阳光油砂

SUNSHINE OILSANDS LTD.

**Sunshine Oilsands Ltd.**
**BA Code A2TF**

# WEST ELLS SAGD

**Scheme No. 11764G**
**AER In Situ Performance Presentation**
**June 5, 2019**

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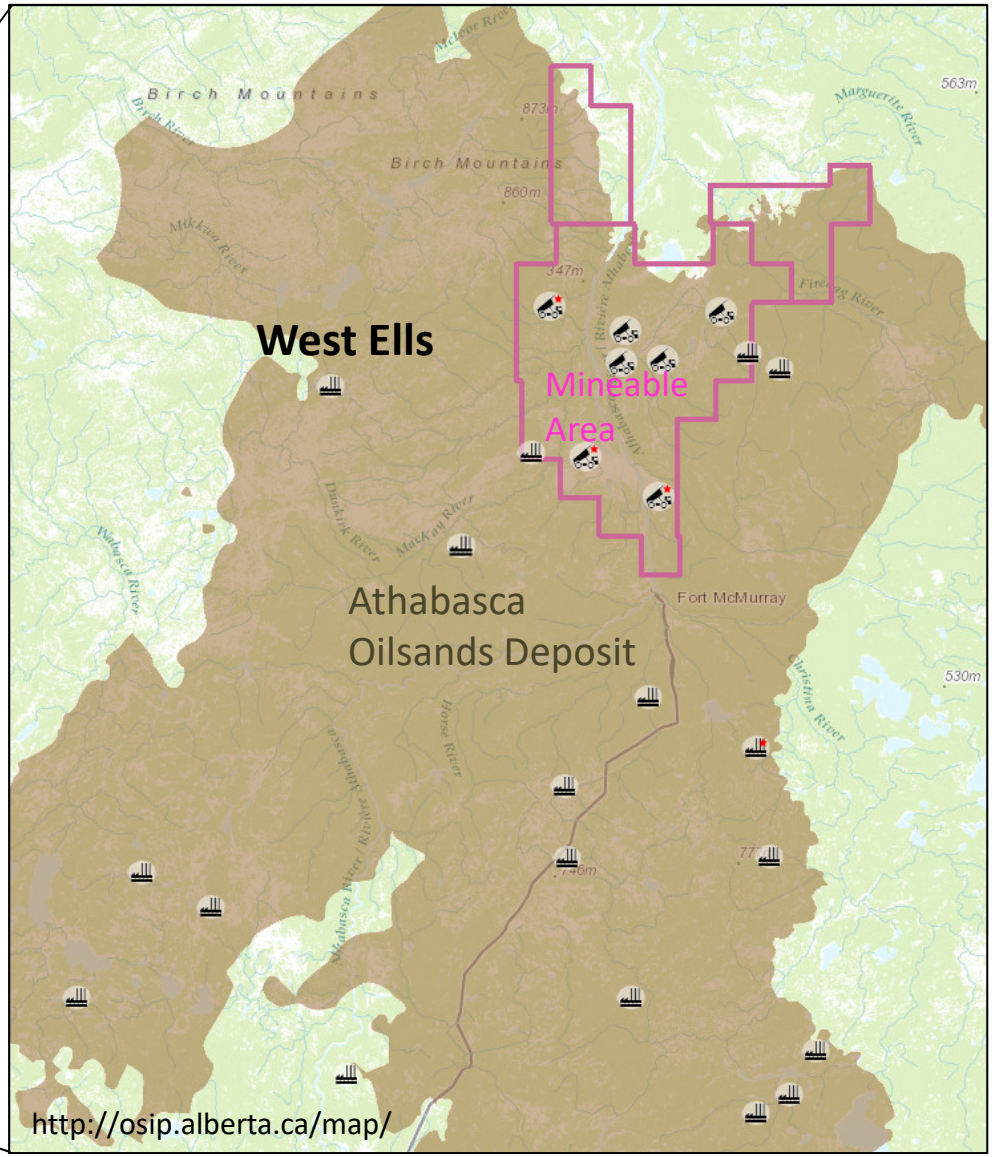
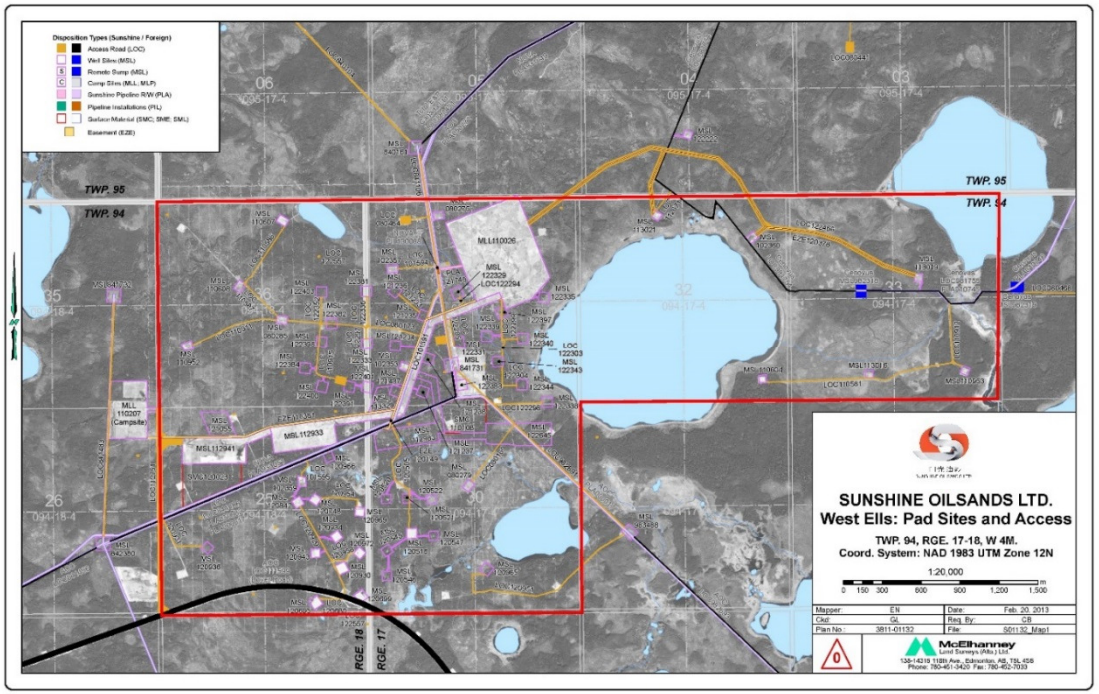
# Location within the Athabasca Oilsands Deposit

**West Ells SAGD Project**
Located in the NW part of the Athabasca Oilsands Deposit, Alberta, Canada

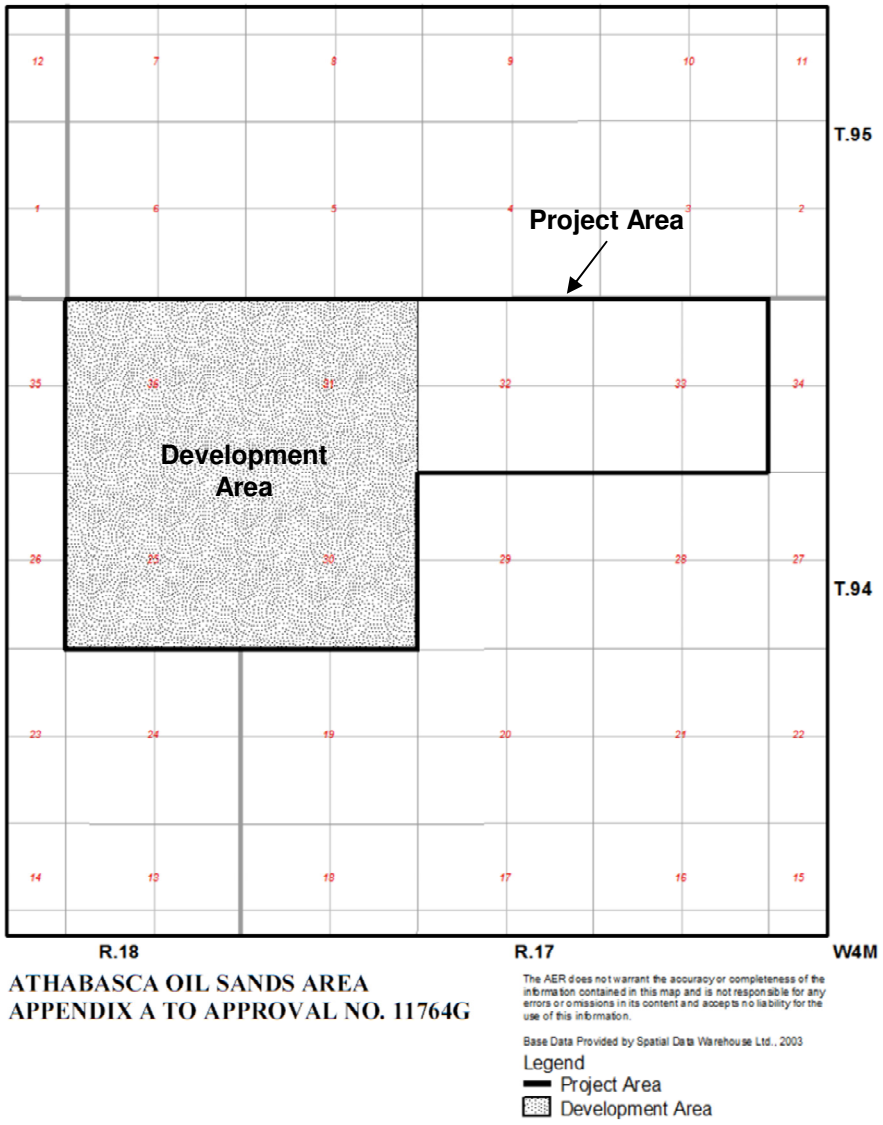


# West Ells SAGD

- Covering 9,856 contiguous gross hectares in the Athabasca Oil Sands Region
- Two phases of 5,000bbl/d
  - Phase 1 currently in Operation since September 2015 is supplied by Pad 2
  - Phase 2 will commence in the future and is supplied by Pad 3 which has already been drilled
  - MSL 112941 and MSL 112933 were cleared of vegetation with no soil disturbance, anticipated to serve as make-up pads as the project advances



# Development and Project Area




| Area | Land Description |
|---|---|
| Development Area (4 sections) | T94 R17W4; Sec 30, 31<br>T94 R18W4; Sec 25, 36 |
| Project Area (6 sections) | T94 R17W4; Sec 30, 31, 32, 33<br>T94 R18W4; Sec 25, 36 |

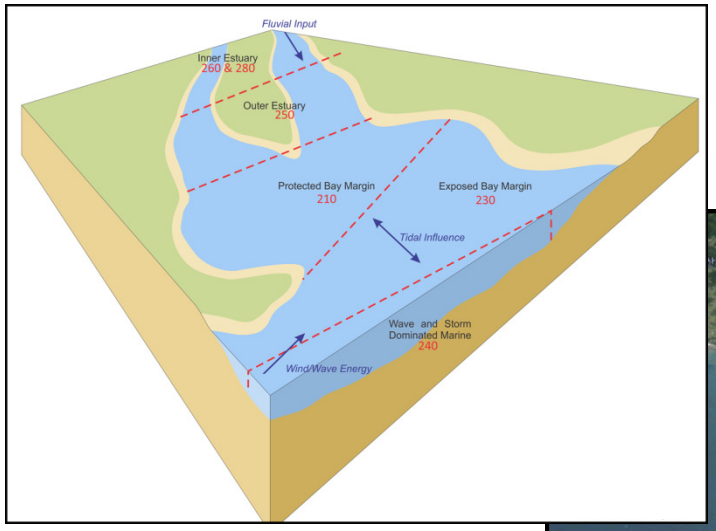
First Steam – September 2015

First Production – December 2015

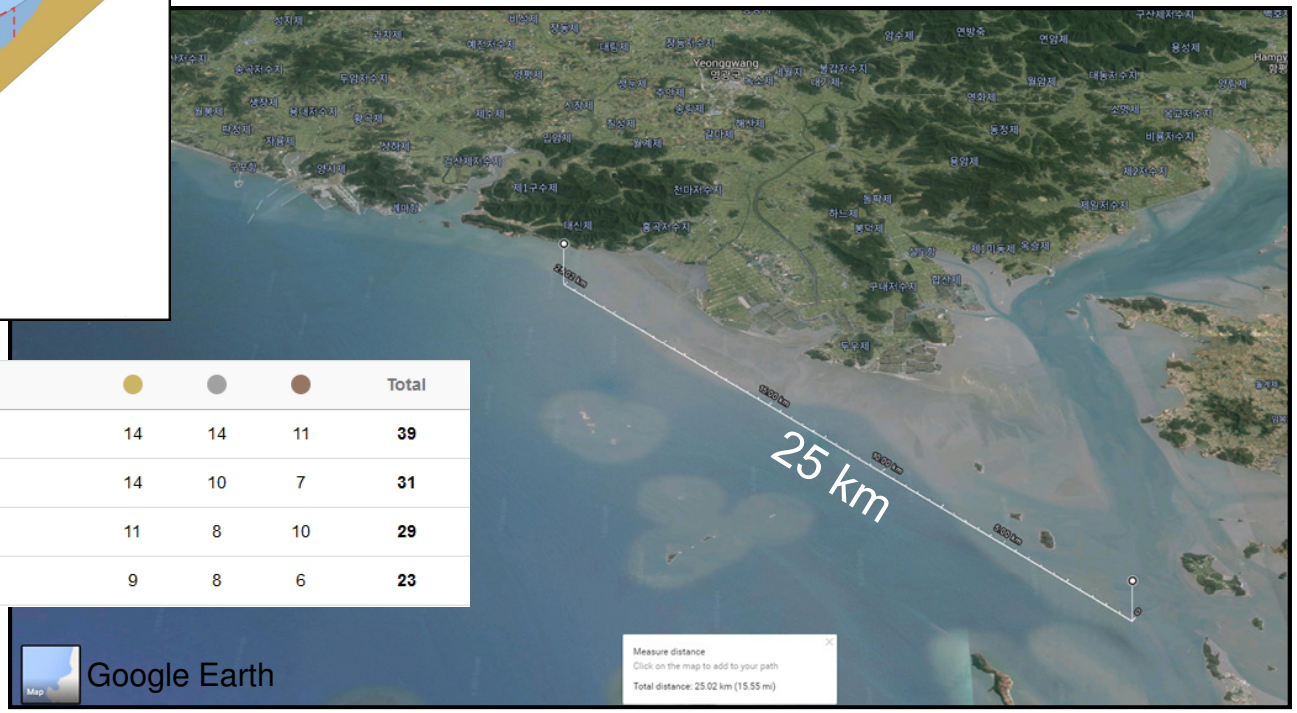
# Geoscience

# Depositional Setting (Shallow Marine)

## West Ells Depositional Model




## Modern Analog: Korea

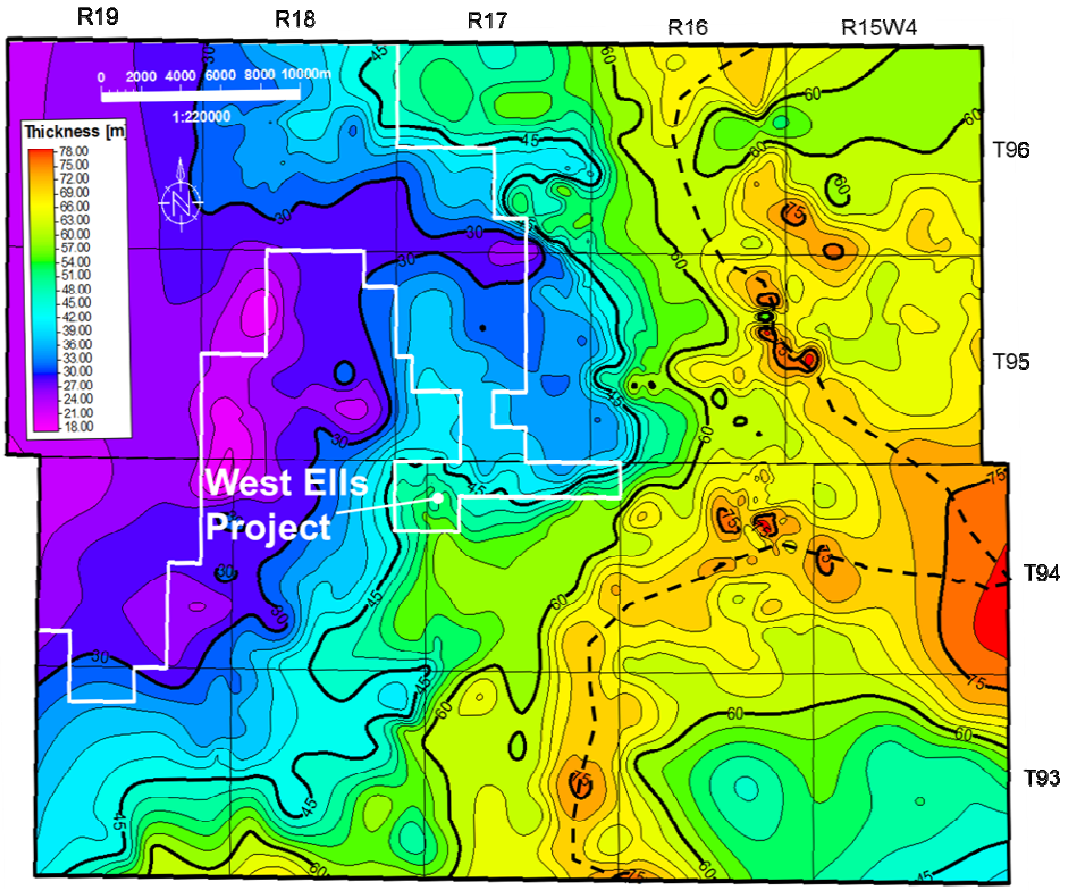



| Rank | NOC | | | | Total |
|---|---|---|---|---|---|
| 1 | Norway | 14 | 14 | 11 | **39** |
| 2 | Germany | 14 | 10 | 7 | **31** |
| 3 | Canada | 11 | 8 | 10 | **29** |
| 4 | United States | 9 | 8 | 6 | **23** |

The Wabiskaw sands are laterally extensive and were deposited along the emergent Devonian highs as the Boreal Sea transgressed over the Athabasca Basin.

# Isopach Map (Clearwater Marker to Devonian)

"Paleotopographic" map

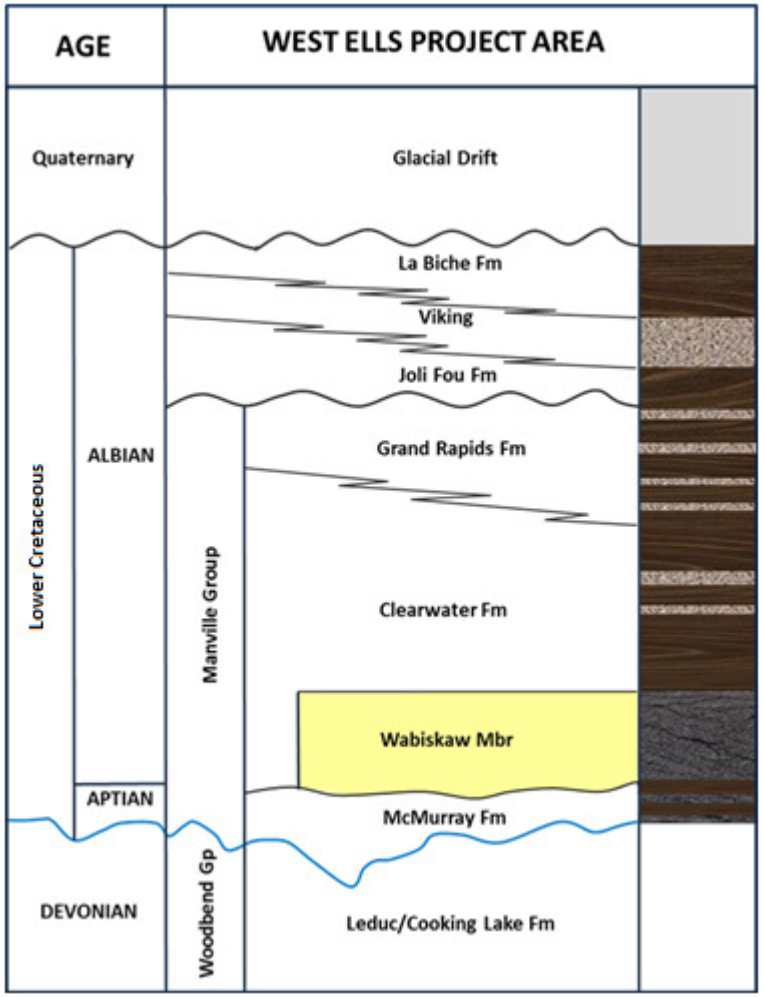



- Reflects paleotopography during the Late Cretaceous
- Warm colors represent valleys and cooler colors represent highs
- Major McMurray drainage systems are marked with a dashed line
- Extensive amalgamated shoreface sands (Wabiskaw A, C, & D) were deposited on the east side of the emergent Devonian strata

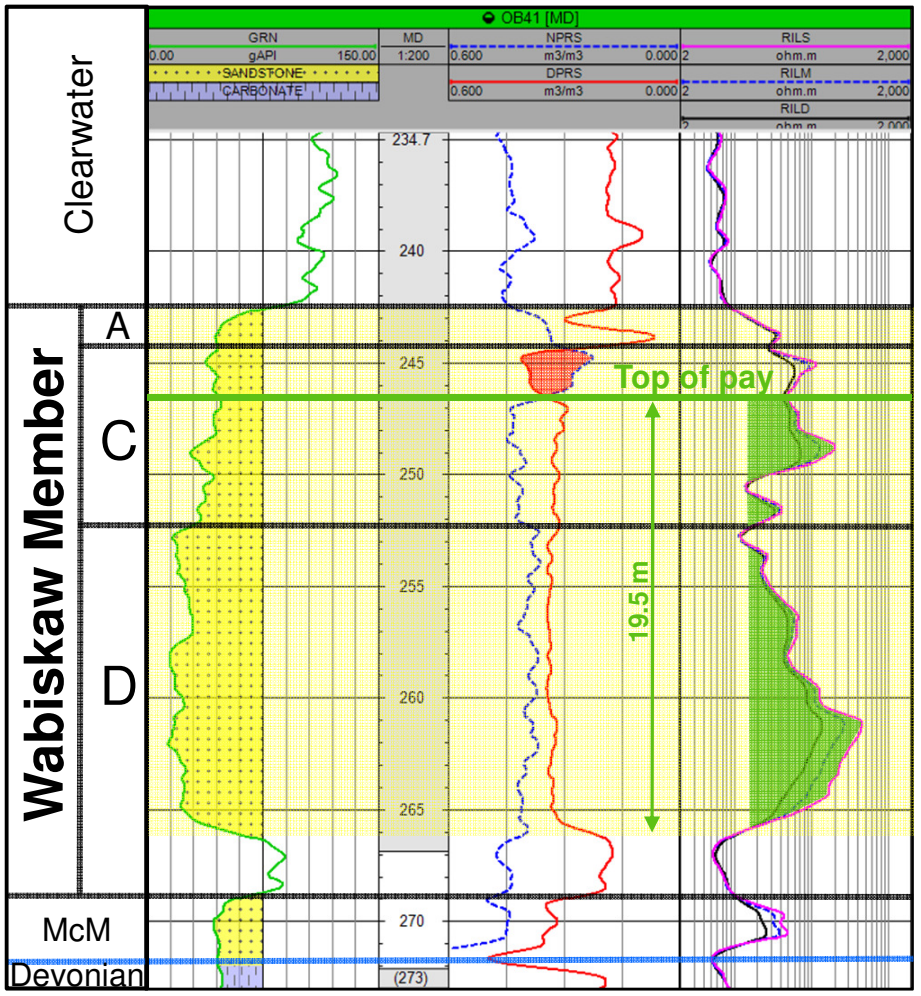
West Ells SAGD Project is located in an embayment in T94 R17 W4M.

