Japan Canada Oil Sands Limited

Thermal In-Situ Scheme Progress Report for 2018
Japan Canada Oil Sands Limited

Approval No. 11910 (Hangingstone Expansion Project)

Original Submitted: February 20, 2019

Revision: March 5, 2019

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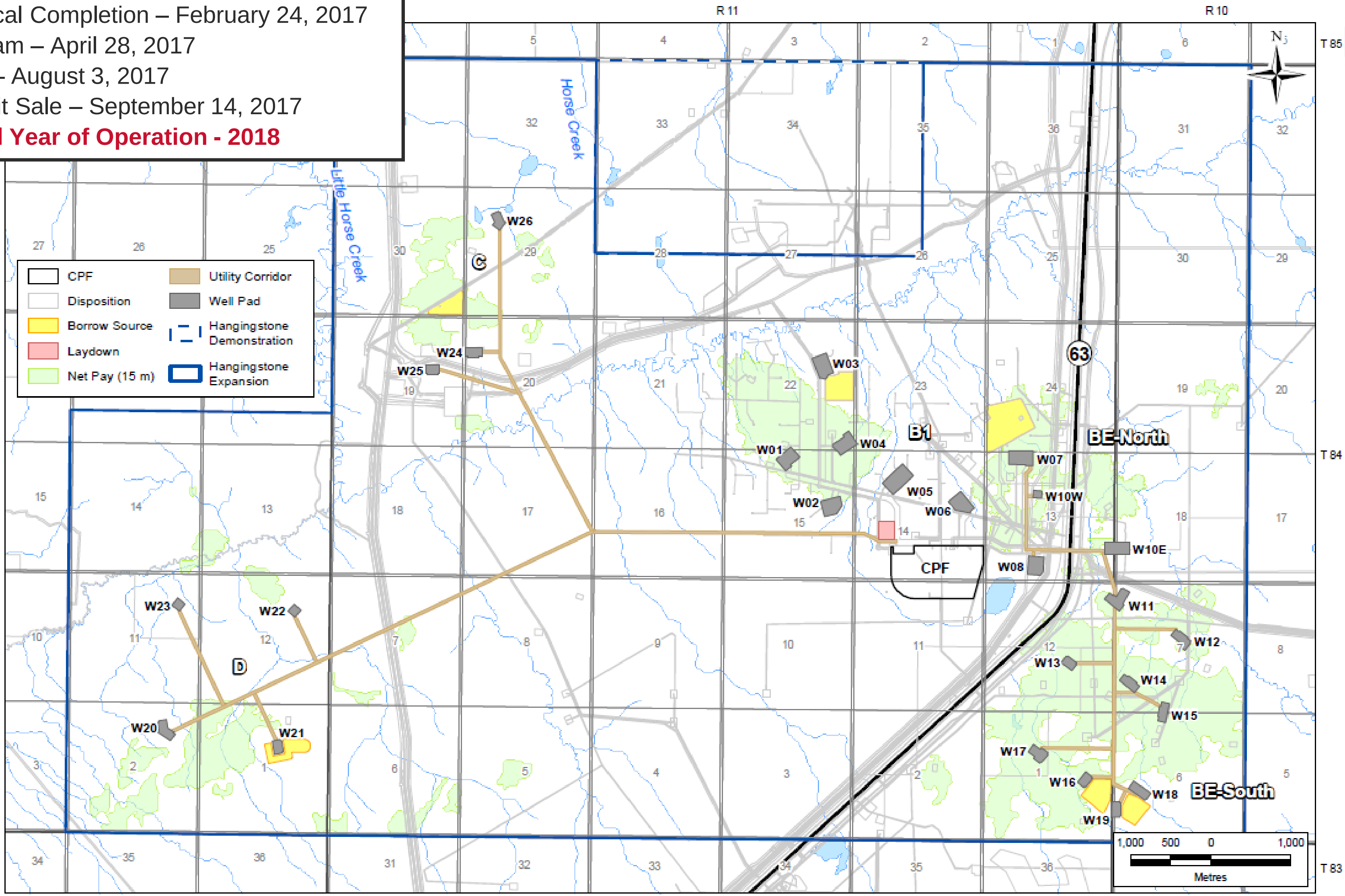
Outline

1. Background – Hangingstone Expansion Project
2. Subsurface
   - Geosciences
   - Reservoir Performance
   - Well Design & Instrumentation
3. Surface Operations
   - Facility Design
   - Measurement & Reporting
   - Sulphur Emissions
   - Water
     - Source
     - Disposal
   - Other Wastes (not presented)
   - Environmental (not presented)
   - Compliance Statements & Approvals

Expansion Scheme No. 11910 Background

- Approved Capacity – 30 Mbbl/d (4,770 m^3/d)
- Mechanical Completion – February 24, 2017
- First Steam – April 28, 2017
- First Oil – August 3, 2017
- First Dilbit Sale – September 14, 2017
- **First Full Year of Operation - 2018**



