



Blackrod SAGD Pilot Project  
Athabasca Oil Sands Area  
Scheme Approval No. 11522E

2015 Annual Performance Presentation  
Alberta Energy Regulator

February 02, 2016



**Blackrod Subsurface**

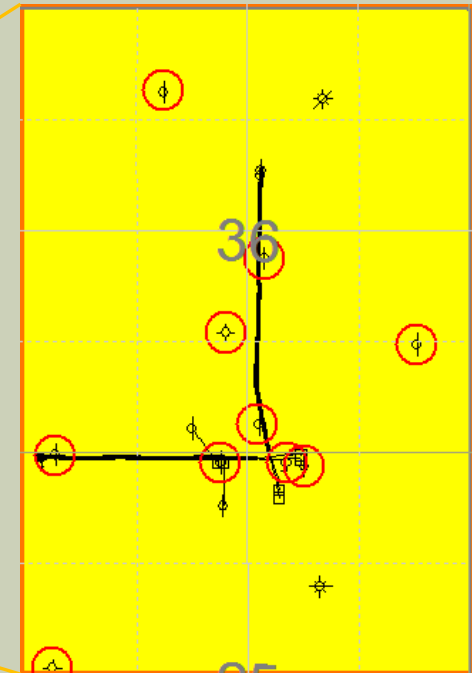
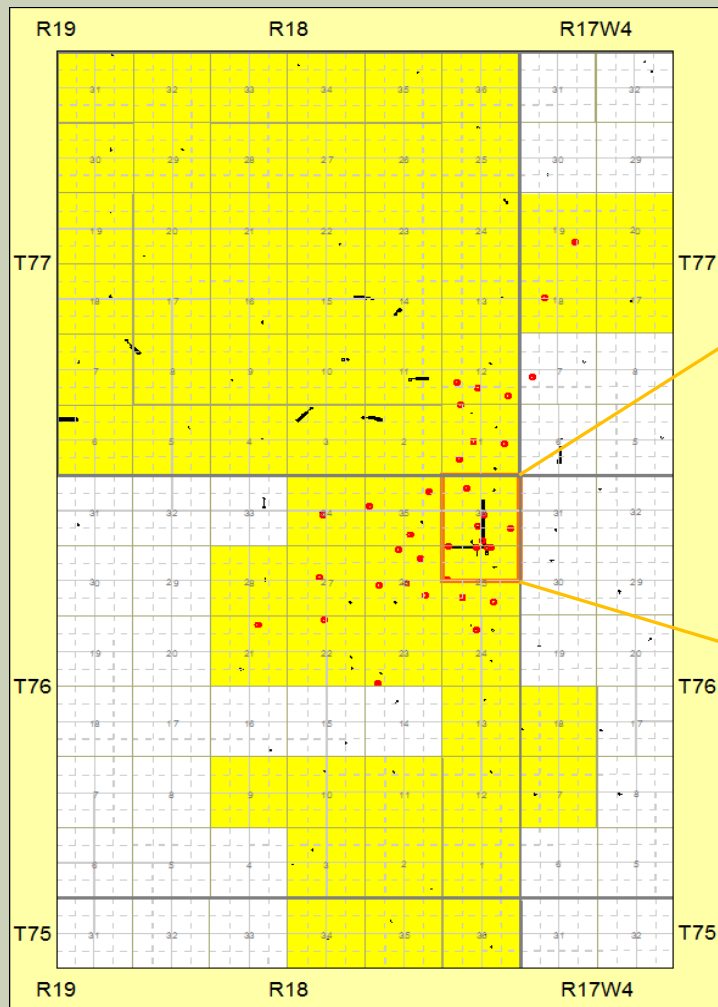
# Subsurface Agenda

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

# Blackrod Subsurface

## 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** 9<sup>th</sup> consecutive month of +500 bopd with an iSOR of <3.0
- **Dec 2015** Produce 265,000 cumulative barrels of oil

## 2. Geology / Geoscience

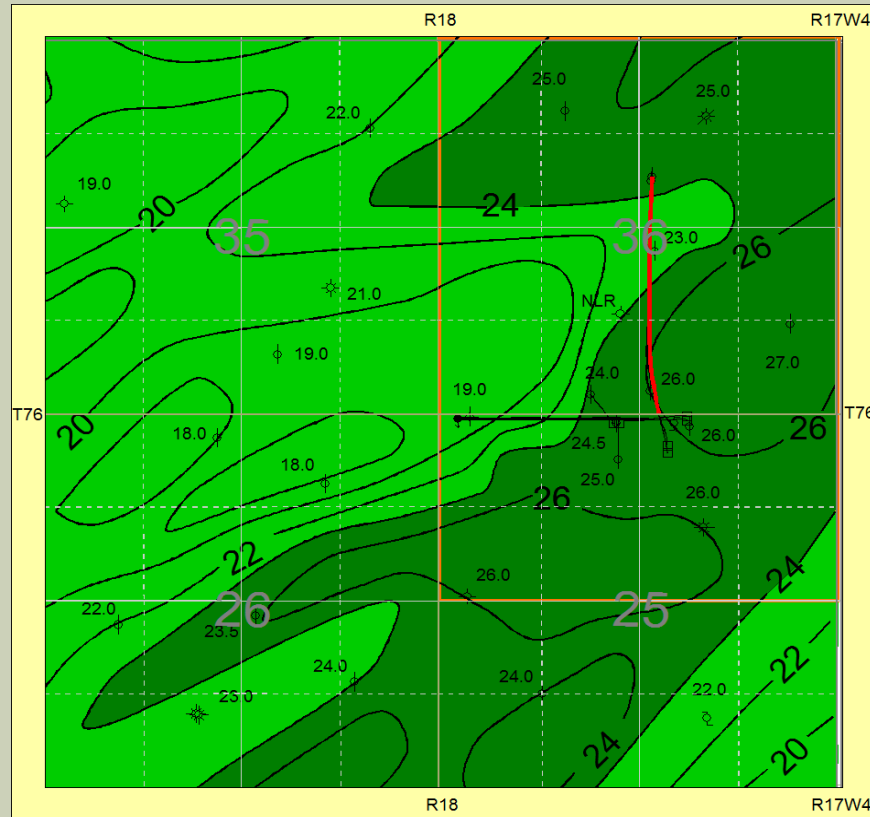
# Original Bitumen in Place

- $OBIP_{WP1} = A_1 * h_1 * So_1 * \phi_1 * Bo$   
 $= (100 \text{ m} * 800 \text{ m}) * 22 \text{ m} * 0.63 * 0.35 * 1.0$   
 $= 388,080 \text{ m}^3$
- $OBIP_{WP2} = A_2 * h_2 * So_2 * \phi_2 * Bo$   
 $= (100 \text{ m} * 1050 \text{ m}) * 25 \text{ m} * 0.63 * 0.34 * 1.0$   
 $= 562,275 \text{ m}^3$

Where:

OBIP =	Original Bitumen In Place
A =	Drainage Area
h =	Thickness
So =	Oil Saturation
$\phi$ =	Average Porosity
Bo =	Expansion Factor
WP1=	1 <sup>st</sup> Pilot Well Pair drilled at 13-25-076-18W4
WP2=	2 <sup>nd</sup> Pilot Well Pair drilled at 10-36-076-18W4

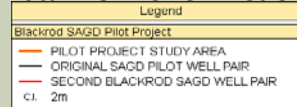
# Lower Grand Rapids (L. GR) Net Pay Map



## LOG CUTOFFS

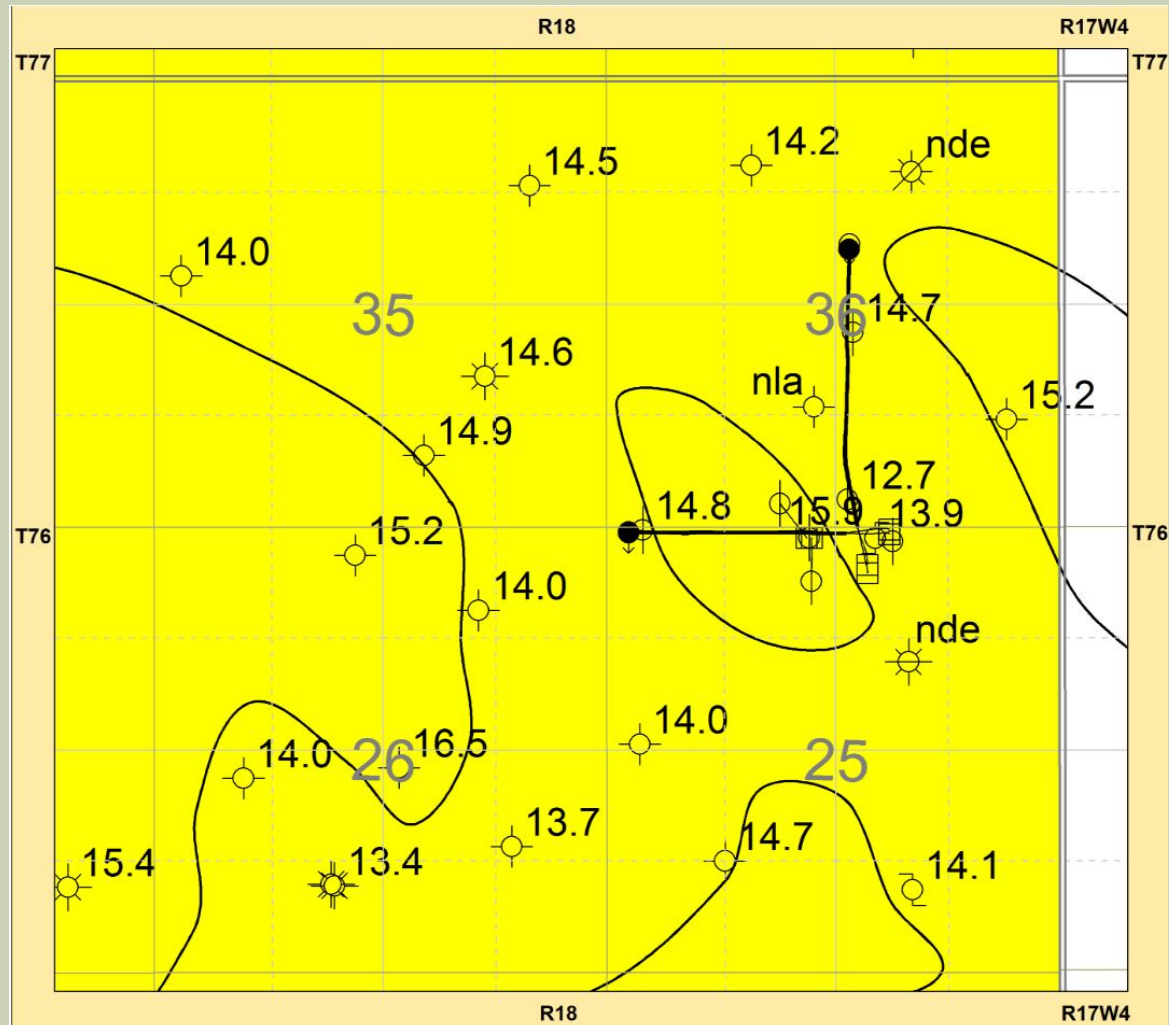
- Gamma Ray < 75 API
- Resistivity > 20 Ohm.m
- Porosity > 33%

