Orion In Situ Oil Sands
2014 Progress Update
Presented May 21, 2015
Agenda

Introduction
Geoscience
Scheme Performance
Surface Operations
Compliance
Future Plans

Bruce Thornton
Jack Pels
Daniel Nugent
Mario Caya
Heather Harms
Bruce Thornton
The Orion Project - History

- Hilda Pilot 1 first steam
- Hilda Pilot 3 first steam
- Commercial Development Application

1997

- EUB Commercial Scheme Approval
- Construction
- Shell acquires Black Rock Ventures Inc
- Commissioning and Start Up
- EDTA Stimulations Conducted
- First Slotted Liner Perforation

Osum Oil Sands Corp. acquires Shell Orion

2000

2005

2010

2015

bopd

10,000

8,000

6,000

4,000

2,000
Well Data
Note: Only 2 out of 13 Observation wells had acceptable readings. Currently recalibrating or looking at replacements on most of these wells.
Clearwater Reservoir

100/15-17-64-3W4

**Abbreviations**
- **SHE**: Sandy Heterolithic Strata
- **ISM**: Interbedded Sand and Mud Strata
- **MHS**: Muddy Heterolithic Strata

**Stratigraphic Units**
- Clearwater Fm
- Clearwater SS
- Top Pay
- Base Pay
- Wabiskaw
- McMurray Fm
- Beaverhill Lake Group
- Upper Grand Rapids Fm
- Lower Grand Rapids Fm
- Viking Fm
- Joli Fou Fm
- Undifferentiated Quaternary Glacial Drift & Till
- Pleistocene QP
- Colorado Fm
- Miocene QP
- Eocene QP
- Cretaceous QP
- Paleozoic QP
- Clearwater Reservoir

**Gas Cap**
- Gas Cap limited to LSD 15, Section 17, 64-03W4

**Dimensions**
- 75 cm
Clearwater Sand Mineralogy

- Sand is angular very fine- to fine-grained feldspathic litharenite
- Clay content is less than 2% of total rock
- Clay composition is Kaolinite, Illite, Chlorite, and Smectite

Abbreviations:
- SHS: Sandy Heterolithic Strata
- ISM: Interbedded Sand and Mud Strata
- MHS: Muddy Heterolithic Strata

Sample: OB 12
- Depth (m): 408.00
- Rock Name: Feld. Litharenite

Reservoir Properties:
- TS Porosity (%): 33
- Core Porosity (%): 37.6
- Kmax (md): 6210
Cross Section W-E
Cross Section N-S
Clearwater SAGD Reservoir – Top Pay
as per Commercial Scheme Approval 10103G
Clearwater SAGD Reservoir – Base Pay
as per Commercial Scheme Approval 10103G
Clearwater SAGD Reservoir – Pay Thickness
as per Commercial Scheme Approval 10103G
# Original Bitumen in Place (OBIP) and Recovery

- Net thickness based on maps TOP to BASE of interpreted Clearwater SAGD Reservoir
- Porosity and oil saturation from logs and core; formation volume factor (FVF) = 1

\[
\text{OBIP} = \text{Area} \times \text{Net Pay} \times \text{porosity} \times \text{oil saturation} \times \text{FVF}
\]

<table>
<thead>
<tr>
<th></th>
<th>Drainage Area, 50 m boundary ((10^2 \text{ m}^2))</th>
<th>Average Net Thickness ((\text{m}))</th>
<th>Porosity ((\text{frac}))</th>
<th>Oil Saturation ((\text{frac}))</th>
<th>Total OBIP ((10^4 \text{ m}^2))</th>
<th>Current Recovery %</th>
<th>Estimated Recovery %</th>
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<td>0.69</td>
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<td>25%</td>
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<td>Hilda Lake Pilot</td>
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<td>0.33</td>
<td>0.70</td>
<td>1.03</td>
<td>51%</td>
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<td>Orion Operating Area</td>
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<td>0.69</td>
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<td>Orion Project Area</td>
<td>10523</td>
<td>18.5</td>
<td>0.33</td>
<td>0.69</td>
<td>45.04</td>
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* Net thickness measured from production well to top pay
Reservoir Properties

