Subsurface Agenda

1. Background
2. Geology / Geoscience
3. Drilling & Completions
4. Artificial Lift
5. Well Instrumentation
6. Scheme Performance
1. Background
Project Overview

Approved Development Area as per ERCB Scheme Approval No. 11522E

- CORED WELLS
- BLACKPEARL OIL SANDS
- LEASE HOLDINGS
Project Summary

- AER Scheme Approval No. 11522E
- Two (2) SAGD Pilot Well Pairs
- Portage area on Oil Sands Lease 7407060158
- Pilot site located in 02-36-076-18W4
- Target formation is the Lower Grand Rapids Unit 1 (L.GR1)
- Initial reservoir data:
  - Pressure: 1700 KPA
  - Temperature: 13°C
  - Depth: 300m
- Traditional SAGD recovery process
- BlackPearl is the 100% W.I. Owner
Blackrod Pilot Site
Project Milestones – 13-25 WP1

- **Oct 2010**  
  AER Scheme Approval No. 11522

- **Dec 2010**  
  Drill 13-25 WP1

- **May 2011**  
  Commission Pilot Facility

- **Jun 2011**  
  Commence Circulation Phase

- **Sep 2011**  
  Convert to SAGD Production Phase

- **Apr 2012**  
  Achieve commercial production monthly rate of 400 bopd

- **Q1 2015**  
  “Ultra-Temp” ESP surpasses 500 days of continuous run-time

- **Aug 2015**  
  Produced 285,000 cumulative barrels of oil
Project Milestones – 10-36 WP2

• **Feb 2012**  AER Approval No. 11522C for 10-36 WP2 and facility expansion

• **Feb 2013**  Drill 10-36 WP2

• **Oct 2013**  Commission Phase 2 Pilot Facility Expansion

• **Nov 2013**  Commence Circulation Phase

• **Mar 2014**  Convert to SAGD Production Phase

• **Apr 2015**  Production surpasses commercial rate of 400 bopd

• **Dec 2015**  9th consecutive month of +500 bopd with an iSOR of <3.0

• **Dec 2015**  Produce 265,000 cumulative barrels of oil
2. Geology / Geoscience
Original Bitumen in Place

- \( \text{OBIP}_{WP1} \) = \( A_1 \times h_1 \times S_o_1 \times \varnothing_1 \times B_o \)
  = \((100 \text{ m} \times 800 \text{ m}) \times 22 \text{ m} \times 0.63 \times 0.35 \times 1.0 \)
  = 388,080 m\(^3\)

- \( \text{OBIP}_{WP2} \) = \( A_2 \times h_2 \times S_o_2 \times \varnothing_2 \times B_o \)
  = \((100 \text{ m} \times 1050 \text{ m}) \times 25 \text{ m} \times 0.63 \times 0.34 \times 1.0 \)
  = 562,275 m\(^3\)

Where:
- OBIP = Original Bitumen In Place
- A = Drainage Area
- h = Thickness
- So = Oil Saturation
- \( \varnothing \) = Average Porosity
- Bo = Expansion Factor
- WP1= 1\(^{st}\) Pilot Well Pair drilled at 13-25-076-18W4
- WP2= 2\(^{nd}\) Pilot Well Pair drilled at 10-36-076-18W4
Lower Grand Rapids (L. GR) Net Pay Map

- Existing lease and access selected for Pilot surface location
- Bottom hole locations for both Pilot Well Pairs selected based on offsetting well control
- L. GR is a Shoreface deposit consisting of three (3) coarsening-upward parasequences:
  - L. GR Unit 1 = upper to middle shoreface bitumen target zone
  - L. GR Unit 2 = middle to lower shoreface transition zone
  - L. GR Unit 3 = bottom H2O saturated aquifer

LOG CUTOFFS
- Gamma Ray < 75 API
- Resistivity > 20 Ohm.m
- Porosity > 33%

Total L.GR1 SAGD Net Oil Pay
Type Log

LOG CUTOFFS
- Gamma Ray < 75 API
- Resistivity > 20 Ohm.m
- Porosity > 33%
**L.GR1 Core Characteristics:**