# Stratigraphic Chart & Type Well

## Stratigraphic chart




## Type Well – OB41 (102/06-31-094-17W4)

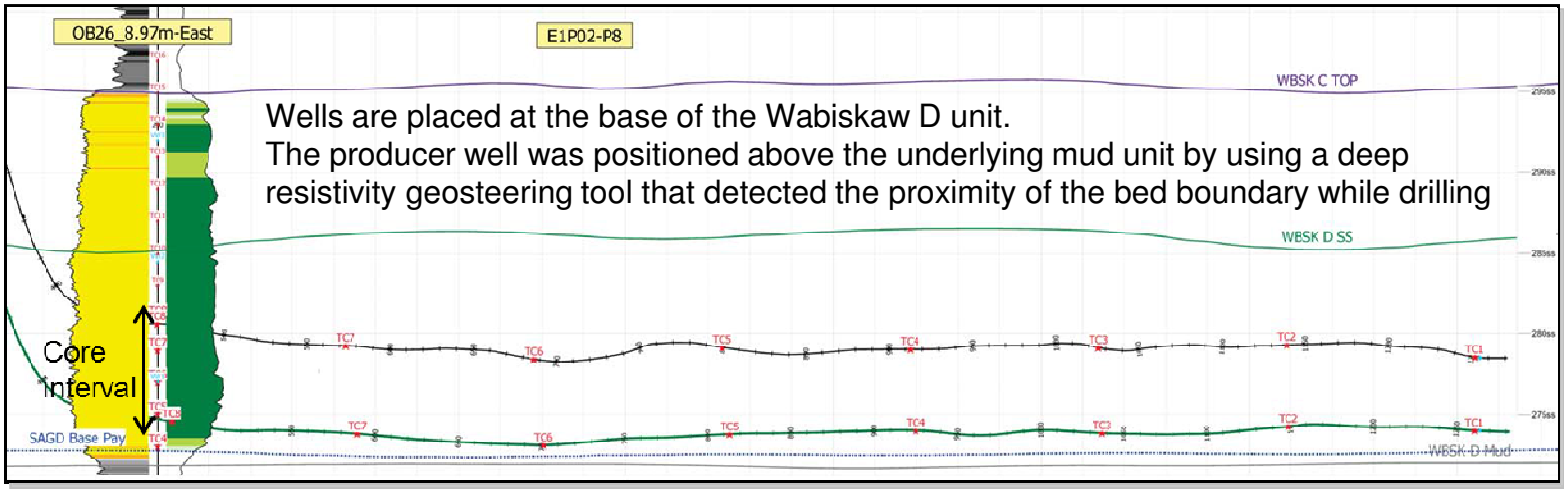



The SAGD wells are located at the base of the Wabiskaw D sand unit

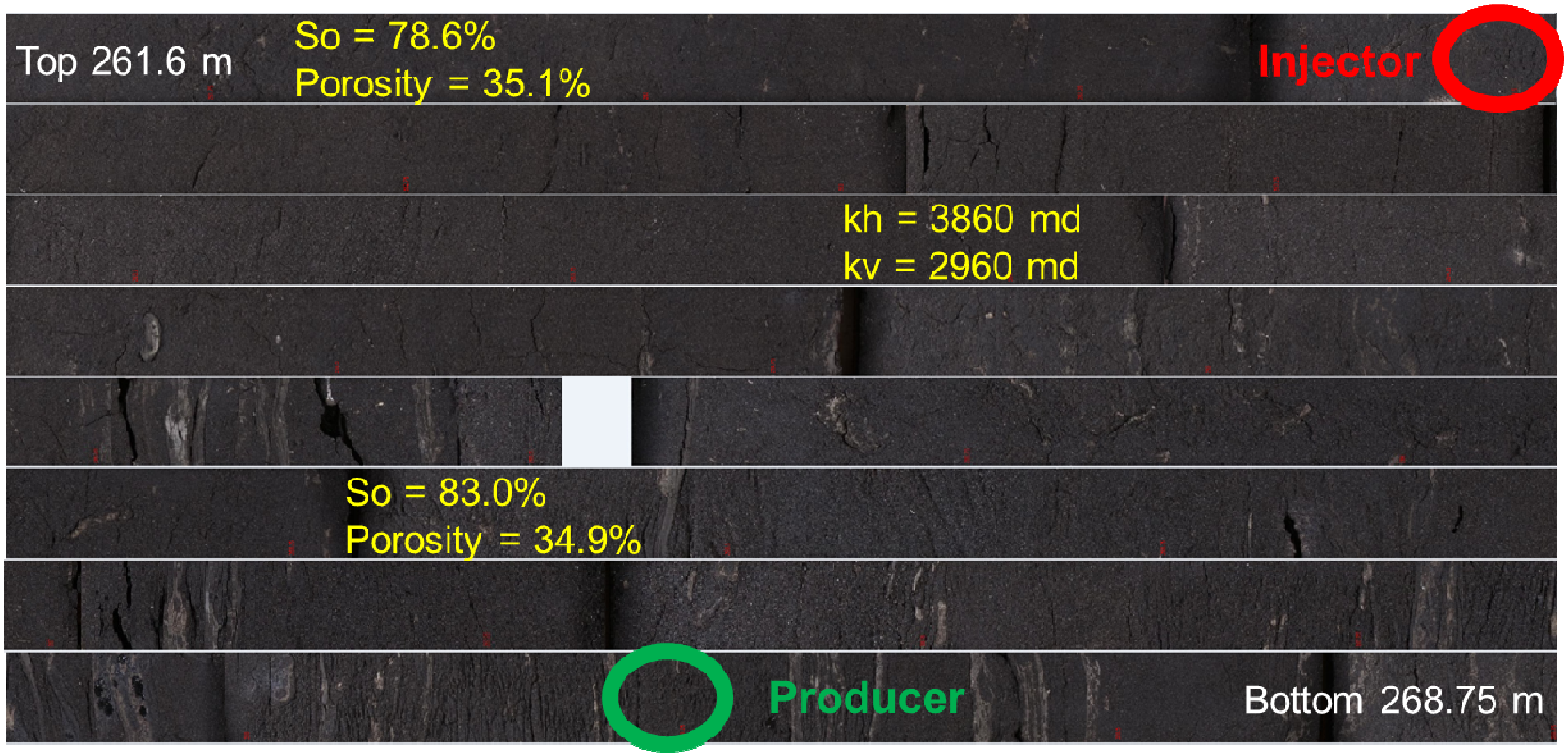
# Average Reservoir Properties for Development Area

| Property | Value |
|---|---|
| Bitumen saturation (%) | 71 |
| Porosity (%) | 33 |
| Grain size | Fine to medium |
| Net pay (m) | 15.2 |
| Horizontal perm. (D) | 2.4 |
| Vertical perm. (D) | 1.7 |
| Reservoir pressure (kpa) | 600 |
| Reservoir temperature (°C) | 9 |
| Reservoir depth (m TVD) | 265 |
| Bitumen viscosity (cp) | > 1 million |
| Well length (m) | 800 |
| Well spacing (m) | 70 |

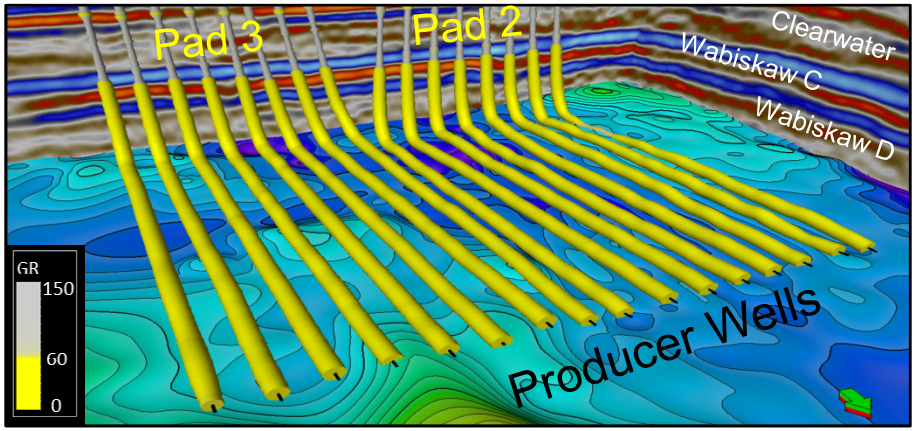
# Typical SAGD Well Placement (e.g. Pair 8)

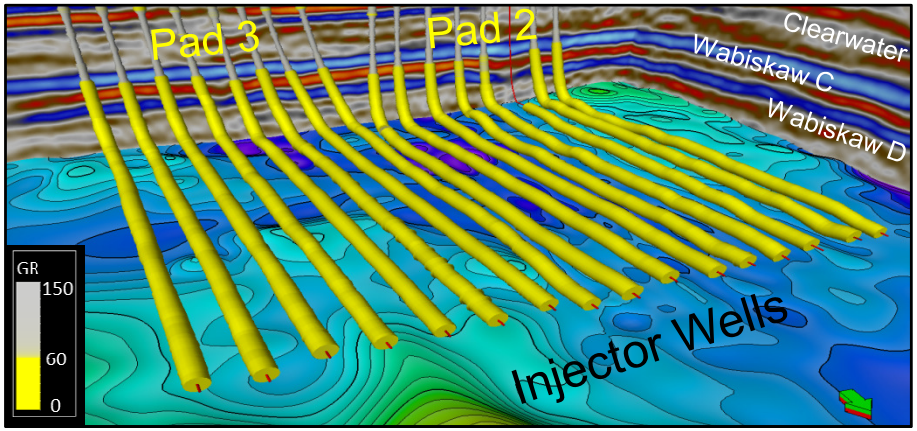



Wells are placed at the base of the Wabiskaw D unit.
The producer well was positioned above the underlying mud unit by using a deep resistivity geosteering tool that detected the proximity of the bed boundary while drilling



# Uniform Gamma Ray Profile on SAGD Wells

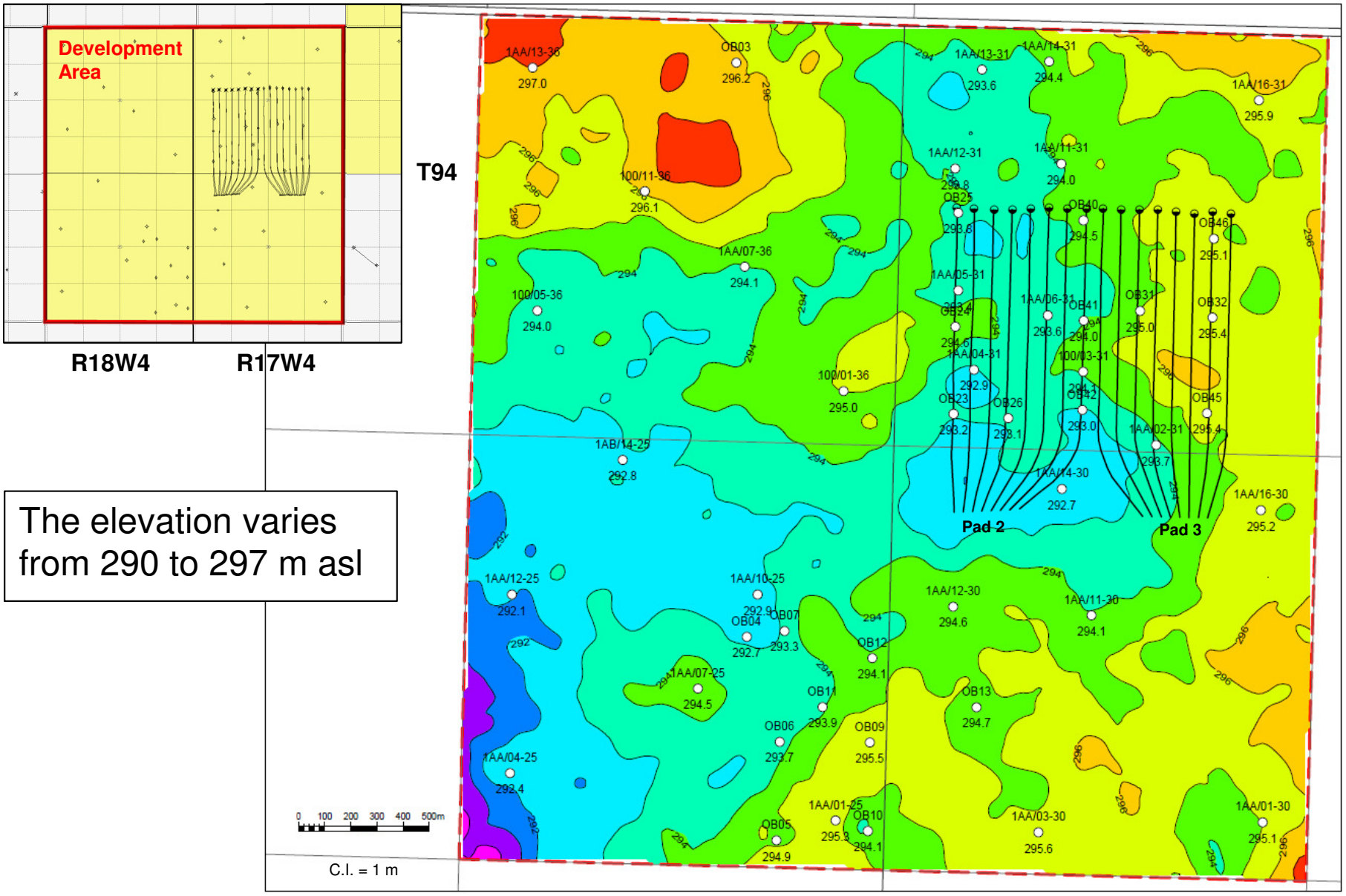



- Uniform gamma ray profile is indicative of a clean sandy shallow marine environment (e.g., shoreface)
- 3D seismic data shows continuity of Wabiskaw reservoir units

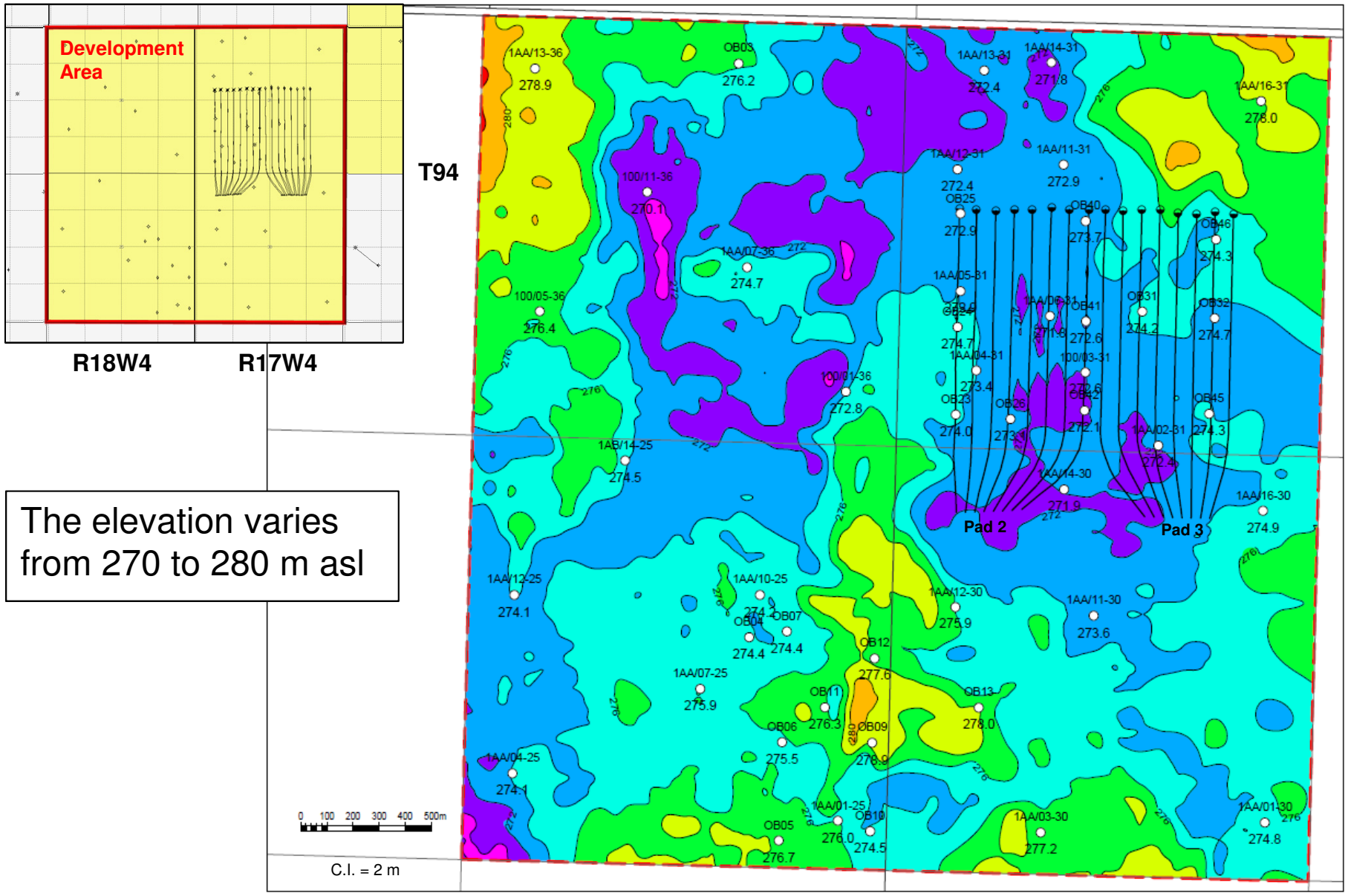
| | Percent Effective Producer (GR < 60) (%) | Percent Effective Injector (GR < 60) (%) | Horizontal Well Length (m) | Interwell spacing (m) |
|---|---|---|---|---|
| **Pad 2** | 99 | 100 | 800 | 70 |
| **Pad 3** | 100 | 100 | 800 | 70 |

# Top of Bitumen Pay Structure Map



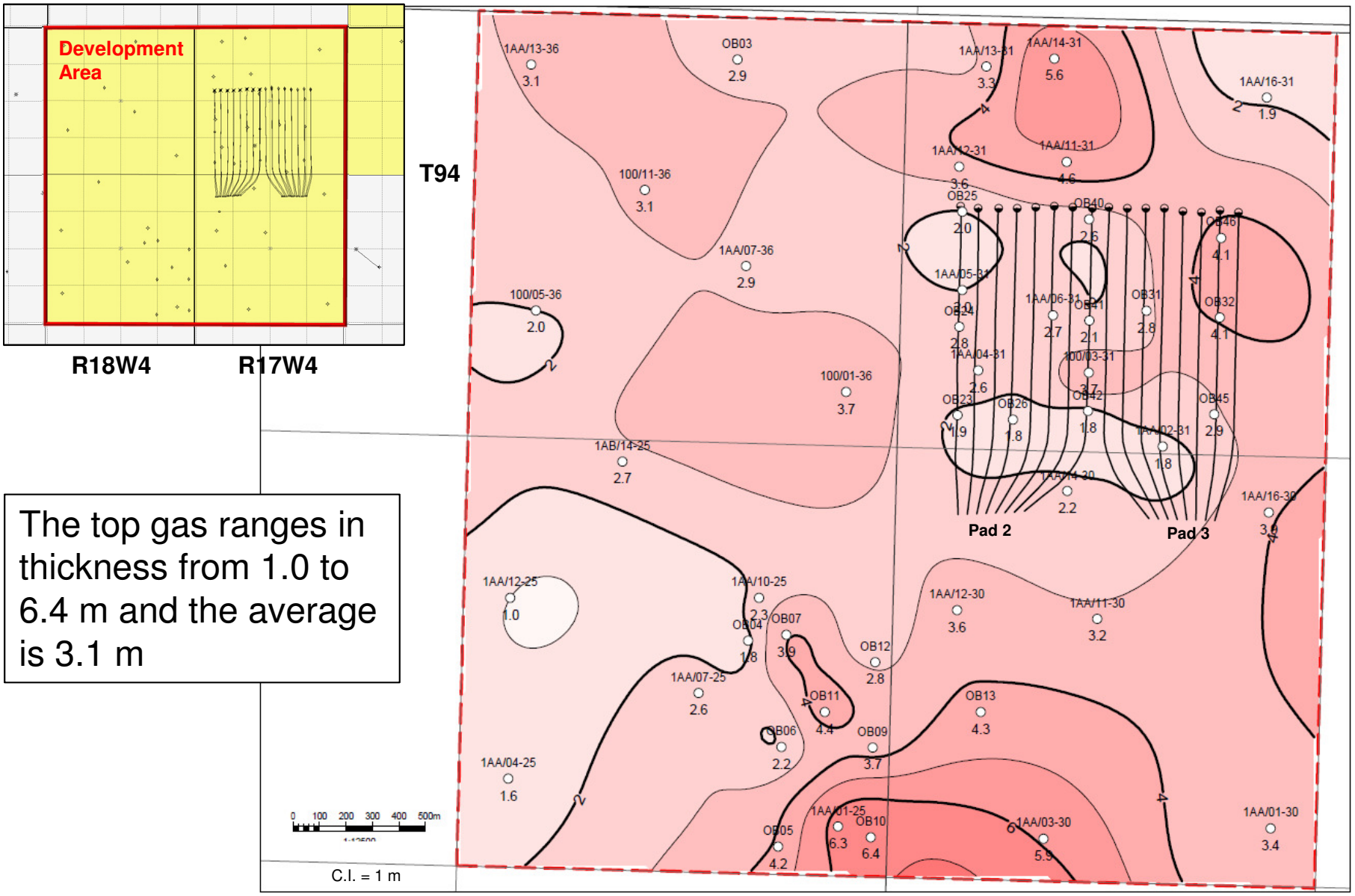

The elevation varies from 290 to 297 m asl

# Base of Bitumen Pay Structure Map



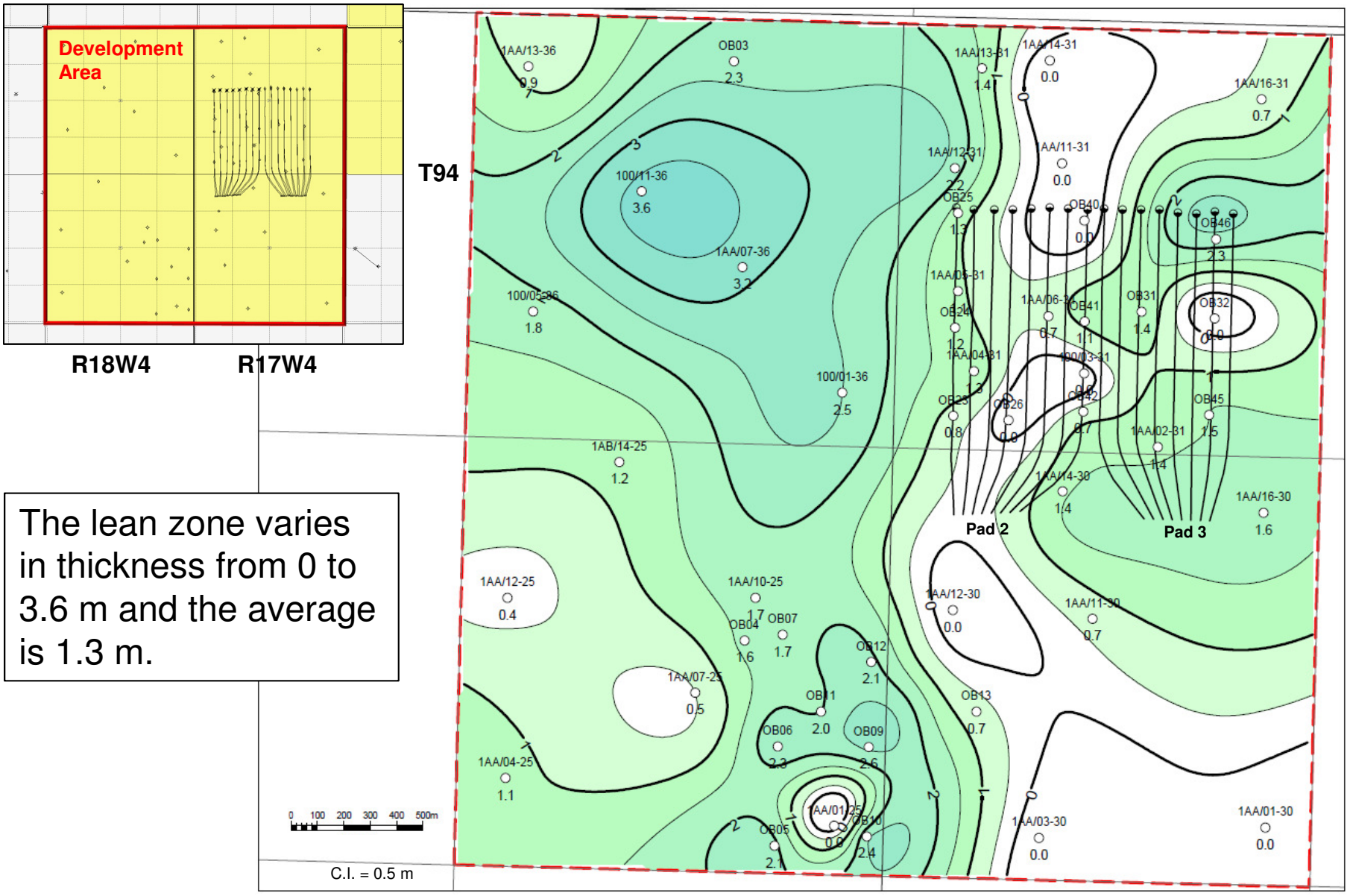

The elevation varies from 270 to 280 m asl

# Wabiskaw C Top Gas Isopach Map




The top gas ranges in thickness from 1.0 to 6.4 m and the average is 3.1 m

# Wabiskaw D Lean Zone Isopach Map




The lean zone varies in thickness from 0 to 3.6 m and the average is 1.3 m.