- Horizontal Permeability: ~2 – 6 D
- Vertical Permeability: ~1.7 - 5.1 D (Kv/Kh = 0.85)
- Viscosity: ~100,000 cP
- Oil Saturation: 67 – 70%
- Porosity: 32 – 34%
- Thickness: 14 – 23 m
- Reservoir Depth: ~425 m KB
- Reservoir Pressure: 3.2 MPa
- Initial Reservoir Temp: 15C
- Basal water: ~10 m below pay
- Sandy heterolithic strata (SHA) facies between pay and basal water
- Minimal Top Gas Limited to LSD 15, Section 17, 64-03W4

**Orion Project Area within reservoir interval**
**SAGD Top and Base as per Approval 10103G**
Clearwater Shale – Caprock Thickness
Caprock

- 3 units of capping shales of significant thickness
- Undisturbed basement mapped on 3D seismic

Depth Structure of Beaverhill Lake based on 3D seismic

Seismic traverse

Unit 3: shales of Colorado Grp ~150 m
Unit 2: shales of Grand Rapids Fm ~100 m
Unit 1: primary caprock - Clearwater Shale 4 ~ 5 m
Seismic Data

3D, 2D, Swath2D

- Hilda 3D
  March 2005, 1.8 km²
- 2D seismic
  Blackrock, 2005
- Orion baseline Swath 2D
  July 2007, 50 km
- Orion 3D
  April 2009, 8.4 km²
- Orion monitor1 Swath 2D
  November 2009, 50 km
- Orion monitor2 Swath 2D
  February 2011, 40 km
- Orion monitor3 Swath 2D
  February 2014, 35 km
Repeat Seismic 2D Swath

RMS extractions of quadrature trace amplitude difference in the Clearwater Reservoir interval: 5 ms above to 3 ms below.

Observations:
- Good thermal conformance and steam-chamber growth along individual horizontal well bores
- Good lateral resolution allow estimates of perpendicular reach of steam chambers, to enable in-fill planning
Repeat Seismic 2D Swath

Hilda Pilot I/P pairs on production ~8 years thermal seismic response

Orion Commercial I/P pairs on production ~8 years after Hilda Pilot thermal seismic response

2007  Reconciled Swath line 45  2014
Scheme Performance
Daniel Nugent
Orion Update

Remediation attempts complete Dec 2014
• 18 perforations, 1 redrill
  – Pilot & redrill WWS, 1 slotted liner not perforated
  – Osum: 7 perforations, 2 stimulation jobs 2015

• High-placed wells: good performance
• Low-placed wells: variable performance
  – Flush production, sustainability uncertain

• Orion forecast: on budget 8,000 bopd
  – 9,250 bopd less turnaround (2wks + ramp up)
Orion Field Production

Production, m3/d

- Water
- Steam
- Oil
- cSOR
**Initial Phase 1 Commercial SAGD**

- Why has pilot success not been repeated?

<table>
<thead>
<tr>
<th>Problem</th>
<th>Remediation</th>
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<tbody>
<tr>
<td>• Liner plugging &amp; completion</td>
<td>• Perforations</td>
</tr>
<tr>
<td>- slots too small</td>
<td></td>
</tr>
<tr>
<td>- open area too small</td>
<td></td>
</tr>
<tr>
<td>- slotted vs wirewrap liner</td>
<td></td>
</tr>
<tr>
<td>• Well placement</td>
<td>• Redrill &amp; perforations</td>
</tr>
<tr>
<td>- too low, in SHS facies</td>
<td></td>
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<tr>
<td>- sand dominated, but lower Kv</td>
<td></td>
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</table>
Good Well Placement – Pilot, Pad 103, Pad 105
Post Perforation Success

- Good placement = good production

Well 103P3
Well Placement Too Low – Pads 104 & 106
Well Placement Too Low (Pads 104 & 106)

Well 104P3: good upside

Graph showing production rates over time, with various labels for Cal Dly Rate (m3/d) and Perforation.
Well Placement Too Low (Pads 104 & 106)

Well 106P2

Cal Div Rate (m3/d)

- Water Prod.
- Oil Prod
- Steam Inj.
- CSOR

Perforation

Oct-06  Feb-08  Jul-09  Nov-10  Apr-12  Aug-13  Dec-14
Clearwater Redrill

1F1/15-16-64-3W4

P106-I5,P5 re-drilled 6 m above original I/P, resulting in increased productivity.
Well Redrill – Pads 106

- Redrilled well placed above SHS facies
Pad Recovery & Performance

![Graph showing recovery vs. PV Steam]

- Recovery %
- PV Steam
Typical Injector Completion

- Downhole pressure is measured continuously via casing annulus pressure gauge (surface) including N2 purges. Downhole temperature is not measured on injectors.