## Total L.GR1 SAGD Net Oil Pay



- 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

# L. GR Unit 3 Bottom Water Isopach Map

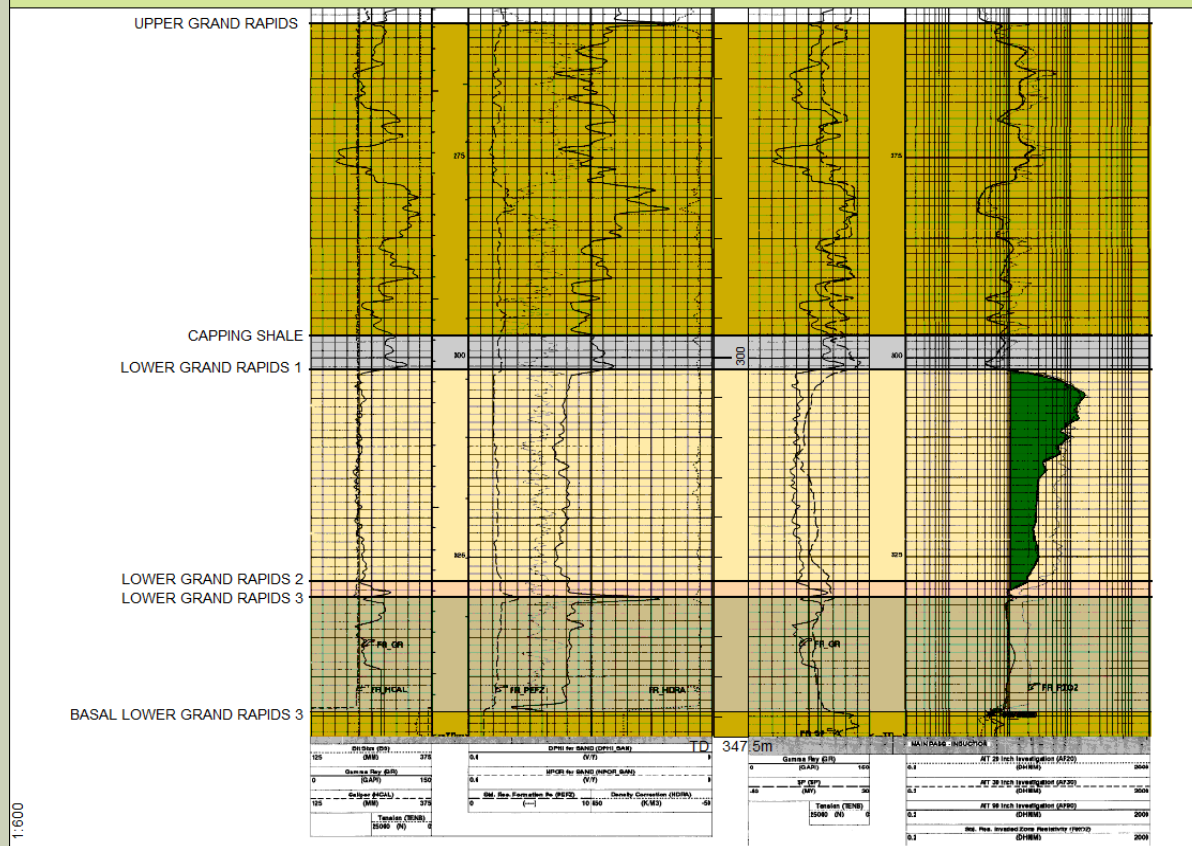


# Type Log

100/15-25-076-18W4/00

+618.2 m 2010/10/28

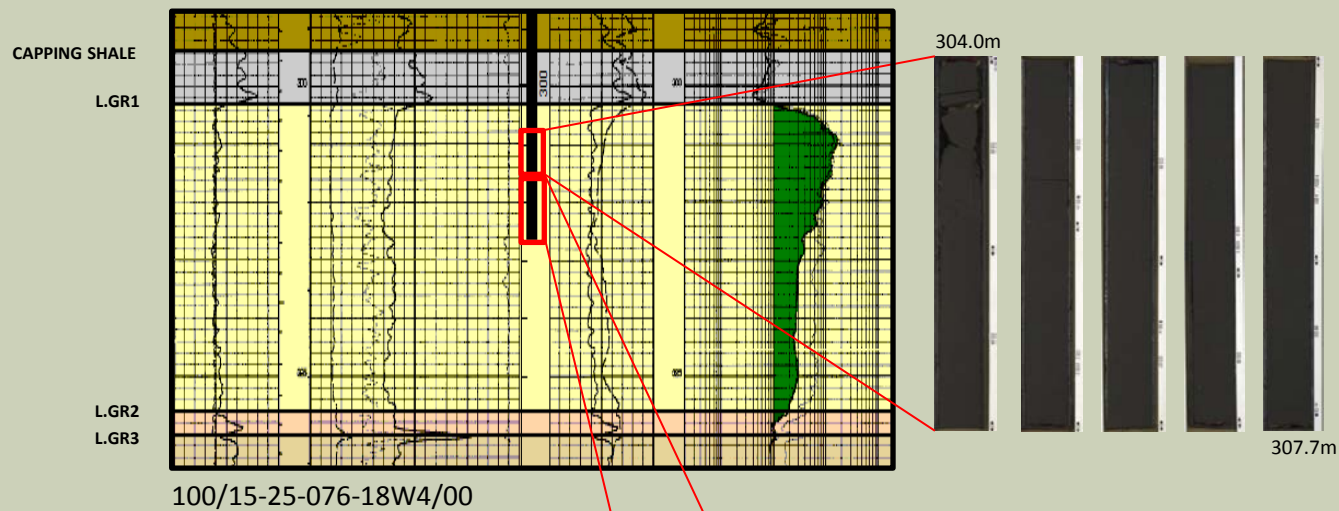
BRI PORTAGE 15-25-76-18



## LOG CUTOFFS

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

# Representative Core

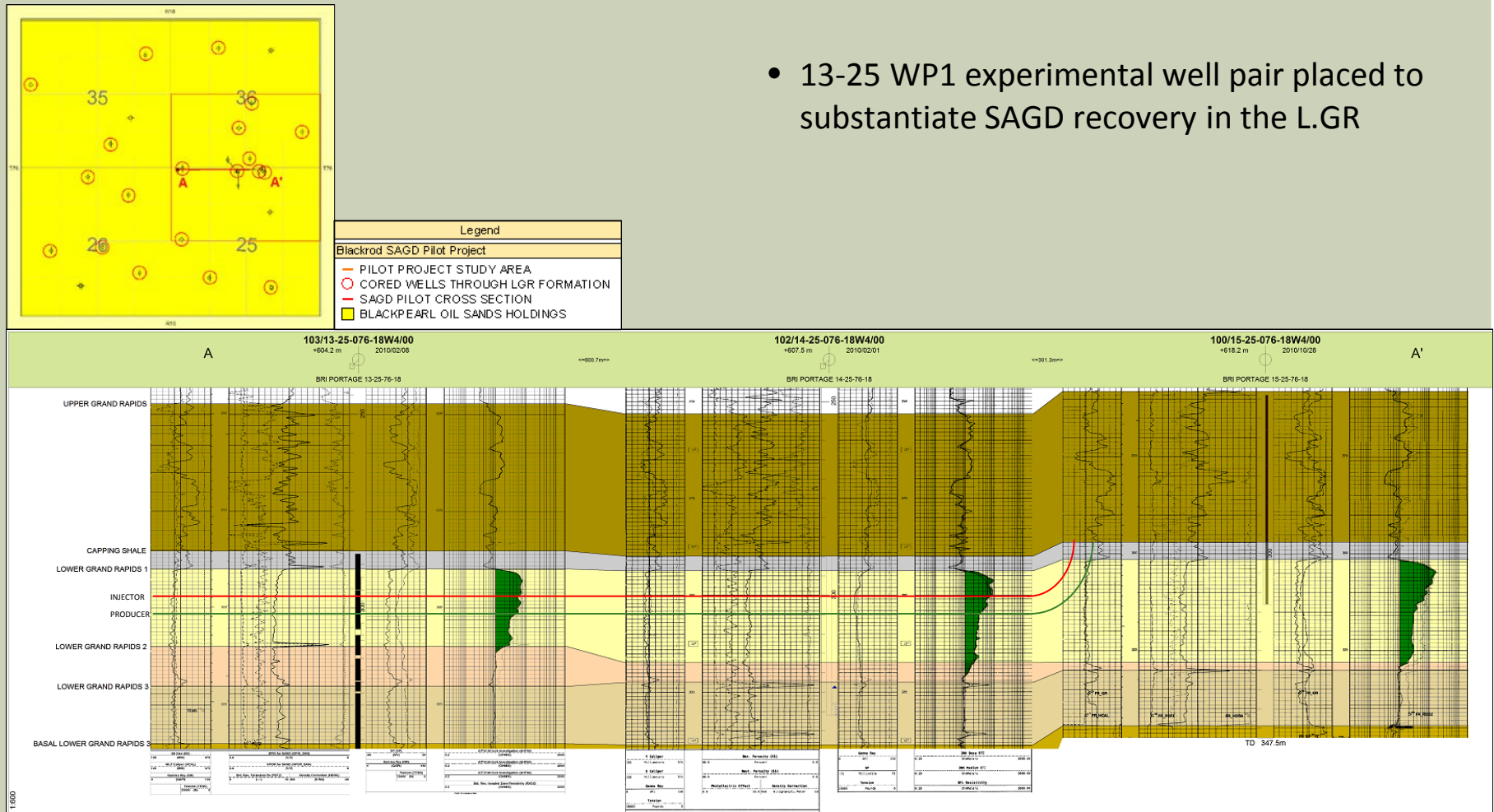


## L.GR1\* Core Characteristics:

- 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)

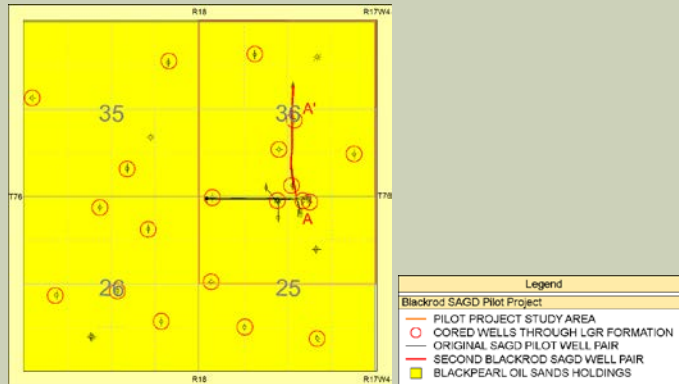
# Cross Section Through 13-25 WP1

- 13-25 WP1 experimental well pair placed to substantiate SAGD recovery in the L.GR

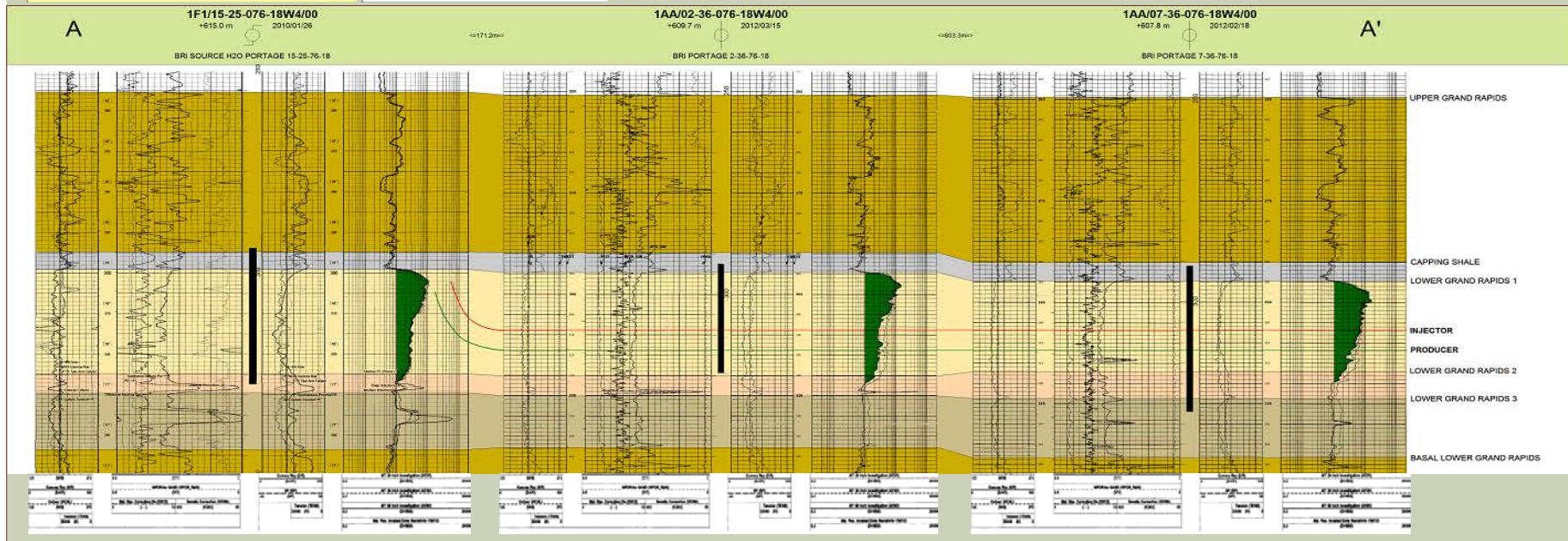




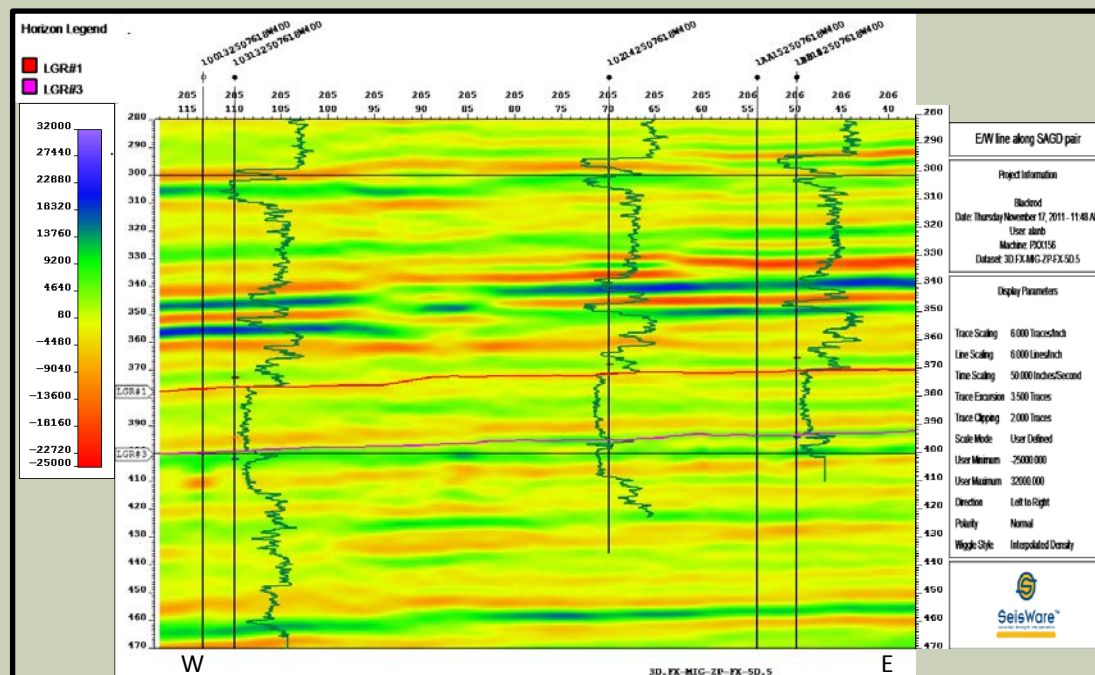
# Cross Section Through 10-36 WP2



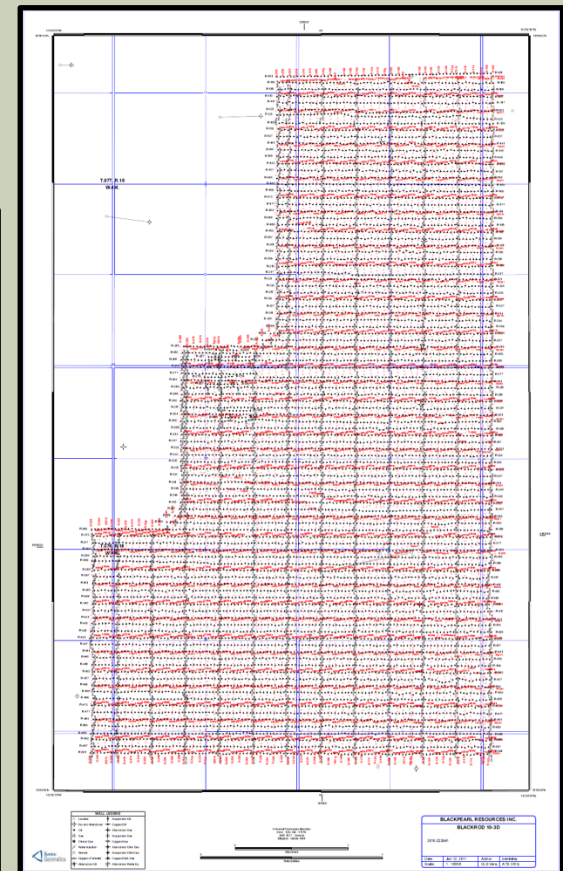
- To maximize oil recoveries, 10-36 WP2 placed deeper and drilled longer than 13-25 WP1