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Subsurface

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Geosciences

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Net Pay

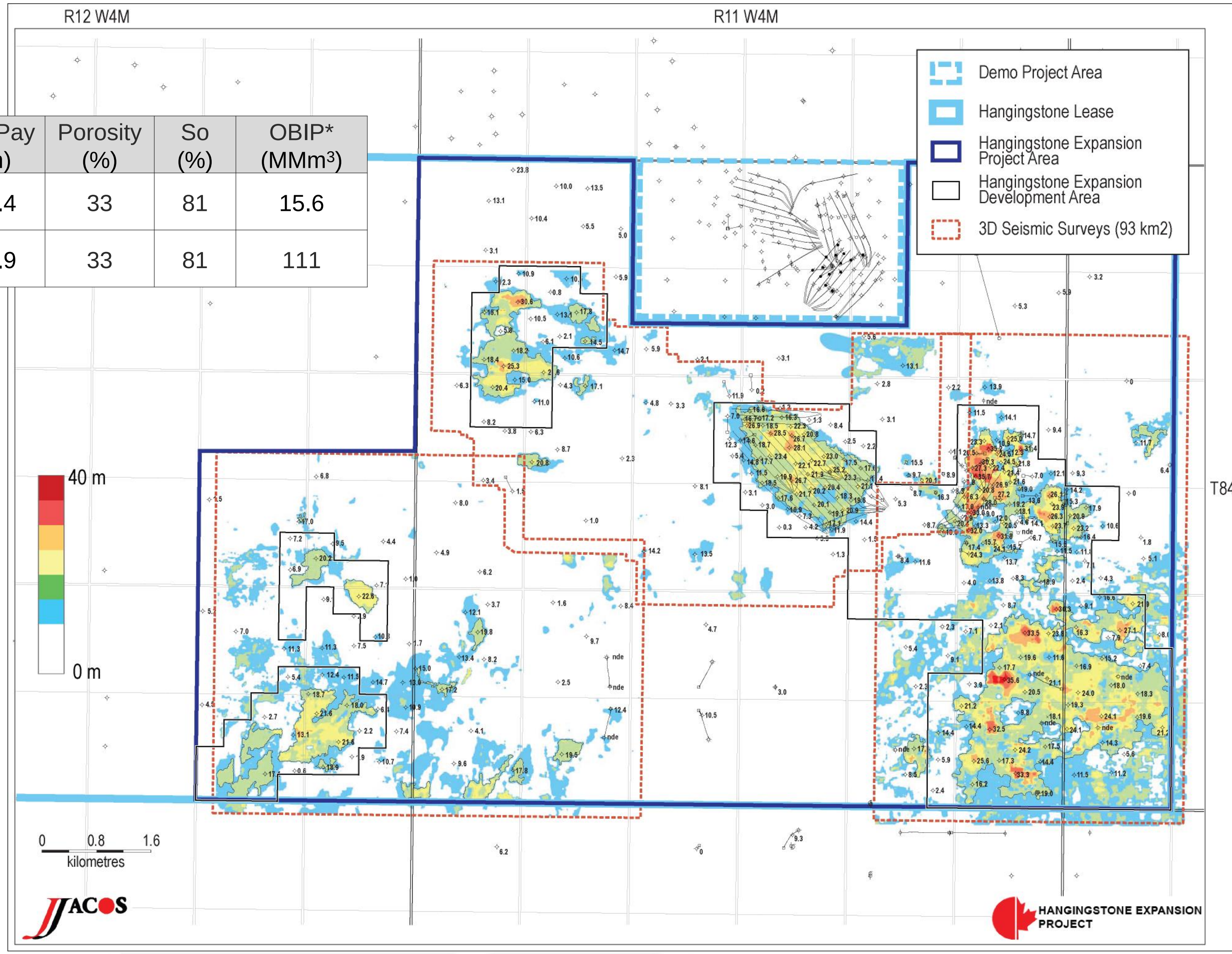
	Area (km²)	Net Pay (m)	Porosity (%)	So (%)	OBIP* (MMm³)
Operating Area	2.6	22.4	33	81	15.6
Approval Area	100.4	16.9	33	81	111

*10 m net pay cutoff

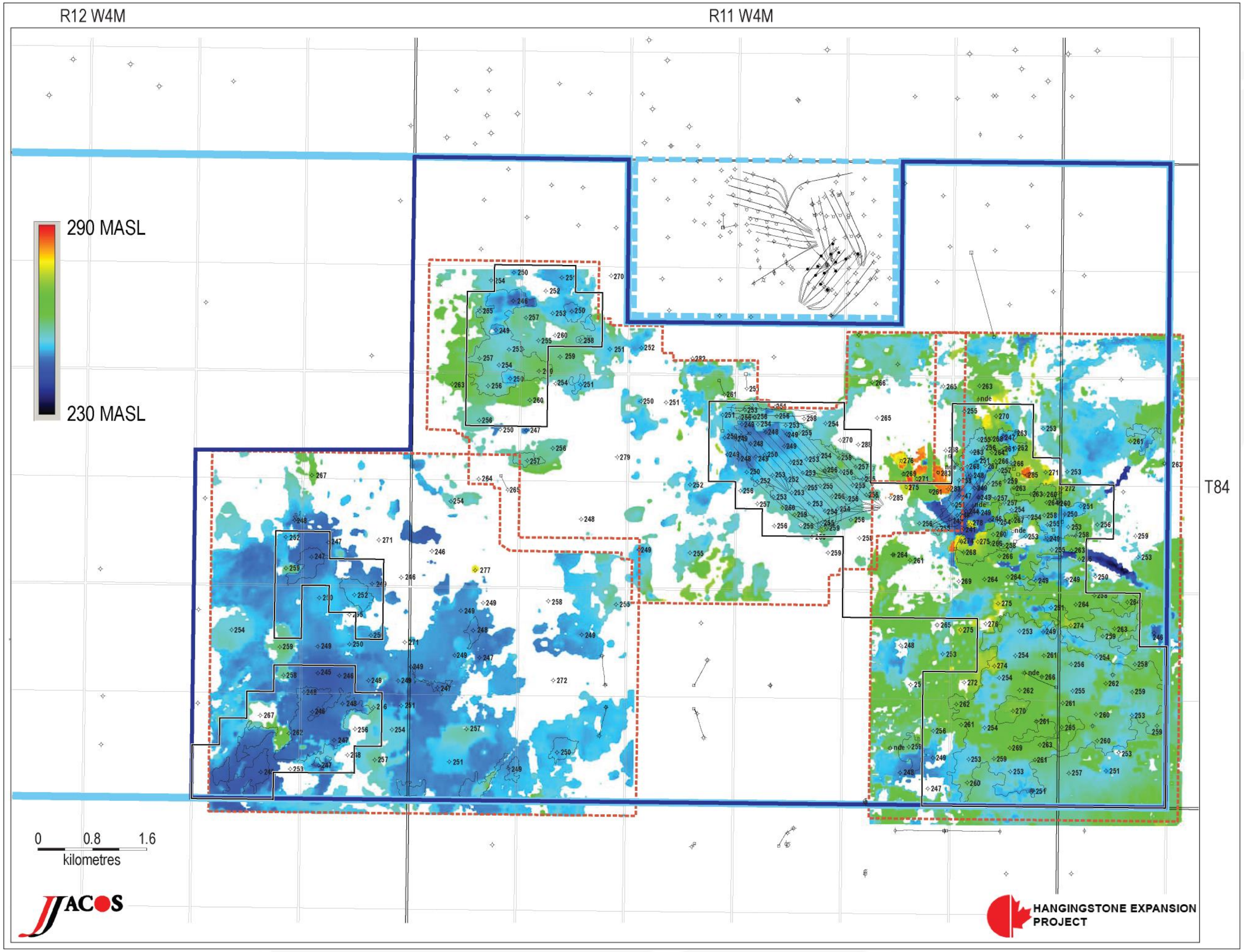
OBIP = RV * Por * So * FVF

where:
RV = Rock Volume
Por = Average Porosity
So = Average Oil Saturation
FVF = Formation Volume Factor (1.001)