- Oil saturation: 0.60
- Bitumen weight: 11%
- Net pay thickness: 26 m
- Porosity: 36%
- Vertical permeability: 3024 mD
- Horizontal permeability: 3450 mD
- Kv/Kh: 0.88
- API Gravity: 9.8 (at 15.6 °C)
Cross Section Through 13-25 WP1

- 13-25 WP1 experimental well pair placed to substantiate SAGD recovery in the L.GR
To maximize oil recoveries, 10-36 WP2 placed deeper and drilled longer than 13-25 WP1.
Seismic

3D X-Line along 13-25 WP1

3D Seismic Area Coverage
Primary Cap Rock

• MFS (Maximum Flooding Shale)
• Directly overlays Lower Grand Rapids formation
• Regionally extensive
• 3 m average thickness

• Mini Frac Analysis:
  – Performed on the 13-25-076-18W4 OSE Core Hole
  – Initial Breakdown Pressure = 8500 kPa
  – Closure Pressure Gradient = 13.7 kPa/m
MFS Cap Rock Base Depth Map
Secondary Cap Rock

- Joli Fou formation
- 45 m above Lower Grand Rapids formation
- Regionally extensive
- 20 m average thickness
- Mini Frac Analysis:
  - Performed on the 01-36-076-18W4 OSE Core Hole
  - Initial Breakdown Pressure = 12,750 kPa
  - Closure Pressure Gradient Range = 19.4 kPa/m
Joli Fou Cap Rock Isopach Map
Joli Fou Cap Rock Base Depth Map
Blackrod Subsurface

3. Drilling and Completions
Blackrod Pilot Well Network
13-25 WP1 – Producer (Prod. Phase)

Well Name: 991-24 PROD1-102-PINTAGE 13-25-76-18
LMM: 109-13-24-070-1695.00
Licence #: 202-2048
Surface: 28.3 - 6 ft Dec 35
Coords: 610.6 m W of E Sec 25
Kil: 615.1 m
Qd: 615.9 m

Surface Hole:
- Size: 113.0 mm
- Cemented to surface with Thermal cement

Intermediate Hole:
- Size: 151.6 mm
- Intermediate: 151.6 mm / 473.0 mm
- Cemented to surface with Thermal cement

KOP:
- D.L.: 122.0 mWCD
- Slope: 8.5 deg / 150'

Guide String:
- Size: 52.4 mm
- Landing @ 477 mWCD

Perf Interval: 530.7 to 1130.7 mWCD

Orifice String:
- Size: Instrumentation
- Landing @ 1460 mWCD
- Thermocouples @ 310 mWCD, 420 mWCD, 720 mWCD, 990 mWCD, and 1500 mWCD
- Nitrogen Filling: Bubble Tube @ 1045 mWCD

Short ESP String:
- Size: 39.0 mm
- Pump: ULTRA TSSBP ESP w/156.76 mm oscillators
- Cable: Plus ratios one hard bubble tube, landing @ 430 mWCD (314.9 mTVD)

Lateral Hole:
- Size: 177.8 mm
- Landing @ 1142.4 mWCD w/ Hanger Set @ 443 mWCD

TD: 316.2 mTVD / 1172.6 mWCD
• Injector Well:
  – No modifications

• Producer Well:
  – No modifications
10-36 WP2 - Injector

Well Name: BW1 HZ BLJ2 112 PORTAGE 10-36-76-18
CWC: 102163-3C-DG-109W1L60
License #: 6,133,339
Surface: 124.0 m N of Sec. 25
Gordo: 030.0 m W of Sec. 25
KB: 617.1 m
GL: 612.9 m

Surface Hole: 444.5 mm
Surface Casing: 110.4 mK
Note: 336.7 mm
Cemented to surface with Thermal cement

Intermediate Hole: 315.0 mm
Intermediate Casing: 314.3 in TVD / 420.9 mMD
Note: 243.5 mm
Cemented to surface with Thermal cement