# Seismic

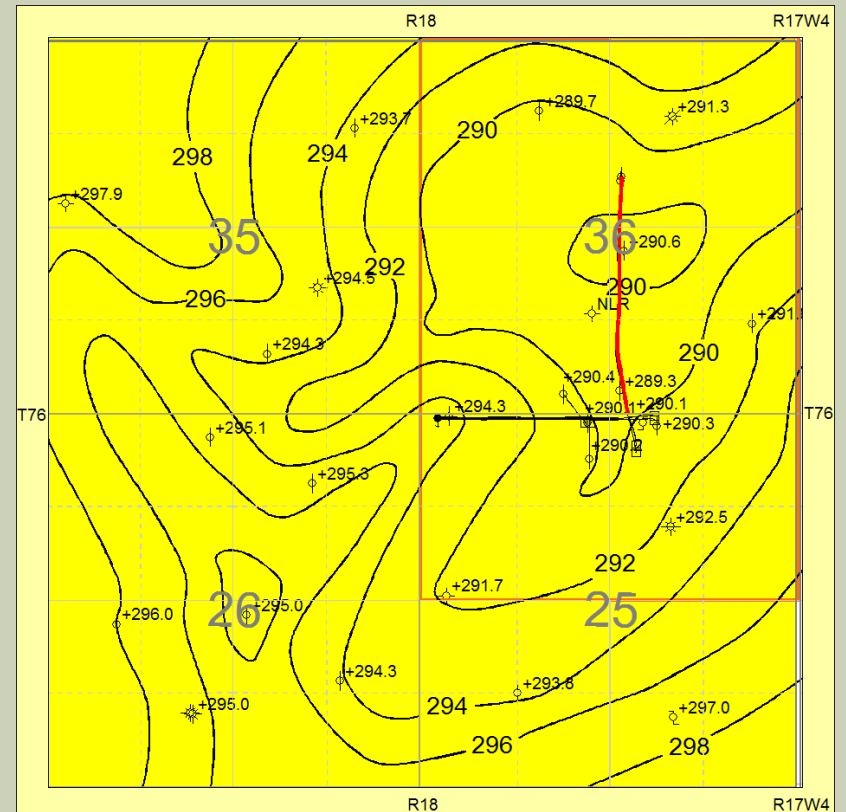
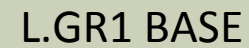


3D X-Line along 13-25 WP1



3D Seismic Area Coverage

L.GR1 TOP



**Legend**

Blackrod SAGD Pilot Project

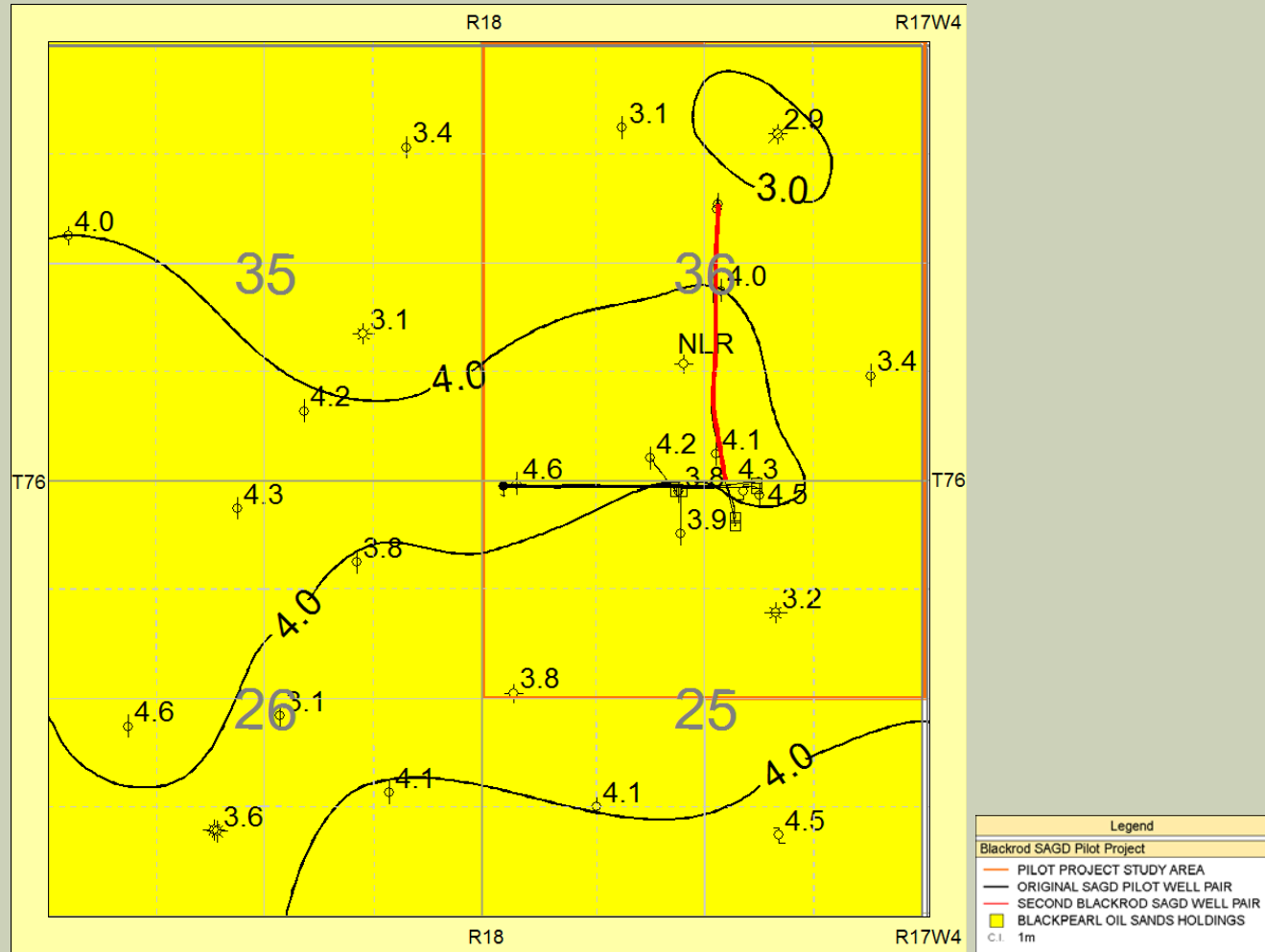
- PILOT PROJECT STUDY AREA
- ORIGINAL SAGD PILOT WELL PAIR
- SECOND BLACKROD SAGD WELL PAIR
- BLACKPEARL OIL SANDS HOLDINGS

C.I. 2m

# Primary Cap Rock

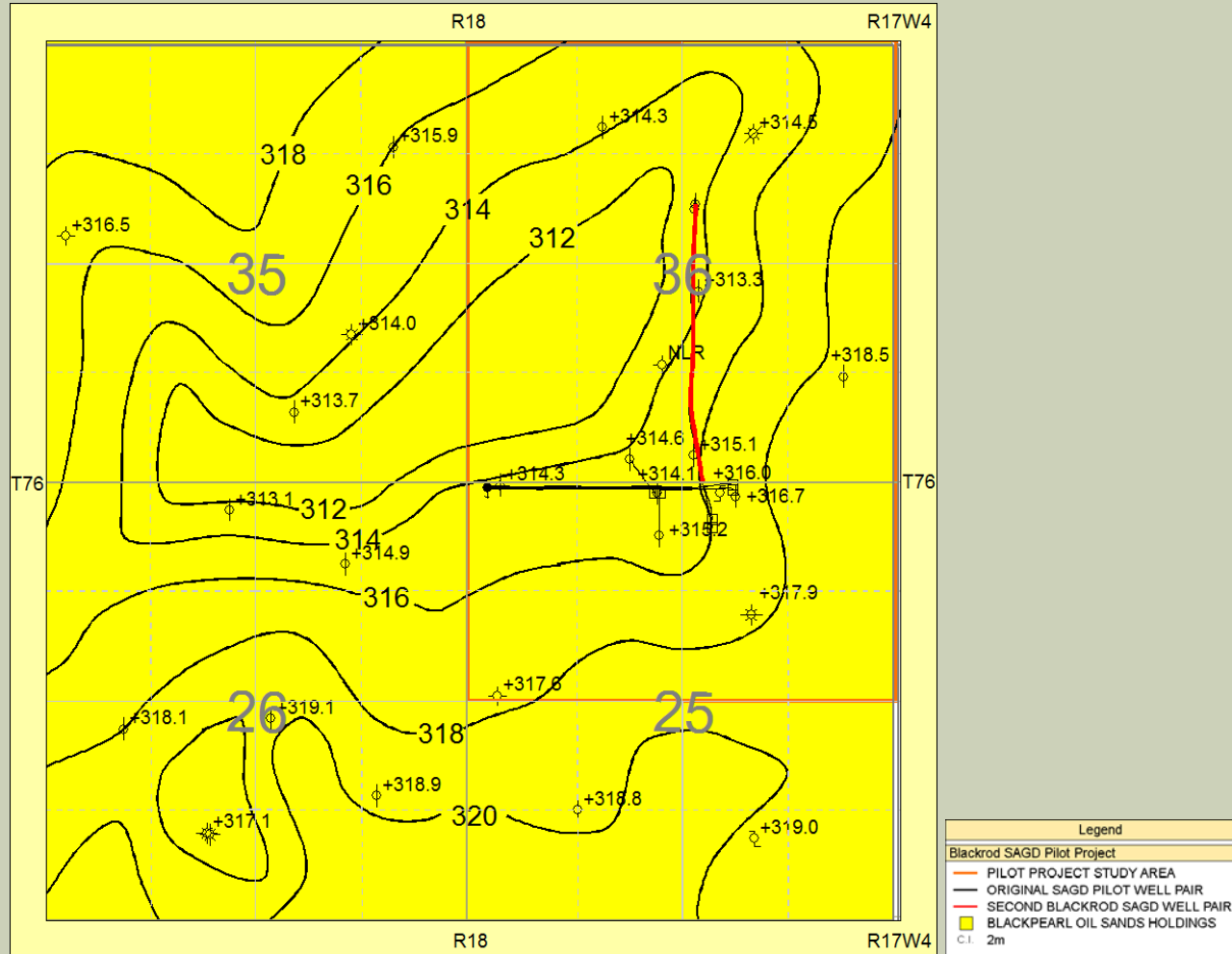
- MFS (Maximum Flooding Shale)
- Directly overlays Lower Grand Rapids formation
- Regionally extensive
- 3 m average thickness
- Mini Frac Analysis:
  - Performed on the 13-25-076-18W4 OSE Core Hole
  - Initial Breakdown Pressure = 8500 kPa
  - Closure Pressure Gradient = 13.7 kPa/m