- 13 3/8” J-55 or H-40, 81.1 kg/m, Non Premium Connection Surface Casing, Landed at 160 m, Thermally Cemented to Surface.

- 9 5/8” L-80 or K-55, 59.53 kg/m, Premium Connection Casing, Landed at 700 m, Thermally Cemented to Surface.

- 2 7/8” J-55, 9.41 kg/m Premium or Semi-Premium Connection Tubing String to Heel String Landed at 700 m.

- 3 ½” J-55, 13.69 kg/m Premium or Semi-Premium Connection Tubing String Landed at Toe (1,380 m).

- 7” K-55, 34.29 kg/m, Semi-Premium connection Liner, Slotted to ±1,400m (700m liner).

- 9 5/8” x 7” Liner Hanger.
Typical Producer Completion – PCP

13 3/8” J-55 or H-40, 81.1 kg/m, Non Premium Connection Surface Casing, Landed at 160 m, Thermally Cemented to Surface

9 5/8” L-80 or K-55, 59.53 kg/m, Premium Connection Casing, Landed at 700 m, Thermally Cemented to Surface

4 1/2” J-55, 22.8 kg/m Premium Semi-Premium Connection Tubing String to Heel Landed at 680 m with PCP

2 1/16” J-55, 4.84 kg/m IJ String Landed at 720 m with 1-1/4” QT-70, 1.98 kg/m Coil to Toe for Instrumentation. DTS fiber in coil in the majority of producers for temperature; Pressure is measured during N2 purges

7” K-55, 34.29 kg/m, Semi-Premium Connection Liner, Wire Wrapped Screen or Perforated Slotted Liner Landed at +/- 1,400m (700m Liner)

9 5/8” x 7” Liner Hanger
Artificial Lift – Orion Wells

<table>
<thead>
<tr>
<th>Natural Lift SAGD</th>
<th>11 Wells</th>
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<tr>
<td>PCP SAGD</td>
<td>10 Wells</td>
</tr>
<tr>
<td>ESP SAGD</td>
<td>1 Well</td>
</tr>
<tr>
<td>Abandoned</td>
<td>1 Well</td>
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Criteria

<table>
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<tr>
<th>Criteria</th>
<th>ESP</th>
<th>All Metal PCP</th>
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<tr>
<td>Operating Temperature Range</td>
<td>250°C</td>
<td>350°C</td>
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<tr>
<td>Rate</td>
<td>280 - 450 m³/d</td>
<td>100 - 370 m³/d</td>
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<tr>
<td></td>
<td>40 - 60 Hz</td>
<td>100 - 350 RPM</td>
</tr>
<tr>
<td>Run Life - Range</td>
<td>5 - 46 months</td>
<td>10 - 43 months</td>
</tr>
<tr>
<td>Run Life - Average</td>
<td>12 months</td>
<td>25 months</td>
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</table>
Typical Producer Completion – Steam Lift

13 3/8” J-55 or H-40, 81.1 kg/m, Non Premium Connection Surface Casing, Landed at 160 m, Thermally Cemented to Surface

9 5/8” L-80 or K-55, 59.53 kg/m, Premium Connection Casing, Landed at 700 m, Thermally Cemented to Surface

2 7/8” J-55, 9.67 kg/m Premium or Semi-Premium Connection Tubing String to Heel Landed at +/- 700 m / Some Well has Instrument Coil to toe

3 1/2” J-55, 13.84 kg/m Premium or Semi-Premium Connection Tubing String Landed at +/- 1,350m. DTS fiber in coil in the majority of producers for temperature; Pressure is measured during N2 purges

7” K-55, 34.29 kg/m, Semi-Premium Connection Liner, Wire Wrapped Screen or Perforated Slotted Liner Landed at +/- 1,400m (700m Liner)