# OBIP for Pads 2 & 3 and Development Area

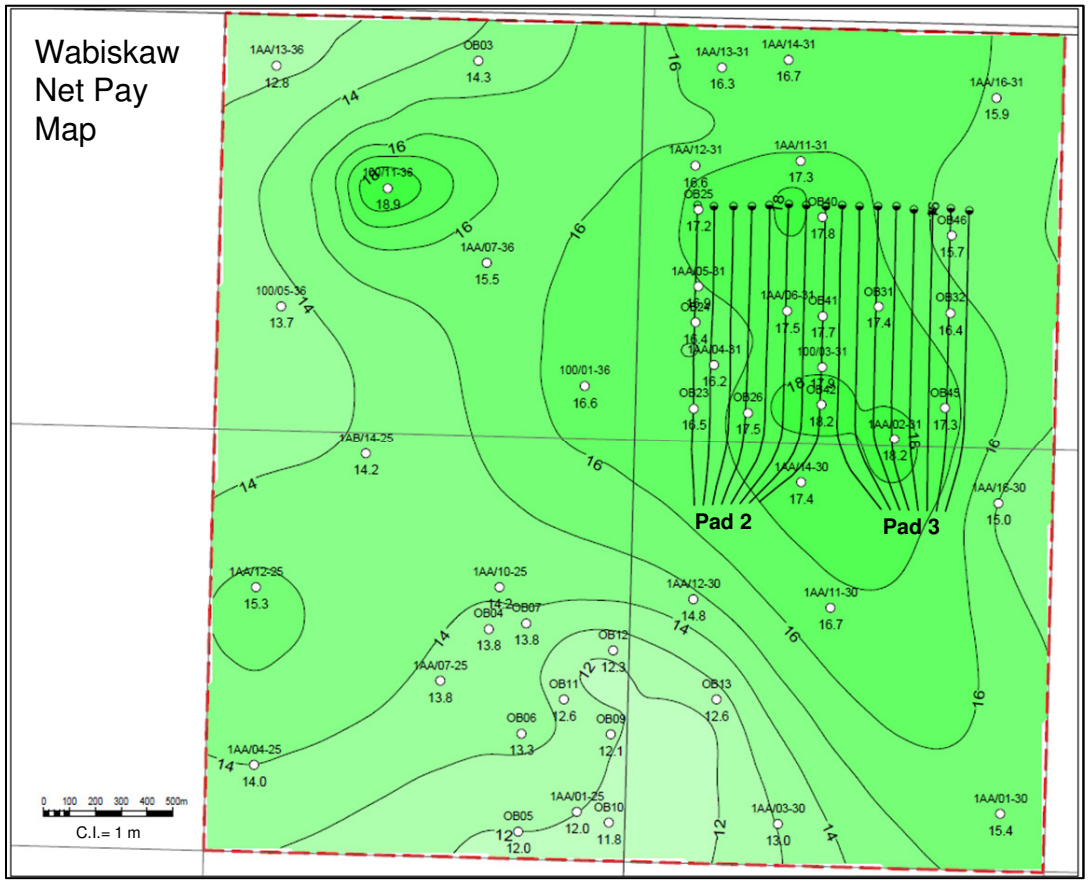
| | Number of SAGD Well Pairs | Well Length (m) | Well Spacing (m) | Drainage Area 50m Boundary ($10^3 m^3$) | Average Net Pay above producer (m) | Total OBIP ($10^6 m^3$) | Cumulative Bitumen Produced* ($m^3$) | Current Recovery Factor (%) | Estimated Recovery Factor (%) |
|---|---|---|---|---|---|---|---|---|---|
| **Pad 2** | 8 | 800 | 70 | 504 | 16.2 | 1.87 | 202,376 | 10.8 | 50-60 |
| **Pad 3** | 8 | 800 | 70 | 504 | 15.4 | 1.86 | 0 | 0 | 50-60 |

*Production to December 31, 2017

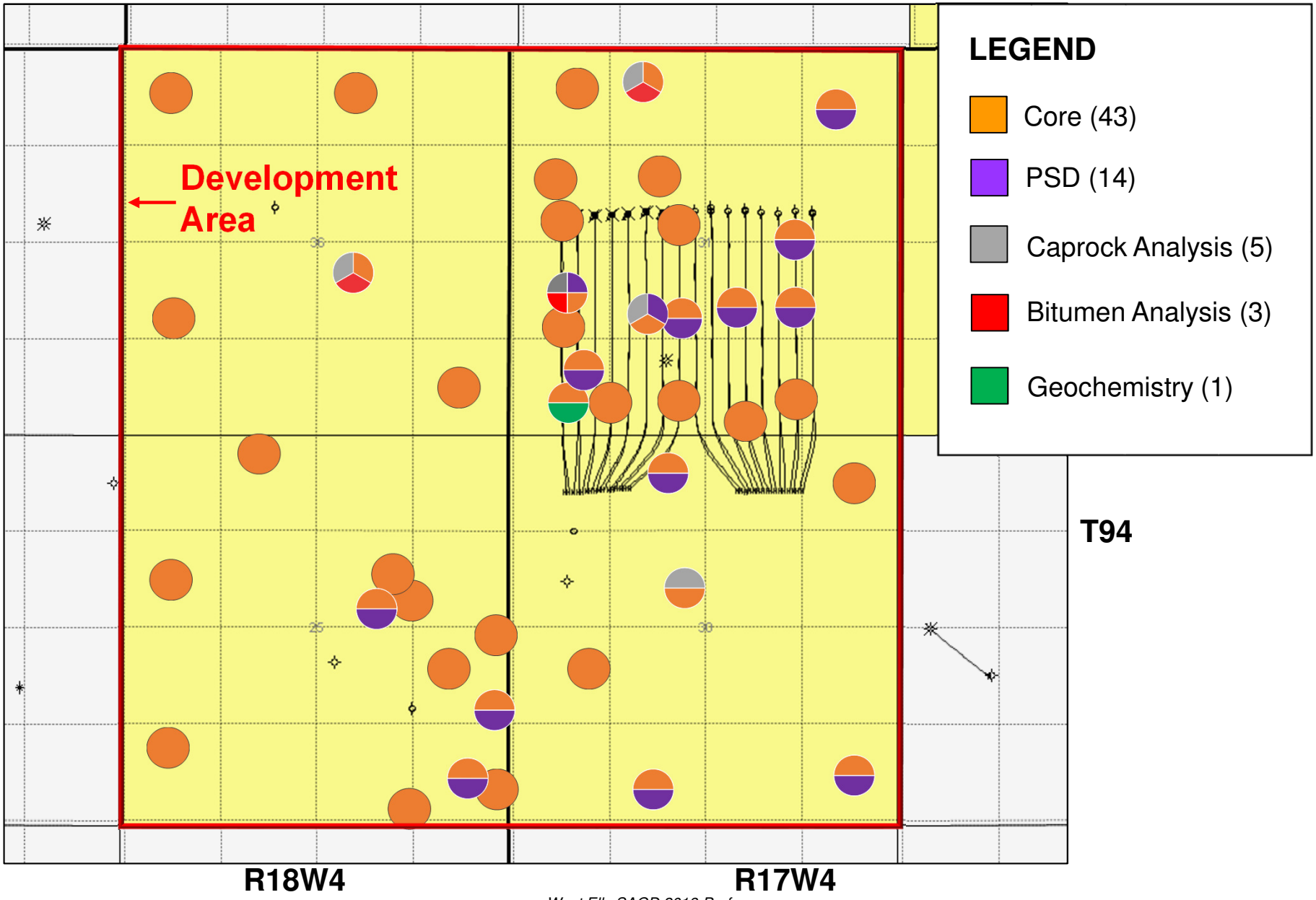
| | Area ($10^3 m^3$) | Average Net Pay (m) | Total OBIP ($10^6 m^3$) |
|---|---|---|---|
| **Development Area** | 10,511 | 15.2 | 37.2 |

OBIP = Area x Net Pay x Porosity x Bitumen Saturation / FVF

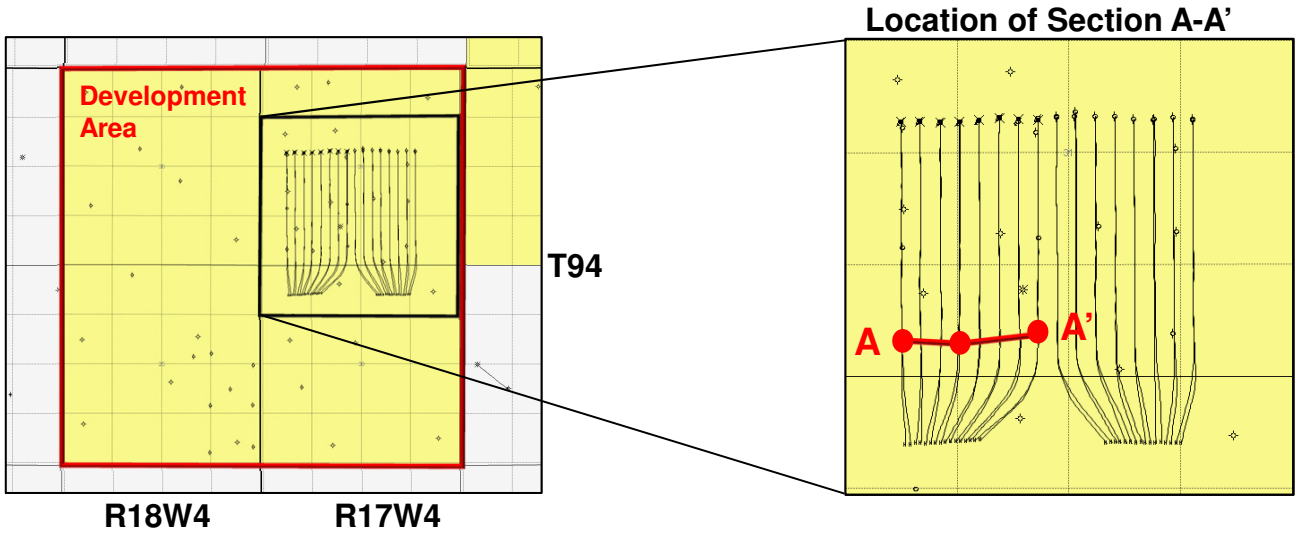
FVF = Formation Volume Factor = 1.005

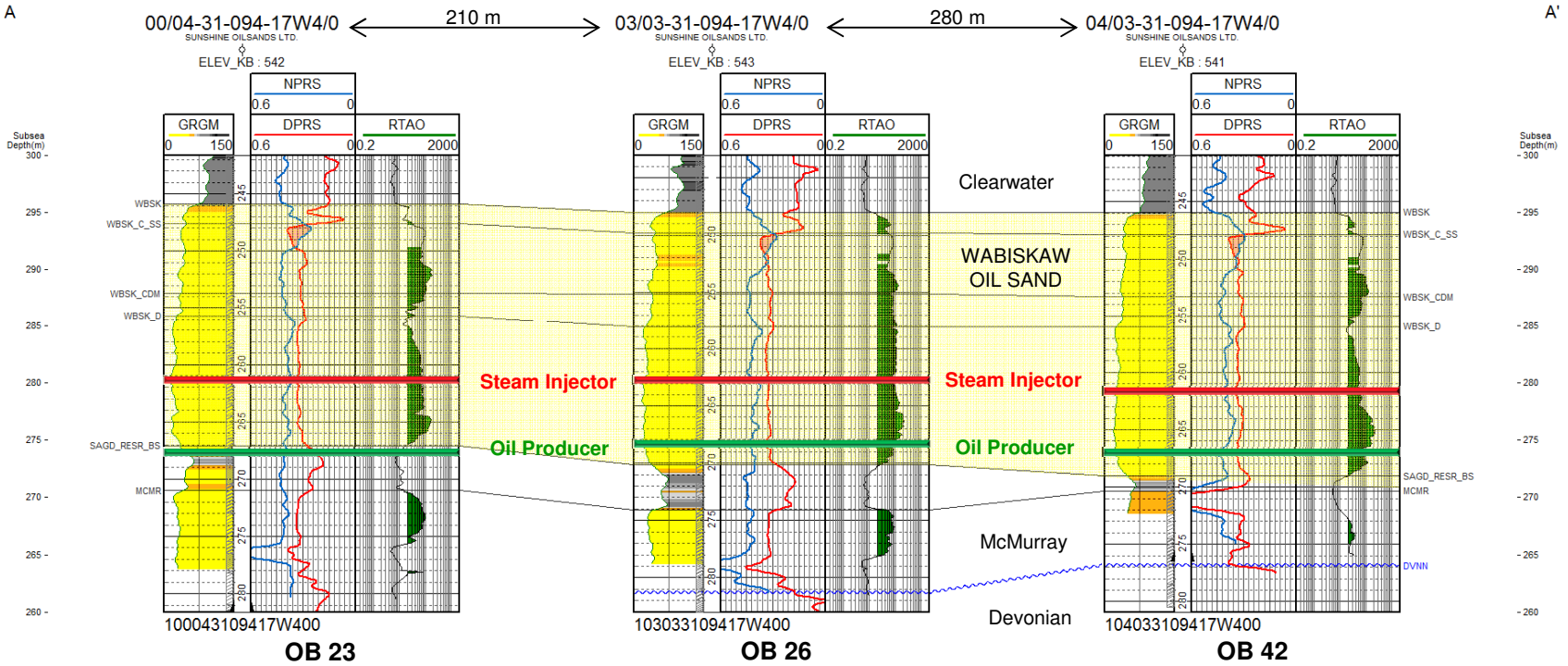


# Wells with Core and Special Core Analysis



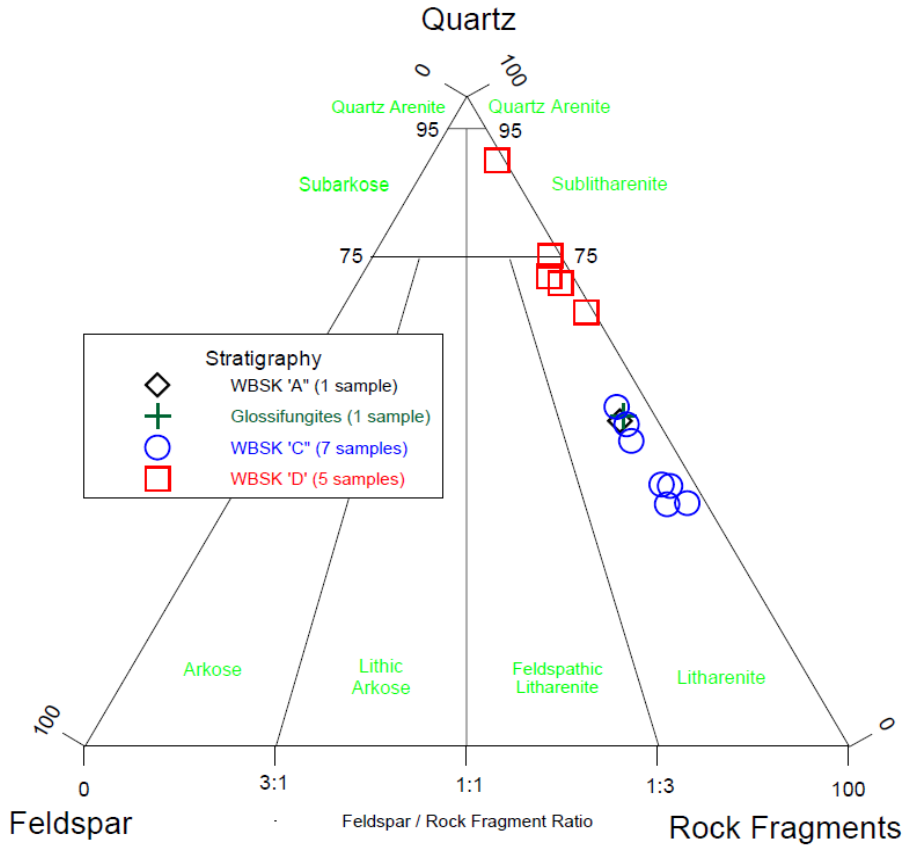
# Structural Cross-Section A-A’



# Composition

Sunshine Oilsands Ltd.
1AA/09-21-096-18W4 & 1AA/06031-094-17W4
Formation: Wabiskaw (14 samples)
Figure 1: Ternary Composition Plot (Folk, 1968)

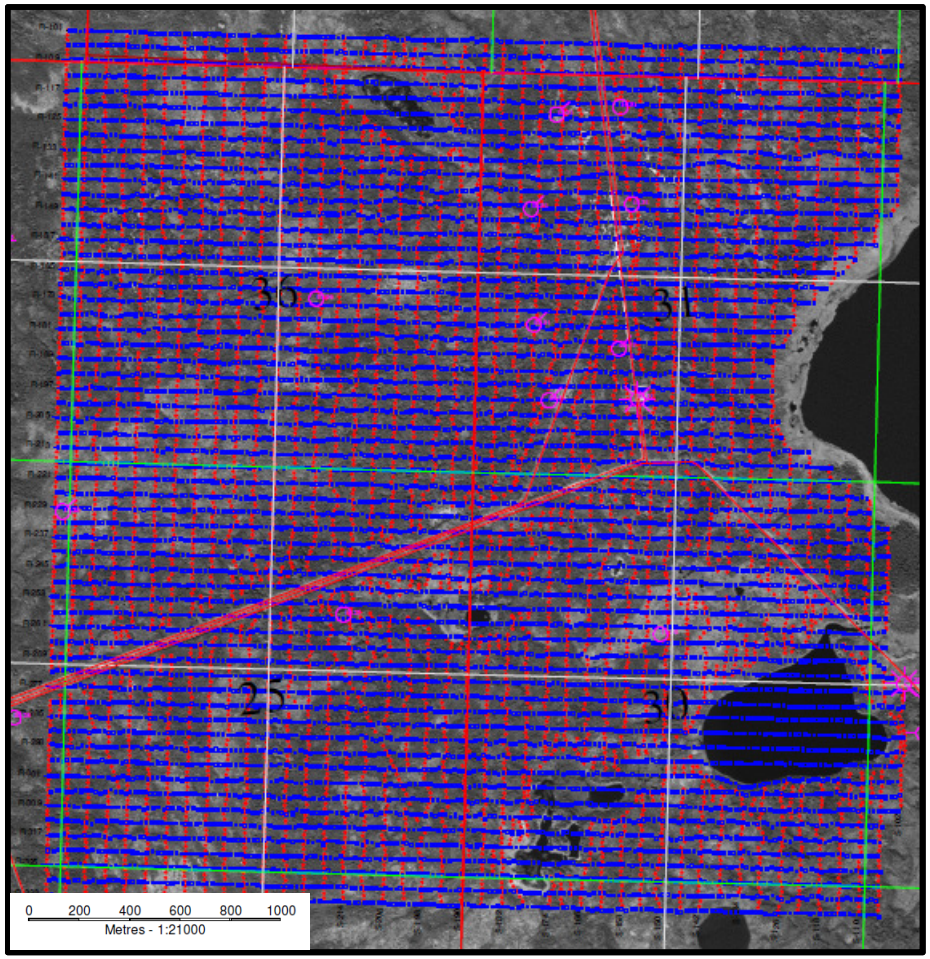



- Small differences in clay content and quartz is seen between WBSK C and D
  - WBSK C =3% clay
  - WBSK D = 0.6%-1.3% clay

# 3D Seismic Survey and Acquisition Parameters

- No new seismic data acquired in this reporting period

## Survey Layout




## Acquisition Parameters

| **Area** 10.7 ($km^2$) | | | |
|---|---|---|---|
| **Source Information** | | **Receiver Information** | |
| Source interval (m) | 20 | Receiver interval (m) | 20 |
| Source line interval (m) | 80 | Receiver line interval (m) | 60 |
| Line orientation | N-S | Line orientation | W-E |
| Total km of line | 167.1 | Total km of line | 194.9 |
| Number of source points | 7078 | Number of receiver points | 9681 |
| Source depth (m) | 6 | | |
| Source type | Dynamite | | |

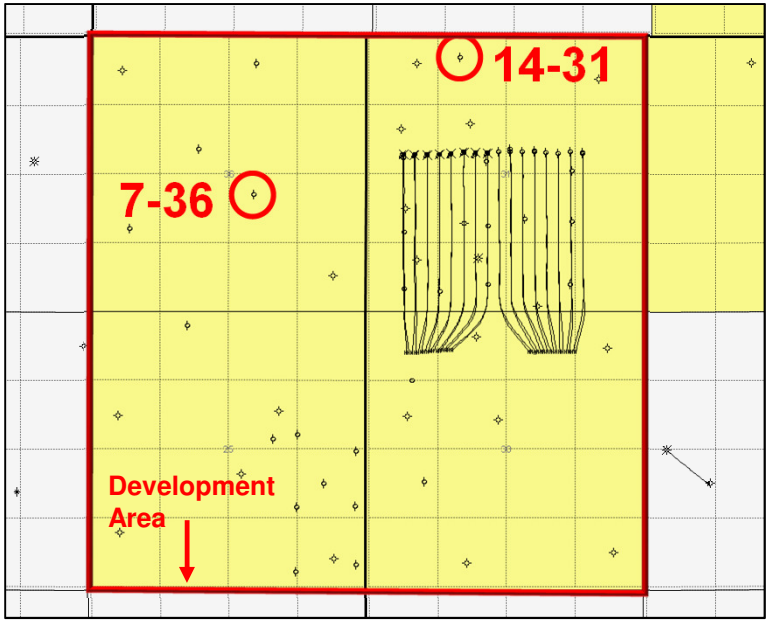
# 4-D Seismic

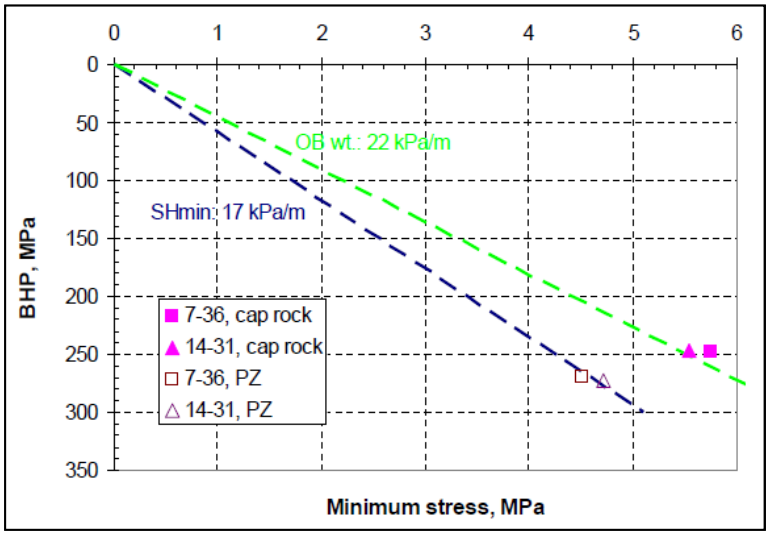
- As measured on the observation wells, the width of the steam chamber is narrow and less than 10 m from the SAGD well pair. Therefore, Sunshine did not plan a 4D seismic acquisition survey in 2018 because it is difficult to image a small steam chamber in the seismic data.

- While there are no plans in 2019 to conduct a 4D seismic survey, Sunshine will consider a 4D seismic survey when it is appropriate and provides an advantage for resource recovery.

# Cap Rock Integrity

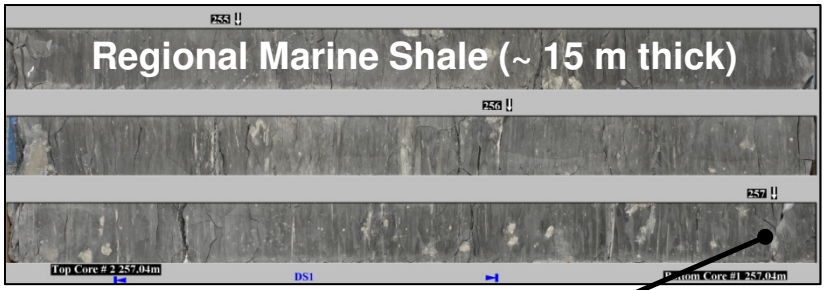
- Mini-frac tests were performed at:
  - 1AA/14-31-094-17W4/0
  - 1AA/07-36-094-18W4/0
- Caprock average minimum stress gradient = ***22*** kPa/m (Wabiskaw Shale Member)
- Oil sand average minimum stress gradient = ***17*** kPa/m (Wabiskaw Sand)
- Sunshine applied for a maximum operating pressure (MOP) of ***4400*** kPag in the Wabiskaw Shale Member based on a 80% safety factor
- The maximum operating pressure (MOP) of ***4400*** kPag was granted on March 10, 2016