# MFS Cap Rock Isopach Map

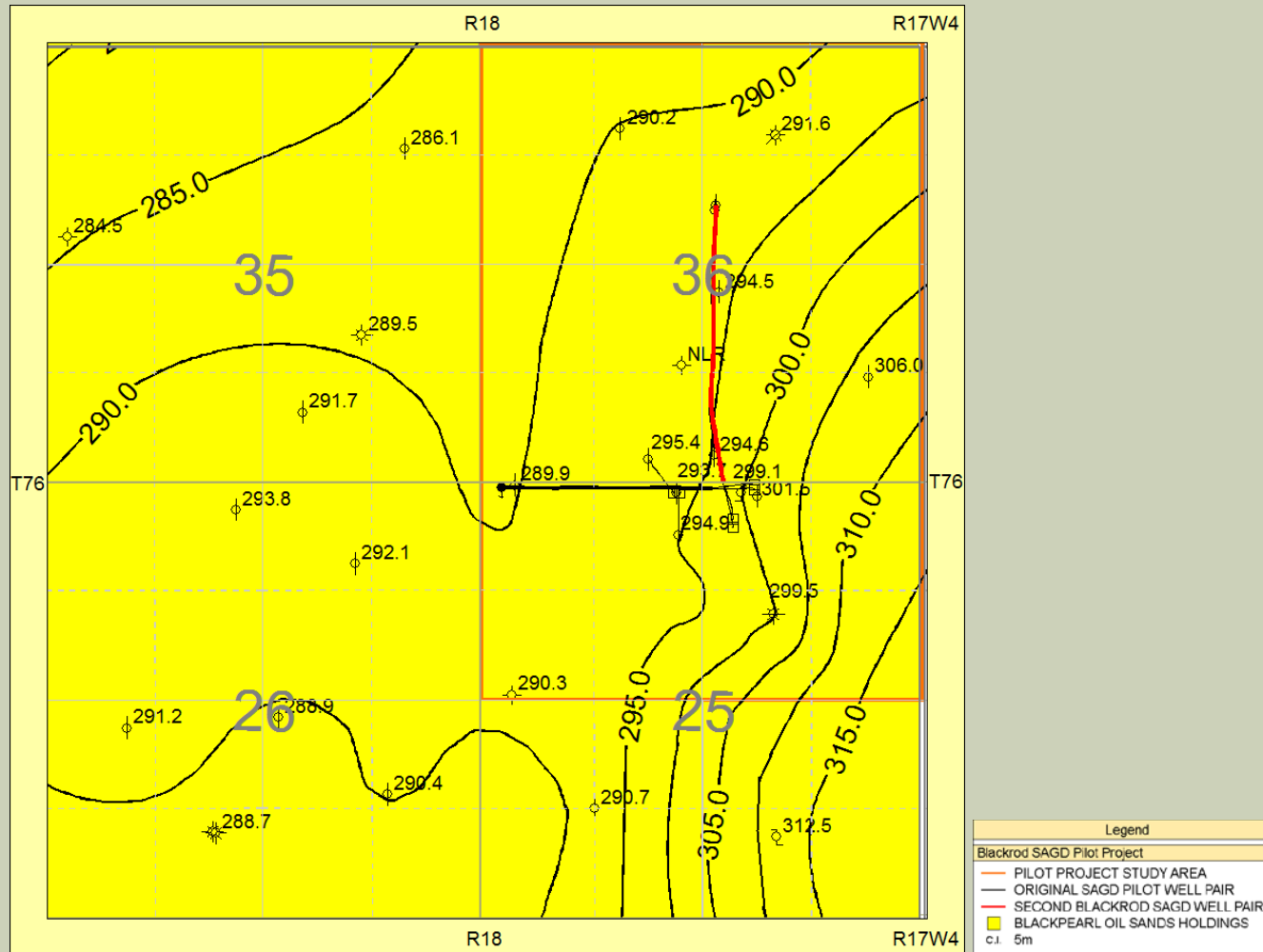




# MFS Cap Rock Structure Map



# MFS Cap Rock Base Depth Map



# Secondary Cap Rock

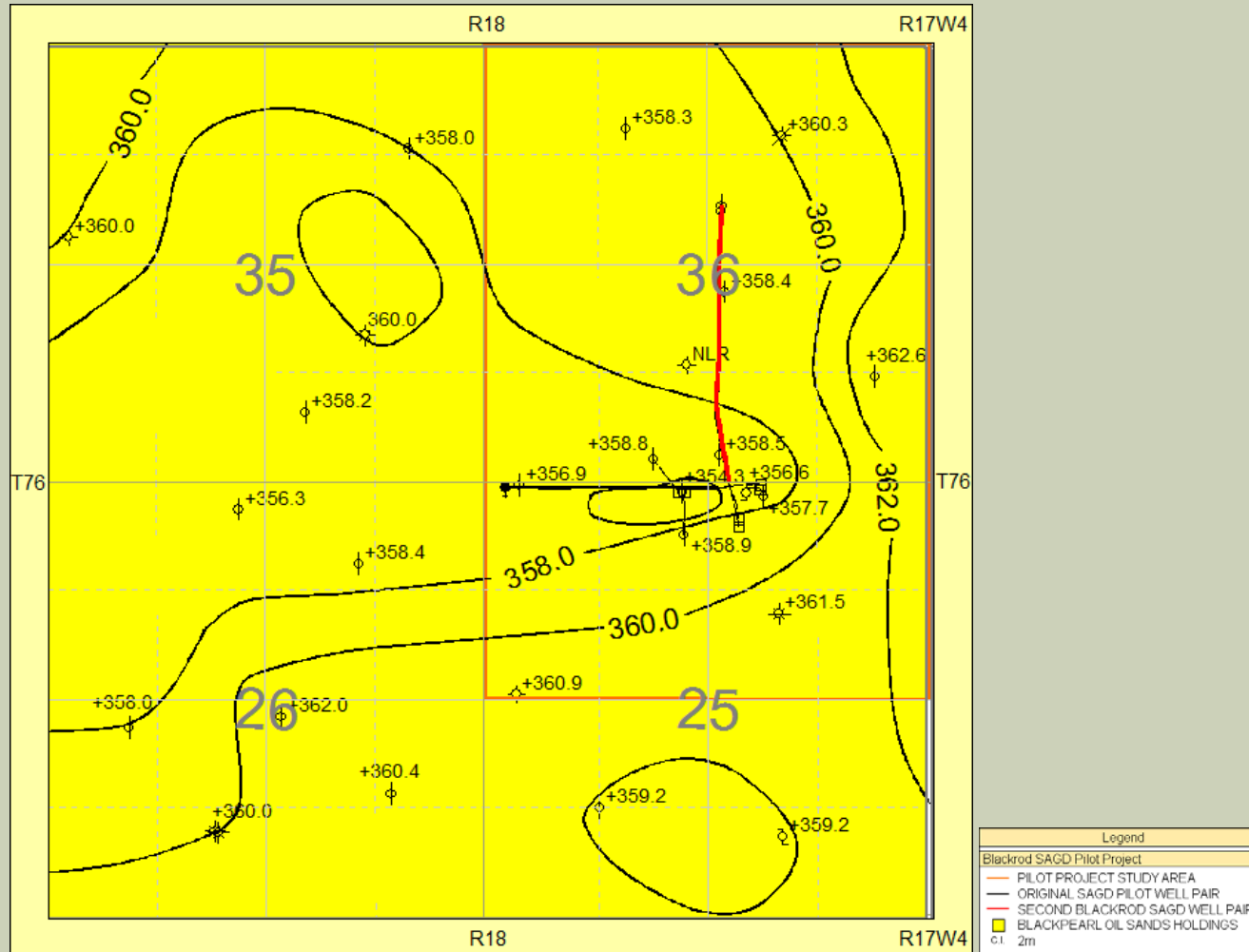
- Joli Fou formation
- 45 m above Lower Grand Rapids formation
- Regionally extensive
- 20 m average thickness
- Mini Frac Analysis:
  - Performed on the 01-36-076-18W4 OSE Core Hole
  - Initial Breakdown Pressure = 12,750 kPa
  - Closure Pressure Gradient Range = 19.4 kPa/m