9 5/8” x 7” Liner Hanger
Ground Uplift Monitoring

- Ground deformation measured with InSAR since March, 2010
- 53 corner reflectors; 938 coherent targets

- Ground uplift is normal and expected with thermal operations
- Osum Orion SAGD operations coincides with < 1.5 cm/yr uplift
- Imperial Oil Ltd CSS operations coincides with < 45 cm/cycle uplift
- No detrimental cap-rock, production or HSE impact reported, or expected
- Five years of monitoring have confirmed SAGD operations result in < 8 cm uplift

Map location of InSAR corner reflectors assigned to areas 1-6

Within CSS operations, uplift up to 45 cm/cycle

Within SAGD operation, near CSS, observe cyclic overprint; uplift < 1.5 cm/yr, < 8 cm over 5 yrs

Source
InSAR Deformation Monitoring Osum Orion and Boundary 2014 Milestone 2, Quarter 4, MDA Geospatial Services, January 20, 2015
Orion Production Performance

• 2014 showed a significant improvement in production performance by reducing differential pressure between injectors and producers
  – Perforations remove source of pressure drop (“mechanical skin”) and therefore subsequent scale precipitation issue as well
  – Sand has not proved to be a significant concern

• Production performance is highly dependant on well pair placement within the reservoir Top and Base Pay interval.

• Future wells in Phase 2 will incorporate this knowledge in order to improve their SAGD efficiency and productivity
Orion SAGD Pressure Scheme

• Osum’s intention is to maintain a constant SAGD chamber pressure of 3.0 - 3.7 MPa until late life SAGD
  – Higher recovery pads (pilot) have begun a slow pressure decline

• Osum is working to optimize the chamber pressure strategy for late life SAGD
Surface Operations
Mario Caya
Plant & Facilities Summary

• Osum has focused on maintaining:
  – A safe operating environment
  – Increasing asset reliability
  – Improving production performance
  – Meeting or exceeding regulatory license requirements

• The steam generation boilers are the primary focus for increased reliability efforts
Orion CPF Plot Plan

Produced GasTrim Cooler E-1012 Bay 1 was added to provide the additional cooling capacity required by increased produced gas rates from the well pads.
Orion Block Flow Diagram
Orion Central Processing Facilities (CPF)

• The CPF has two conventional drum boilers to generate steam to inject into the reservoir

• The crude emulsion is in three phases: bitumen, water and casing gas

• The emulsion is delivered (via pipeline) to the CPF for separation

• The small amount of gas separated from the bitumen, along with purchased Natural Gas and Vapor Recovery Unit (VRU) gas, is burned as fuel in the boilers

• The water treatment facilities clean and treat the produced water allowing it to be re-used to generate steam. The process allows us to reuse almost all the Produced Water. Brackish Water from the McMurray formation is the source of the industrial make-up water

• The waste produced during the water recycling and treatment process is trucked offsite to an AER approved waste disposal facility
Orion Well Pad Facilities

- The facility has 6 well pads with a total of 22 SAGD well pairs
- Typical well pad configuration is 4 SAGD well pairs, which consists of 4 injector and 4 producer wells
Orion Bitumen Production Treatment

• The Bitumen treating system allows for three phase separation (Oil, Water, Gas) of the produced emulsion fluid.

• Primary equipment consists of:
  – Diluent injection system for emulsion separation and to meet sales oil blending specifications
  – Chemical injection to aid emulsion separation
  – 3 Phase separation equipment; Free Water Knock Out and Treater (the treater is equipped with an electrostatic grid); Heat exchange equipment; shell and tube for bitumen coolers and produced water cooling. Rejected heat is captured in both the Glycol and BFW systems as part of the heat integration
  – Vapour recovery system
  – Bitumen storage and blending for transport via pipeline
  – Bitumen quality (Sales Oil) is < 0.5% BS&W
Orion Vapour Recovery System

• The vapour recovery system allows for collection, compression and complete utilization of produced vapours. All recovered vapour is used as fuel in the steam generation system. The sources of vapour are:
  – Evaporator vent recovery
  – 10 storage tanks
  – Diluent recovery system
  – Induced Gas Flotation

• The vapour recovery system is integrated with the Low Pressure (LP) flare system. If the vapour recovery system is not available the recovered vapour is diverted to the LP flare system
De-Oiling