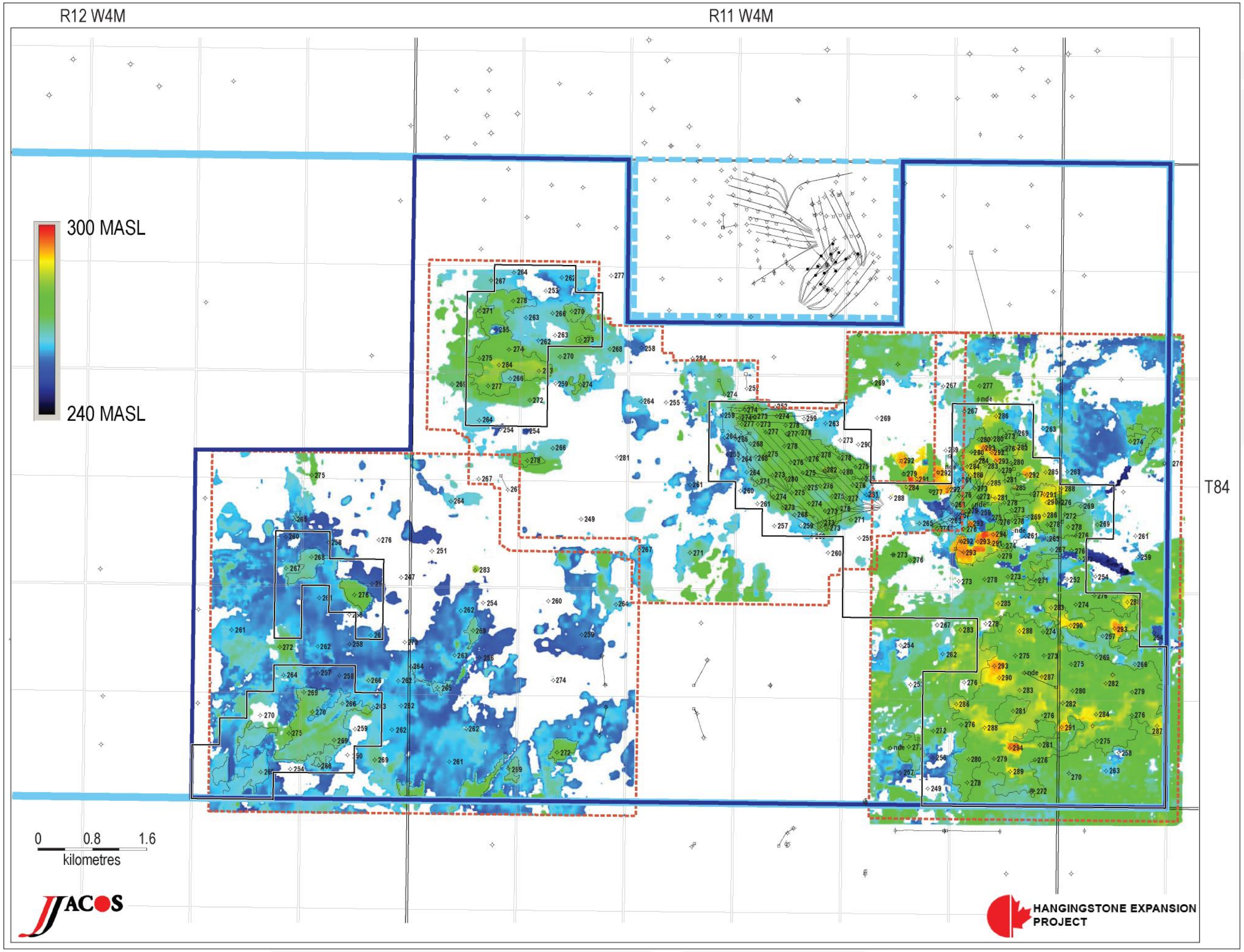
Avg. Kv: 4050 mD
Avg. Kh: 5800 mD
Avg. Depth: 340 m



Base Reservoir Structure



Top Reservoir Structure



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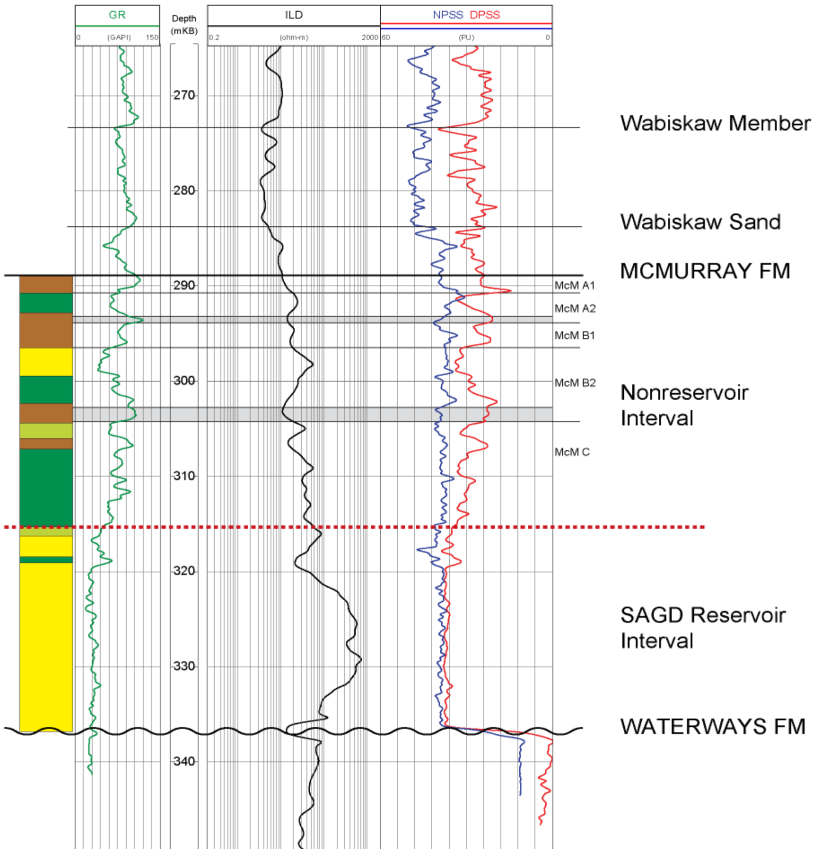
Hangingstone Expansion Composite Well B1 Area