RIP: 133.1 mK
DBL: 9 - 11 long / 30m
Long / Guide String: 66.0 mm
Landing @ 1336.8 mK

Steam Spitters:
Landing @ 789.3 and 1499.2 mK
Size: 63.5 - 76.2 mm / ID = 71.4 mm
Perf. = 8.33 mm
Note: GCA's remain closed during Circulation Phase

Short String: Landing @ 455.0 mK
Size: 33.9 mm

Lateral Hole:
Stretched Liner
Size: 127.9 mm
Landing @ 1336.8 mK Ranger Set @ 607.0 mK
10-36 WP2 – Downhole Modifications

- Injector Well:
  - No modifications

- Producer Well:
  - Install new “Ultra Temp” ESP and pulled scab liner in Mar 2015
4. Artificial Lift
Electrical Submersible Pump

- Fluid production via “Ultra Temp” Electrical Submersible Pumps (ESP) on both 13-25 WP1 and 10-36 WP2

- ESP advantages:
  - Operate and lift fluids at controlled downhole pressures
  - Maintain continuous fluid production

- Variable Flow Drive (VFD) utilized to control pump speed and production rates

- Current ESPs meeting expectations
5. Well Instrumentation
13-25 WP1 – Obs Wells

• Toe Obs Well:
  – 103/13-25-076-18W4
  – 8.5 m North of WP1
  – RTD gauges to monitor temperature above, below, and within L.GR1
  – RTD temperature profile indicating maturing steam chamber

• Heel Obs Well:
  – 102/14-25-076-18W4
  – 17.7 m South WP1
  – RTD gauges to monitor temperature above, below, and within L.GR1
  – RTD temperature profile indicating maturing steam chamber
  – P/T gauge to monitor pressure & temperature within L.GR3 aquifer
13-25 WP1 – Instrumentation Overview
10-36 WP2 – Obs Wells

• Toe Obs Well:
  - 100/07-36-076-18W4
  - 17.5 m West of WP2
  - Thermocouples to monitor temperature above, below, and within L.GR1
  - Thermocouple profile indicating early stages of steam chamber development
  - P/T gauge to monitor pressure & temperature within L.GR3 aquifer

• Heel Obs Well:
  - 100/02-36-076-18W4
  - 16.1 m East of WP2
  - Thermocouples to monitor temperature above, below, and within L.GR1
  - Thermocouple profile indicating early stages of steam chamber development
  - P/T gauge to monitor pressure & temperature within L.GR3 aquifer
Groundwater Monitoring Wells

- **100/03-36-076-18W4 GWM:**
  - Directionally drilled from 14-25 lease
  - PCP to sample/analyze non-saline L.GR3 $\text{H}_2\text{O}$
  - P/T gauge to monitor pressure & temperature within L.GR3 aquifer

- **100/14-25-076-18W4 GWM:**
  - Directionally drilled from 14-25 lease
  - PCP to sample/analyze non-saline L.GR3 $\text{H}_2\text{O}$
  - P/T gauge to monitor pressure & temperature within L.GR3 aquifer

- **100/15-25-076-18W4 GWM:**
  - PCP to sample/analyze non-saline Viking $\text{H}_2\text{O}$
  - P/T gauge to monitor pressure & temperature within Viking aquifer

*Annual Groundwater Monitoring Summary Report Submitted to the AER in Q1 2015*
6. Scheme Performance
13-25 WP1 Performance as of Aug 31, 2015

- Four (4) years of SAGD Production Phase
- Maturing steam chamber / Declining oil production
- ESP failed Aug 2015 and well is currently shut in
13-25 WP1 Summary

• Objective(s):
  • Prove SAGD recovery works in the Lower Grand Rapids reservoir
  • Test production techniques to establish best operating practices

• Well Placement:
  • “Ultra-conservative” placement above L. GR Unit 3 Bottom Water
13-25 WP1 Key Learnings

• Consistent up-time is critical for optimal steam chamber development and productivity