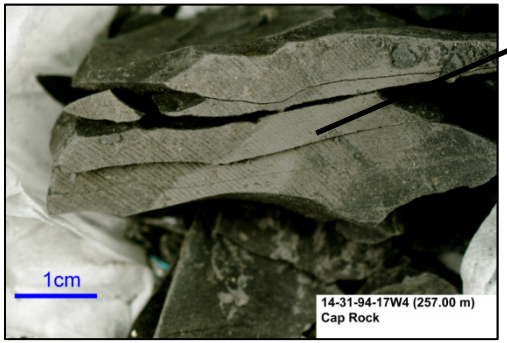


# Caprock and Oil Sand from 14-31-94-17W4 Location

## Caprock - Wabiskaw Shale Member

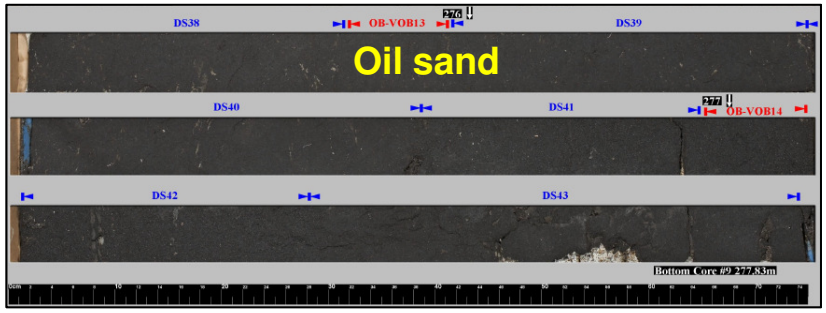


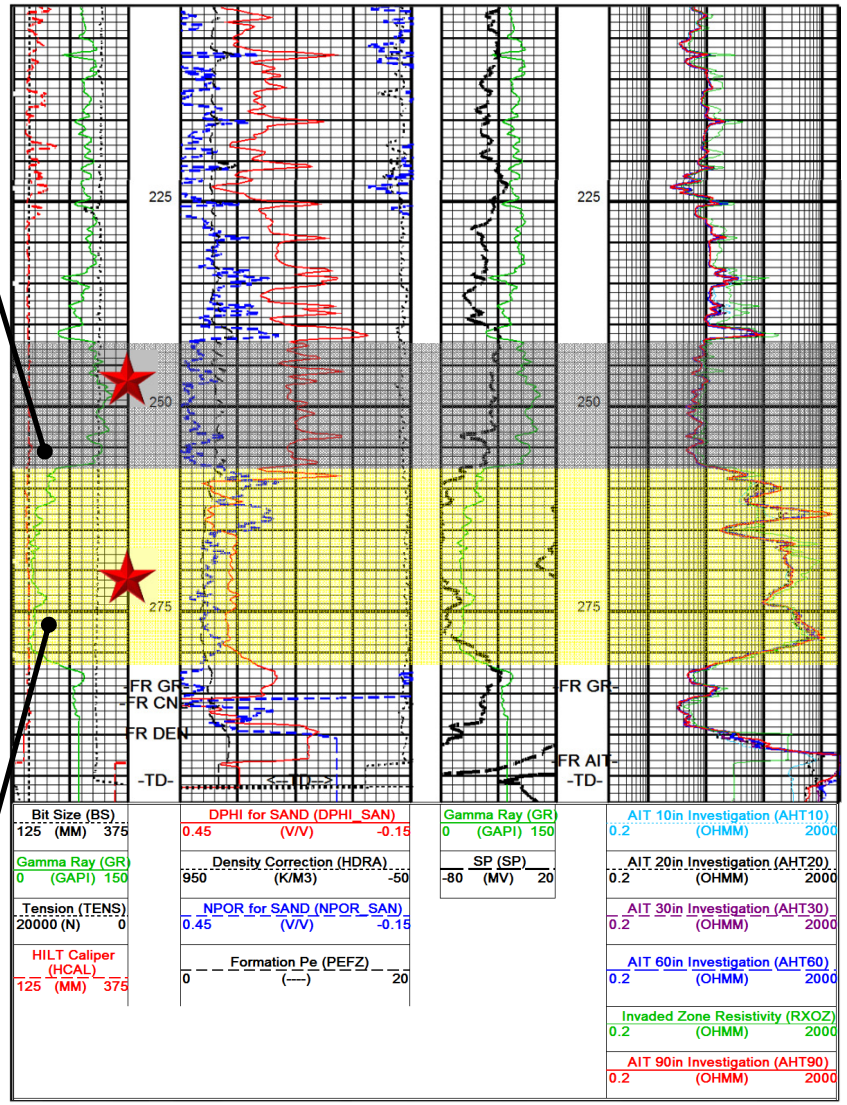

Caprock mini-frac

Oil sand mini-frac

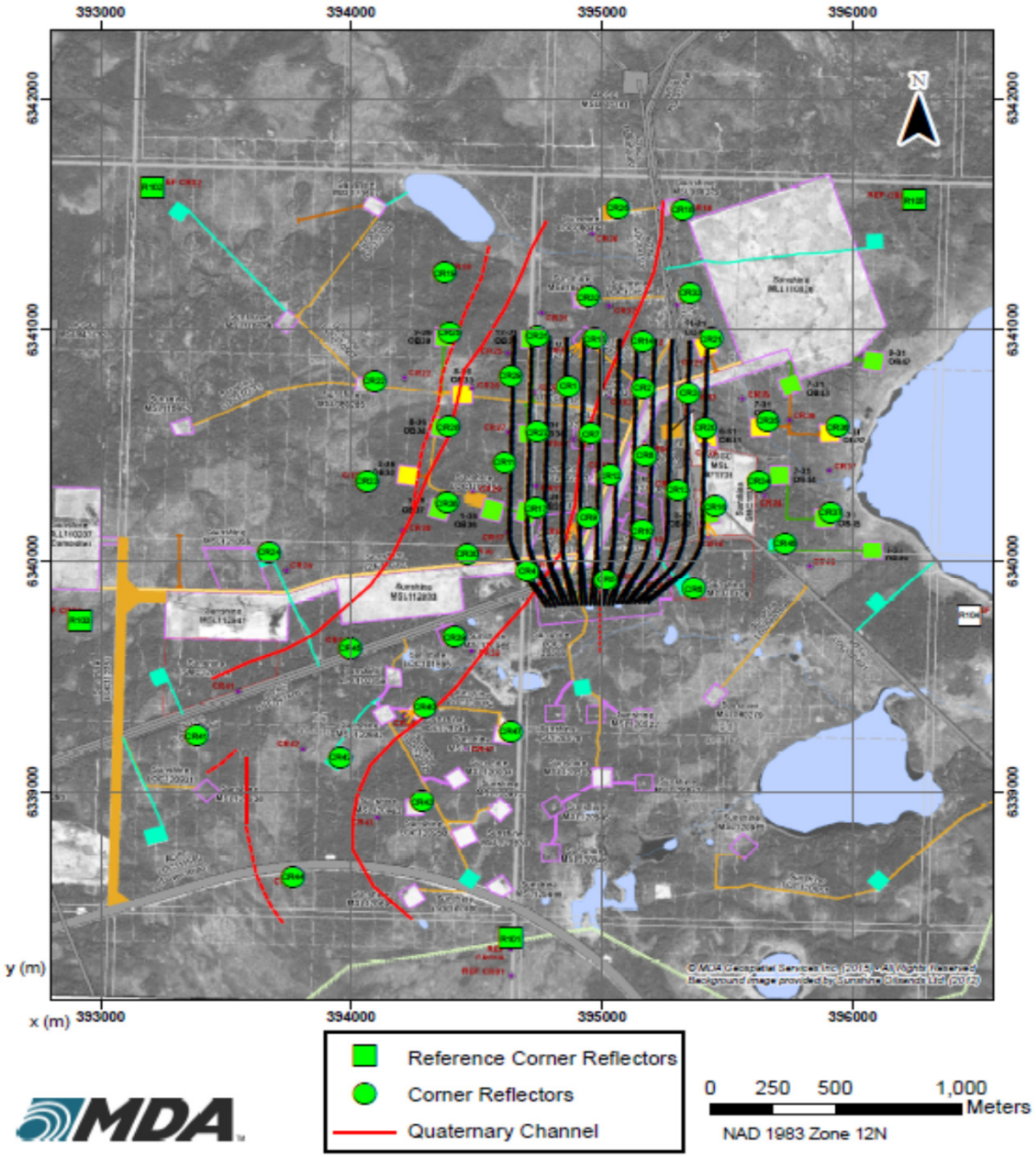
## Oil sand - Wabiskaw Sand




## 1AA/14-31-094-17W4/0 Well Log



# Surface Heave – Corner Reflector Locations

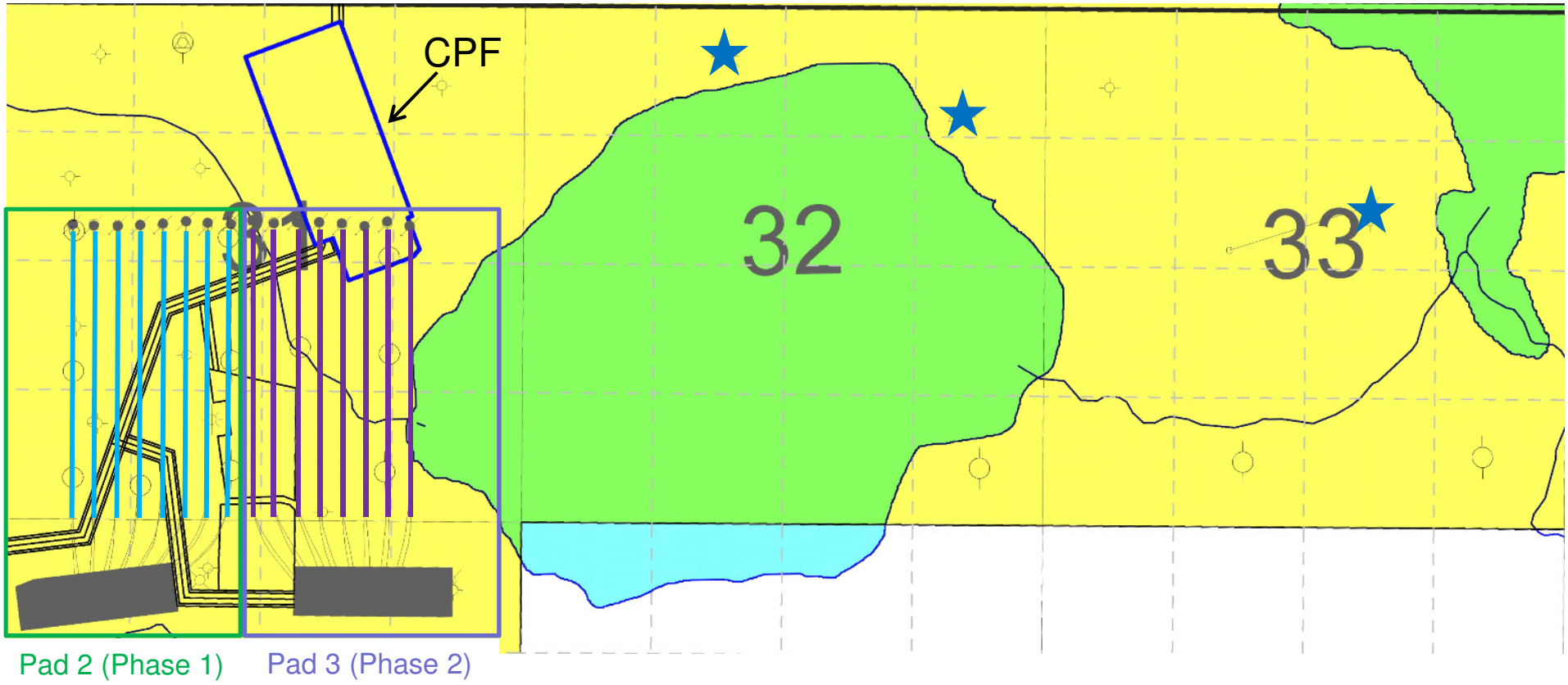


# Surface Heave Monitoring

- 52 corner reflector locations
- Baseline information gathered prior to steaming operations
- Since the start up of the wells, 30-55 mm of surface expression due to SAGD related activities has been observed at some corner reflector locations

# Drilling and Completions

# West Ells Pad & Well Locations



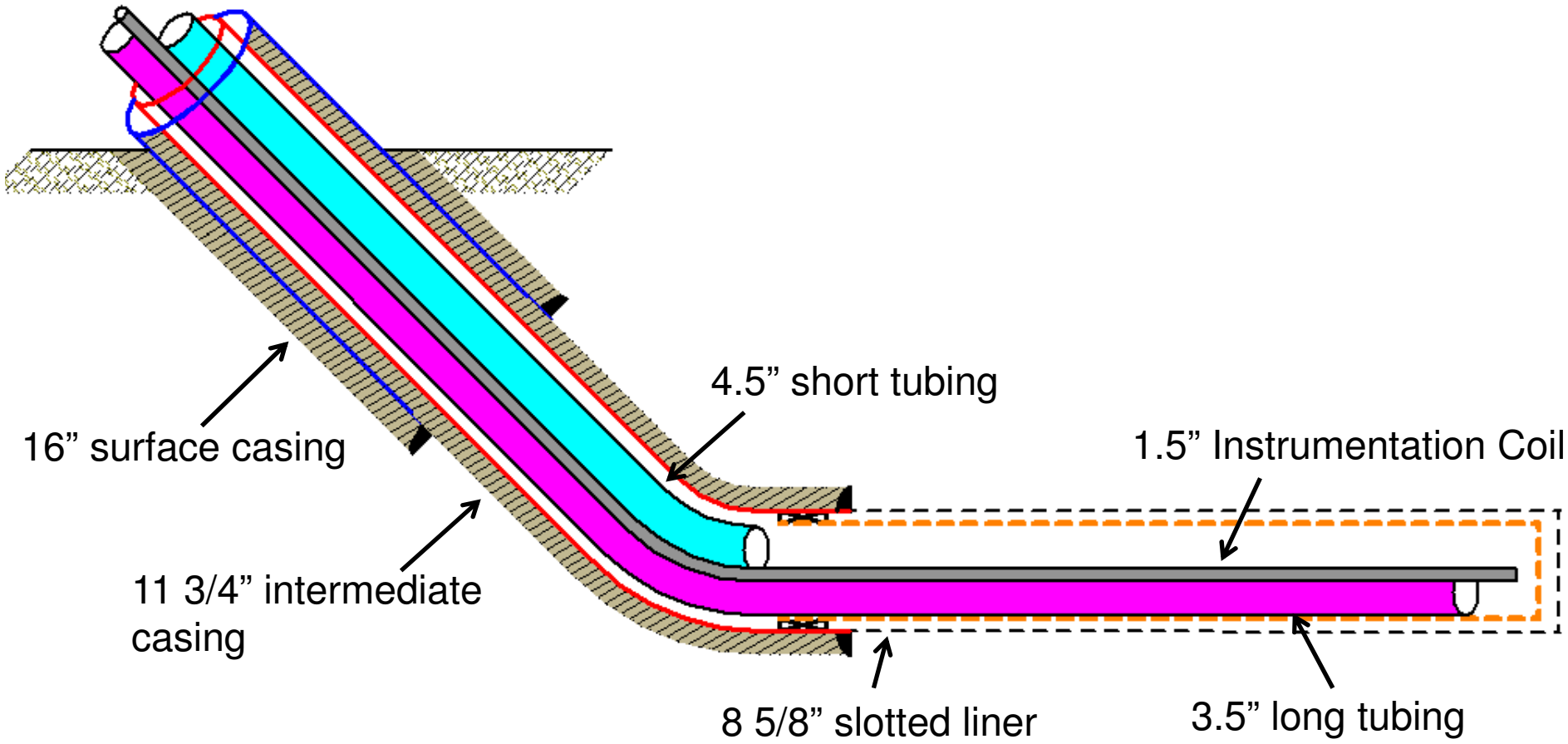

SAGD Well Pair – Drilled & Completed

SAGD Well Pair – Drilled, liners installed, pump and instrumentation install not complete.

Source Water Well – Drilled & Completed

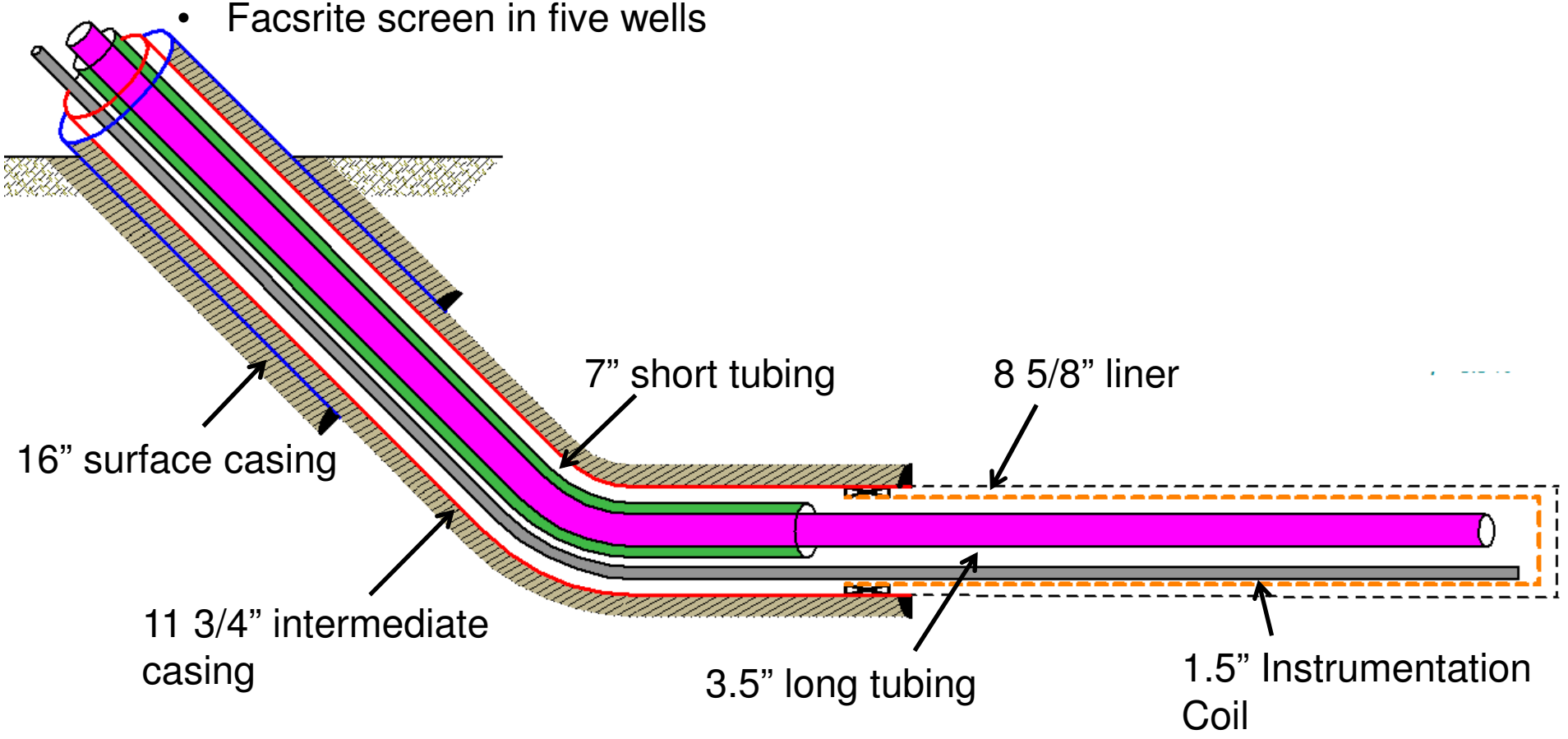
# Injector Well Completions

- Steam injection down long and short tubing
- Blanket gas held on intermediate casing annulus



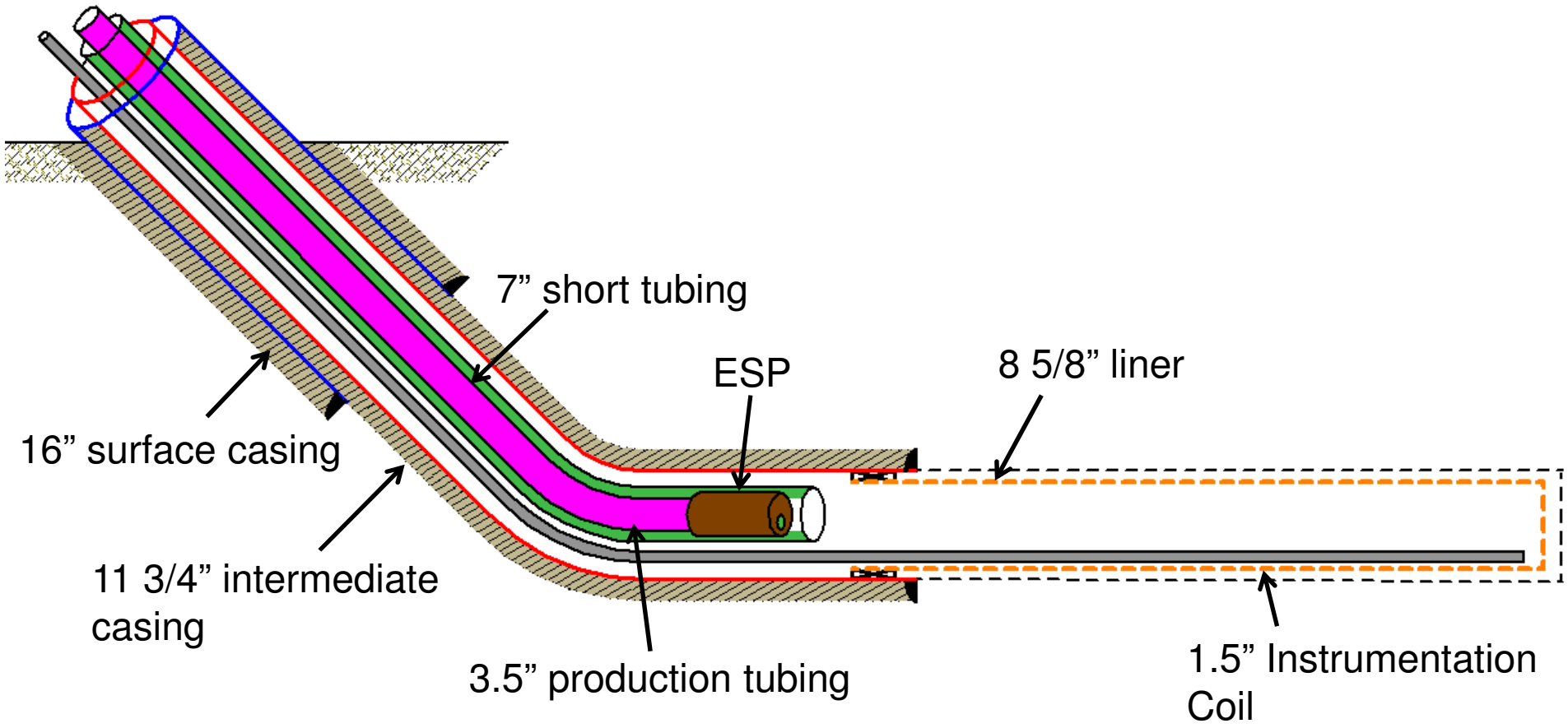
# Producer Well Completions – Circulation Phase

- Steam injection through long tubing
- Circulation returns via intermediate casing
- Blanket gas contained in short tubing
- Slotted liner in three wells
- Facsrite screen in five wells



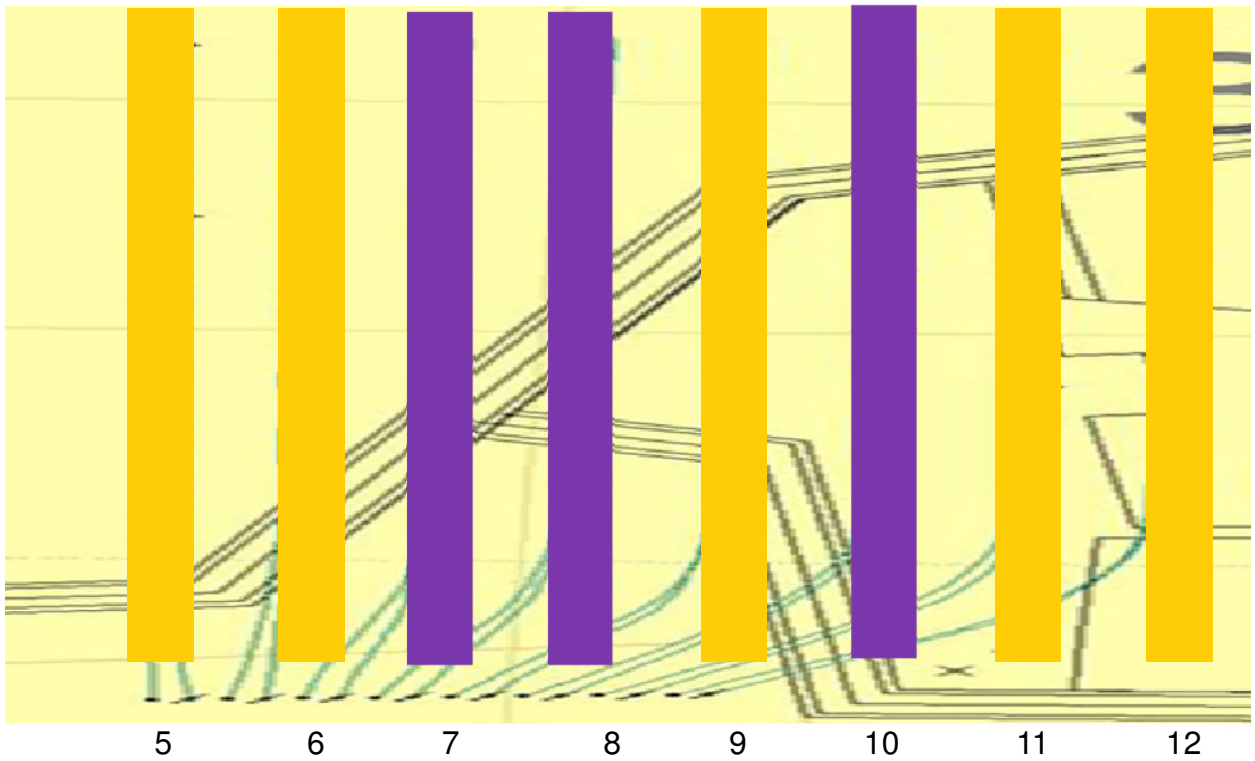
# Producer Well Completions – SAGD Phase

- Electric Submersible Pumps (ESPs) installed in all SAGD producers
- Blanket gas held on short tubing and intermediate casing



# Producer Well Completions – Liner Type

- Slotted Liner – 0.012” x 0.020” RT
- Facsrite – 250 Micron



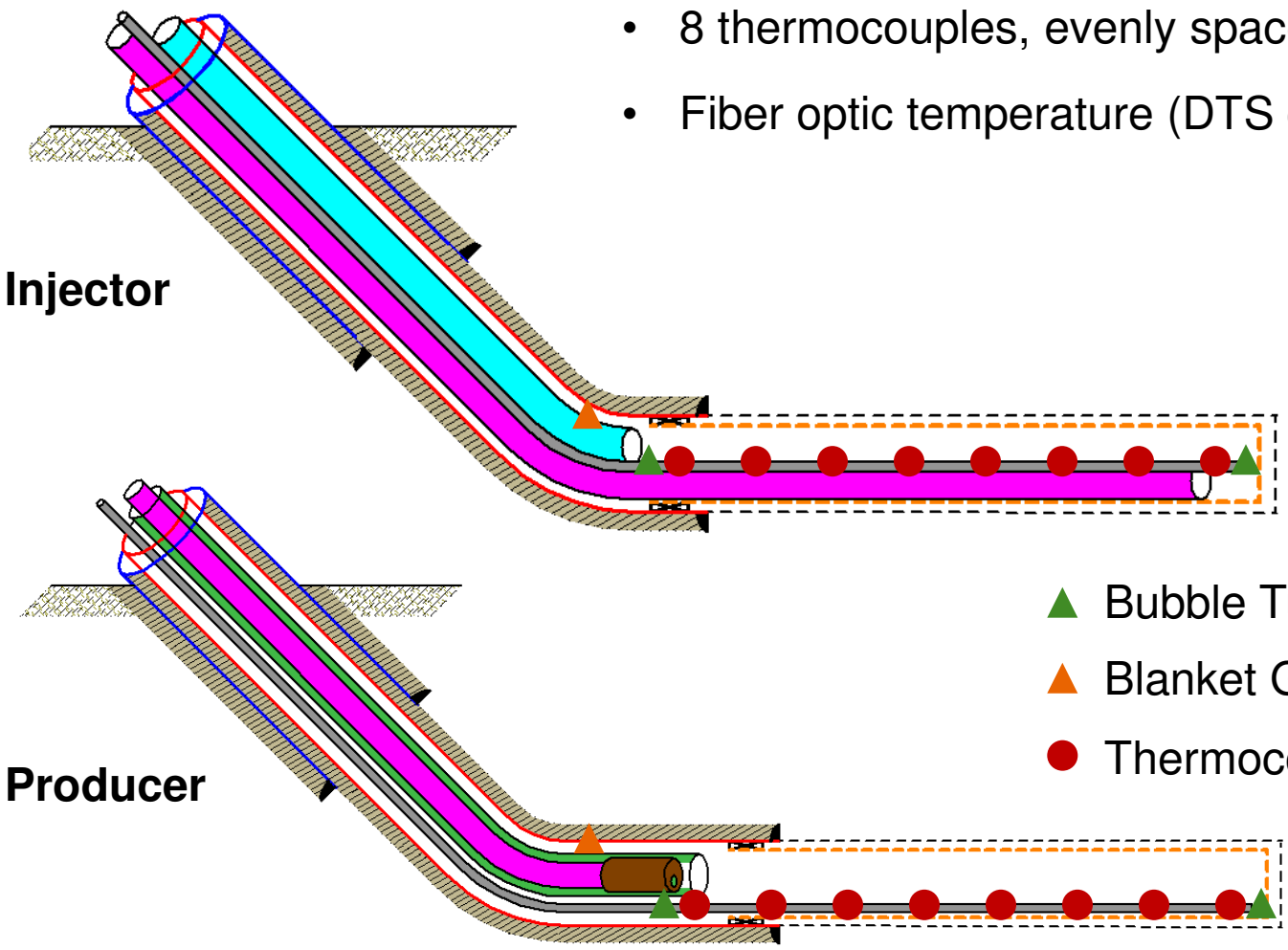
# Artificial Lift

- All SAGD production wells were designed to use Electric Submersible Pumping (ESP) systems
- Designed production capacity of the ESPs is 50-720 $m^3/d$ for initial stage of operation
- Current emulsion rate varies between 80-550 $m^3/d$
- Designed operational temperature of ESP is at 230℃
- Current operational temperature between 150-200℃