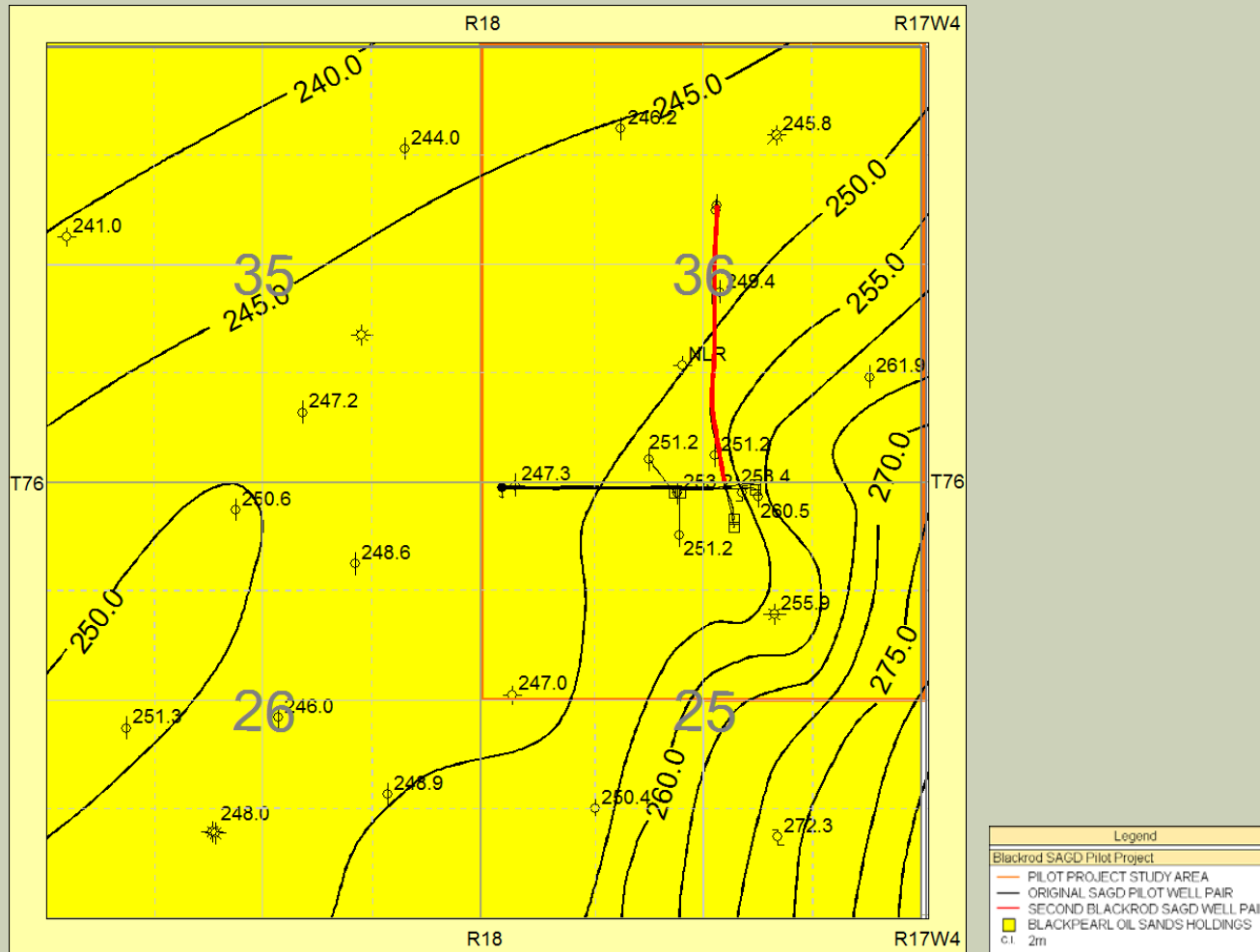
## 25



# Joli Fou Cap Rock Structure Map

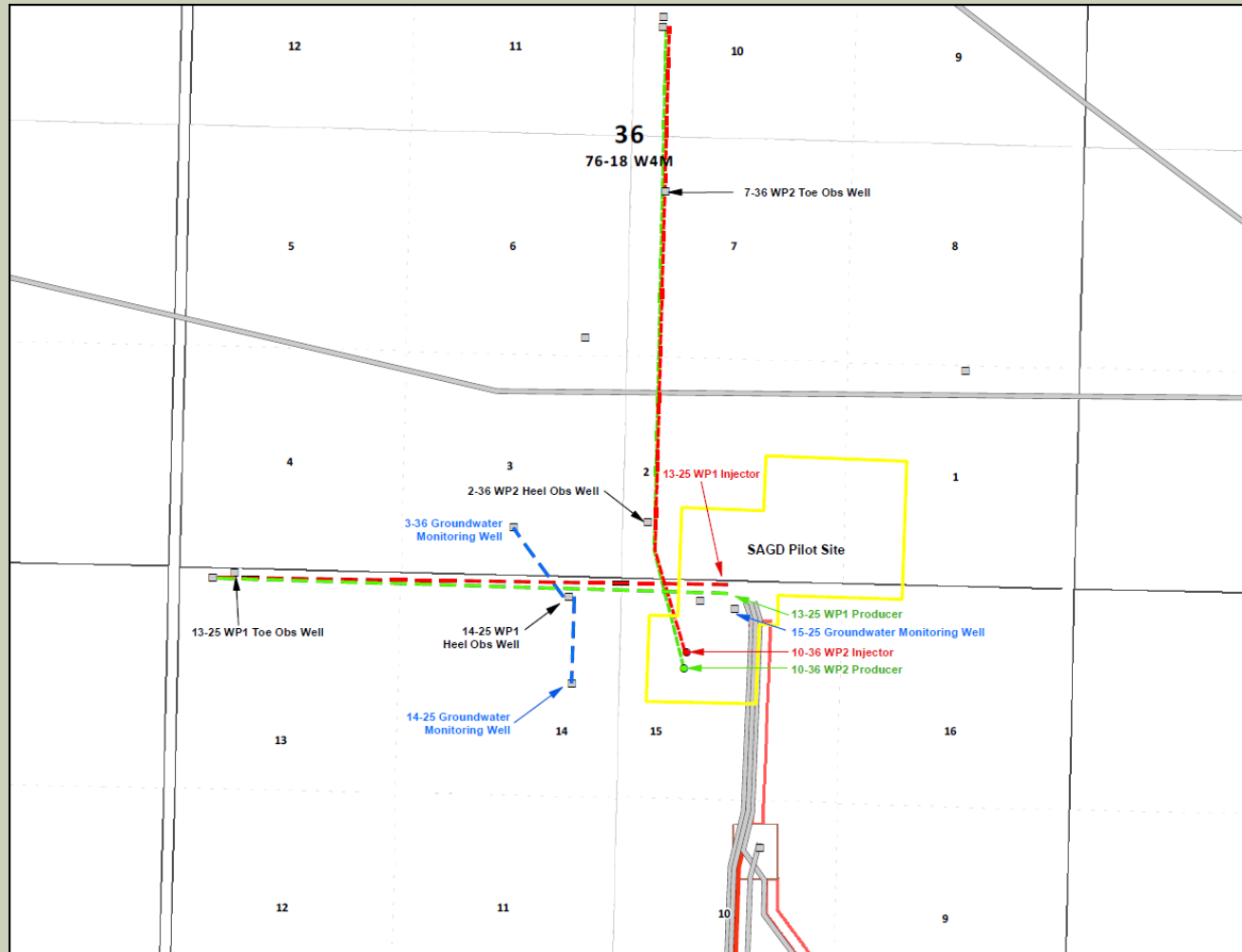


# Joli Fou Cap Rock Base Depth Map



## 3. Drilling and Completions

# Blackrod Pilot Well Network

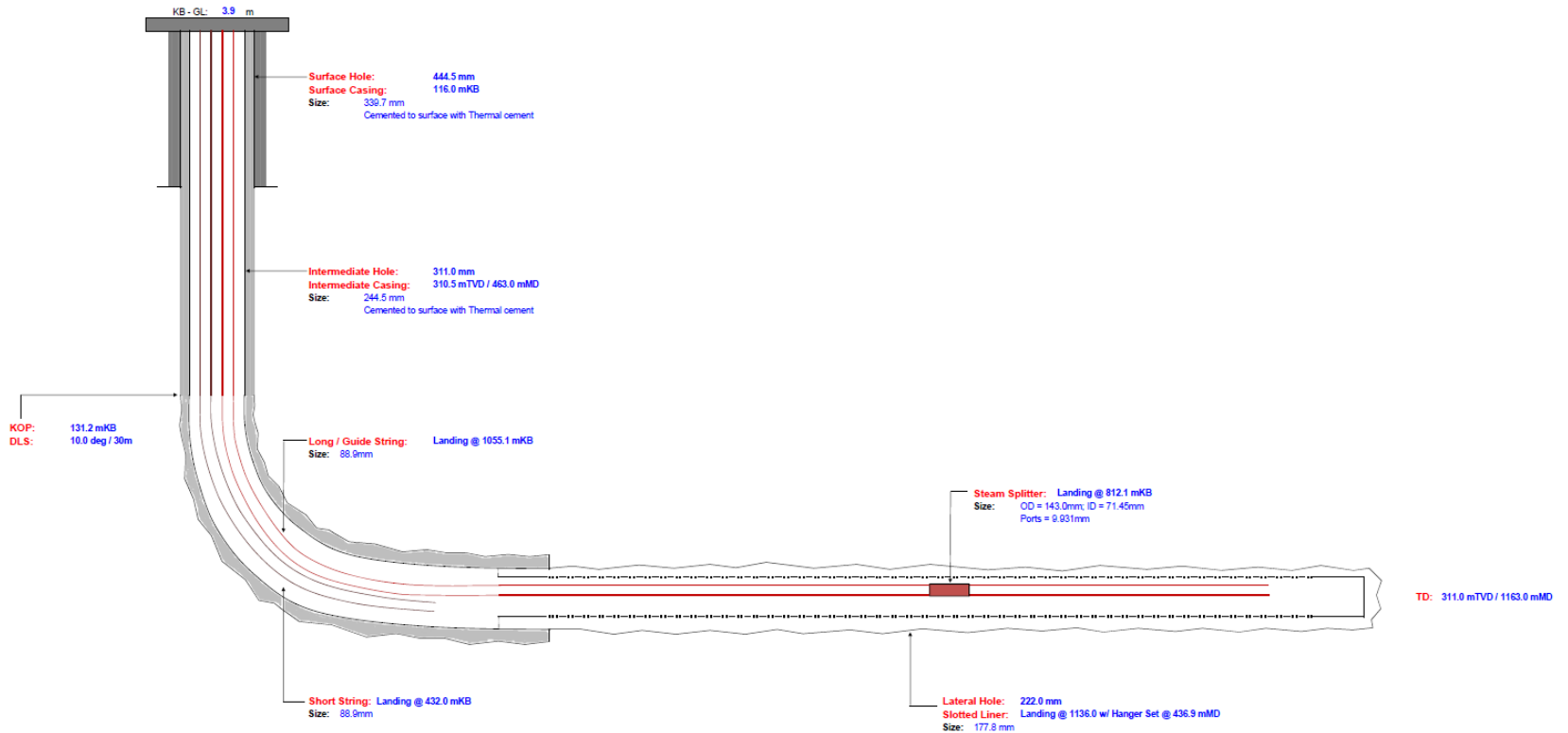


# 13-25 WP1 - Injector

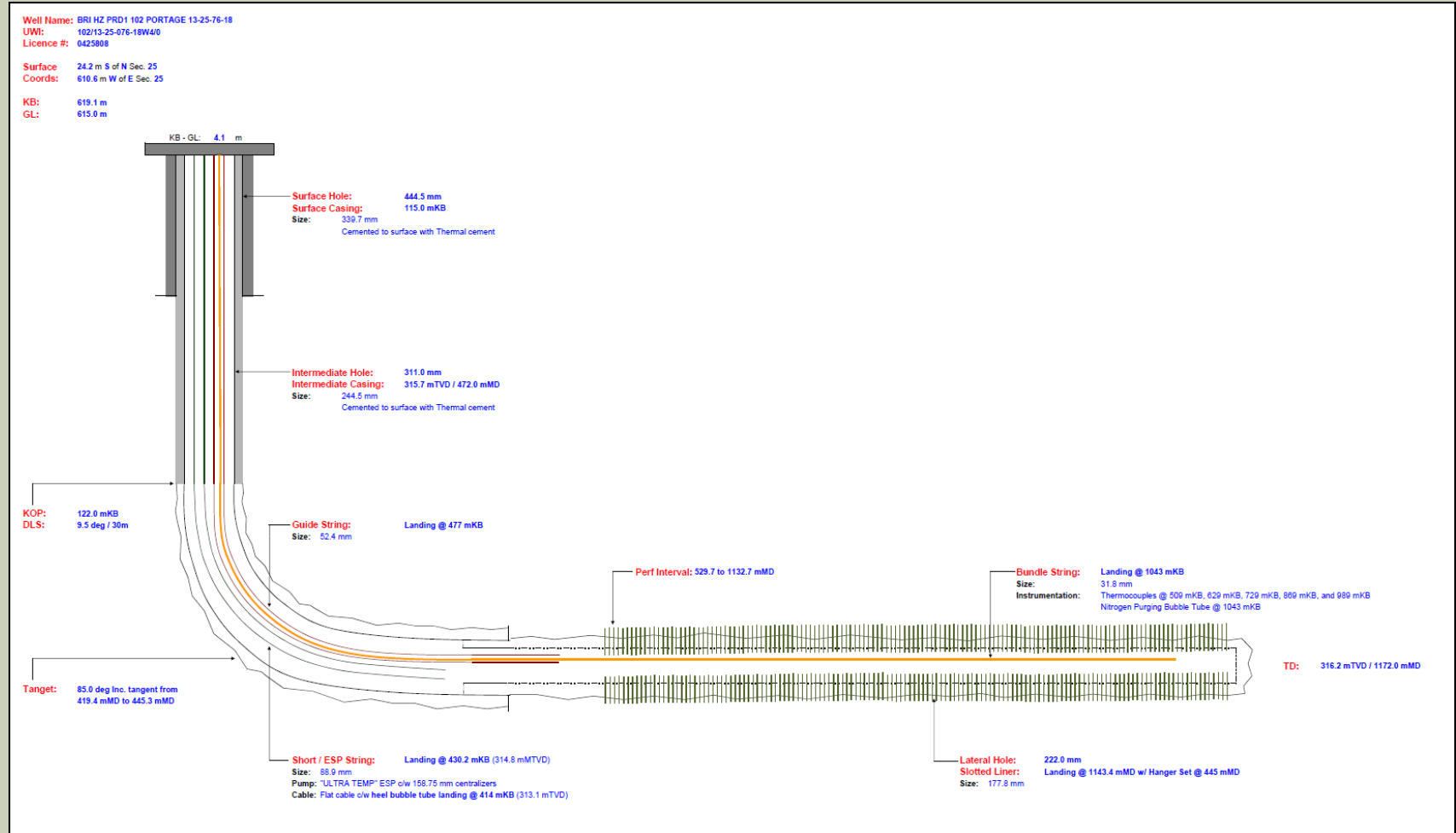
Well Name: BRI HZ INJ1 100 PORTAGE 13-25-76-18  
 UWI: 100/13-25-076-18W40  
 Licence #: 0425796

Surface: 8.4 m S of N Sec. 25  
 Coords: 610.3 m W of E Sec. 25

KB: 619.00 m  
 GL: 615.10 m



# 13-25 WP1 – Producer (Prod. Phase)



# 13-25 WP1 – Downhole Modifications

- Injector Well:
  - No modifications
- Producer Well:
  - No modifications

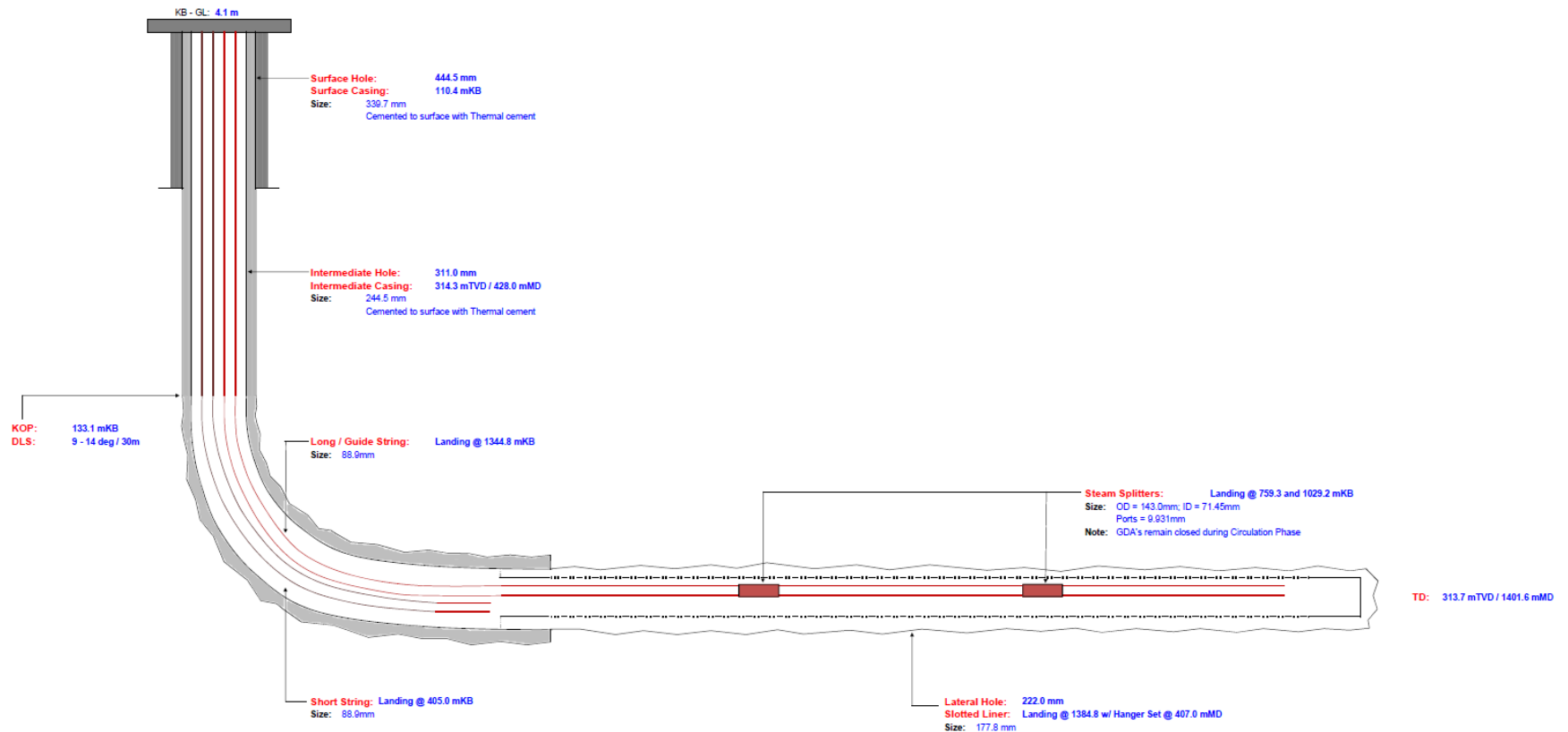


# 10-36 WP2 - Injector

Well Name: BRI HZ INJ2 102 PORTAGE 10-36-76-18  
 UWI: 102/10-36-076-18W40  
 Licence #: 0453330

Surface: 134.8 m S of N Sec. 25  
 Coords: 690.3 m W of E Sec. 25

KB: 617.1 m  
 GL: 613.0 m

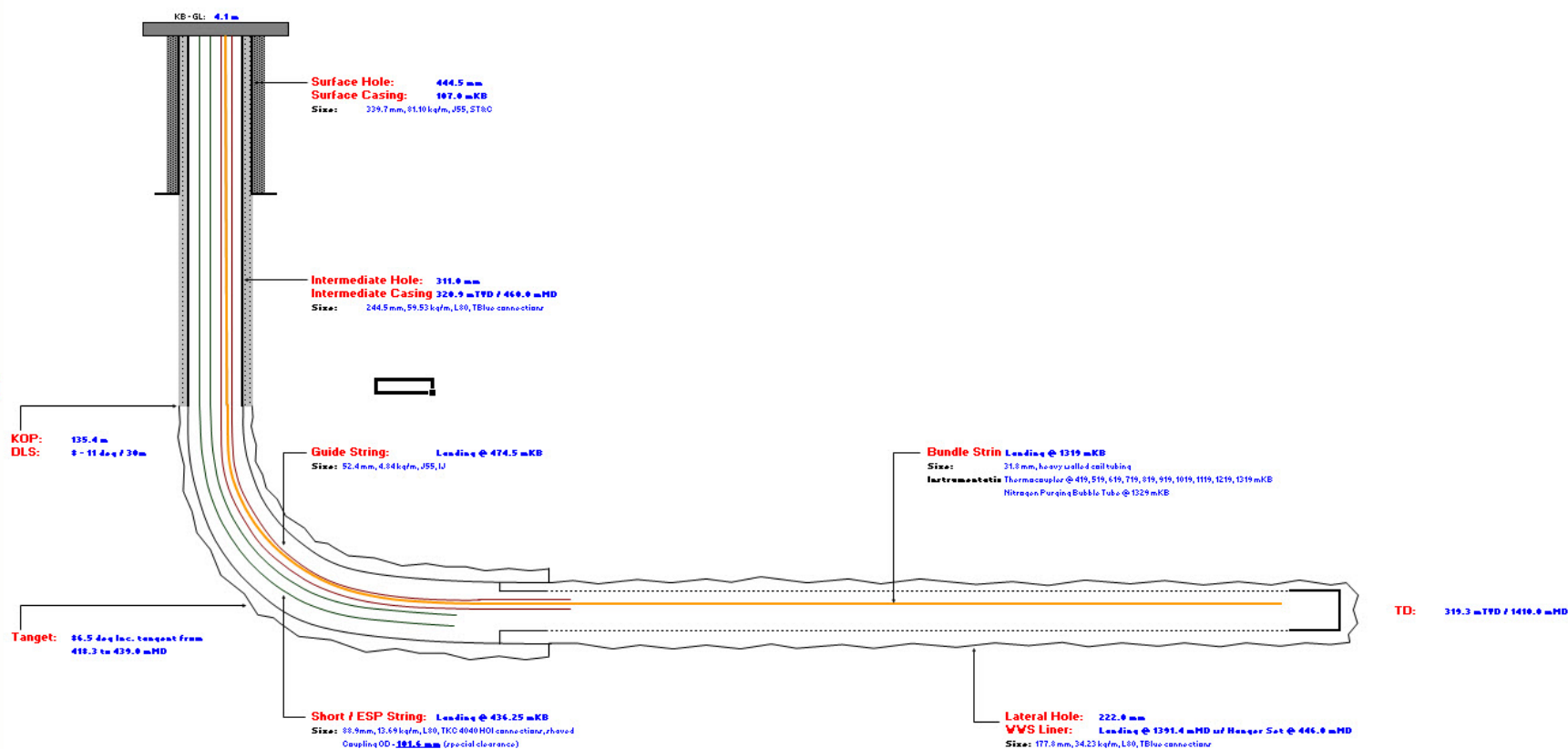


# 10-36 WP2 – Producer (Prod. Phase)

Well Name: BRN HZ PRD2 100 PORTAGE 10-36-76-10  
 UWI: 100/10-36-076-10W410  
 Licence # 6453203