DEPLETION AREA B1
1AA/02-22-84-11W4M



No aquifers are identified in the McMurray Formation at the B1 Depletion Area

Clean Sand	Muddy IHS
Sandy IHS	Shale
Mud-Clast Breccia	Aquifer

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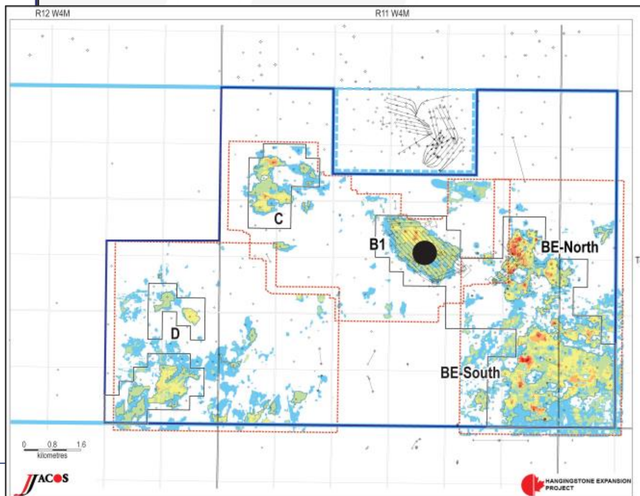
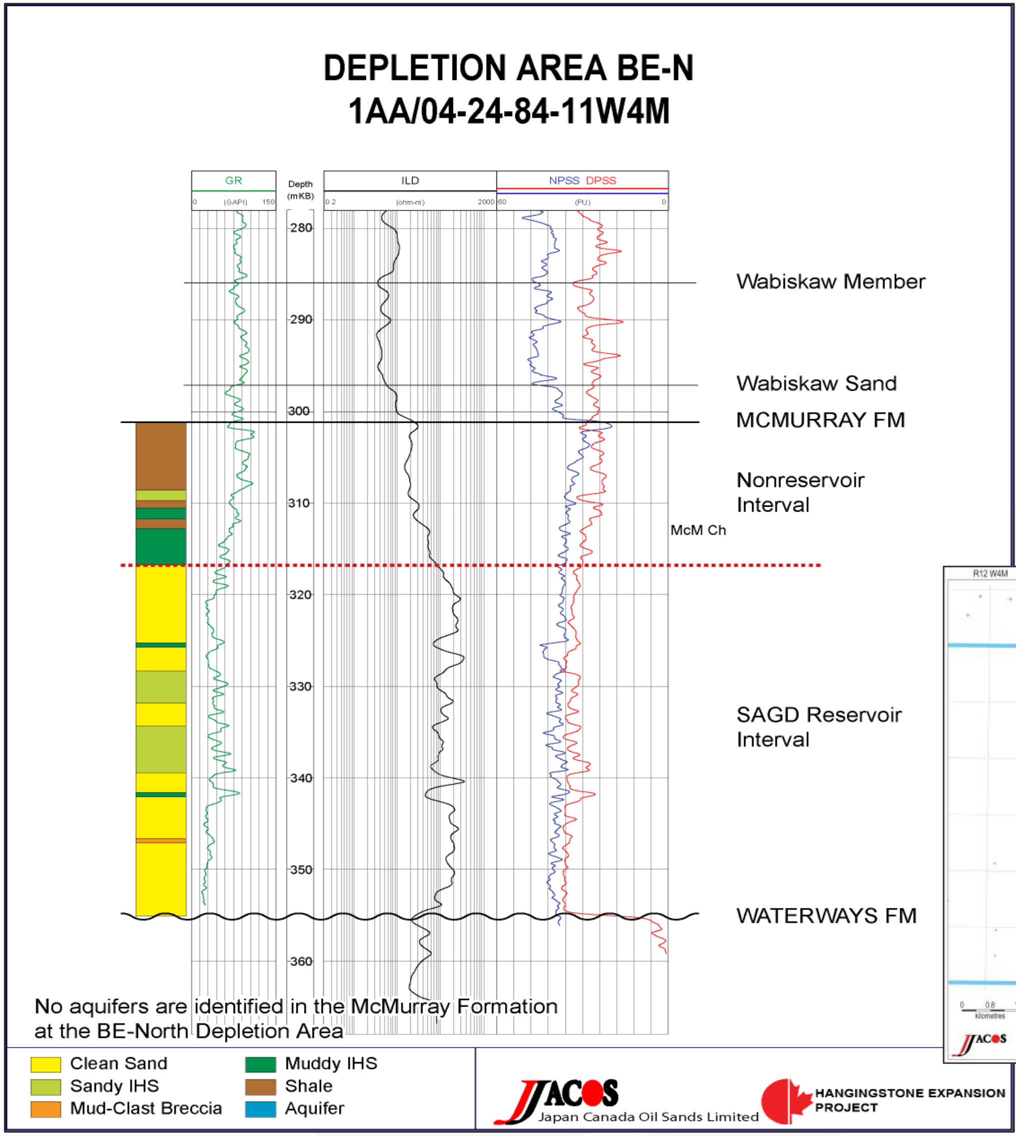
HANGINGSTONE EXPANSION PROJECT

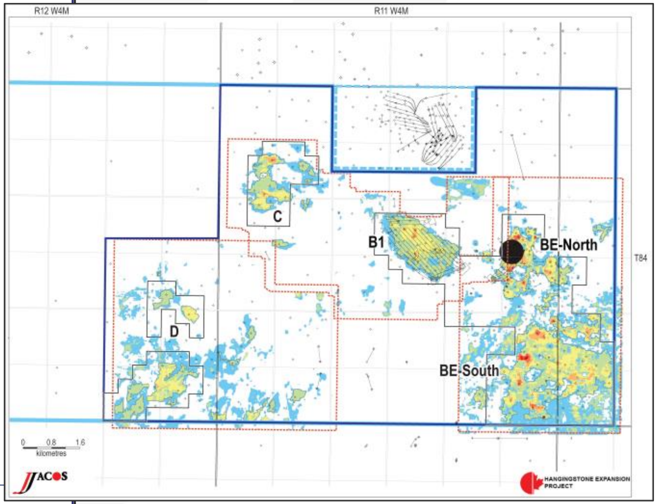
petrographic analysis identified trace chlorite and smectite