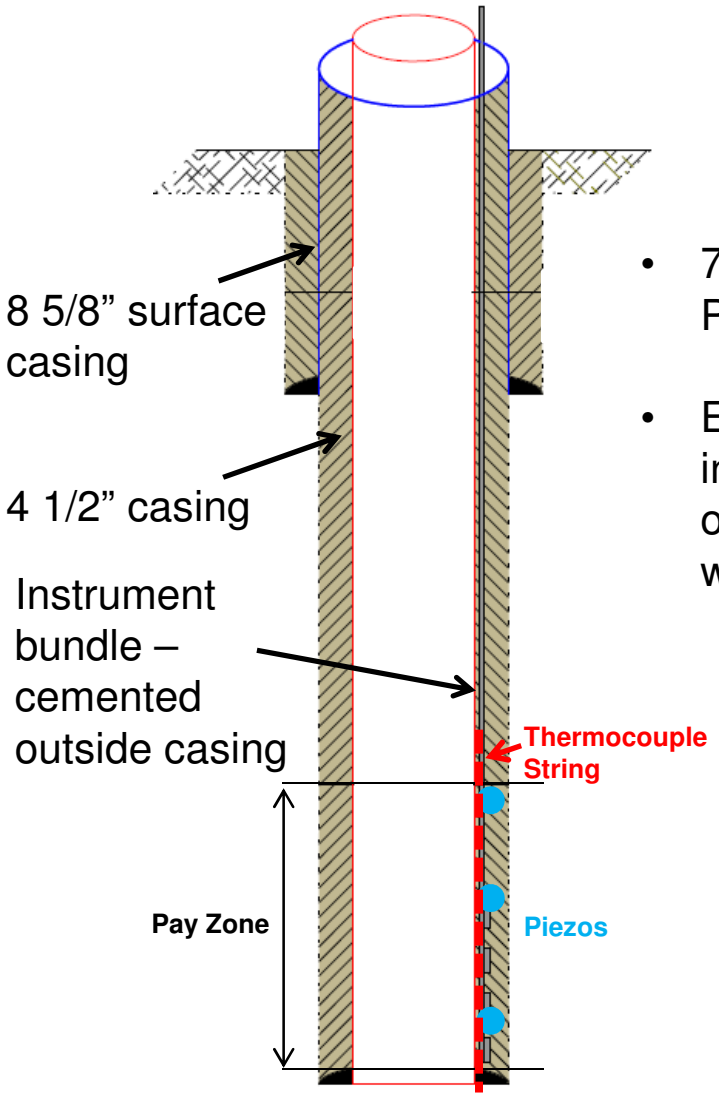
# Well Instrumentation

1.5” instrumentation coils include (all wells):

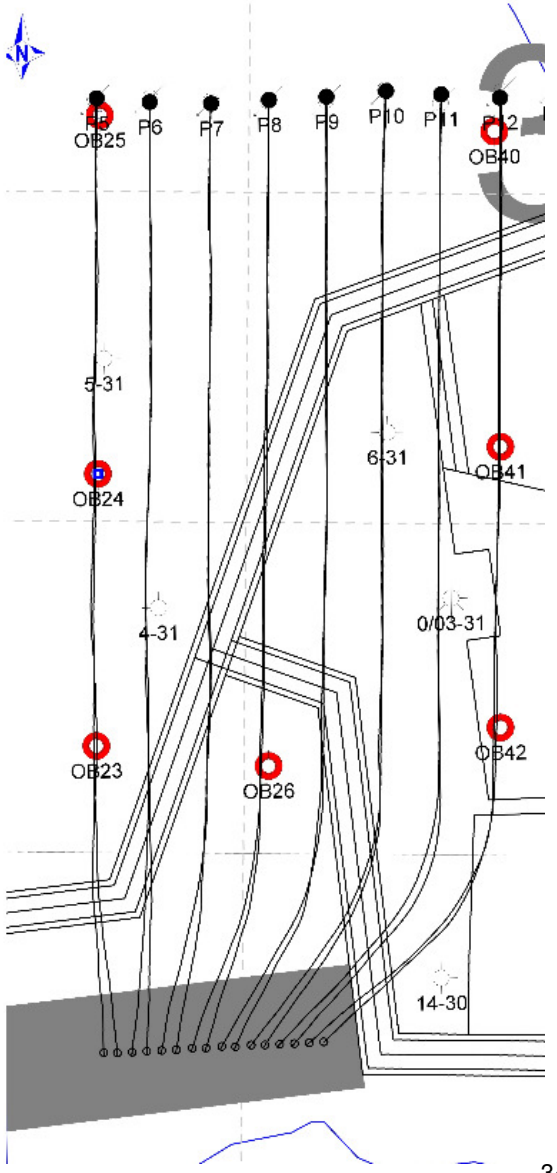
- Heel and toe bubble tube – pressure
- 8 thermocouples, evenly spaced
- Fiber optic temperature (DTS or 40-point FBG)



# Observation Wells



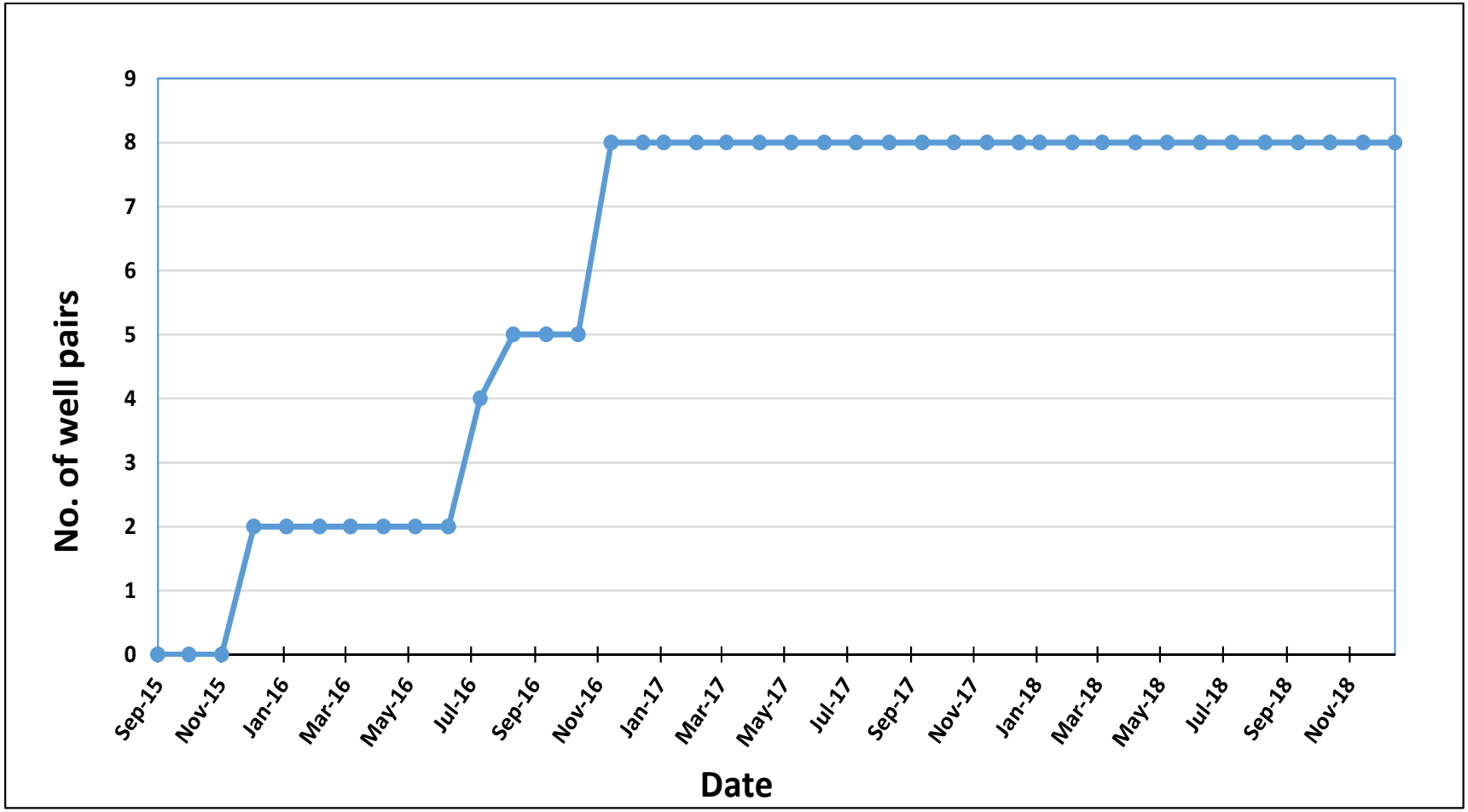

- 7 vertical OB wells drilled on Pad 2 (Phase 1) across zone
- Each well equipped with instrument bundle cemented outside 4 ½” casing, equipped with:
  - 20 thermocouples spaced from above the cap rock to below base of pay
  - 3 piezometers in zones of interest: gas cap, mid-pay, and lower pay



# Subsurface and Scheme Performance

# Subsurface Performance

- All 8 well pairs are now in production mode

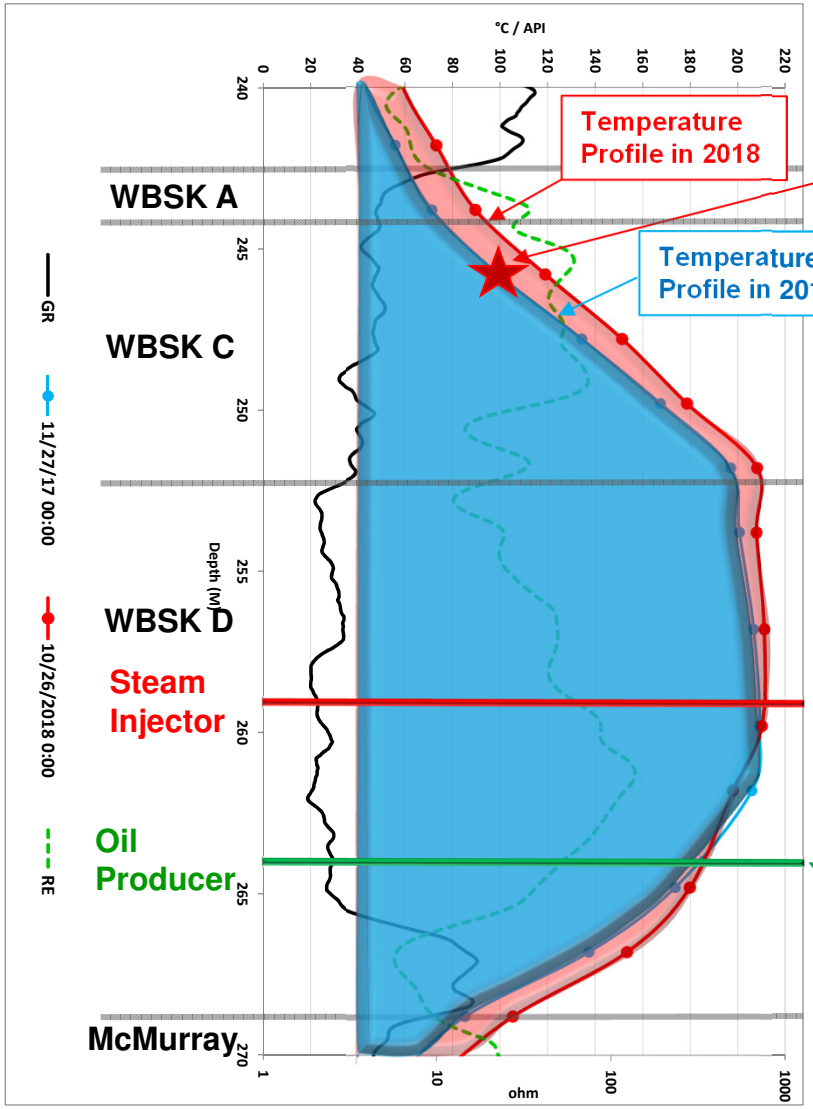


# Injection and Production Pressure

- SAGD steam chamber still developing
- The injection pressure varied from 2000 kPa to 2400 kPa
- Producer pressure registered between 1000 kPa and 2000 kPa
- Sunshine's near term operating strategy is to maximize steam rates to achieve and sustain a bottom hole injection pressure of around 2500 kPa
- Sunshine's injection pressure is within approved limit of 4400 kPa

# Temperature Response on Type Well (102/06-31-094-17W4)

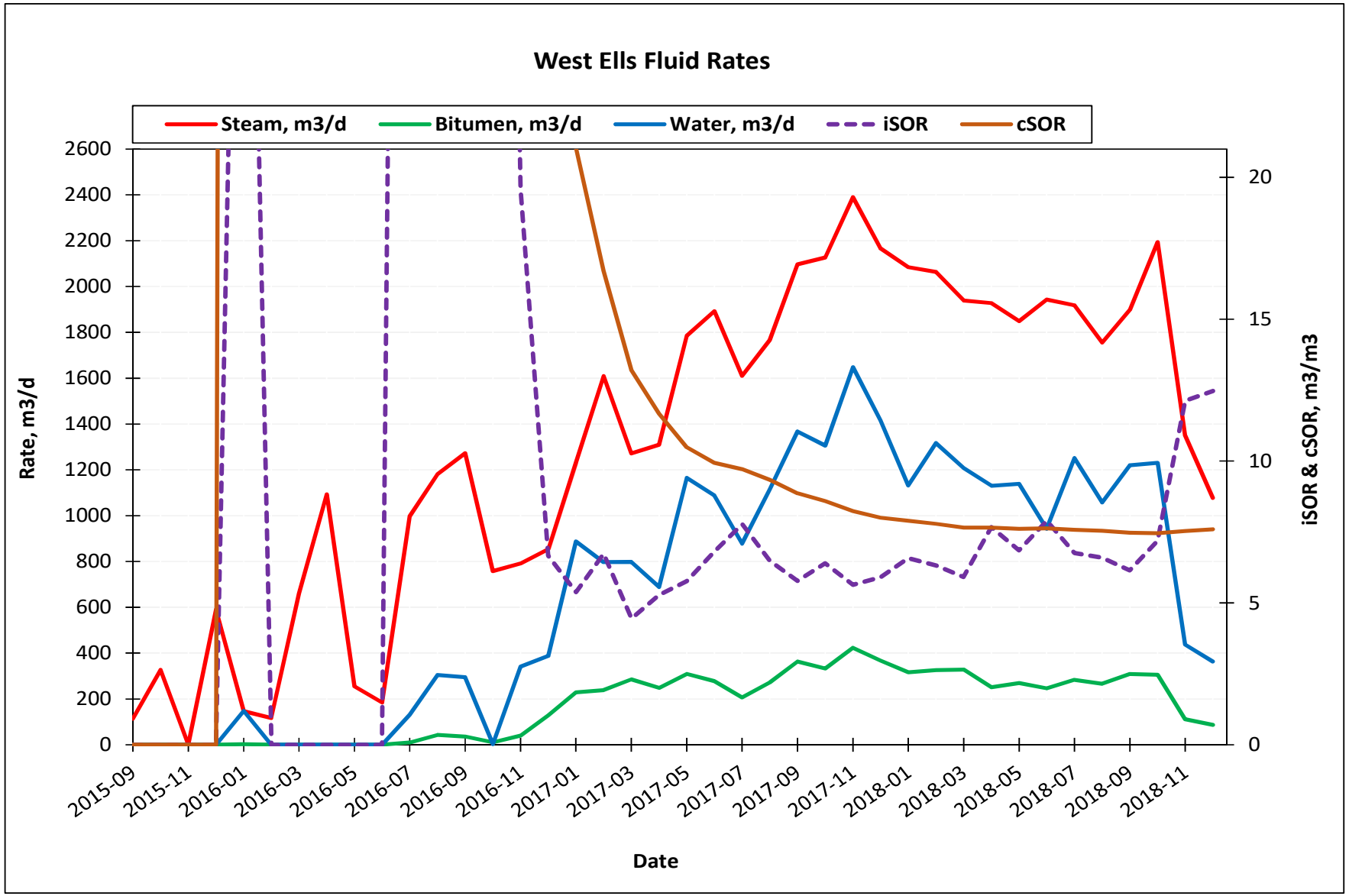
## OB41 Temperature Log



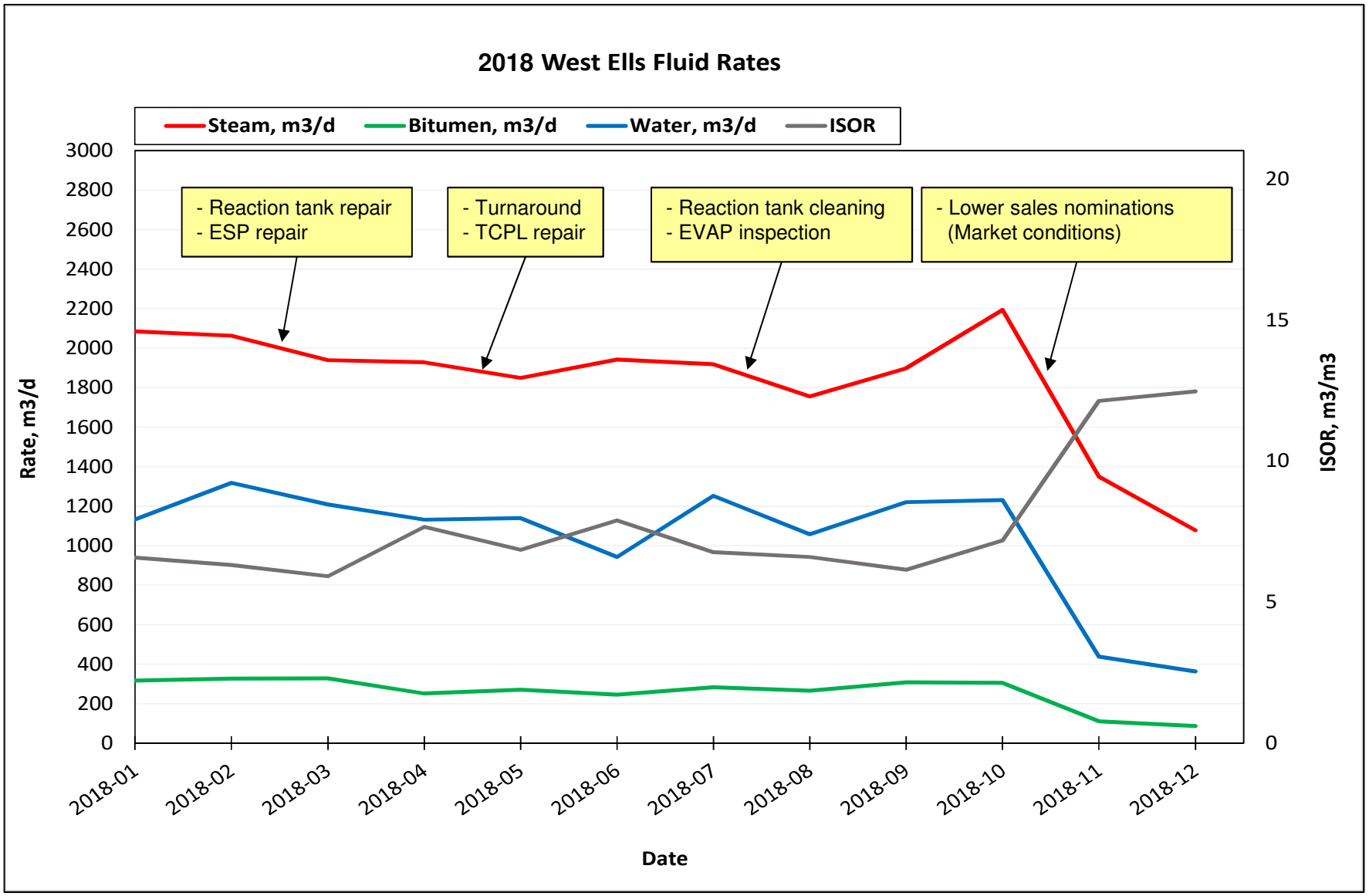

## Core


- OB41 is 4.2 m east of Pair 12
- Oil sand with mm to cm silt/shale laminate (act as a baffle and not a barrier)
- Original reservoir temperature is 9℃
- Temperature near the injector level is about 210℃

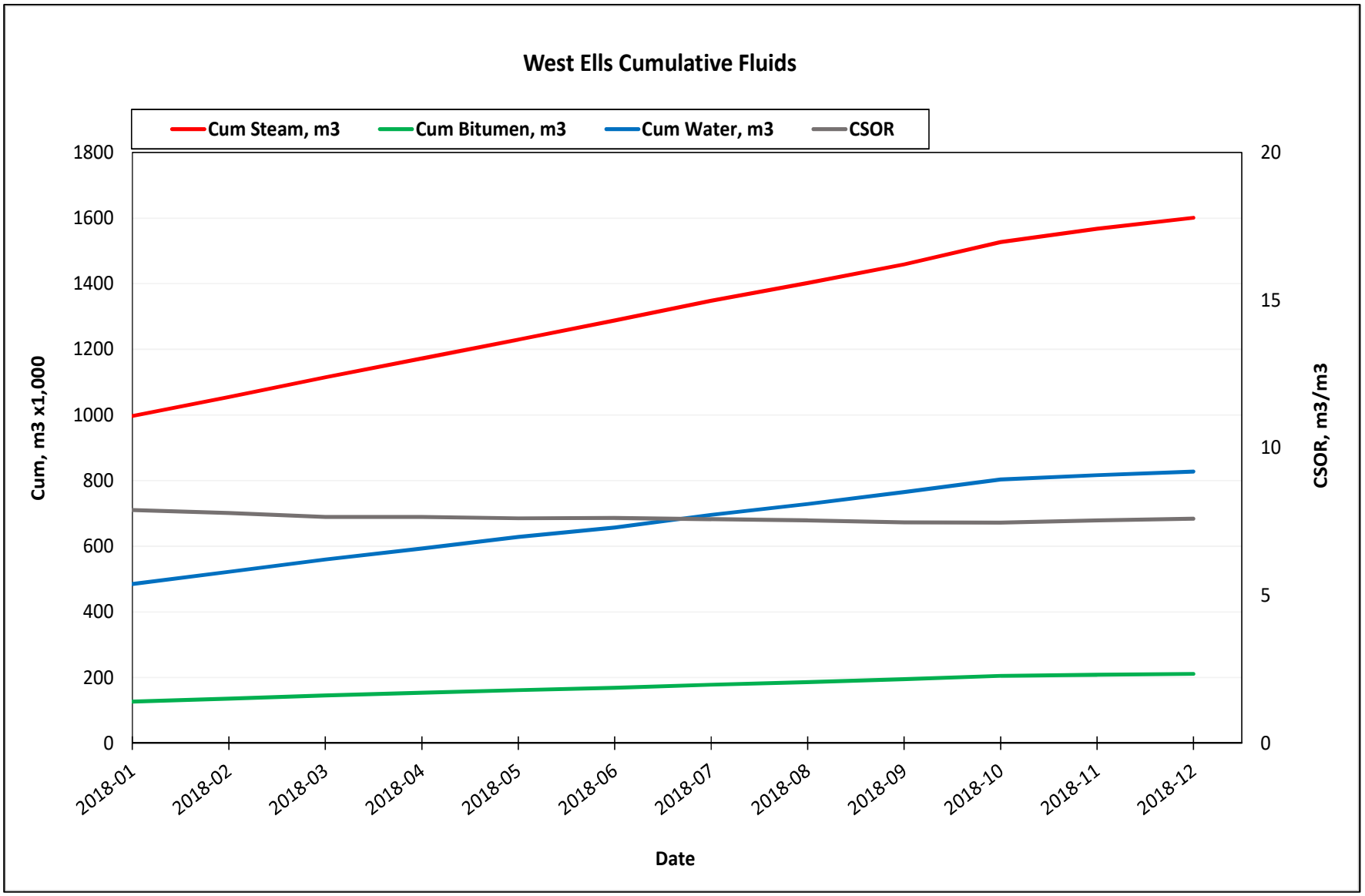
# Fluid Rates


West Ells Fluid Rates
Steam, m3/d
Bitumen, m3/d
Water, m3/d
iSOR
cSOR
Rate, m3/d
iSOR & cSOR, m3/m3
Date
2600
2400
2200
2000
1800
1600
1400
1200
1000
800
600
400
200
0
20
15
10
5
0
2015-09
2015-11
2016-01
2016-03
2016-05
2016-07
2016-09
2016-11
2017-01
2017-03
2017-05
2017-07
2017-09
2017-11
2018-01
2018-03
2018-05
2018-07
2018-09
2018-11

