pilot Water Disposal Well 100/09-25-083-07 W4M Injection Rate (Keg River)

Subsection 3.1.2 (4h)
Pilot Water Disposal Well 100/09-25-083-07 W4M Well Head Pressure (Keg River)

Approval Max. WHP for 100/09-25: 6,000 kPa

Pilot Disposal Water to S1
### Waste Description

#### Solid Waste

<table>
<thead>
<tr>
<th>Waste Description</th>
<th>Disposal Weight (kg)</th>
<th>Disposal Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recycled Materials</td>
<td>1,750</td>
<td>Recycled</td>
</tr>
<tr>
<td>Dangerous Oilfield Waste</td>
<td>597</td>
<td>Landfill</td>
</tr>
<tr>
<td>Non-Dangerous Oilfield Waste</td>
<td>1,326</td>
<td>Landfill</td>
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</tbody>
</table>

#### Fluid Waste

<table>
<thead>
<tr>
<th>Waste Description</th>
<th>Disposal Volumes (m³)</th>
<th>Disposal Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dangerous Oilfield Waste</td>
<td>284</td>
<td>Cavern</td>
</tr>
<tr>
<td>Non-Dangerous Oilfield Waste</td>
<td>149</td>
<td>Cavern</td>
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</table>
Sulphur Production

Subsection 3.1.2 (5)
Daily Sulphur Emissions

Subsection 3.1.2 (5b i)
Monthly Sulphur Emissions

Subsection 3.1.2 (5a i)
Daily $\text{SO}_2$ Emissions

Subsection 3.1.2 (5c)
Passive Ambient Air Quality Results - \( \text{H}_2\text{S} \)

- Peak Reading
- Average
- Limit (ppb)

Passive Ambient Air Quality Results - \( \text{SO}_2 \)

- Peak Reading
- Average
- Limit (ppb)
Environmental Compliance

Subsection 3.1.2 (6)
Environmental Compliance

Groundwater Monitoring

- 2015 results within historical/background concentrations.

Soil Monitoring

- 2015 results within historical/background concentrations.

Reclamation Programs

- No reclamation in 2015.
Compliance Confirmation

Subsection 3.1.2 (7)
ConocoPhillips Canada is in compliance in all areas of the regulations for all of 2015 with the exception of a flare event as detailed in Subsection 3.1.2 (8).
Non Compliance

Subsection 3.1.2 (8)
Flaring Event

• One flaring event sustained over four hours within 24 hour period.
• Reported to Bonnyville field office and entered into DDS system.
• The event did not exceed the $30 \, 10^3 \text{m}^3$ daily volume limit.
Future Plans

Subsection 3.1.2 (9)
Future Plans

- Thief zone pressure management.
- Reservoir blow down.
- Facility exit.
- Gas cap monitoring.