Hangingstone Expansion Composite Well BE-North Area



petrographic analysis identified trace chlorite and smectite



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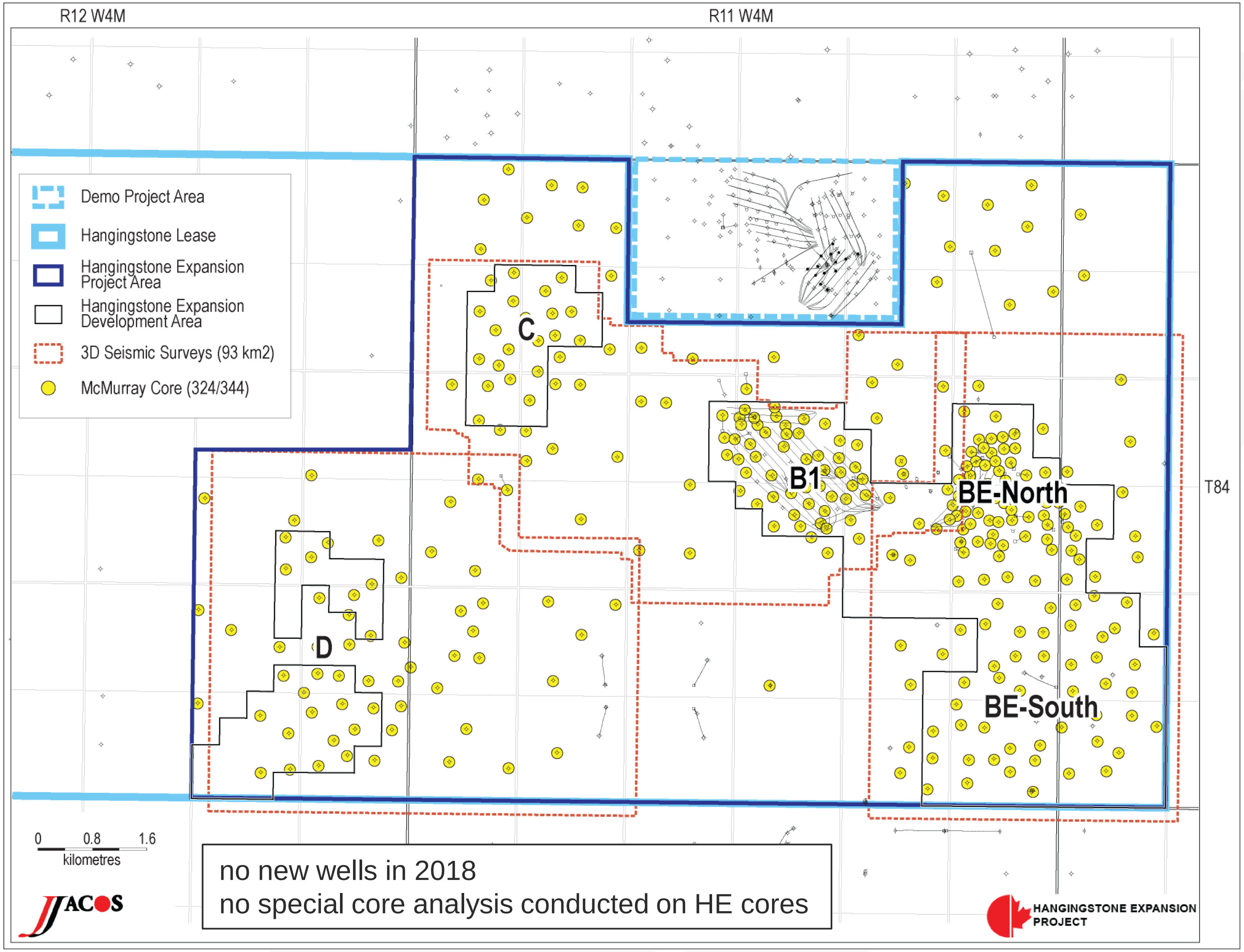
Database