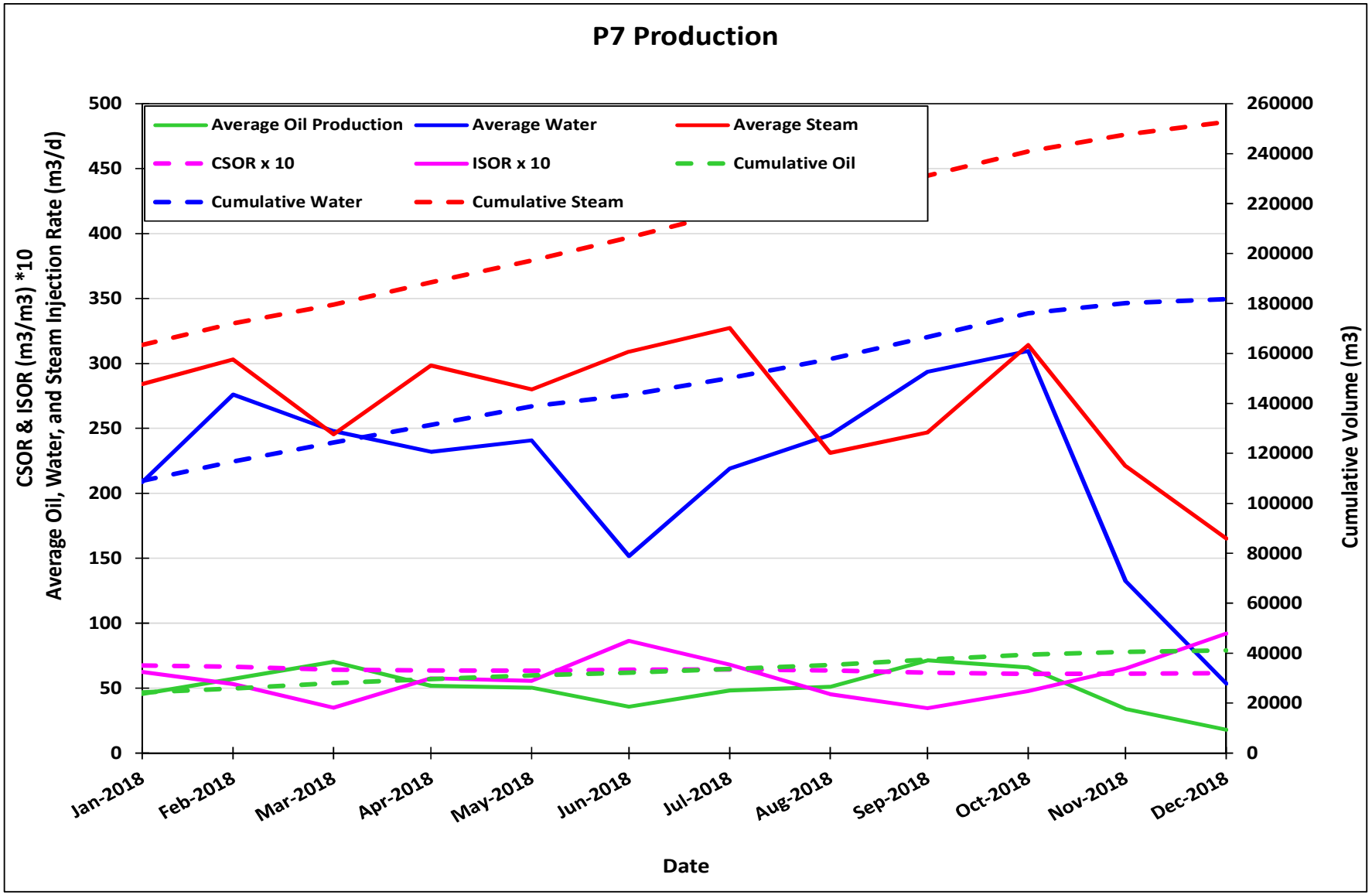
# Fluid Rates


2018 West Ells Fluid Rates
Steam, m3/d
Bitumen, m3/d
Water, m3/d
ISOR
- Reaction tank repair
- ESP repair
- Turnaround
- TCPL repair
- Reaction tank cleaning
- EVAP inspection
- Lower sales nominations
(Market conditions)
Rate, m3/d
ISOR, m3/m3
3000
2800
2600
2400
2200
2000
1800
1600
1400
1200
1000
800
600
400
200
0
20
15
10
5
0
2018-01
2018-02
2018-03
2018-04
2018-05
2018-06
2018-07
2018-08
2018-09
2018-10
2018-11
2018-12
Date

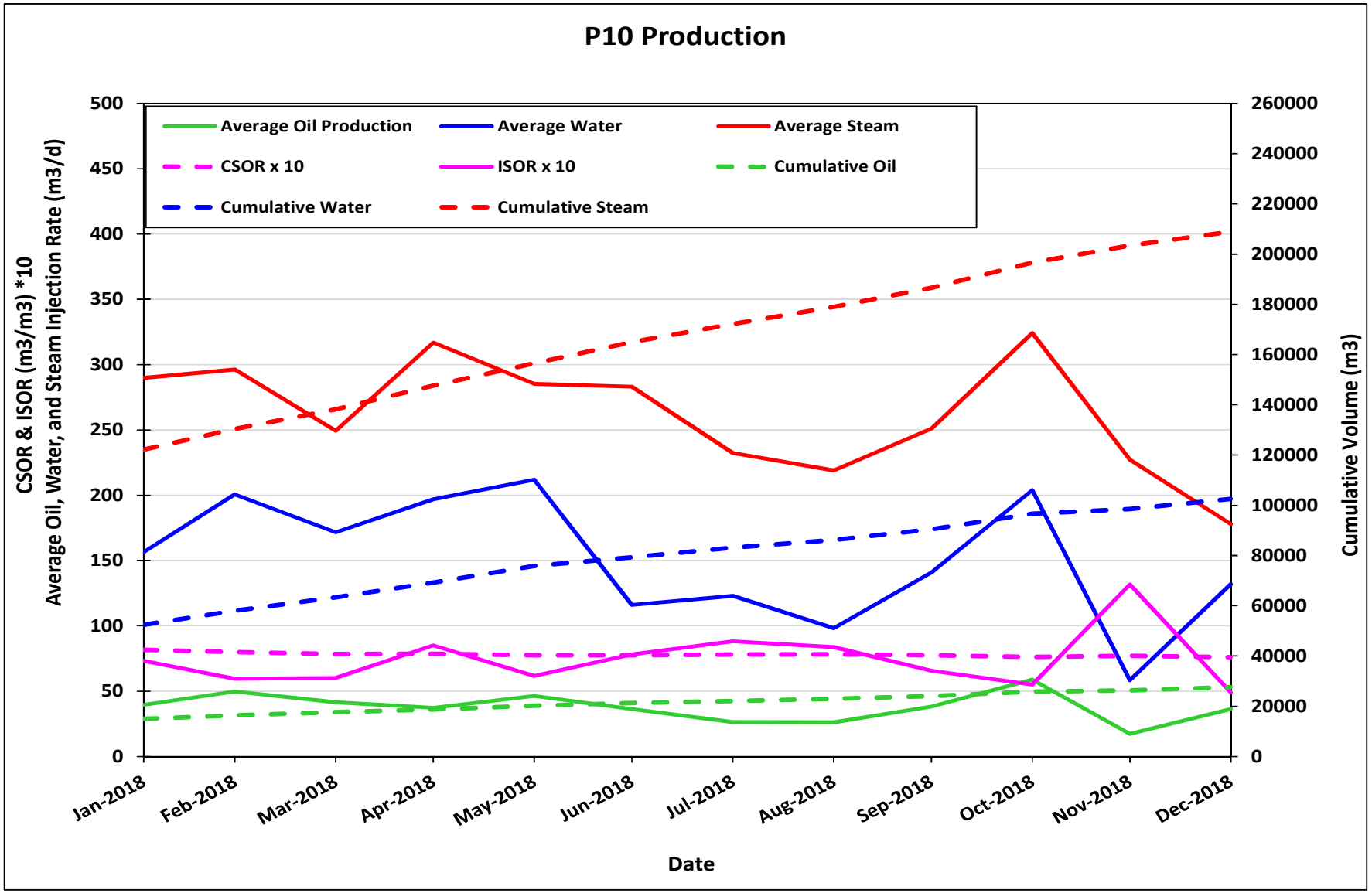
# Cumulative Fluid Rate



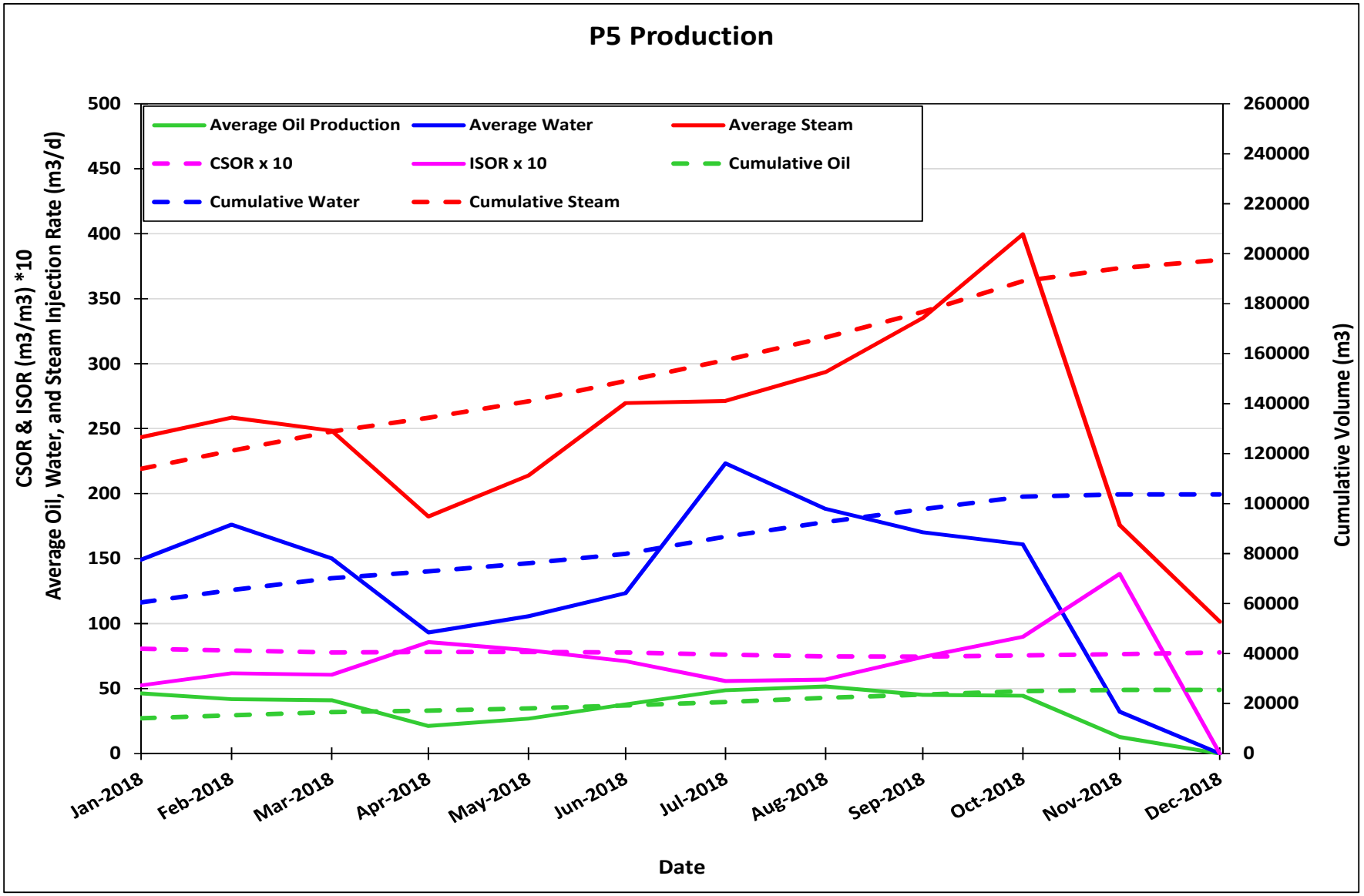
# Recovery Patterns Pair 7 - High



# Recovery Patterns Pair 10 - Medium



# Recovery Patterns Pair 5 - Low



# Steam Strategy

- West Ells is in the early stage of the SAGD process
- Focus on even steam chamber development and maximizing efficiency
- Steam will be continually optimized in individual wells based on the steam chamber growth rate, with a target pressure of around 2500 kPa
- Once the steam chamber has reached the top of the reservoir/peak rates, the target pressure will be reviewed again
- Continue building the steam chamber and ramp up production toward nameplate capacity

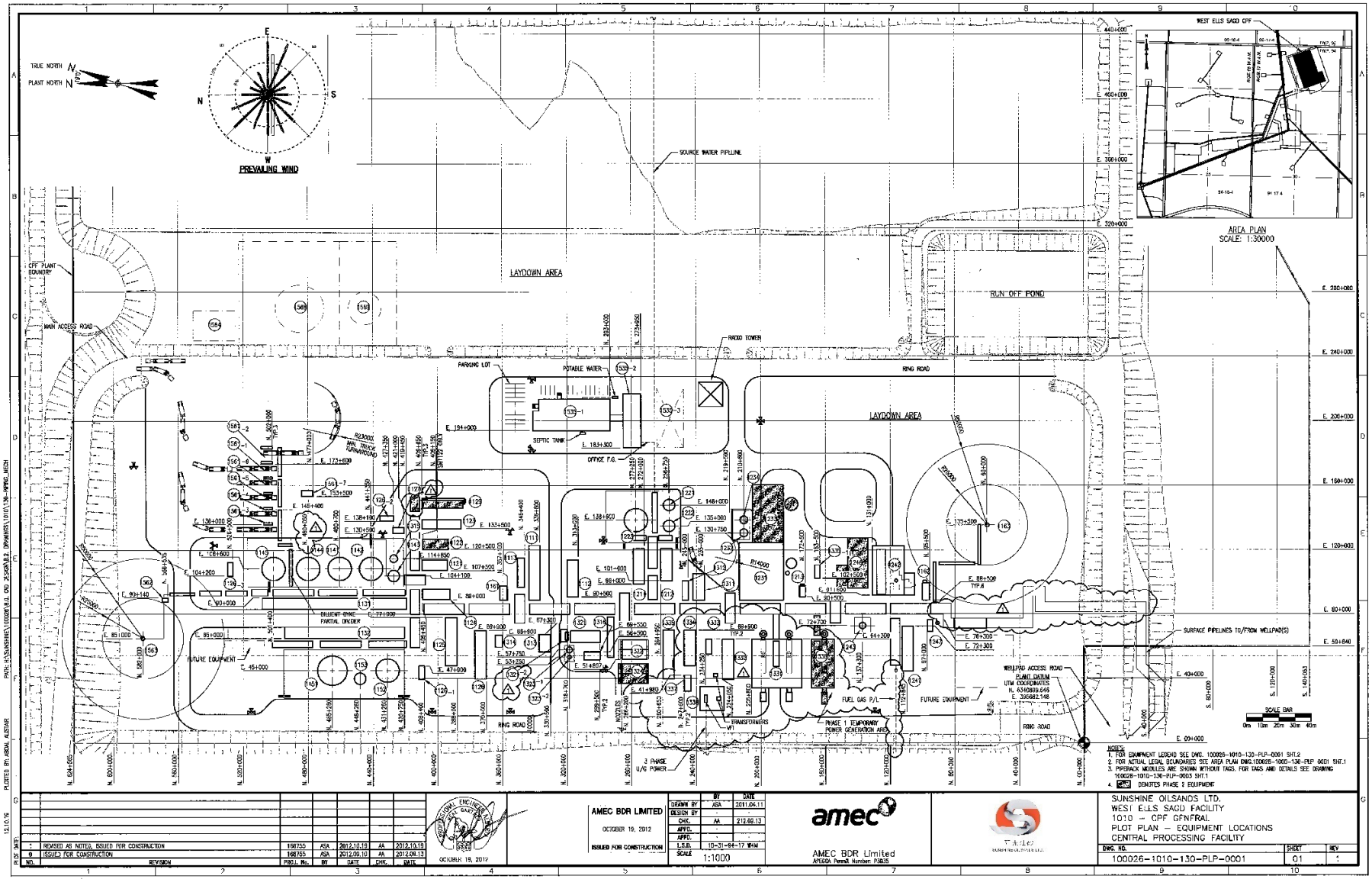
# Key Learnings

- A gradual production ramp-up/down plan is key to minimize a chance of experiencing water balance problems at CPF
- Better control of BS&W helps to maintain good performance of Evaporator and saves the cost of waste water disposal
- Product inventory and trucking management is crucial in case of experiencing extreme weather and poor road conditions

# Facilities

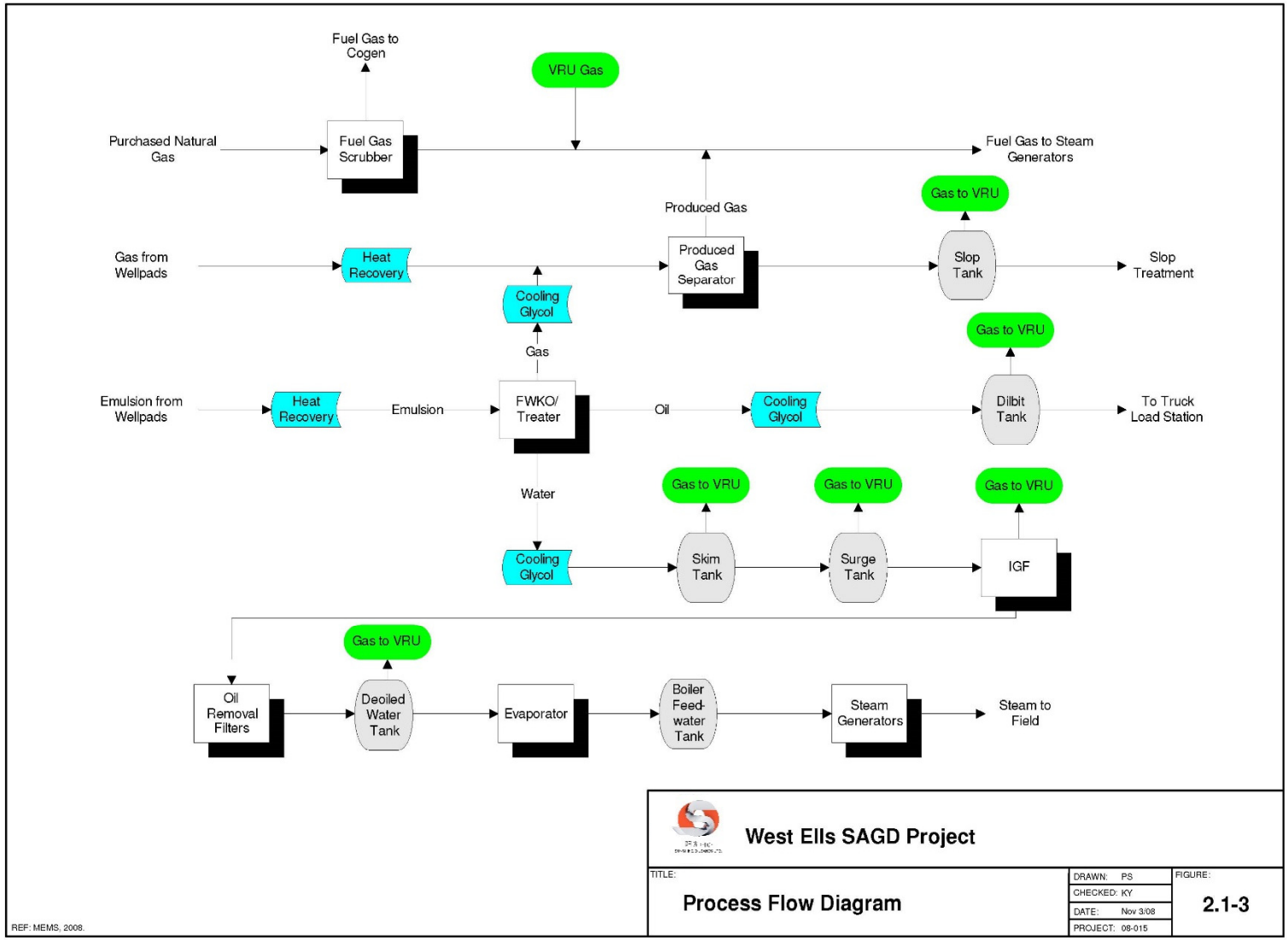
# CPF Plot Plan

- No major facility modifications during this reporting period



# Aerial Photo of CPF

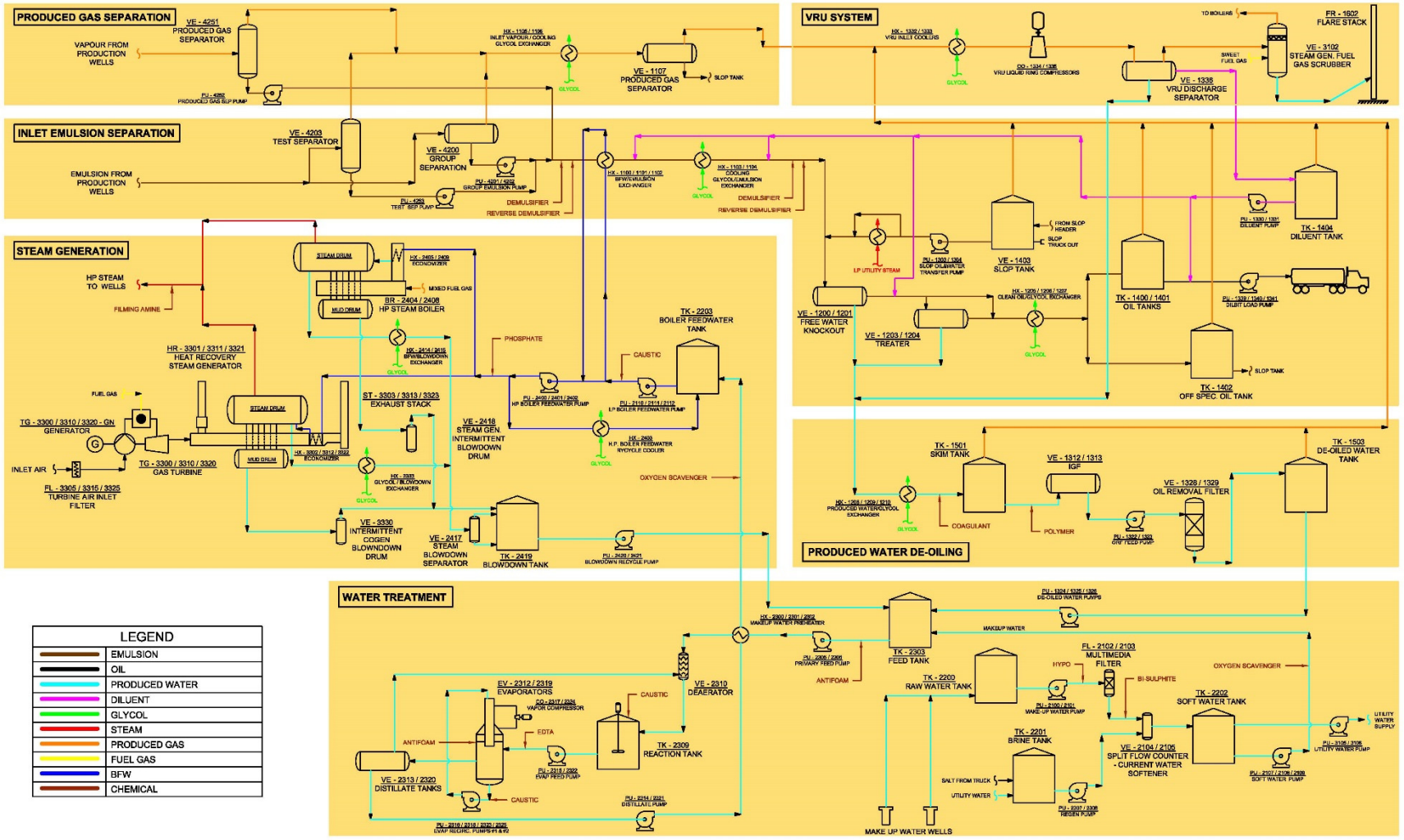
# CPF Process Flow Simplified



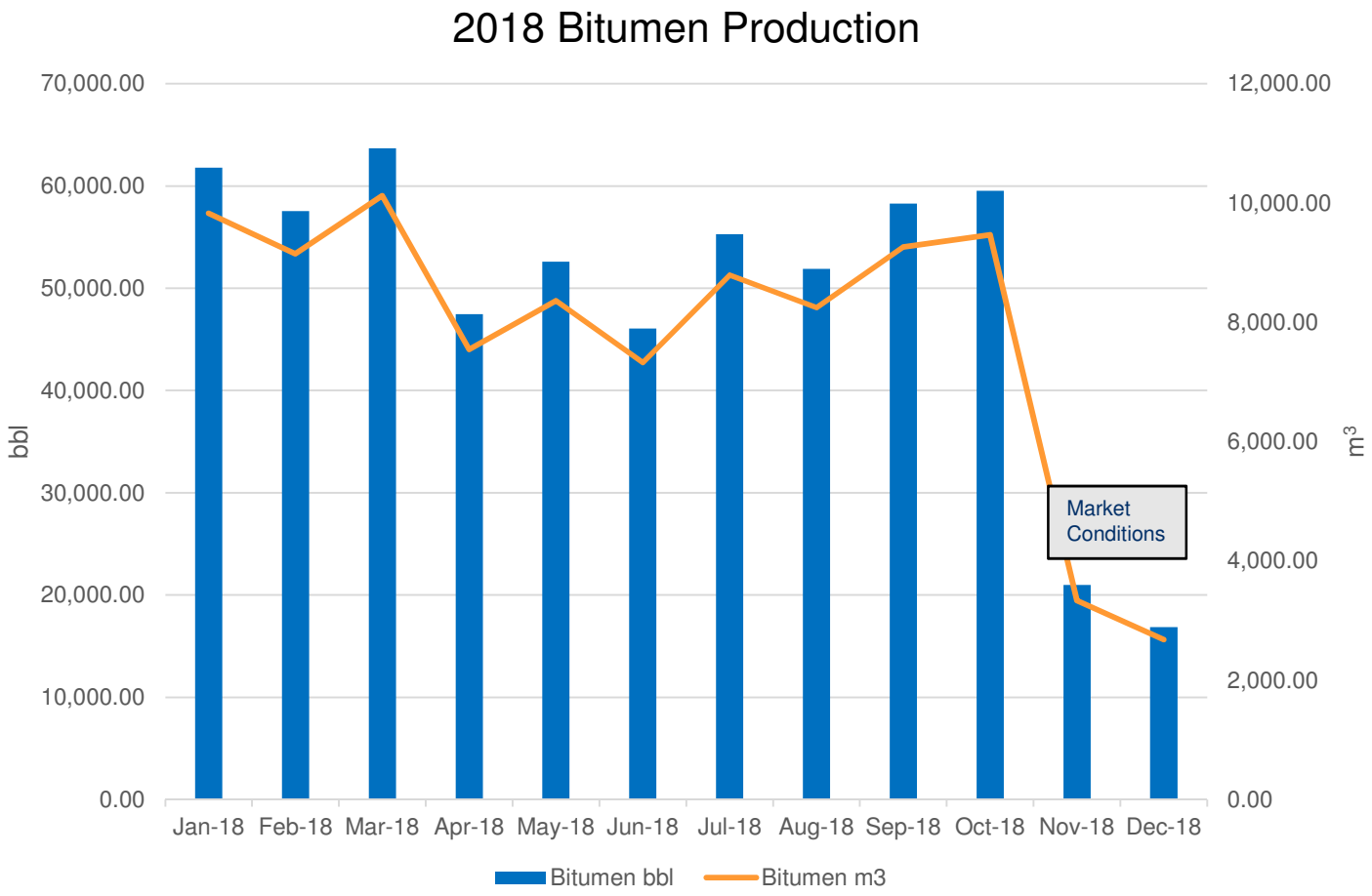
# CPF Process flow

- No modifications during this reporting period

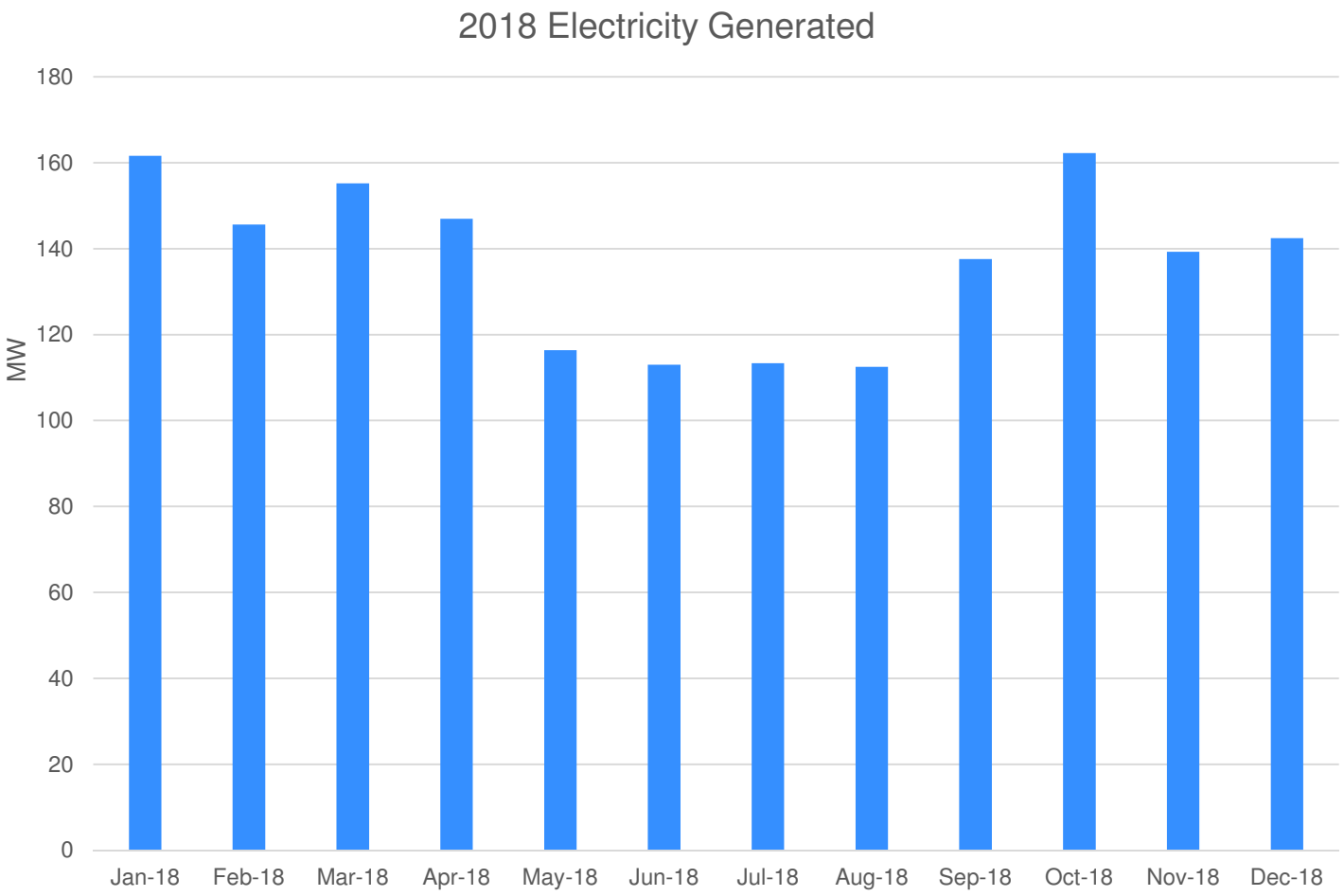
SUNSHINE WEST ELLS
10,000 BOPD SAGD FACILITY
FLOW DIAGRAM DRAFT