- Produced Water from the Production Treating Train is Deoiled using the following equipment:
  - Skim Tank – Designed to maximize retention time
  - Induced Gas Flotation Vessel – Micro-Bubble Flotation (Hydrocarbon Content < 10ppm oil/water)
  - Oil Removal Filters – walnut shell Deep Bed Filtration
Water Treatment

• Evaporator technology is utilized to produce Boiler Feedwater (BFW). The evaporators at Orion:
  – Produce BFW that meets or exceeds the water criteria set out by ASME
  – Generate a concentrated brine waste stream that is disposed of at an AER approved facility
  – Have a 95% design conversion rate of feed to distillate
Orion Water Usage and Treatment
Steam Generation

• Conventional Boilers generate 100% quality steam at 6,000 kPag for injection at the Well Pads

• A small concentrated blowdown of 3-5% of the inlet mass flow is recycled back to the Evaporator Feed Tank for re-use
Monthly Steam Production – 2014

Design Capacity ~144,500 m³/month
Plant & Facilities Summary

• It is expected that the boiler reliability improvement measures identified will be fully implemented in 2015 to support production and operating cost targets:
  – Increased boiler and overall plant reliability to target measures
  – Stabilized reservoir conditions / production
  – Predictability of operation and reduced downtime
  – Minimized safety exposure
  – Minimized maintenance capital costs

• Facility performance and site condition improvements:
  – Well pad berm rebuild for improved containment capability
  – Site grounds grading for better run-off management
  – Revised Well pad maintenance program
  – Optimized process chemical usage
  – Improvements to boiler control parameters yielding higher steam production rates
  – Maintain oil production rates during short term steam production reductions
Measurement, Accounting & Reporting Plan (MARP)

• Approved Phase 1 MARP

• Annual revision submitted April 6th, 2015

• Accounting meters calibrated / verified on an annual basis

• A Phase 2 MARP application is planned for Q3/2015
Orion Well Integrity

• Wellhead Integrity Maintenance
  – Include wellhead integrity checks as part of all completions activities
  – Yearly Wellhead Integrity Maintenance scheduled in June, 2015: Total 218 valves will be greased and purged; 46 thermal wellheads and its components will be visually inspected and re-torqued to specification
  – Wellhead components inventory and tracking system components specifications, up-to-date pictures, scheduled maintenance information will be available online through service provider’s website

• Sept 2014 – May 2015
  – Caliper Log was run on the intermediate casing string of P104-P1 SAGD producer. No issues were identified
  – Ran a detailed temperature log on P104-P3 SAGD Producer Horizontal section to confirm bottom hole temperature before perforating
  – MFC Caliper and Cement Bond Logs run on 15-16-64-3W4M Brackish Water Source Well. Logs were required to identify a casing leak. AER approval received for a casing patch
Monthly Gas Usage – 2014

Gas produced in 2014

Gas produced (10^3 m^3)

- Jan-14
- Feb-14
- Mar-14
- Apr-14
- May-14
- Jun-14
- Jul-14
- Aug-14
- Sep-14
- Oct-14
- Nov-14
- Dec-14

Gas purchased in 2014
Monthly Energy Intensity – 2014

[Graph showing monthly energy intensity for Bitumen Production and GJ/Bitumen Production across different months from January 2014 to December 2014.]
Water Proration Factors – 2014

Range - 0.91 to 1.02
Oil Proration Factors – 2014

Range - 0.91 to 1.13
Gas Proration Factors – 2014

Range - 1.0 to 1.13

- January 2014
- February 2014
- March 2014
- April 2014
- May 2014
- June 2014
- July 2014
- August 2014
- September 2014
- October 2014
- November 2014
- December 2014
Brackish Water Usage – 2014

Total Brackish WaterUsage in 2014 = 104,558 m$^3$
Water Disposal Limits - 2014

% of Produced Water
- Disposal Limit %
- Actual Disposal %
- Disposal Volume Limit

Disposal Limit %
Actual Disposal %
Disposal Volume Limit

Avg. 7.6%

m3 / month
On-Site Water Disposal – 2014

• License permits produced water and recovered steam condensate to be disposed into the Granite Wash formation. Disposal Approval #8175