Surface: 164.8 m S of H Sec. 25  
 Coords: 699.6 m W of E Sec. 25

KB: 617.3 m  
 GL: 613.2 m



# 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

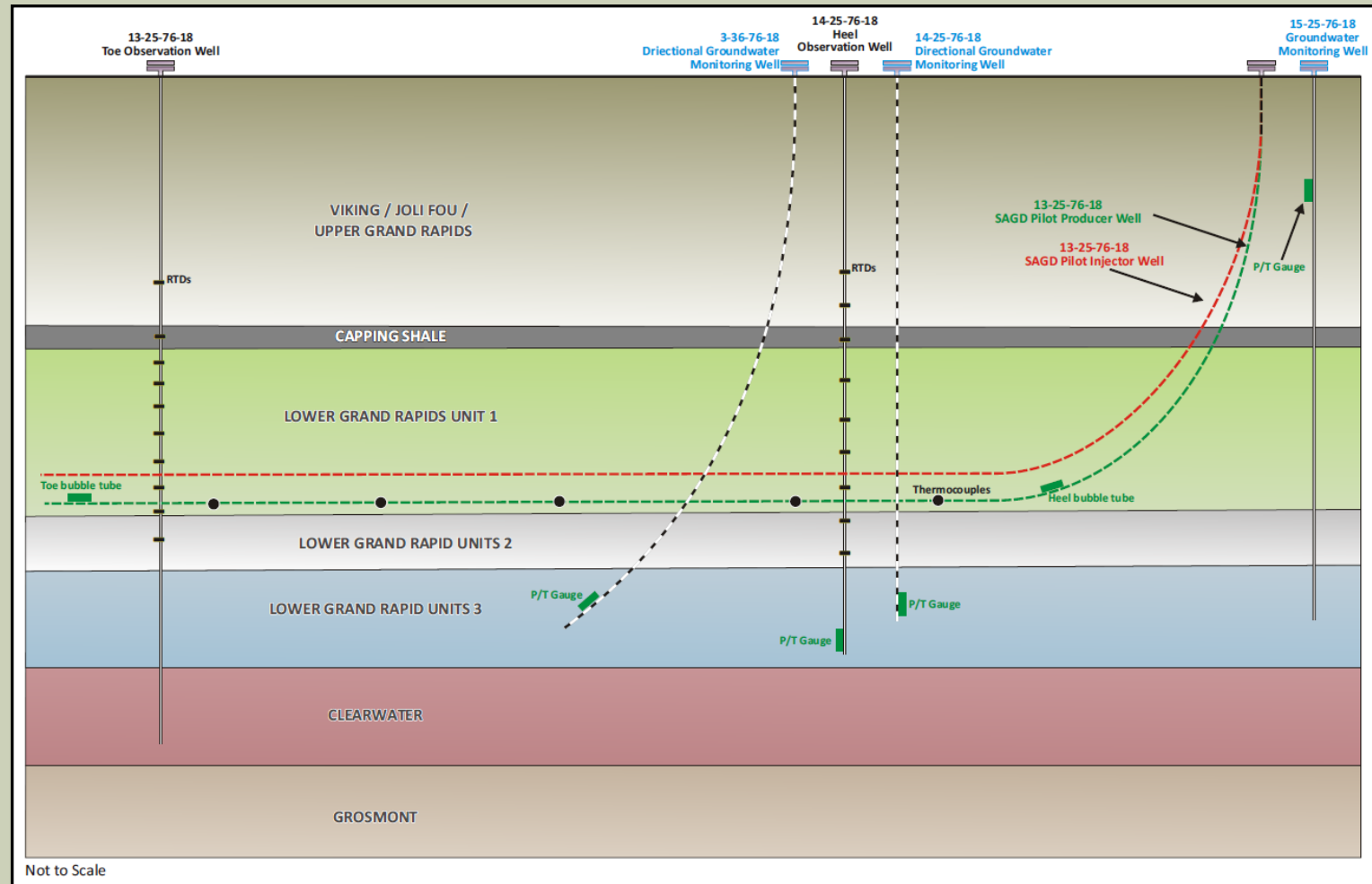
- Fluid production via “Ultra Temp” Electrical Submersible Pumps (ESP) on both 13-25 WP1 and 10-36 WP2
- ESP advantages:
  - Operate and lift fluids at controlled downhole pressures
  - Maintain continuous fluid production
- Variable Flow Drive (VFD) utilized to control pump speed and production rates
- 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

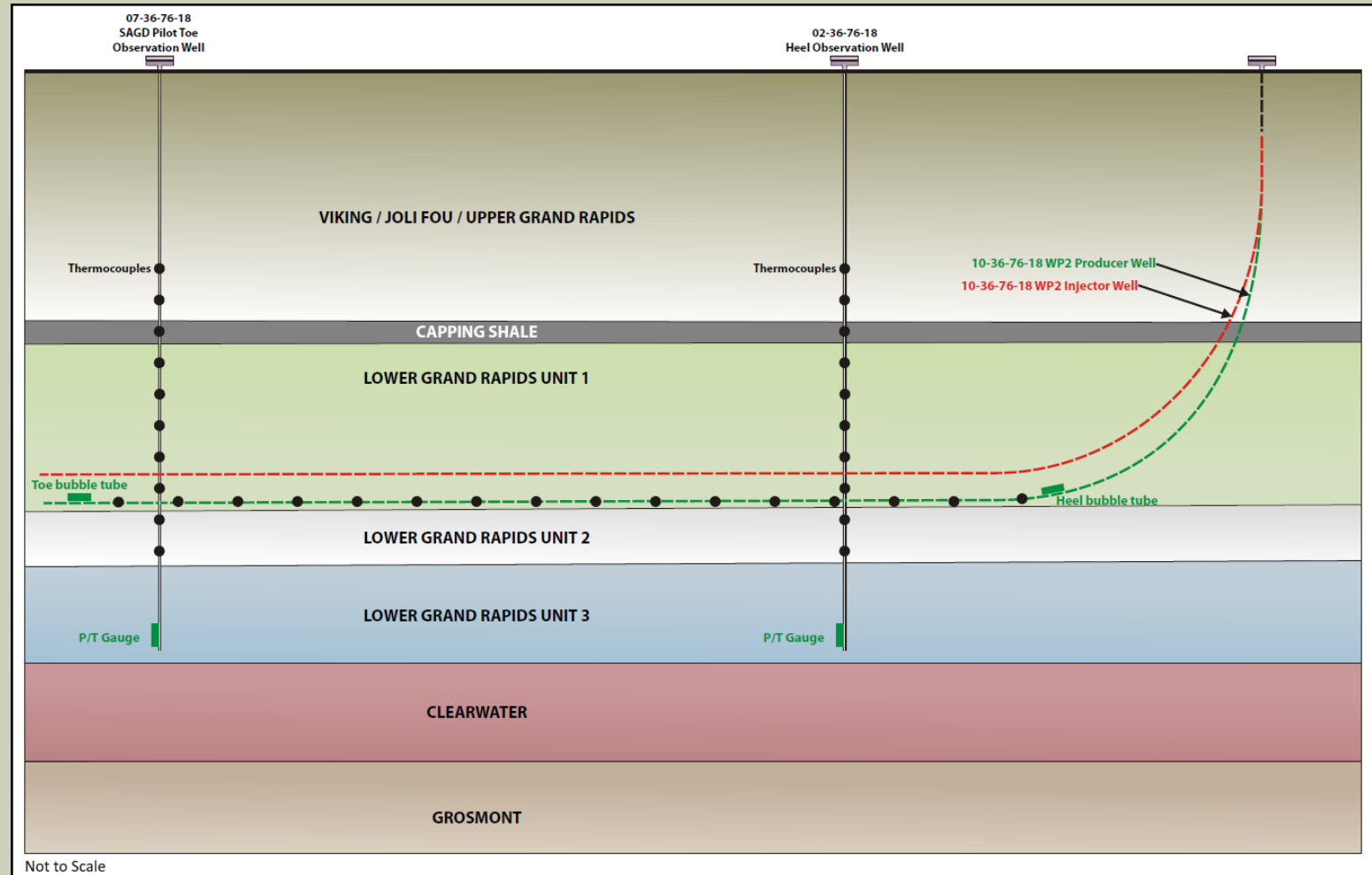
- Toe Obs Well:

- 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

# 10-36 WP2 – Instrumentation Overview



# Groundwater Monitoring Wells

- 100/03-36-076-18W4 GWM:
  - Directionally drilled from 14-25 lease
  - PCP to sample/analyze non-saline L.GR3 H<sub>2</sub>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 H<sub>2</sub>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 H<sub>2</sub>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

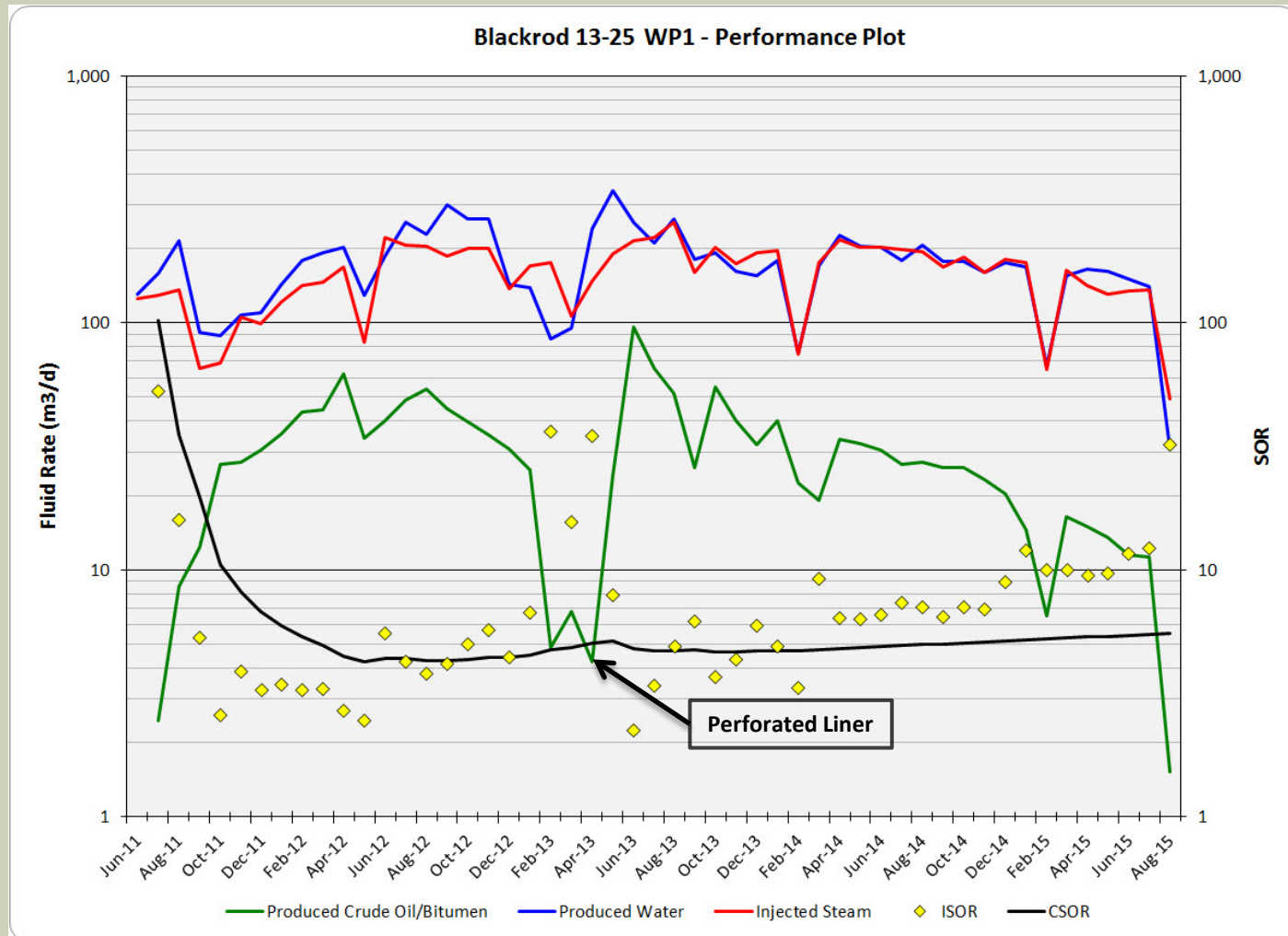
- Cumulative Production = 45,500 m<sup>3</sup>
- Recovery to Date = 11.7%
- Ultimate Recovery = 20 - 25% (lower due to 13-25 WP1 well placement)
- CSOR including Circ. Phase = 5.4
- CSOR during Prod. Phase only = 5.2
- Average Rate during Prod. Phase = 31.6 m<sup>3</sup>/day
- Max Rate during Prod. Phase = 96 m<sup>3</sup>/day



## 13-25 WP1 Steam Injection as of Aug 31, 2015

- Average Steam Chamber Pressure = 2400 kPa
- Average Surface Steam Temperature = 265 °C
- Wellhead Steam Quality = 95 – 100%

# 13-25 WP1 Performance Plot



## 10-36 WP2 Performance as of Dec 31, 2015

- 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 m<sup>3</sup>/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

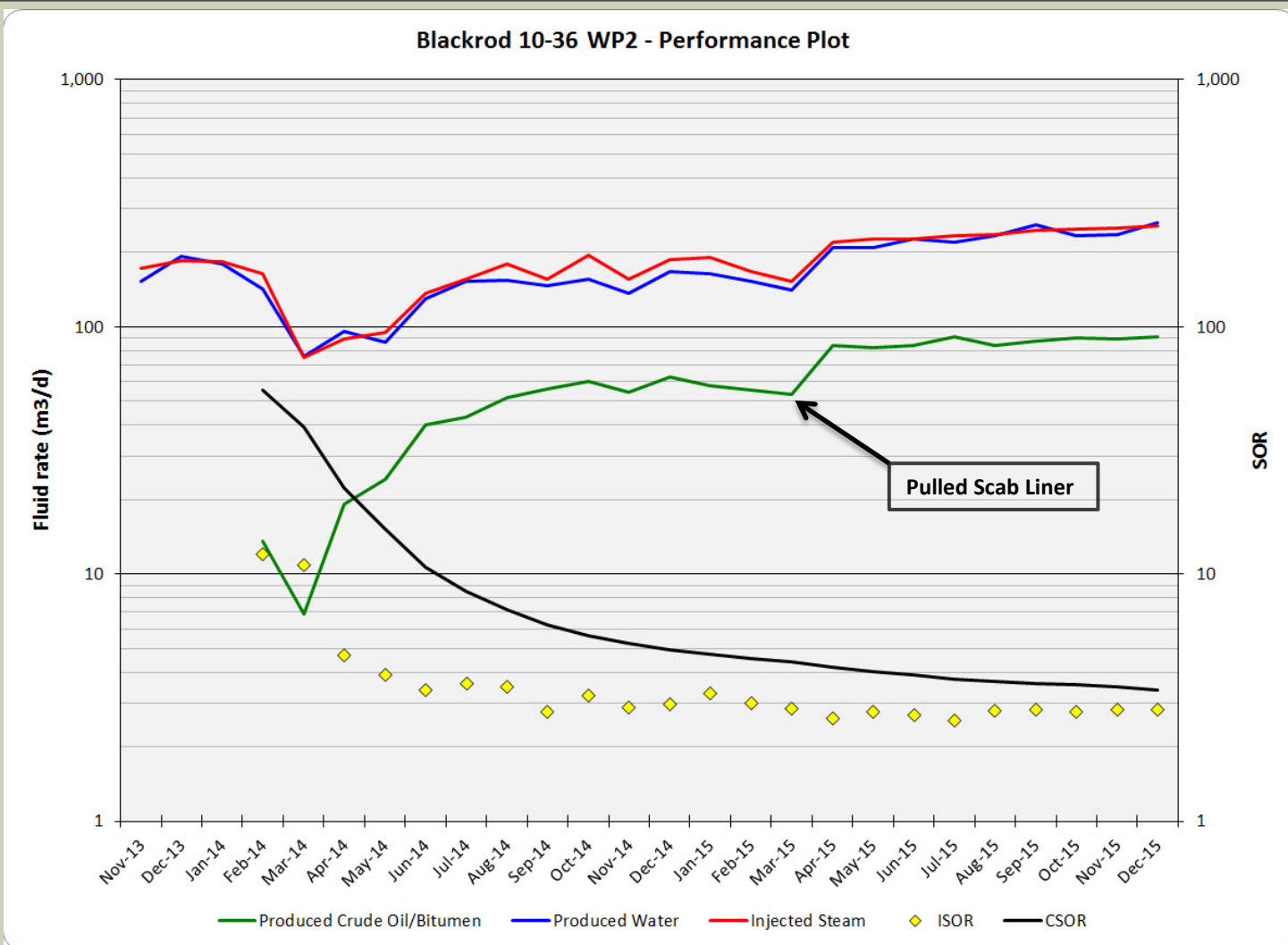
## 10-36 WP2 Oil Production as of Dec 31, 2015