# Bitumen Production



# Electricity Generated



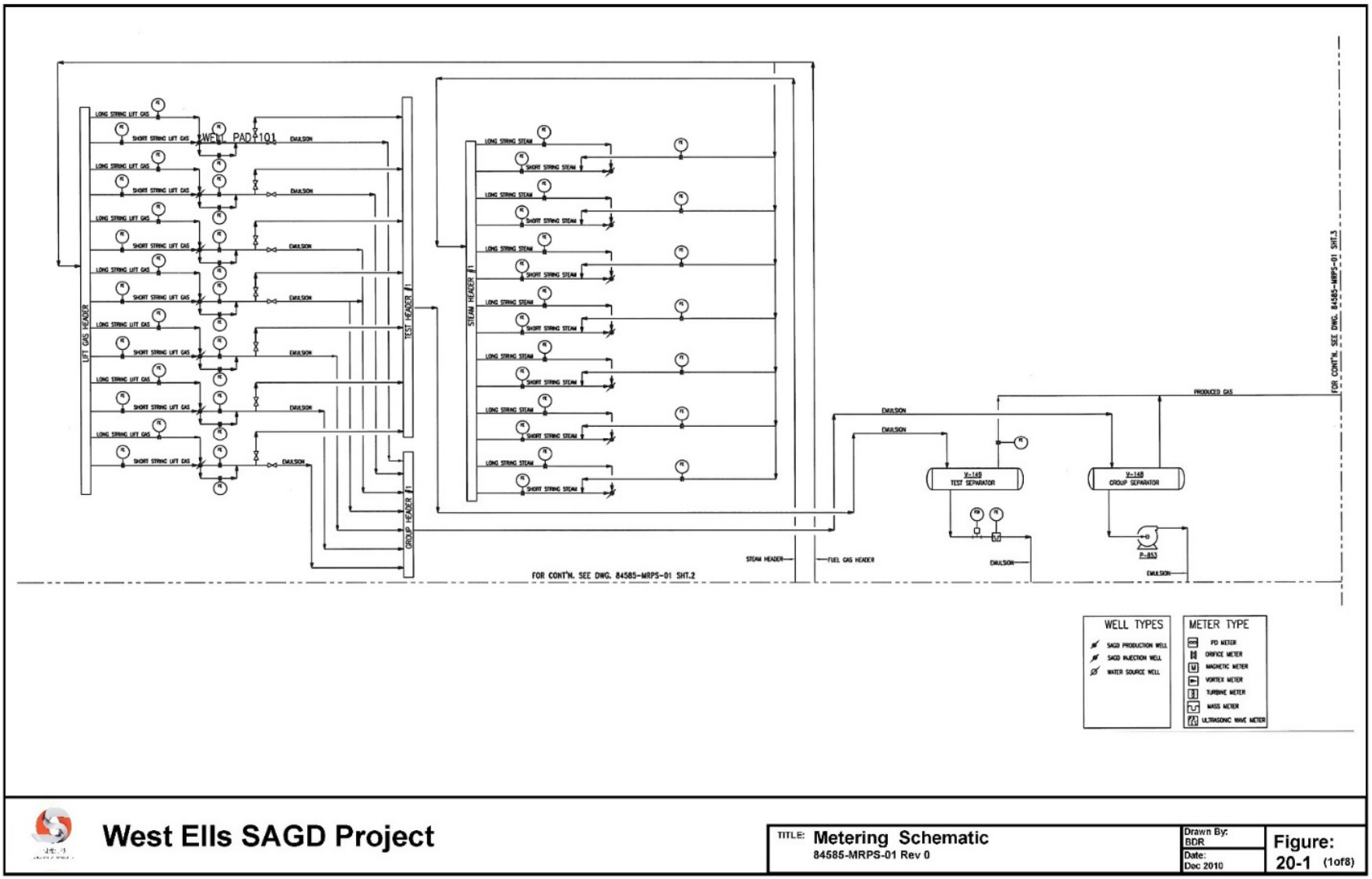

- 365 Running days
- 39.504 GWh total generated in 2018

## Measurement, Accounting and Reporting Plan (MARP)

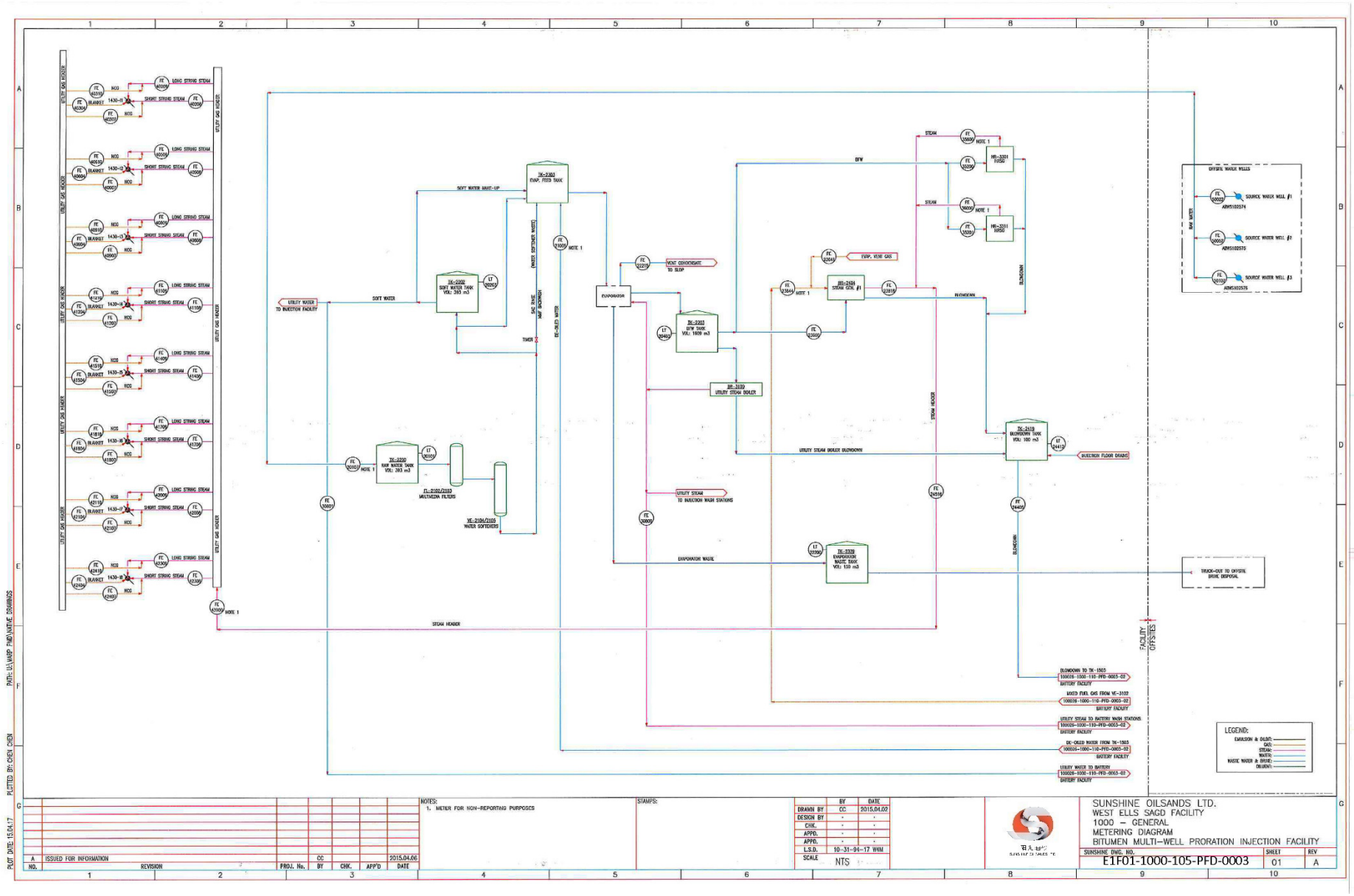
- Reporting codes associated with West Ells
  - ABBT0123666
  - ABIF0123667
  - ABWS0139258, ABWS0139259, ABWS0139260

- MARP approved August 2012
- MARP updated in 2015
- MARP Meter list revised in 2018
- No further changes or alterations made during the 2018 reporting period

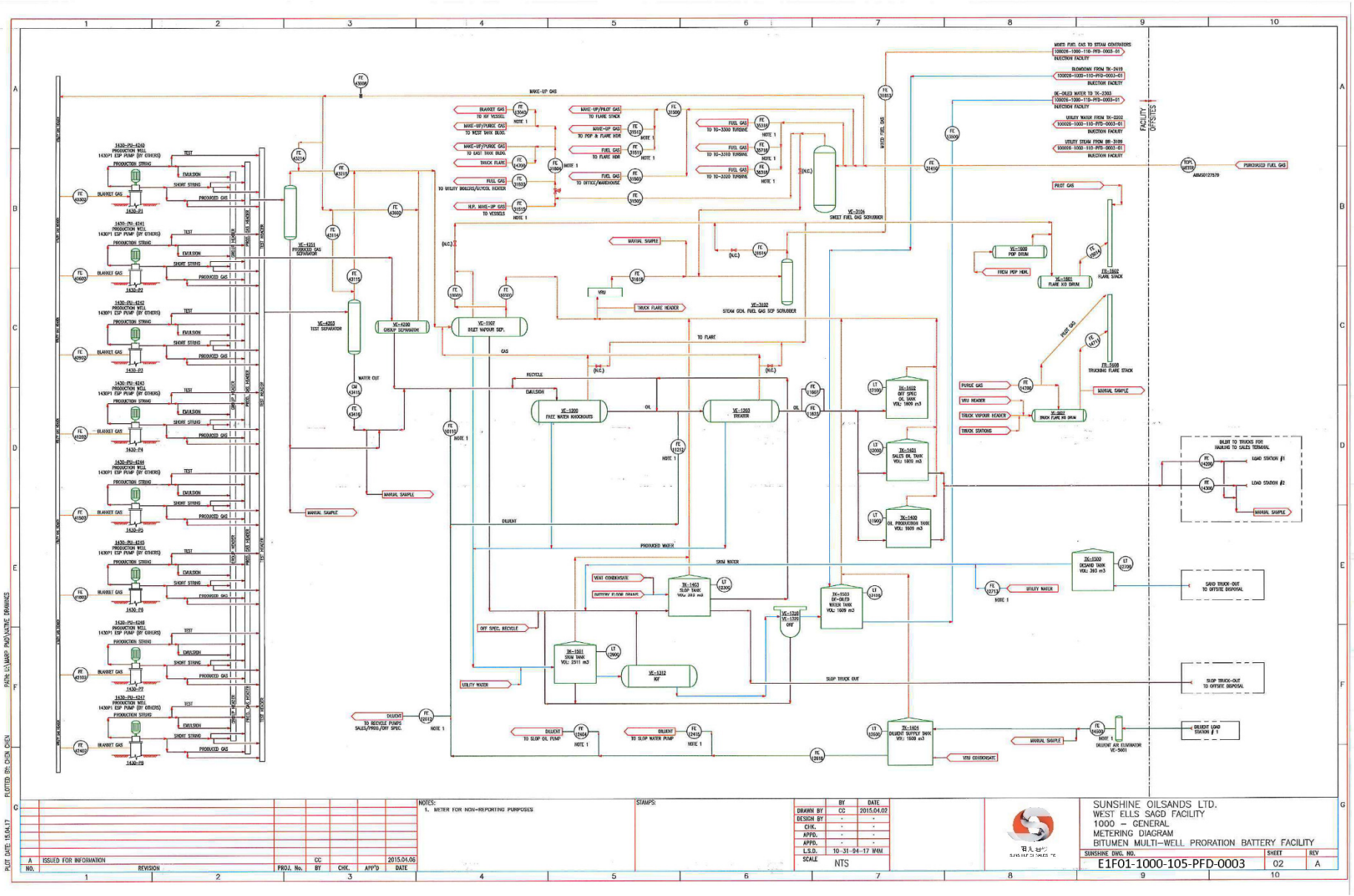
# Metering Schematic – Well Pads



# Metering Schematic – Injection Facility



# Metering Schematic - Battery

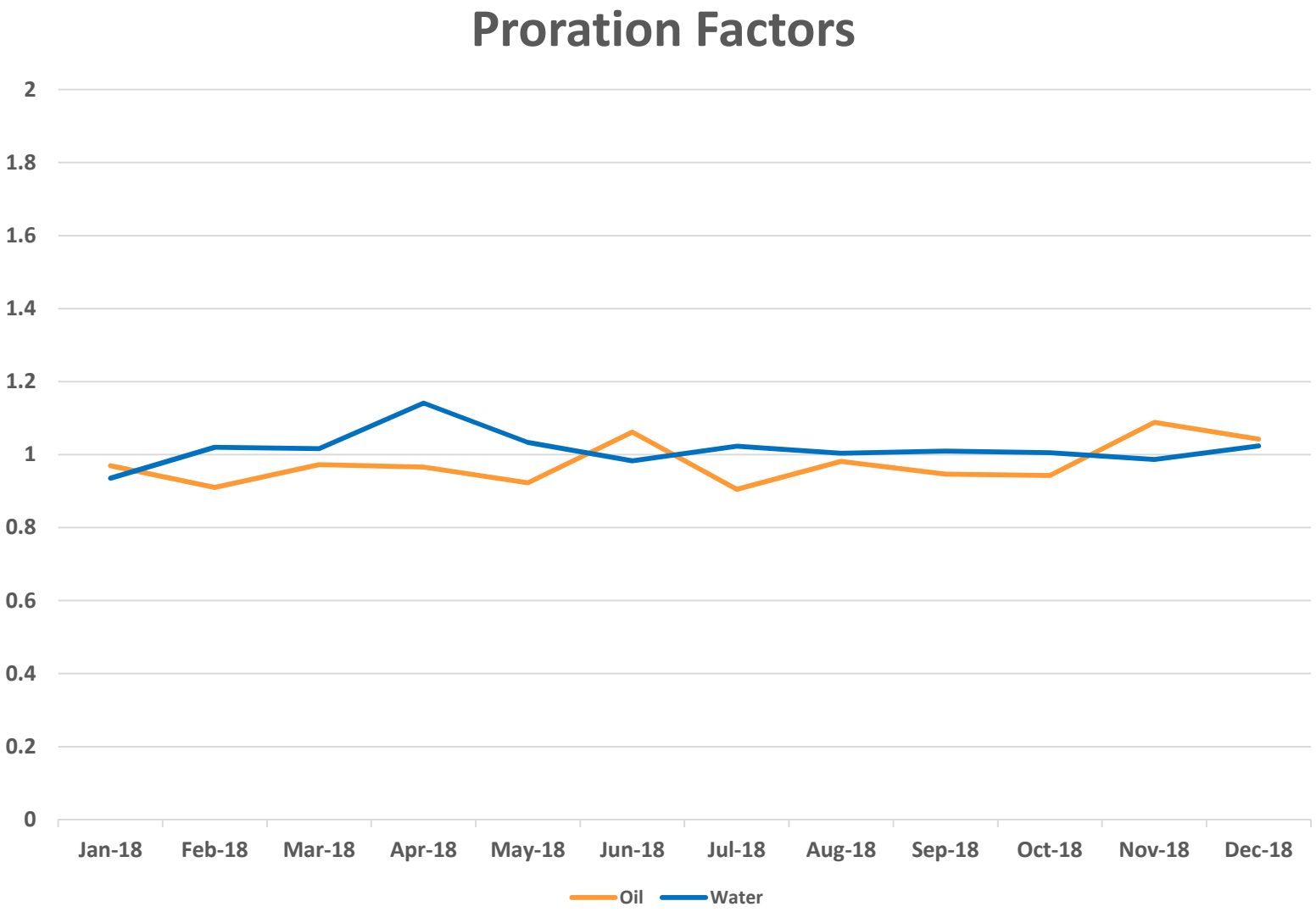


# Measurement Methodology

- No changes or alteration made to measurement methodology in reporting period
- Daily oil rate of each well is calculated by multiplying the most current well emulsion rate with the manual oil cut
  - Emulsion rate is the test flow rate from the test separator and oil cut is measured manually by taking a sample of the flow
  - Due to the slugging nature of the wells and high water flow during initial production, the test separator is not fully commissioned
  - There is only one separator on the well pad and well tests generally last for 8 to 15 hours depending on the fluid rate from the well (includes time to purge the test pipeline and test vessel)
  - To properly conduct a well test, with 8 wells on a pad, only one well can be tested every 4 - 5 days
- With the total production from the pad, individual well volumes are prorated against the overall production volume
- The same philosophy and process is applied to produced water and gas
- Currently, the meters on the test separator are being verified every time by comparing the results with the manual oil cut and water

# Measurement & Reporting

## Proration of Oil and Water

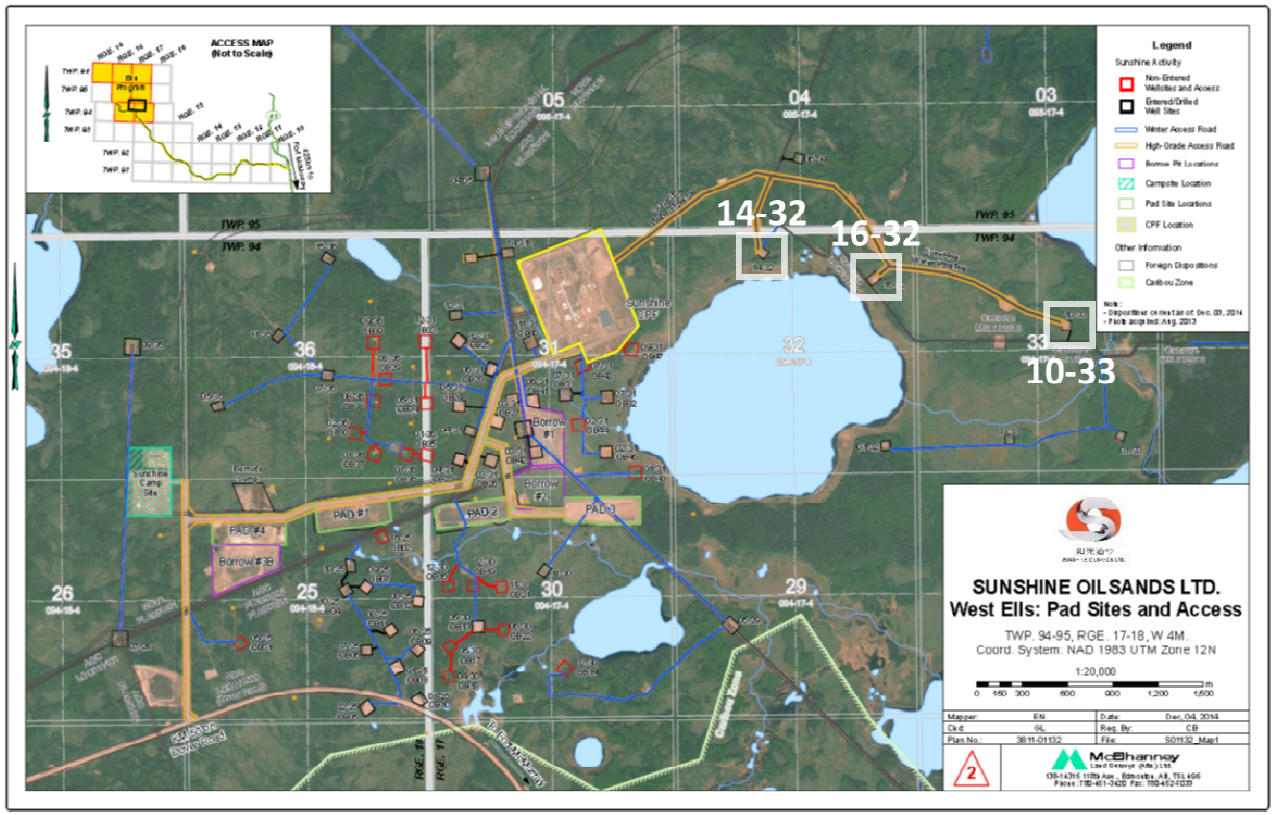


# Location of Water Source Wells

## Non-Saline Water Wells

- Observation wells are located at 16-32-094-17 W4 and 10-33-094-17 W4

| Well ID | Location | Formation | Maximum Rate of Diversion ($m^3/d$) |
|---|---|---|---|
| WSW 16-32a (1180021) | 16-32-094-17 W4 | Viking | 300 |
| WSW 16-32b (1180020) | 16-32-094-17 W4 | Viking | 300 |
| WSW 16-32c (1180019) | 16-32-094-17 W4 | Viking | 1,400 |
| WSW 14-32 (1165702) | 14-32-094-17 W4 | Viking | 1,244 |



# Water Source Composition

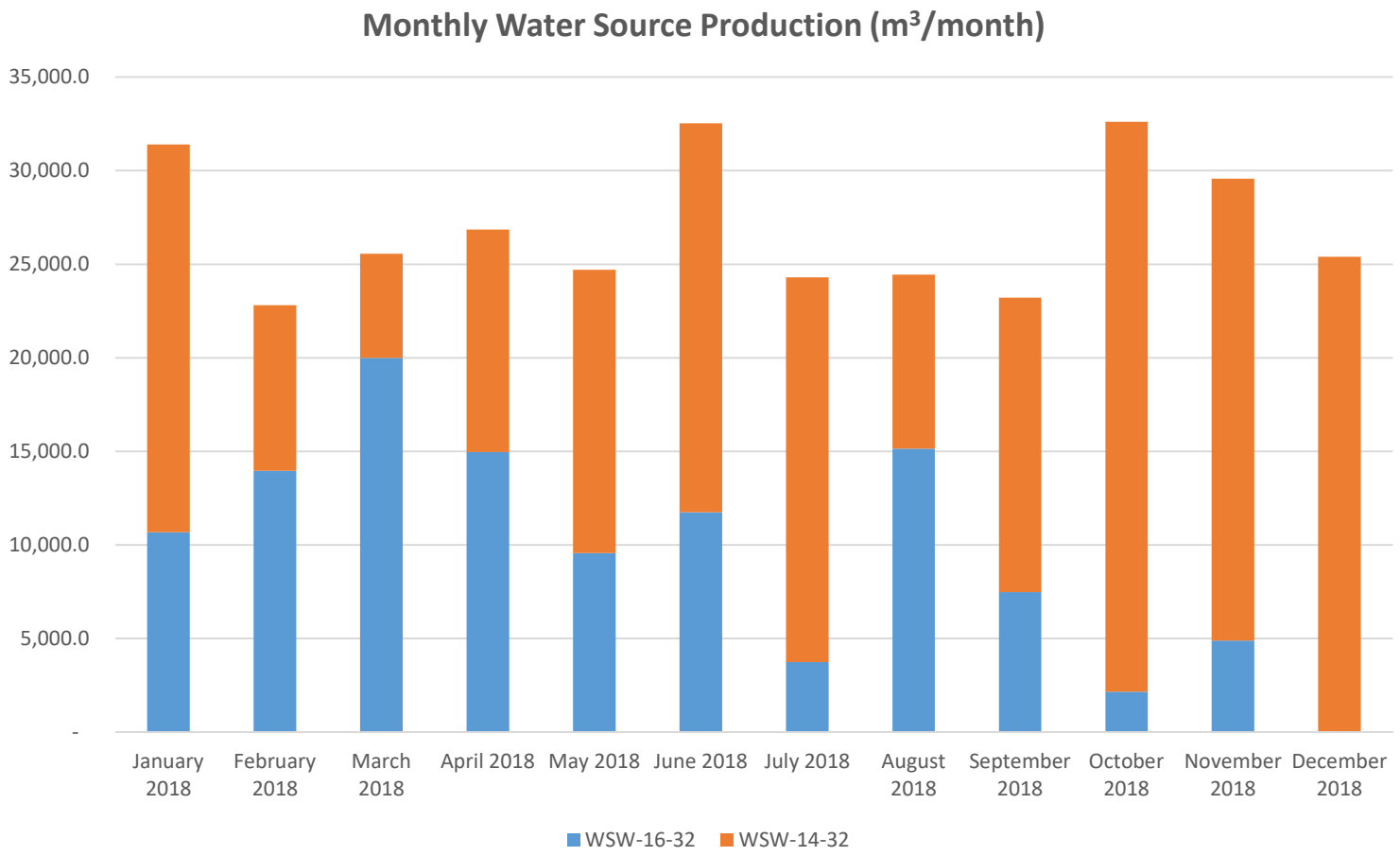
## Typical Water Analysis

| Parameter | Unit | WSW 14-32 | WSW 16-32c |
|---|---|---|---|
| Lab pH | pH | 7.98 | 7.91 |
| Lab Ec | µS/cm | 1240 | 908 |
| Ca | mg/L | 39.0 | 75.3 |
| Mg | mg/L | 16.1 | 21.8 |
| Na | mg/L | 197 | 81 |
| K | mg/L | 4.6 | 4.5 |
| Cl | mg/L | 3 | <1 |
| Total Alkalinity | mg/L | 490 | 370 |
| $HCO_3$ | mg/L | 598 | 451 |
| $CO_3$ | mg/L | <5 | <5 |
| $SO_4$ | mg/L | 157 | 110 |
| Hardness | mg/L | 164 | 278 |
| TDS | mg/L | 711 | 514 |
| Nitrate | mg/L | <0.5 | <0.5 |
| Iron | mg/L | <0.1 | <0.1 |