• Granite Wash water disposal well – 02/16-17-064-03W4M (AER License # 0192346)
  – Normal Operating Pressure Range: 10000 - 12000 KPa
  – protected by a high pressure shutdown limit of 13,950 KPa
  – Normal Disposal Temperature Range: 60 - 80 deg C
  – 2014 Disposal Volume: 26,582 m³

• McMurray water disposal well – 03/16-17-064-03W4M (AER License # 0196880)
  – Suspended Nov. 2011
Fresh Non-Potable Water Usage – 2014

Water drawn from well (WSW) situated at 13-16-064-03 W4M under Water Act Approval 242090-00-00.
- Water levels have steadily increased since monitoring began in 2006 even though water production increased from 2013-2014.
- TDS concentration is 750 mg/L
- Dissolved iron concentration is 2.4 mg/L
- Dissolved manganese concentration is 0.63 mg/L

(All concentrations exceed Drinking Water Quality Guidelines)
Water is used for administrative

Max Annual Allowable Volume = 23,725 m³

Total 2014 Fresh Water Usage = 3,302 m³
2014 Cumulative Water Balance

Water Treatment and Steam Generation

In
- Produced Water: 1,336,951 m³
- Fresh Water: 3,265 m³
- Diluent Pipeline: 70 m³
- Brackish Water: 104,558 m³
- Total: 1,444,844 m³

Out
- Steam: 1,331,291 m³
- Sales Oil Pipeline: 1,954 m³
- Disposal: 102,860 m³
- Total: 1,436,105 m³

Difference
- Due to metering error: 8,739 m³
- Disposal Limit: 12%
- Actual Disposal: 7%
Compliance
Heather Harms
Off-Site Waste Disposal – 2014

• Tervita-Lindbergh – Class 1b – 05-26-056-05W4M
  – Evaporator Blowdown – 54,934 m³
  – Contaminated Surface Water 79 m³
  – Contaminated Snow 58 m³
  – Drilling Waste and Sludge 86 m³

• Tervita-Bonnyville – Class II Landfill – NE-09-061-03-W4M
  – Contaminated Soil – 143 m³

• RBW Waste Management
  – Disposal or Recycling
  – Glycol, Lube Oil, Filters, Oily Rags, Aerosols, Methanol 8.9 m³
Domestic Waste Disposal – 2014

• Domestic waste water from the administrative offices washrooms and kitchens are collected in holding tanks and disposed of weekly by a commercial septic service. Total volume disposed of at a Town of Bonnyville Waste Facility was 948 m³

• Domestic waste is hauled to municipal landfills in either Cold Lake or Bonnyville. Approximately 67 tonnes was disposed

• A paper and cardboard recycling program is in effect
Air Monitoring Program – 2014

• Monthly air contaminant concentrations for SO₂/NOₓ, annual manual stack survey results, fugitive emissions, greenhouse gas emission and summarized monthly emission reporting is submitted in accordance with EPEA Approval requirements.

• Sulphur dioxide numbers were revised for 2014 as produced gas volumes and recorded volumetric concentrations of H₂S did not yield the reported values of SO₂ emissions. Recalculated emissions were based on standard methodology.

• Exceedances of SO₂ limits were discovered after recalculation in January and select dates in February 2014, these were self-reported by Osum.
Original SO₂ Submitted Values with Re-Calculated Values

Prior to Osum

Osum Operatorship

Monthly Limit
27-27.9 based on 0.9 t/d

Volume (Tonnes/Month)

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<th>Jan-14</th>
<th>Feb-14</th>
<th>Mar-14</th>
<th>Apr-14</th>
<th>May-14</th>
<th>Jun-14</th>
<th>Jul-14</th>
<th>Aug-14</th>
<th>Sep-14</th>
<th>Oct-14</th>
<th>Nov-14</th>
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<td>12.94</td>
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<td>18.27</td>
<td>17.5</td>
<td>18.54</td>
<td>17.5</td>
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<tr>
<td>Recalculated</td>
<td>28.75</td>
<td>24.91</td>
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<td>14.15</td>
<td>17.33</td>
<td>15.01</td>
<td>21.73</td>
<td>11.17</td>
<td>10.9</td>
<td>15.77</td>
<td>15.66</td>
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Quarterly SO$_2$ Volumes