no new wells in 2018
no special core analysis conducted on HE cores

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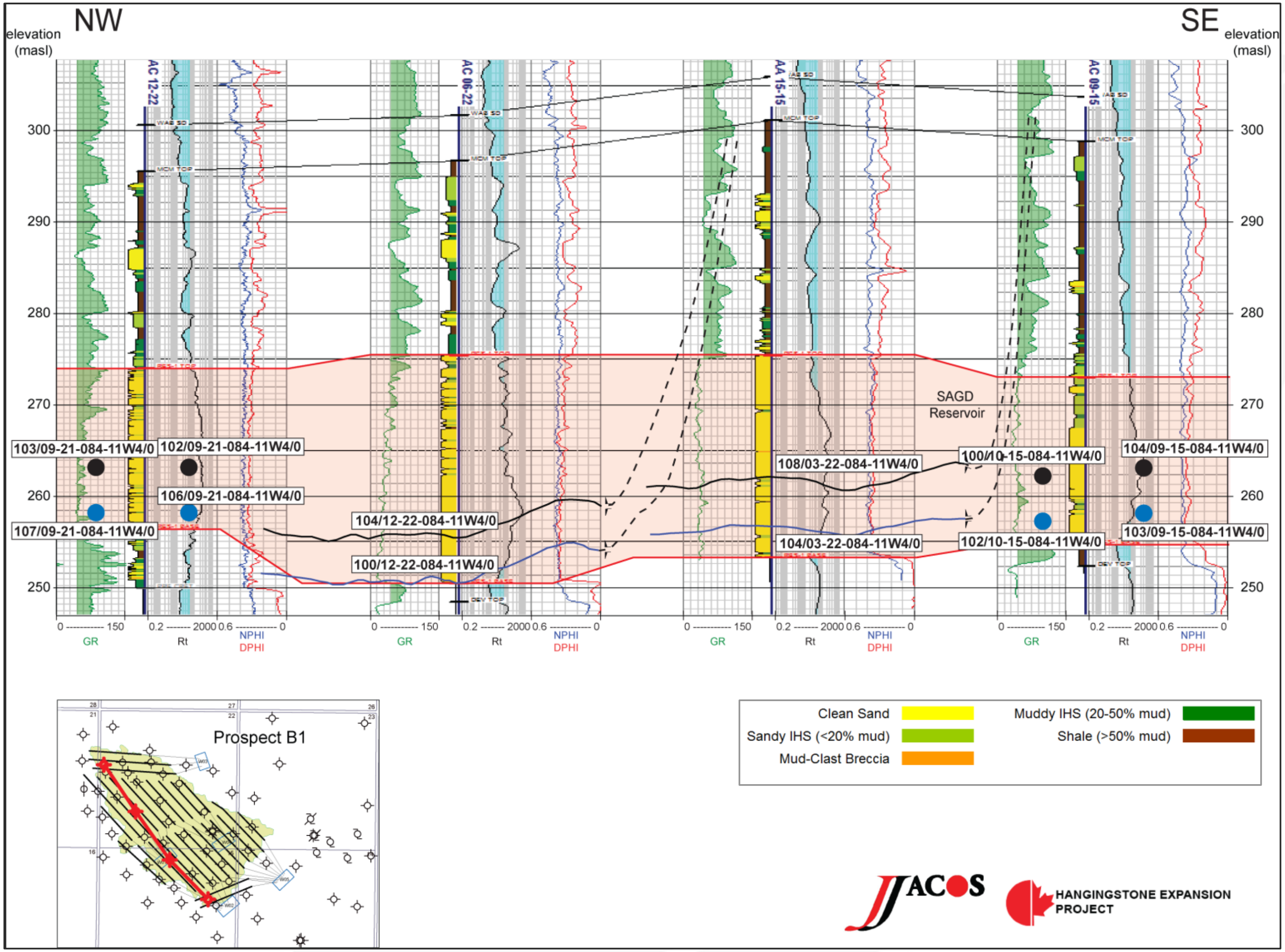
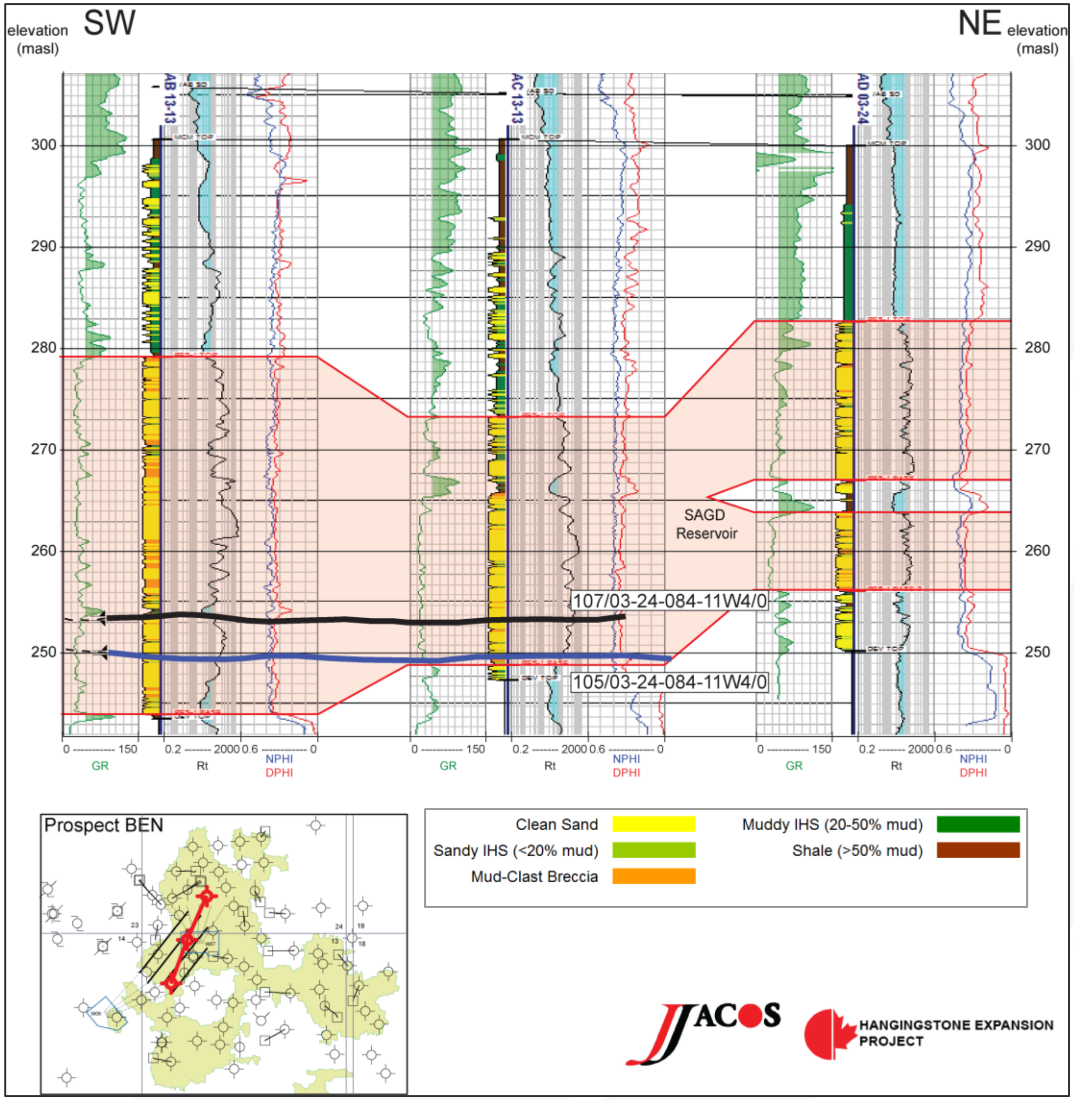
Hangingstone Expansion
Phase 1 Scheme Cross-Section (1)