• Fines & clays can be mobile, reactive plugging mechanisms

• Heat conformance can be achieved across 700+ m HZ section
13-25 WP1 Oil Production as of Aug 31, 2015

- Cumulative Production = 45,500 m³
- Recovery to Date = 11.7%
- Ultimate Recovery = 20 - 25% (lower due to 13-25 WP1 well placement)
- CSOR including Circ. Phase = 5.4
- CSOR during Prod. Phase only = 5.2
- Average Rate during Prod. Phase = 31.6 m³/day
- Max Rate during Prod. Phase = 96 m³/day
• Average Steam Chamber Pressure = 2400 kPa

• Average Surface Steam Temperature = 265 °C

• Wellhead Steam Quality = 95 – 100%
22 months of SAGD Production Phase
Still in ramp up phase; steam chamber has not yet reached the roof across full horizontal section
Oil production currently averaging 90 m³/d and continuing to ramp-up
10-36 WP2 Summary

• Applied Learnings:
  • Improved well design (i.e. longer HZ section and WWS for sand control)

• Objective(s):
  • Evaluate SAGD performance from a commercial well pair prototype
  • Target 100% up-time

• Well Placement:
  • “Cautious” placement above L. GR Unit 3 Bottom Water
10-36 WP2 Key Learnings

• Longer ramp-up periods now expected at Blackrod
• WWS favorable to the Blackrod L. GR reservoir
• Scab liner effective in protecting ESP and facilitating heat conformance across HZ section
• Heat conformance can be achieved across 950+ m HZ section
10-36 WP2 Oil Production as of Dec 31, 2015

- Cumulative Production = 42,000 m³
- Recovery = 7.5%
- Ultimate Recovery = 55 - 60%
- CSOR including Circ. Phase = 3.4
- CSOR during Prod. Phase only = 3.0
- Average Rate during Prod. Phase = 64.2 m³/day (404 bopd)
- Current Rate = 90 m³/day (566 bopd)
10-36 WP2 Steam Injection as of Dec 31, 2015

- Average Steam Chamber Pressure = 2314 kPa
- Average Surface Steam Temperature = 265 °C
- Wellhead Steam Quality = 95 – 100%
10-36 WP2 Performance Plot

- **Fluid rate (m³/d)**
- **SOR**

Graph showing performance plots over time with labels for different fluids and rates.

- *Pulled Scab Liner*
Blackrod Surface Operations
Surface Operations Agenda

1. Facilities
2. Measurement & Reporting
3. Water Source
4. Disposal
5. Environmental
6. Compliance Statement
1. Facilities
Pilot Facility Overview
Pilot Facility Plot Plan
Pilot Facility Performance

• No issues with bitumen treatment, water treatment, or steam generation

• Pilot Facility uptime 99.7% in 2015 – only downtime associated with scheduled shut-downs

• Generated steam, produced bitumen, produced water, and produced gas volumes reported to Petrinex

• Purchased gas volumes reported to Petrinex

• Flared gas volumes reported to AER and Petrinex

• \( \text{SO}_2 \) & \( \text{NO}_x \) emissions and ambient air quality data submitted to AER both monthly and annually as per terms of EPEA Approval 00264736-00-00

• GHG emissions reporting not required for Blackrod Pilot Facility as per terms of EPEA Approval 00264736-00-00
Pilot Facility Modifications

• Replaced flare meter with new Ultra Sonic meter
2. Measurement & Reporting
BlackPearl remains compliant with AER Directive 017 as well as Directive 042 as per the terms of our approved MARP (Measurement, Accounting, and Reporting Plan).