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<th>Month</th>
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<th>Feb</th>
<th>Mar</th>
<th>Apr</th>
<th>May</th>
<th>June</th>
<th>July</th>
<th>Aug</th>
<th>Sept</th>
<th>Oct</th>
<th>Nov</th>
<th>Dec</th>
</tr>
</thead>
<tbody>
<tr>
<td>SO$_2$ (Tonnes/month)</td>
<td>28.75</td>
<td>24.91</td>
<td>20.96</td>
<td>14.15</td>
<td>17.33</td>
<td>15.01</td>
<td>21.73</td>
<td>11.17</td>
<td>10.90</td>
<td>15.77</td>
<td>15.66</td>
<td>18.13</td>
</tr>
<tr>
<td>Quarterly SO$_2$/tonnes</td>
<td>74.62</td>
<td>46.49</td>
<td>43.8</td>
<td>49.56</td>
<td></td>
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</tr>
</tbody>
</table>
Monthly NOx Emissions Per Boiler

Nox Emissions limit 7.5-7.8 tonnes/month based on limit of 10.5 kg/hour

<table>
<thead>
<tr>
<th></th>
<th>Jan</th>
<th>Feb</th>
<th>Mar</th>
<th>Apr</th>
<th>May</th>
<th>June</th>
<th>July</th>
<th>Aug</th>
<th>Sept</th>
<th>Oct</th>
<th>Nov</th>
<th>Dec</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boiler 1</td>
<td>6.50</td>
<td>5.22</td>
<td>3.60</td>
<td>5.31</td>
<td>6.16</td>
<td>6.16</td>
<td>4.88</td>
<td>6.19</td>
<td>6.91</td>
<td>6.47</td>
<td>6.88</td>
<td>7.00</td>
</tr>
<tr>
<td>Boiler 2</td>
<td>6.40</td>
<td>5.86</td>
<td>6.70</td>
<td>1.68</td>
<td>6.16</td>
<td>6.16</td>
<td>6.86</td>
<td>6.78</td>
<td>5.48</td>
<td>6.68</td>
<td>6.86</td>
<td>7.18</td>
</tr>
</tbody>
</table>
Air Monitoring Program – 2014 Passive

- The passive air network was re-evaluated with the EPEA renewal air modeling - it was determined that the fence-line monitoring will continue and one station at a stakeholder request (H4) reducing number of stations from 11 to 5

- Ambient air monitoring is fulfilled by supporting the LICA Airshed through AEMERA and participating on the Airshed steering committee
Air Monitoring Program – 2014 Passive

- Fugitive Emissions testing indicated 22 small volume leaking components

- All components requiring shutdown have been moved into the turnaround event

- All others were promptly fixed

- The vessels that require work to Pressure Relief Valves (PRV) or Pressure Vacuum Relief Valve (PVRV) are being addressed through a deductive process as an evaluation of the blanket gas system. Initially, the pressure control valve regulators will be inspected to determine operability as they are suspect in over-pressuring the blanket gas system. Should these valves be deemed faulty, they will be serviced and / or replaced. If these actions do not rectify the leaks, the PRV’s and PVRV’s will be replaced.
Monthly Greenhouse Gas Emissions (Tonnes CO$_2$E)

Compliance Emission Rate 0.6568 CO$_2$eq/m$^3$
Actual 0.4485 CO$_2$eq/m$^3$
Soil Monitoring Program – 2014

• Soils monitoring program was executed in August 2014

• Historical salinity and hydrocarbon impacts associated with the Hilda pilot and Pad 107 pilot area are consistent with previous monitoring events

• Salinity impacts in the evaporator area and heavy metals at the Hilda Lake tank farm are surficial

• A soils management program proposal will be prepared in 2015 to progress remedial activity
Groundwater Monitoring Program – 2014

- The groundwater monitoring program was consistent with previous years, no negative trends were detected
- No new wells were added
- Arsenic well program sampling events were increased to quarterly
Wildlife Monitoring Program – 2014

• The wildlife monitoring program included a breeding bird, yellow rail and amphibian survey and a winter tracking event

• A comprehensive report summarizing the last 7 years of monitoring will be submitted in 2016