# Monthly Water Source Production

West Ells Water Act Licence 00316770-01-00 annual allocation is 365,000 $m^3$

- Did not exceed the maximum daily or maximum approved diversion volume
- Did not impact the groundwater levels in the overlying Quaternary sediment



# Water Disposal

- There are no approved disposal facilities or wells associated with the West Ells Project
- All water is trucked off site to approved waste management facilities in the form of Evaporator Blowdown water
- The Directive 81 disposal limit for 2018 was 5.11%
  - ((Fresh In x $D_f$ + Produced In x $D_p$)/(Fresh In + Produced In)) x 100
- West Ells has had an average disposal rate of 1.29% for 2018
  - ((Total Disposal)/ (Fresh In + Produced In)) x 100
- West Ells was compliant with disposal limits for the entirety of 2018

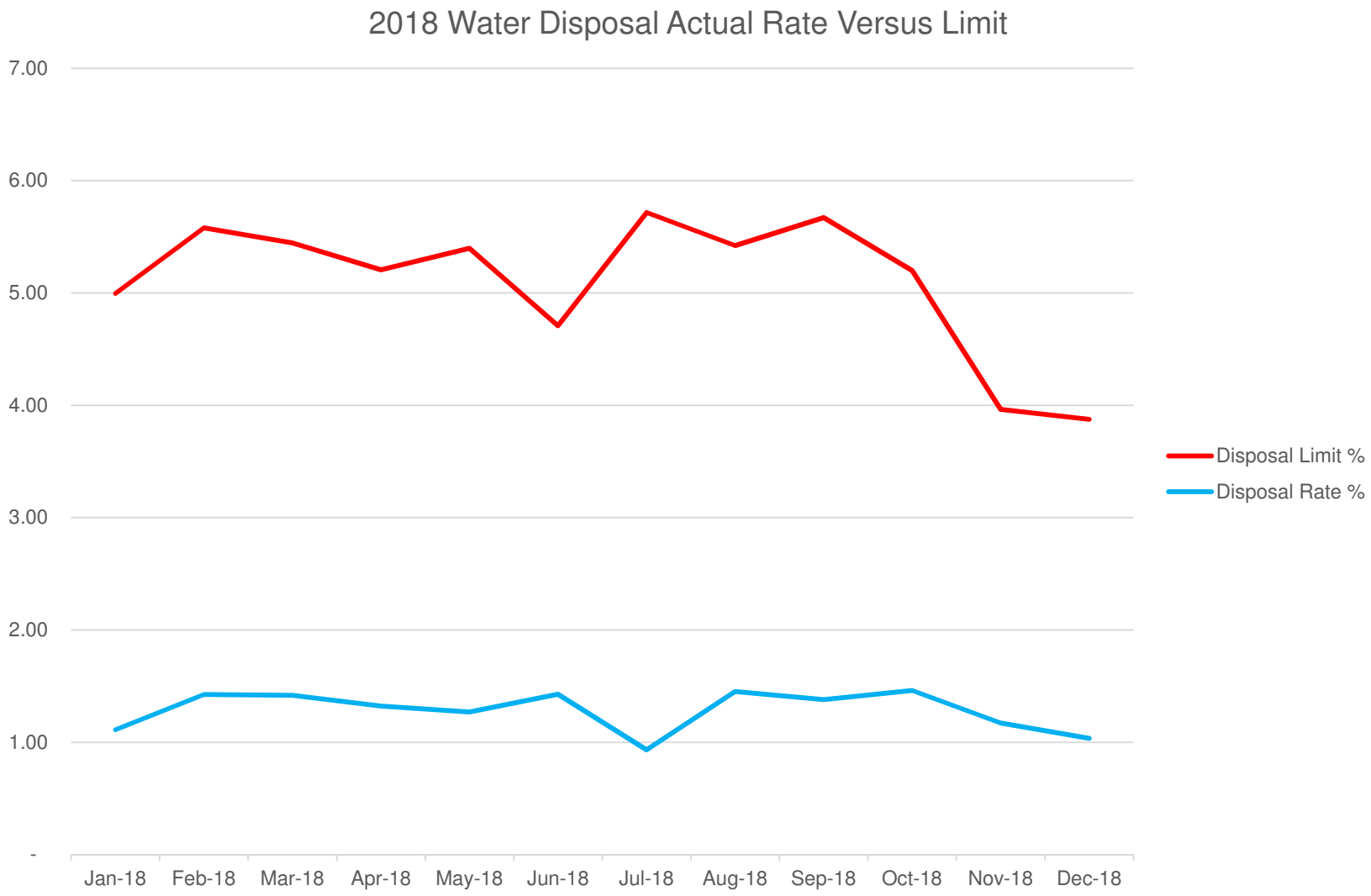
# Water Disposal And Recycle Rates

## Directive 081 Monthly balances

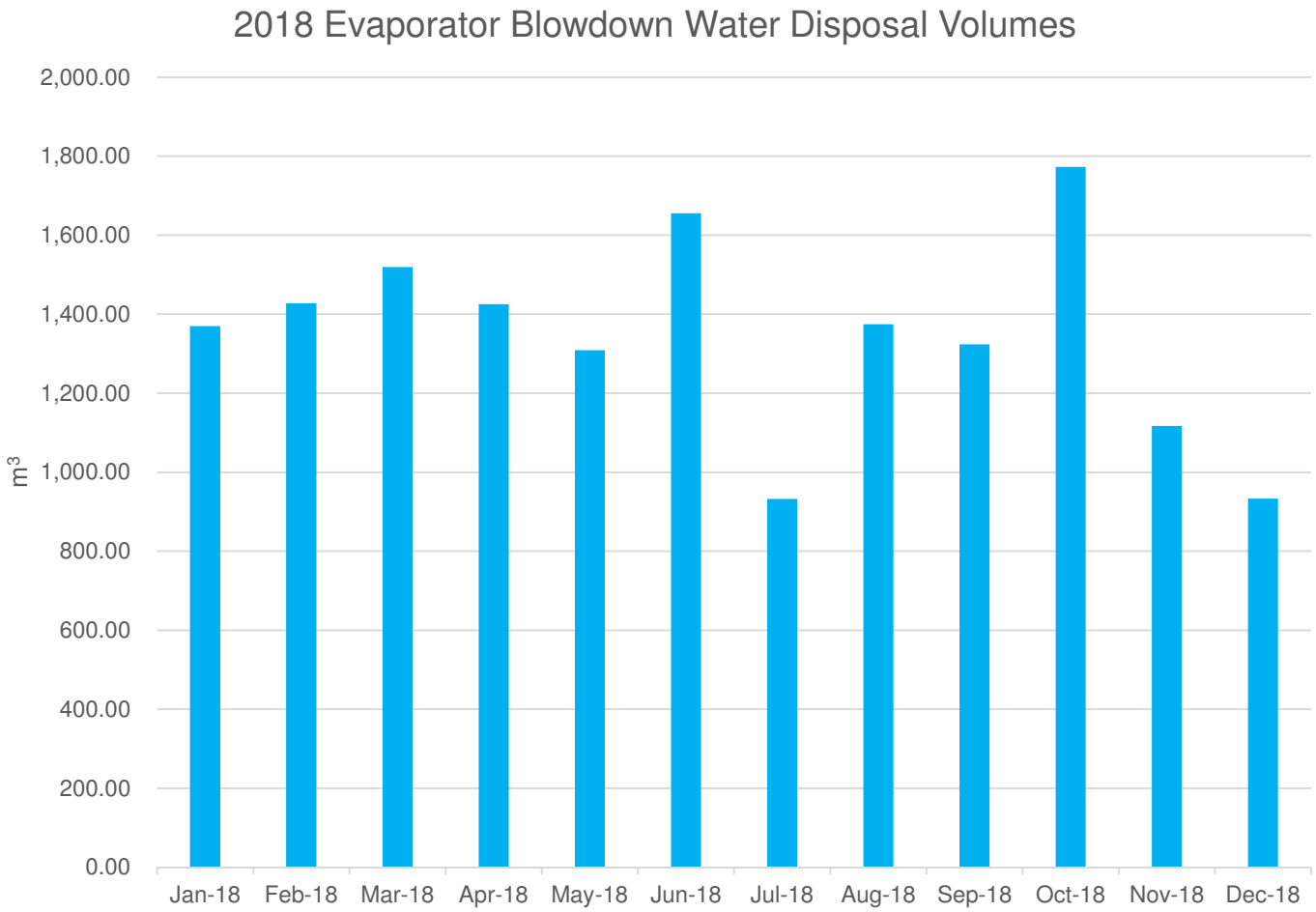
| | January 2018 | February 2018 | March 2018 | April 2018 | May 2018 | June 2018 |
|---|---|---|---|---|---|---|
| Fresh Water In (m3) | 88,018.20 | 63,193.20 | 69,727.80 | 73,740.10 | 67,732.30 | 87,599.60 |
| Produced Water In (m3) | 35,111.40 | 36,893.50 | 37,450.30 | 33,933.70 | 35,309.30 | 28,277.80 |
| Disposal Total (m3) | 1,370.00 | 1,427.90 | 1,519.50 | 1,425.00 | 1,308.50 | 1,655.20 |
| Disposal Factor, Fresh Water | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 |
| Disposal Factor, Produced Water | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 |
| Disposal Limit % | 5.00 | 5.58 | 5.45 | 5.21 | 5.40 | 4.71 |
| Disposal Rate % | 1.11 | 1.43 | 1.42 | 1.32 | 1.27 | 1.43 |

| | July 2018 | August 2018 | September 2018 | October 2018 | November 2018 | December 2018 |
|---|---|---|---|---|---|---|
| Fresh Water In (m3) | 61,256.60 | 61,977.90 | 59,323.80 | 83,267.60 | 82,241.00 | 78,834.40 |
| Produced Water In (m3) | 38,814.70 | 32,784.80 | 36,613.00 | 38,162.10 | 13,136.20 | 11,276.40 |
| Disposal Total (m3) | 932.00 | 1,374.80 | 1,324.00 | 1,773.20 | 1,117.20 | 933.50 |
| Disposal Factor, Fresh Water | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 |
| Disposal Factor, Produced Water | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 |
| Disposal Limit % | 5.72 | 5.42 | 5.67 | 5.20 | 3.96 | 3.88 |
| Disposal Rate % | 0.93 | 1.45 | 1.38 | 1.46 | 1.17 | 1.04 |

# Water Disposal Rate

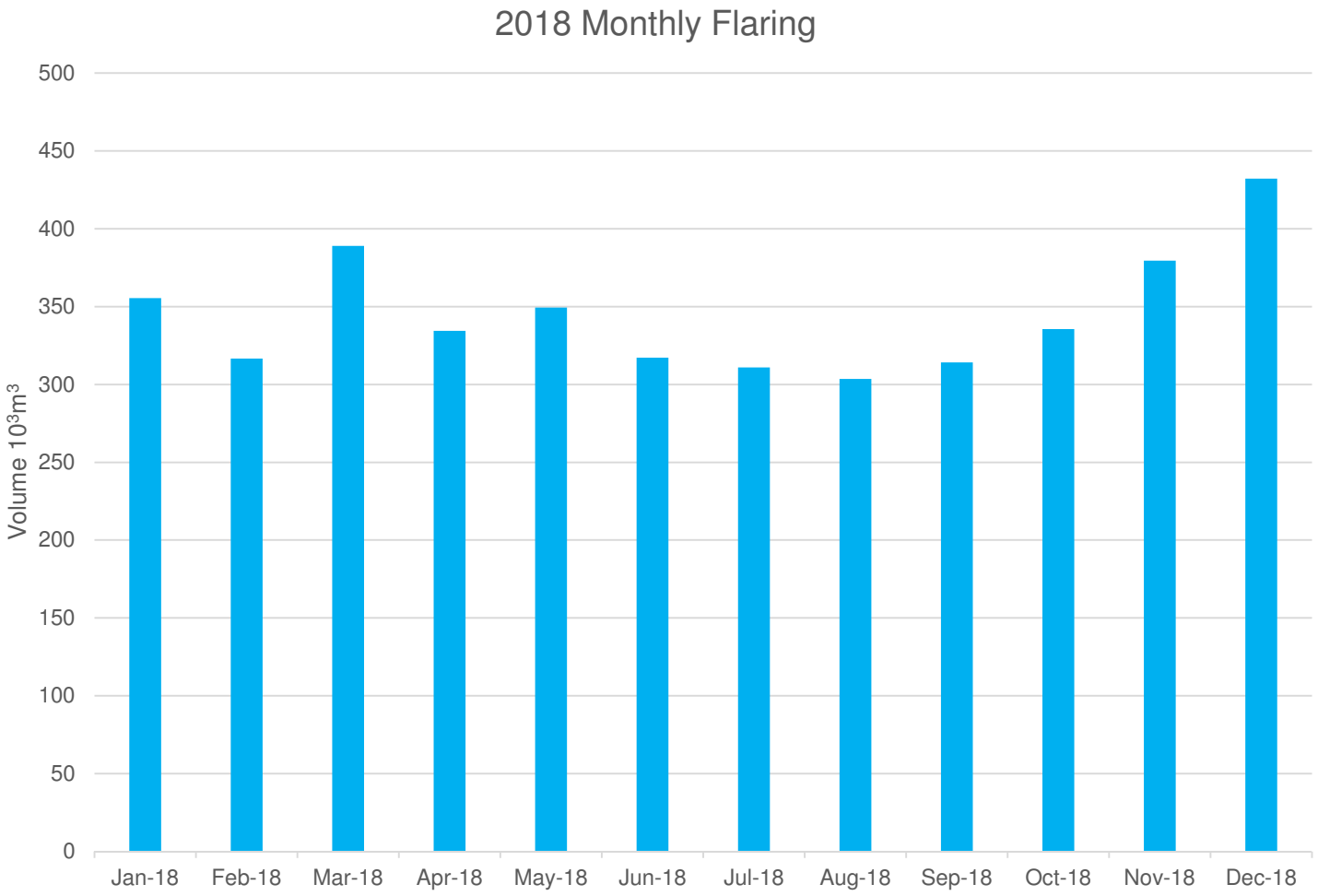


# Waste Water Disposal



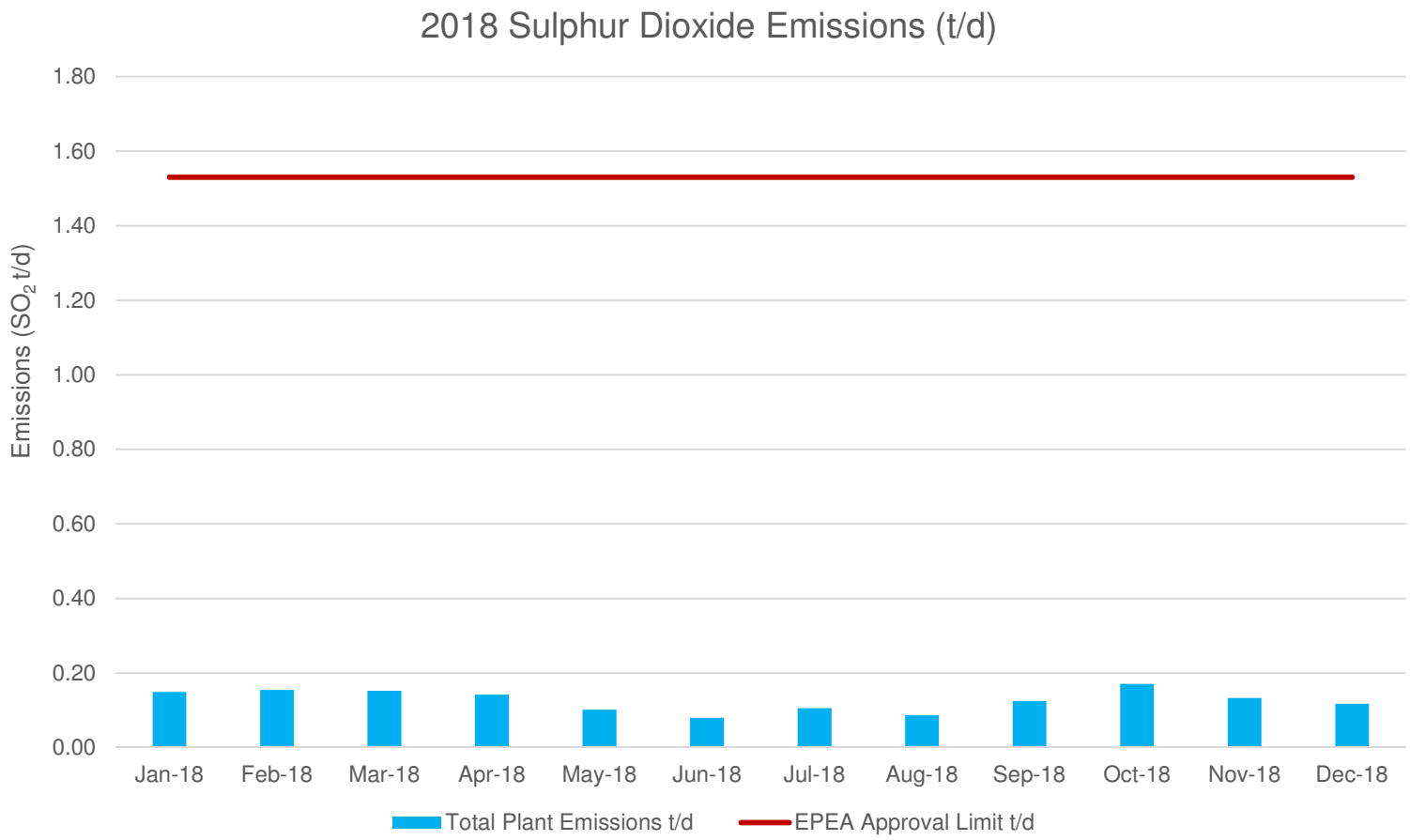
# Flaring & Venting

- There were no reportable flaring events in 2018
- There was no venting in 2018



# Sulphur Production

- There are no sulphur recovery facilities at West Ells




- Total Plant $SO_2$ = Flared $SO_2$ + Steam Generator $SO_2$ + Co-Generation Units $SO_2$

# Regulatory and Compliance

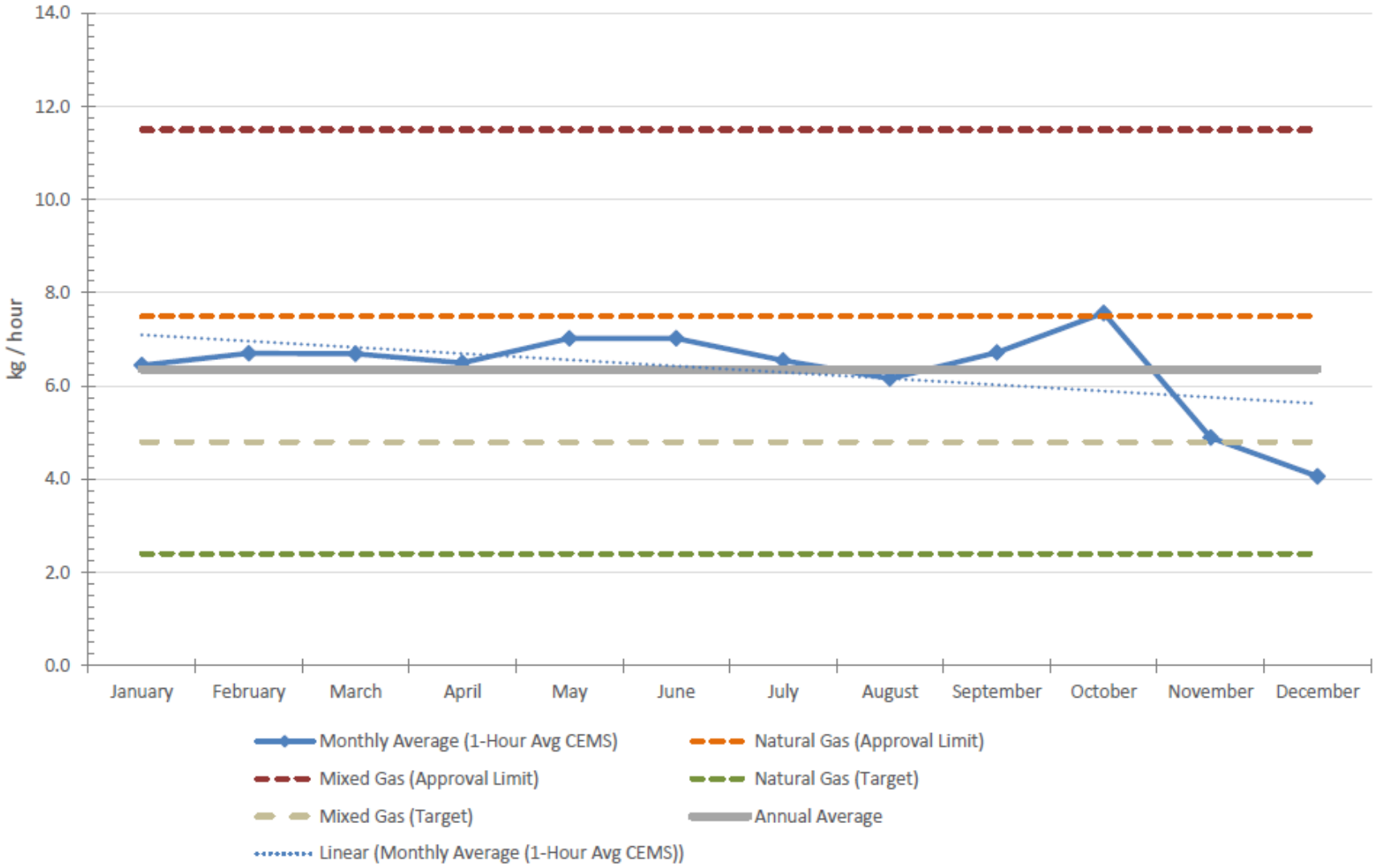
# Compliance – Monitoring Programs

## Ambient Air Quality Monitoring

| Passive Ambient Monitoring 2018 | | |
|---|---|---|
| Month | Peak $SO_2$ (ppbv) | Peak $H_2S$ (ppbv) |
| January | 0.9 | 3.11 |
| February | 1.1 | 0.99 |
| March | 2.20 | 1.04 |
| April | 1.2 | 0.15 |
| May | <0.2 | 0.02 |
| June | 0.5 | 0.58 |
| July | 0.5 | 0.31 |
| August | 0.7 | 0.61 |
| September | 0.5 | 0.34 |
| October | 0.8 | 0.46 |
| November | 0.8 | 0.8 |
| December | 0.9 | 0.36 |

# Compliance – Monitoring Programs

**2018** ***Comparison of hourly mass $NO_x$ emissions to performance targets and Approval limits***



# Compliance – Approval Contraventions

- The following list summarizes non-compliance events for the 2018 reporting period
- There were no reportable spills or flaring events for the 2018 reporting period

| Date | CIC # | Description |
|---|---|---|
| 31-Jan-18 | 334491 | The CEMS $NO_x$ analyzer did not meet the required monthly 90% operational time for the month of January 2018. |
| 01-Aug-18 | 341689 | Monthly submissions of CEMS data is required to be submitted by the end of month following the month in which the data was collected. The June report was submitted on August 1, 2018, which was beyond the July 31, 2018 deadline. |
| 17-Dec-18 | 347687 | The 2017 Annual Water Use report was not completed, observation well water level was not measured consistently and data wasn't consistently reported into the WUR. |
| 29-Mar-19 | 351380 | A manual stack survey of one of the Co-generation Units was not performed in 2018. |
| 29-Mar-19 | 351381 | Volumes of contained surface water released in 2018 were not consistently estimated and records do not show lab analysis results to accompany field testing of some releases. In addition, groundwater monitoring activities did not take place in 2018. |

# Compliance

## Inspections

- AER Inspection of CPF and Pad 2 conducted July 18, 2018
  - Inspection completed September 6, 2018

# Compliance Declaration

Sunshine fell short of required monitoring programs in 2018 and strives to be compliant with all AER approvals and regulatory requirements going forward.

# Future Plans

- Solvent Surfactant Application
  - Apply for solvent surfactant approval to improve resources recovery
- Phase I (5,000 bpd)
  - Continue to fully demonstrate the reservoir productivity before advancing to Phase II
- Phase II (10,000 bpd)
  - Planning continues for the Phase II development

# Contact

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