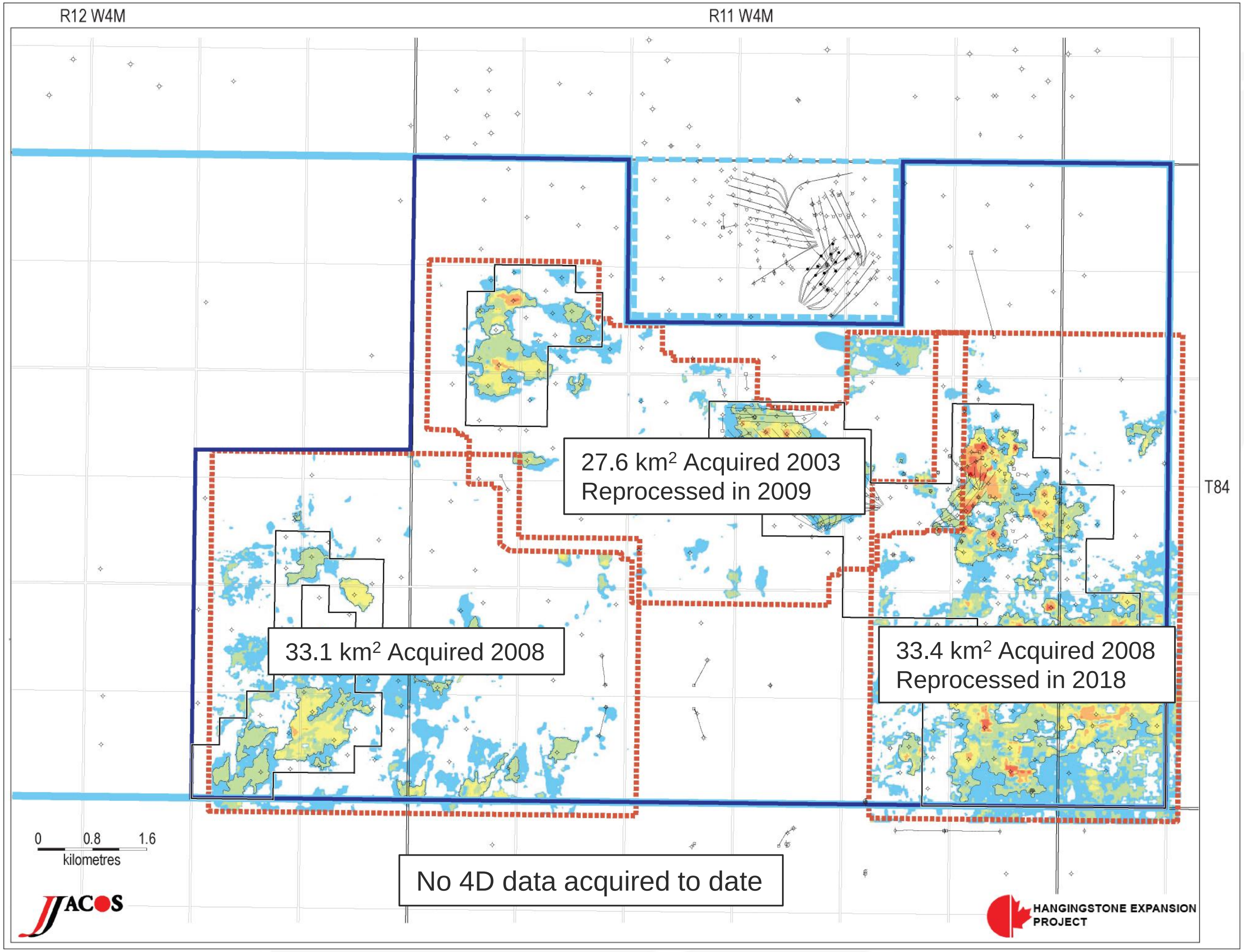
- Clean Sand
- Sandy IHS (<20% mud)
- Mud-Clast Breccia
- Muddy IHS (20-50% mud)
- Shale (>50% mud)

HANGINGSTONE EXPANSION PROJECT

Hangingstone Expansion
Phase 1 Scheme Cross-Section (2)



3D Seismic Data



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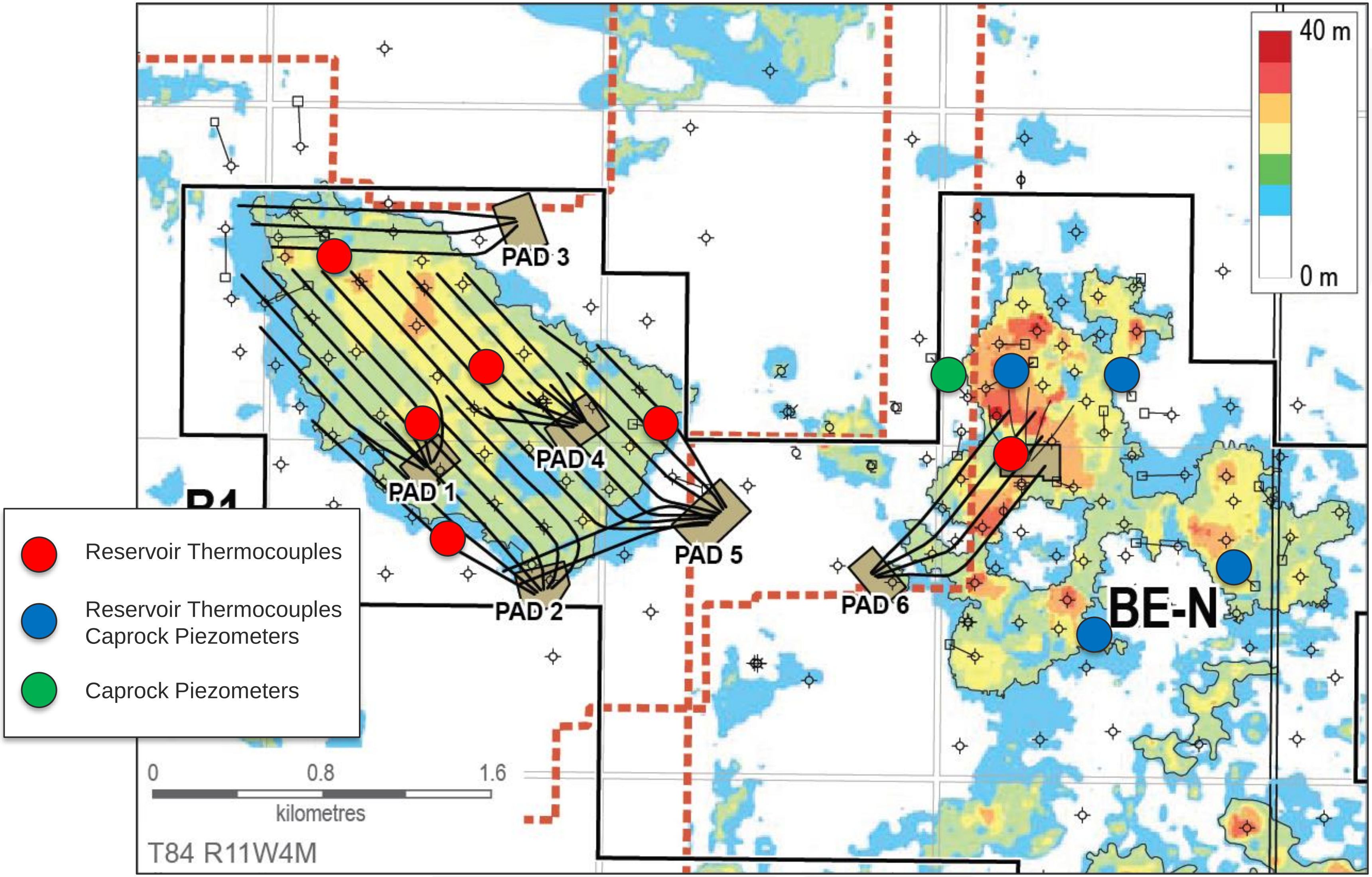
Phase 1