- Cumulative Production = 42,000 m<sup>3</sup>
- 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 m<sup>3</sup>/day (404 bopd)
- Current Rate = 90 m<sup>3</sup>/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







## Blackrod Surface Operations

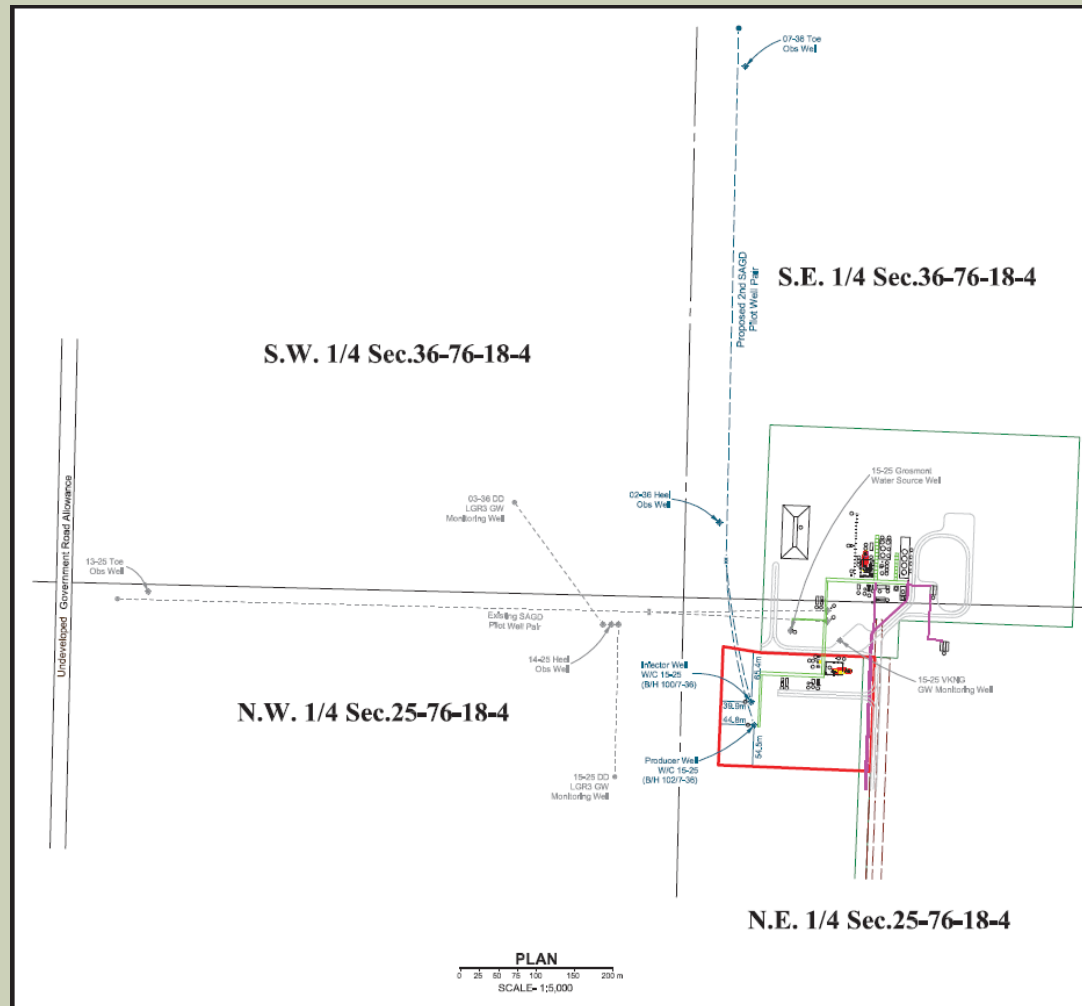
# Surface Operations Agenda

1. Facilities
2. Measurement & Reporting
3. Water Source
4. Disposal
5. Environmental
6. Compliance Statement

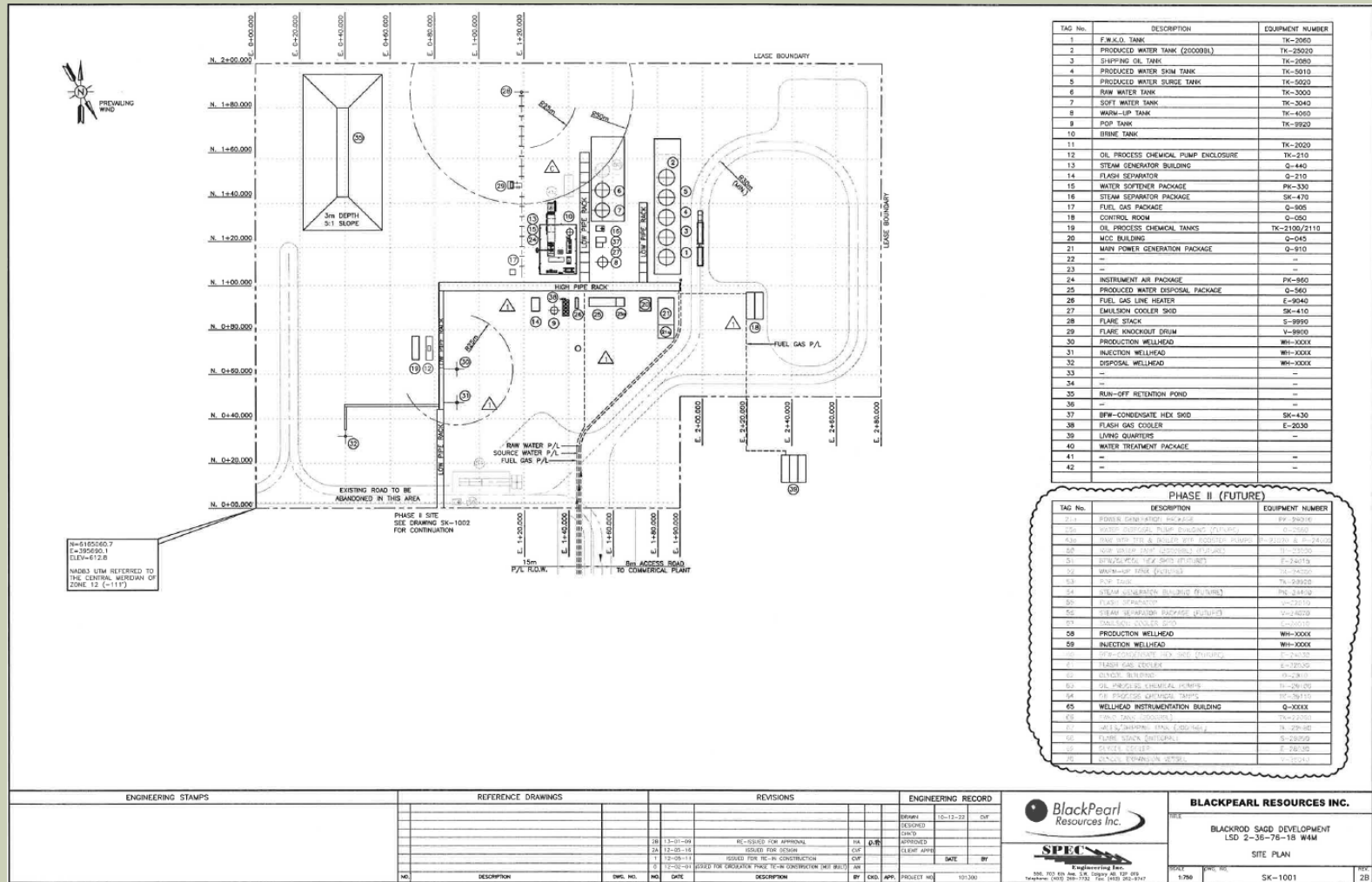
# Blackrod Surface Operations

## 1. Facilities

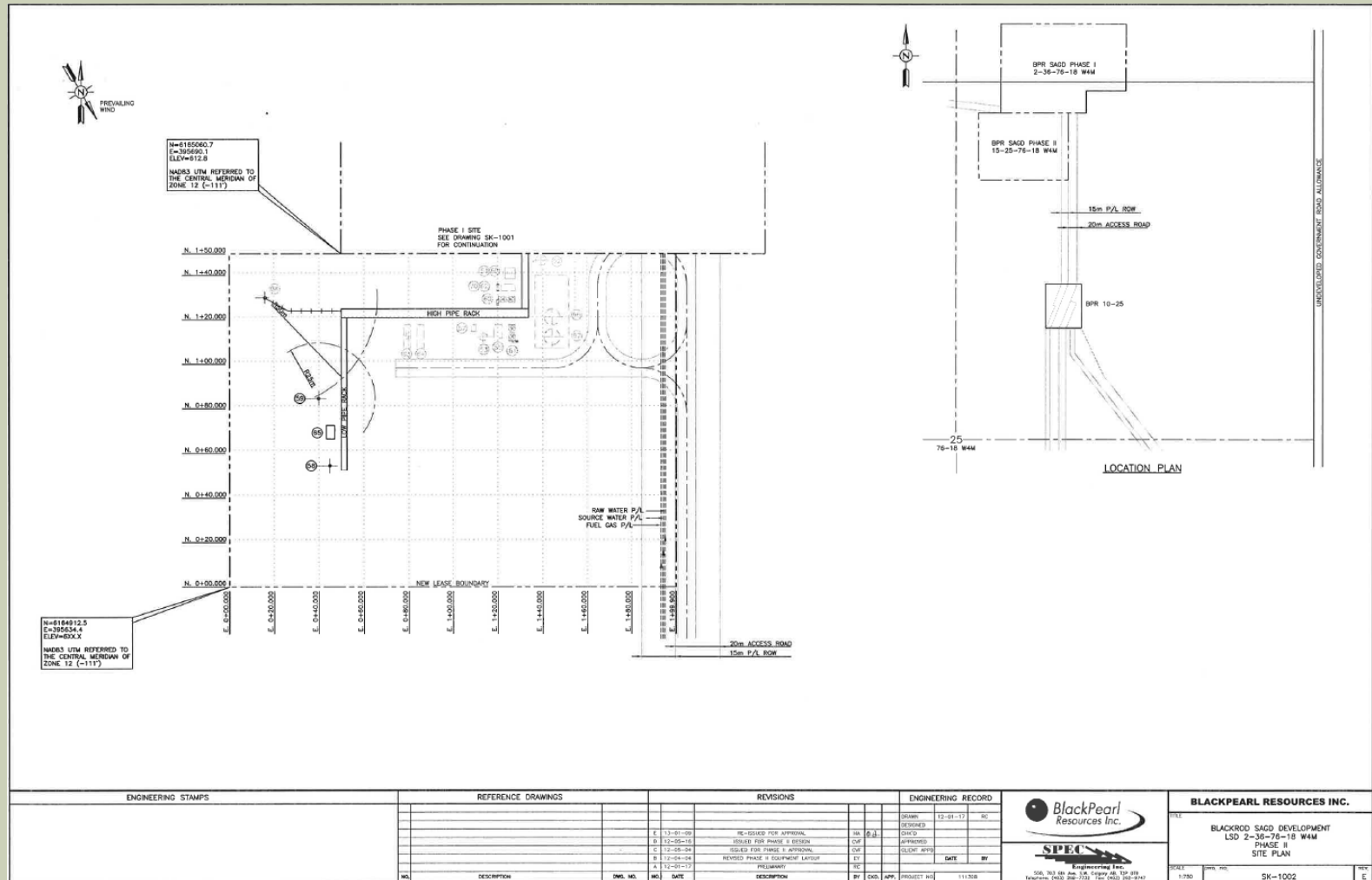
# Pilot Facility Overview



# Pilot Facility Plot Plan



# Pilot Facility Plot Plan (cont.)



# 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
- SO<sub>2</sub> & NO<sub>x</sub> 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



# Blackrod Surface Operations

## 2. Measurement & Reporting

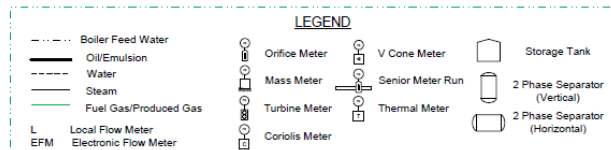
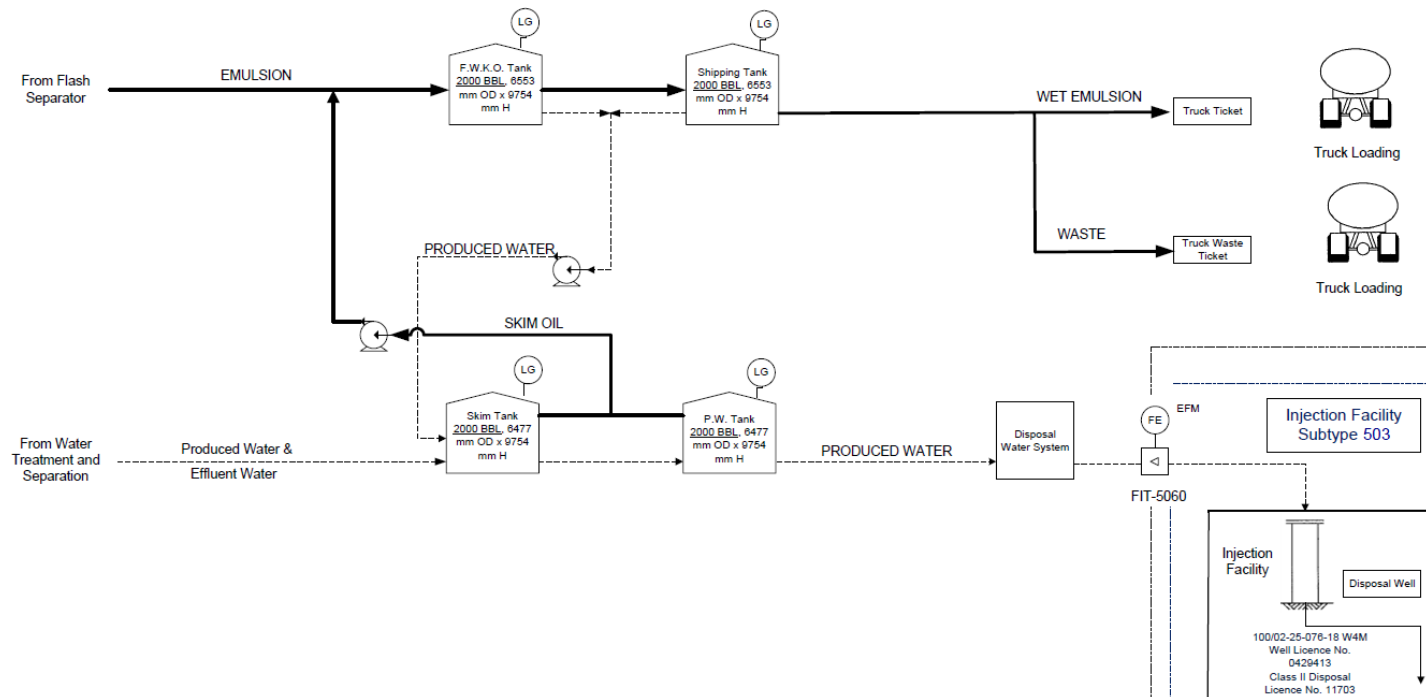
# Blackrod MARP

- 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

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# Process Flow Diagram (cont.)