To validate compliance with Directive 017 and Directive 042, BlackPearl performs a detailed EPAP (Enhanced Production Audit Program) review annually as per Directive 076 with an independent consulting group.
Individual Well Testing

• Production volumes from both pilot well pairs are determined using the test-to-test method as per the terms of our approved MARP:

  – Both the 13-25 and 10-36 Producer wells are tested individually through the flash separator for 36 hours cumulative every month

  – Bitumen and water production rates are measured through a mass flow (coriolis) meter downstream the flash separator with BS&W cuts determined through a proportional fluid sampler

  – Total battery gas production is measured through the flare gas meter and is prorated to the 13-25 and 10-36 Producer wells based on the production volumes determined using the test-to-test method

  – As of Sep-2015, 10-36 Producer has been on continuous test since 13-25 WP1 has been shut-in
Proration Factors

Blackrod Prorations

Proration Factor

Bitumen  Water  Gas

3. Water Source
Blackrod Water Source(s)

- **1F1/14-24-076-18W4 L.GR3 WSW:**
  - Non-saline (~3700 TDS)
  - AER Water Act Licence No. 00308617-01-00 valid until Jun 2019
  - Approved for 109,500 m³ annually
  - Production volumes reported to AER and Petrinex
  - 100/14-24-076-18W4 monitoring well 20 m North of 1F1/14-24 WSW
  - No issues with water softening process

- **1F1/15-25-076-18W4 Grosmont Member D WSW:**
  - Saline (~12,800 TDS)
  - No issues with saline treatment process
Blackrod Water Source(s)

Monthly Source Water Volumes

Volume (m³)

June 13, July 13, August 13, September 13, October 13, November 13, December 13, January 14, February 14, March 14, April 14, May 14, June 14, July 14, August 14, September 14, October 14, November 14, December 14, January 15, February 15, March 15, April 15, May 15, June 15, July 15, August 15, September 15, October 15, November 15, December 15

LGRL (54-24-36-71 WA/4)
Grossmont (51-25-76-18 WA/4)
4. Disposal
Blackrod Disposal

• Produced Water:
  – 100/02-25-076-18W4 Class 1b Disposal Well
  – AER Scheme Approval No. 11703A
  – Disposal into Grosmont Members B, A
  – Maximum wellhead injection pressure of 6300 kPa
  – This well continues to operate on vacuum with no pressure at the wellhead
  – All disposal volumes reported to Petrinex

• Waste:
  – Waste fluids (i.e. sewage, sludge, etc.) trucked out to third party disposal facilities.
100/02-25-076-18W4 Disposal Well

*02-25 Disposal Well continues to operate on vacuum*
Blackrod Surface Operations

5. Environmental Issues
Blackrod Environmental

• No environmental issues to date

• January 2015 BlackPearl AER Inspection follow up:
  – Blackrod had 4 follow-up items for EPEA Approval No. 264736-00-01.
  – As of September 23, 2015 all follow-up items were completed by BlackPearl

• BlackPearl remains compliant with the terms of AER Approval No. 264736-00-00:
  – CPP (Caribou Protection Plan)
  – Air Monitoring
  – Groundwater Monitoring
  – Soil Monitoring
  – Etc.
6. Compliance
Blackrod Compliance

• January 2015 BlackPearl AER Inspection follow up:
  – Blackrod had 23 follow-up items for LIC F42400
  – As of September 23, 2015 all follow-up items were completed by BlackPearl

• To the best of BlackPearl’s knowledge, the Blackrod SAGD Pilot Project is currently in full compliance with all conditions and regulatory requirements related to AER Scheme Approval No. 11522E
Blackrod Future Plans
1. Ongoing Pilot Objectives
Ongoing Pilot Objectives

• Continue to ramp-up and optimize 10-36 WP2

• Plan and apply for a 3rd Pilot Well Pair incorporating flow control devices and a longer horizontal profile

• Plan and apply for NCG co-injection
2. SAGD Commercial Development
SAGD Commercial Development

- 80,000 bbl/d (12,720 m³/d) to be developed in phases, with the first phase planned for 20,000 bbl/d; two additional phases of 30,000 bbl/d each to follow

- Commercial SAGD Application No. 1728831 submitted in Q2 2012 currently under AER review

- BlackPearl is awaiting AER approval
Appendices

1. Pressure & Temperature Data
   • 13-25 WP1
   • 10-36 WP2
   • Heel & Toe Observation Wells