• The 2015 monitoring program is augmented with the addition of remote cameras for above ground pipeline crossing utilization and acoustical recorders in addition to the approved program
Environmental Monitoring Program – 2014

• In accordance with Conditions outlined in EPEA Approval 141258-00-00 and Water Act Approval 242090-00-00 the remaining annual reports were prepared and submitted for:
  – Industrial Waste Water and Surface Water
  – Surface Water Quality
  – Conservation and Reclamation
  – Domestic Water Use

• Conditions were reflective of previous years for these reports
Amendments to Existing Approvals

• Osum Production Corp. acquired the Orion facility in August 2014, Scheme Amendment 10103I and EPEA Amendment 141258-00-03 authorize the change in ownership of the facility

• EPEA Approval 141258-00-00 expires on July 31, 2015. An EPEA Renewal Application was submitted on April 30, 2015 in accordance with the authorization to extend the required submission date from January 31, 2015 to April 30, 2015
Compliance

• Sulphur dioxide emissions were recalculated based on accepted methodology. This resulted in a non-compliance for January – February 2014 which was then self-reported by Osum (Reference Number 295757).

• Osum has not had any compliance issues since acquiring ownership.

• Osum has requested an audit of the facility by the AER to ensure continued compliance efforts and identify any gaps requiring correction.
Future Plans
Bruce Thornton
Future Plans – Field Development for Orion Phase 2

• Osum has reviewed the previous work associated with the Phase 2 Expansion which was approved by AER in Scheme Approval 10103E to increase growth and sustain the current production at 20,000 bopd

• Overall Osum is planning on 4 Pads (Pads 301, 302, 404 and 403) as outlined in the recently submitted Amendment Application

• The Project and Development Areas remain the same as well as the steam generation capacity (5 boilers) and associated emissions

• Amendment Application Approval is requested by September 2015 to allow for clearing to commence by winter 2015/2016. First steam for Phase 2 would be mid 2017
Phase 2 – Well Placement / Design

Key Design Elements for Success

- Well Placement: above SHS facies
  - Avoid baffle intensity

- Liner Selection/Sizing
  - Wirewrap liners, Weatherford test, avoid plugging

- Startup
  - Artificial lift, manage pressure difference injection / production
  - Effective circulation strategy
Orion Central Plant Facilities Expansion

• Central Processing Facility (CPF) is a 10,000 BPD capacity expansion

• Existing (pre-built) infrastructure for:
  – Sales system
  – Instrument air
  – Piperacks

• New “Brownfield” construction for:
  – Evaporators (water treatment)
  – Steam generation
  – Oil treatment
  – Skim tank
  – Misc. small systems

• Long Lead Boilers and Evaporators at site
Orion Pads & Pipelines Expansion

• New Well Pads, complete with:
  – Group separation and pumps
  – Test separators
  – Standard well modules
  – M2M PCP artificial lift system

• 1.8 km of above-ground Pipelines to/from CPF:
  – Production
  – Steam
  – Casing gas
  – Natural gas
  – Instrument air
Brackish Water Wells

(1F1/16-17-064-03W4/00 & 1F1/15-16-064-03W4/00)

- As per Clause 8 of the Commercial Scheme Approval 10103l Osum was required to submit a report detailing the information from a long term supply pumping test performed in the McMurray formation

- Makeup brackish water supply requirement is estimated at 1300 m$^3$/d for Phase 1 & 2 combined

- An aquifer test was conducted in March 2015 on WSW 15-16. The well efficiency has significantly improved which led to a lower drawdown since the original well test in 2005

- It was concluded from this test and the prior year testing by Shell that the total predicted drawdown for the regional and local drawdowns is sustainable over the long term from both the 15-16 and 16-17 WSW’s
Future Plans for Resource Recovery

• Continue with SAGD recovery as per existing Scheme Approval

• Evaluation of infill feasibility/viability
  – Currently reviewing optimal timing, well TVD placement, well spacing and steam capacity
  – Existing interwell spacing on Phase 1 wells is 100 meters and consideration is being given to placing infill producer wells at 50 meter spacing between existing SAGD pairs on a single Pad initially to evaluate overall recovery and productivity
  – Modelling is also being done on the optimum interwell spacing for future SAGD pairs beyond Phase 2
Thank you