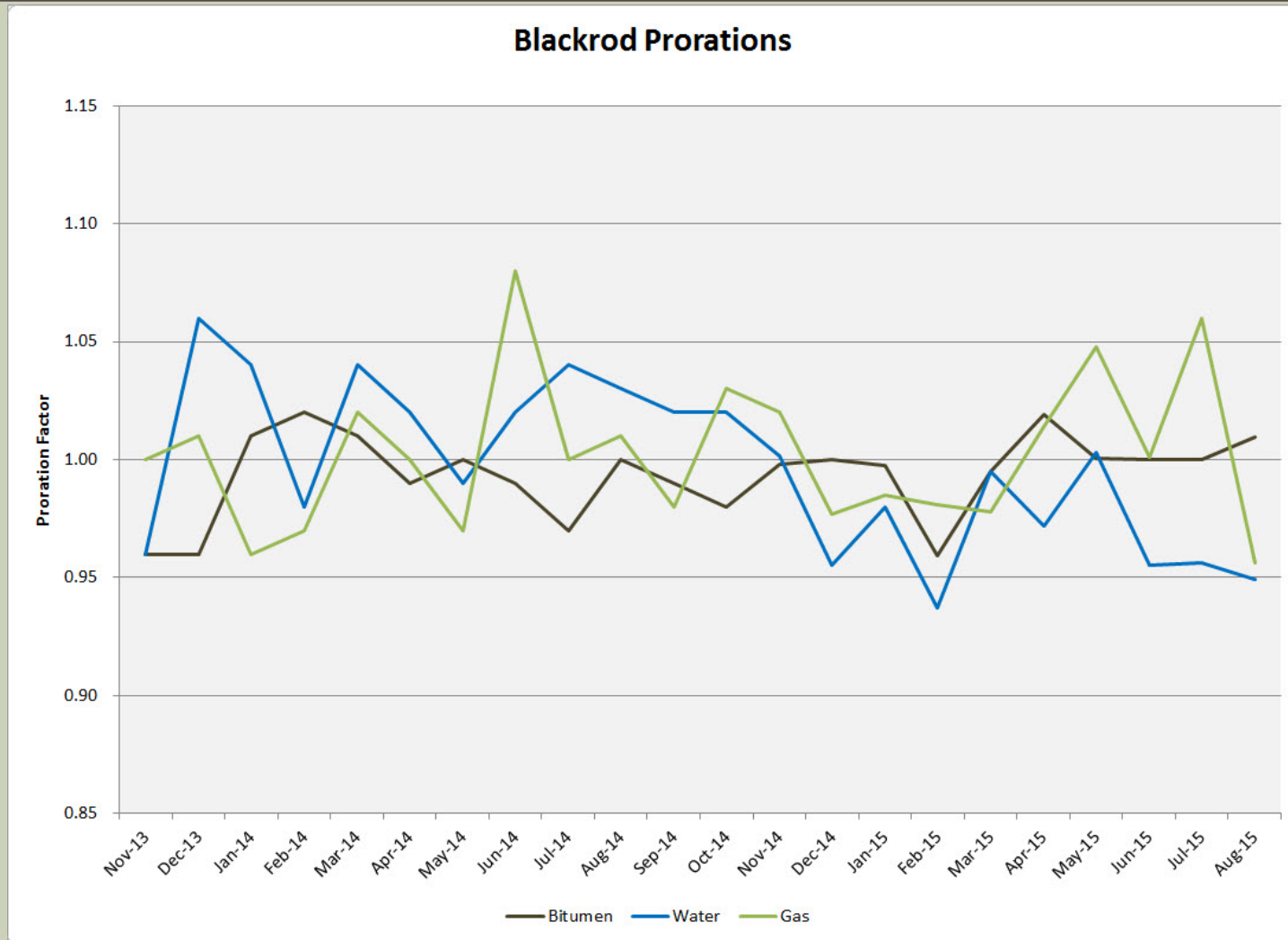


BlackPearl Resources Inc.  
 BlackRod In-Situ Oil Sands – IF  
 LSD 15-25-76-18 W4M  
 ABIF – 0113720 Subtype 506  
 Disposal Well  
 ABBT-0118585 Subtype: 503  
 Drawing: 0113720-02  
 Date: 03/05/12  
 Reviewed by: Heath Williamson Rev. 1

# 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 Surface Operations

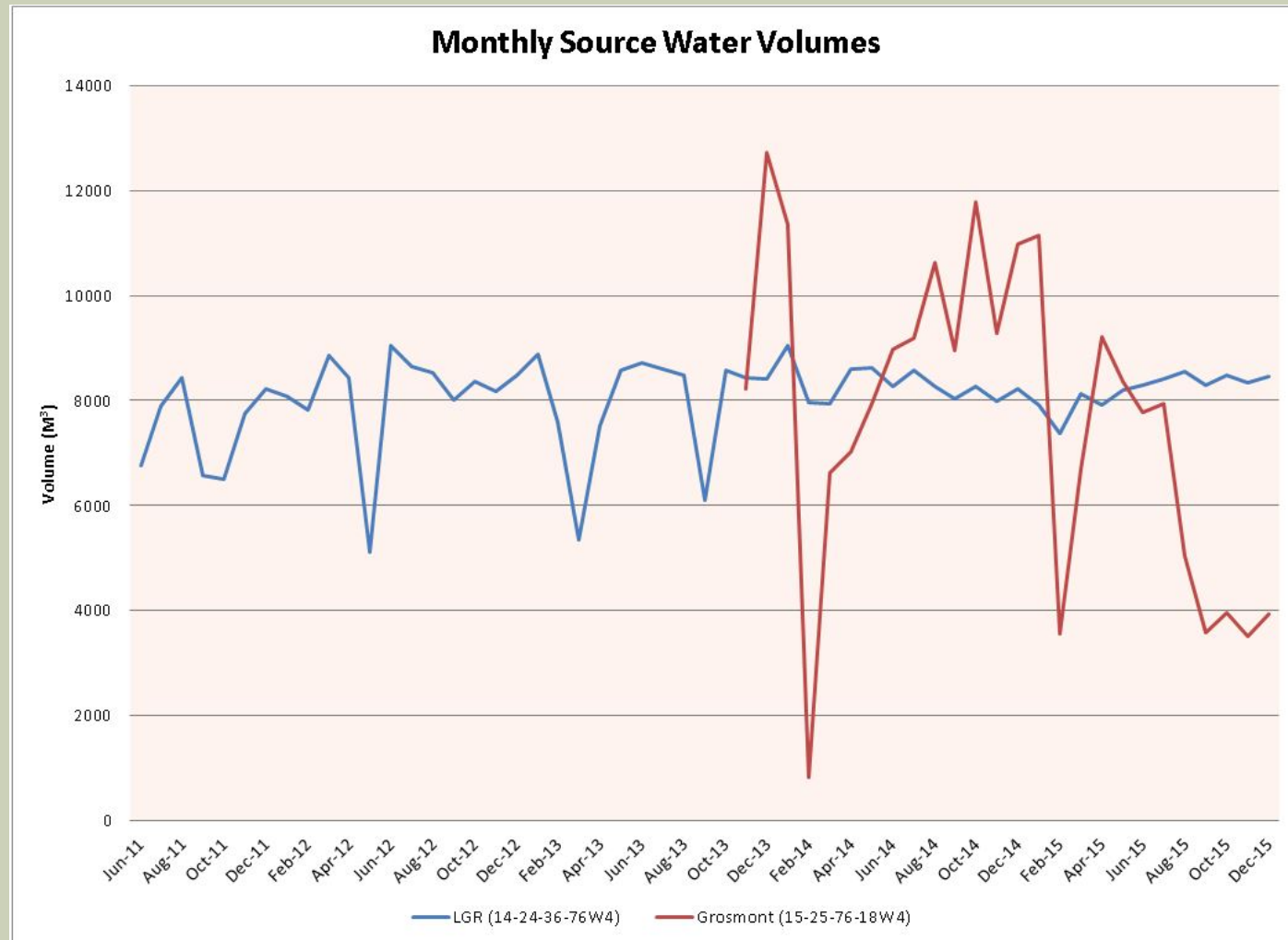
## 3. Water Source

# 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 m<sup>3</sup> 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)



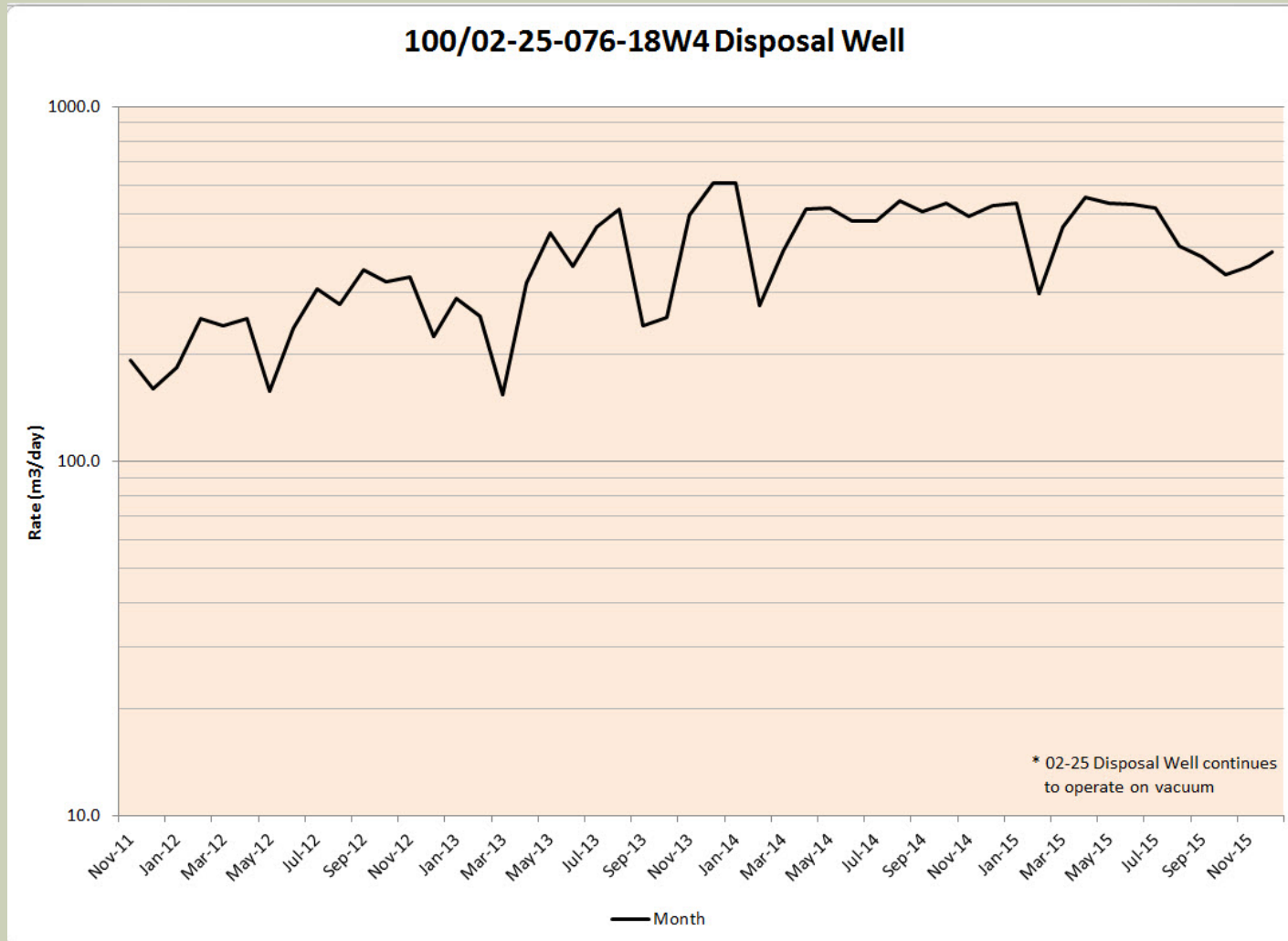
# Blackrod Surface Operations

## 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.

# Blackrod Disposal



# 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.

# Blackrod Surface Operations

## 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

# Blackrod Future Plans

## 1. Ongoing Pilot Objectives

# Ongoing Pilot Objectives

- Continue to ramp-up and optimize 10-36 WP2
- Plan and apply for a 3<sup>rd</sup> Pilot Well Pair incorporating flow control devices and a longer horizontal profile
- Plan and apply for NCG co-injection

# Blackrod Future Plans

## 2. SAGD Commercial Development

# SAGD Commercial Development

- 80,000 bbl/d (12,720 m<sup>3</sup>/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

# Appendices

## 1. Pressure & Temperature Data

- 13-25 WP1
- 10-36 WP2
- Heel & Toe Observation Wells