40 m
0 m
PAD 3
PAD 4
PAD 1
PAD 5
PAD 2
PAD 6
BE-N
Reservoir Thermocouples
Reservoir Thermocouples
Caprock Piezometers
Caprock Piezometers
0
0.8
1.6
kilometres
T84 R11W4M

Cap Rock Integrity

- Initial determination of injection pressures was based on mini-frac tests in 1980s
- 2010 Mini-frac test for Hangingstone Expansion (HE) Project Cap Rock Integrity Study shows consistent results
- HE Project Cap Rock Study concluded 5 MPa to be a safe operating pressure (80% of fracture pressure)
- Monitoring of cap rock observation well pressures & temperatures showed no material anomalies in 2018

	Depth (m)	Min. Stress		Vert. Stress		Stress regime
		MPa	kPa/m	MPa	kPa/m	
McM Sands	327.0	5.59	17.09	6.91	21.13	V. frac
McM Shale	314.5	5.55	17.65	6.64	21.11	V. frac
WBSK Shale	297.0	6.17	20.77	6.26	21.08	H. frac
CWTR Shale	272.0	5.39	19.82	5.73	21.07	H. frac (?)

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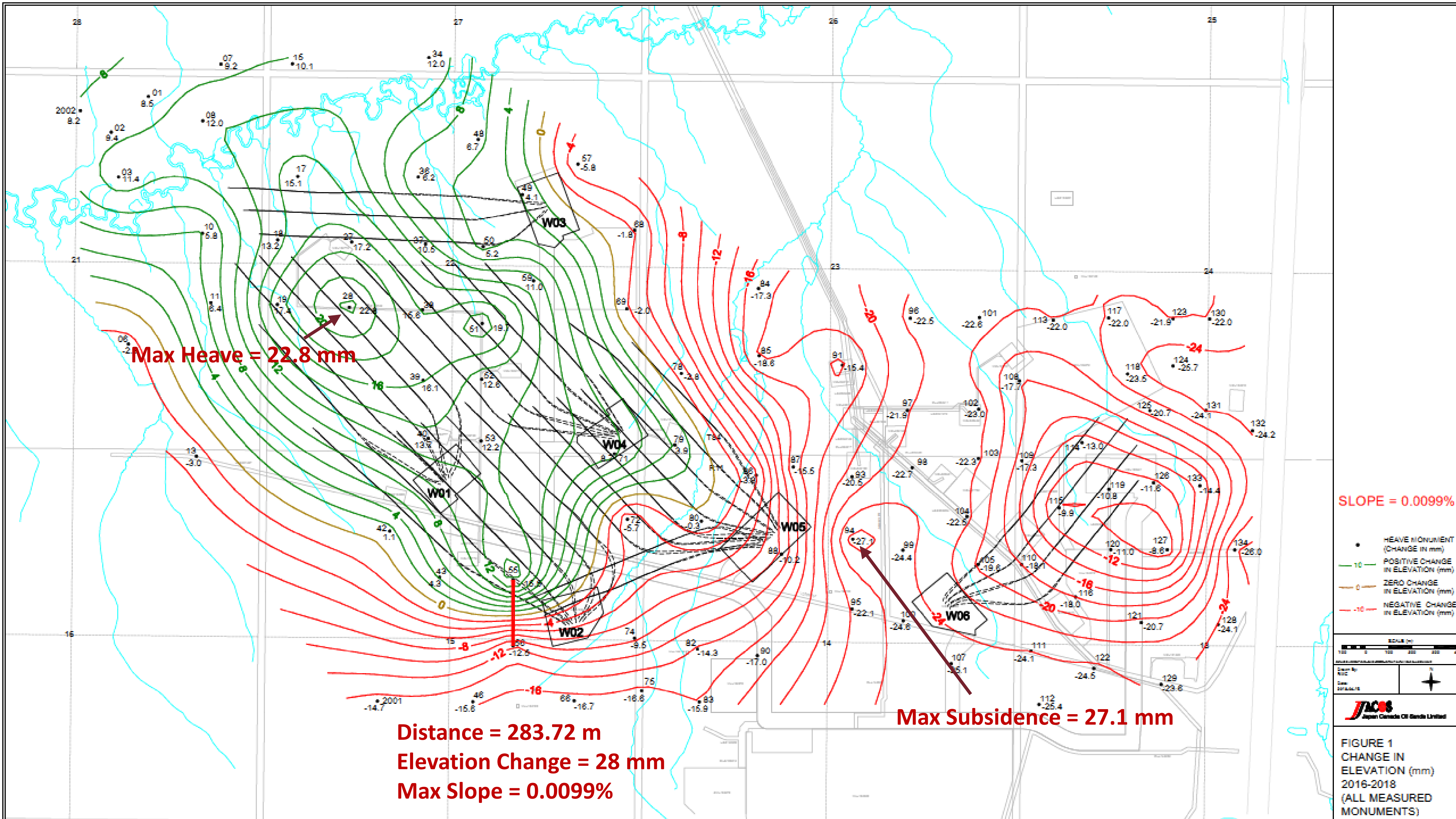
Surface Heave

- First **heave survey** after commencement of operations - completed **Q1-2018**
- Maximum heave of 22.8 mm and maximum slope of 0.0099% over operational well pads (at time of survey) within expectations.
- Subsidence observed in eastern area of the development is being analyzed.



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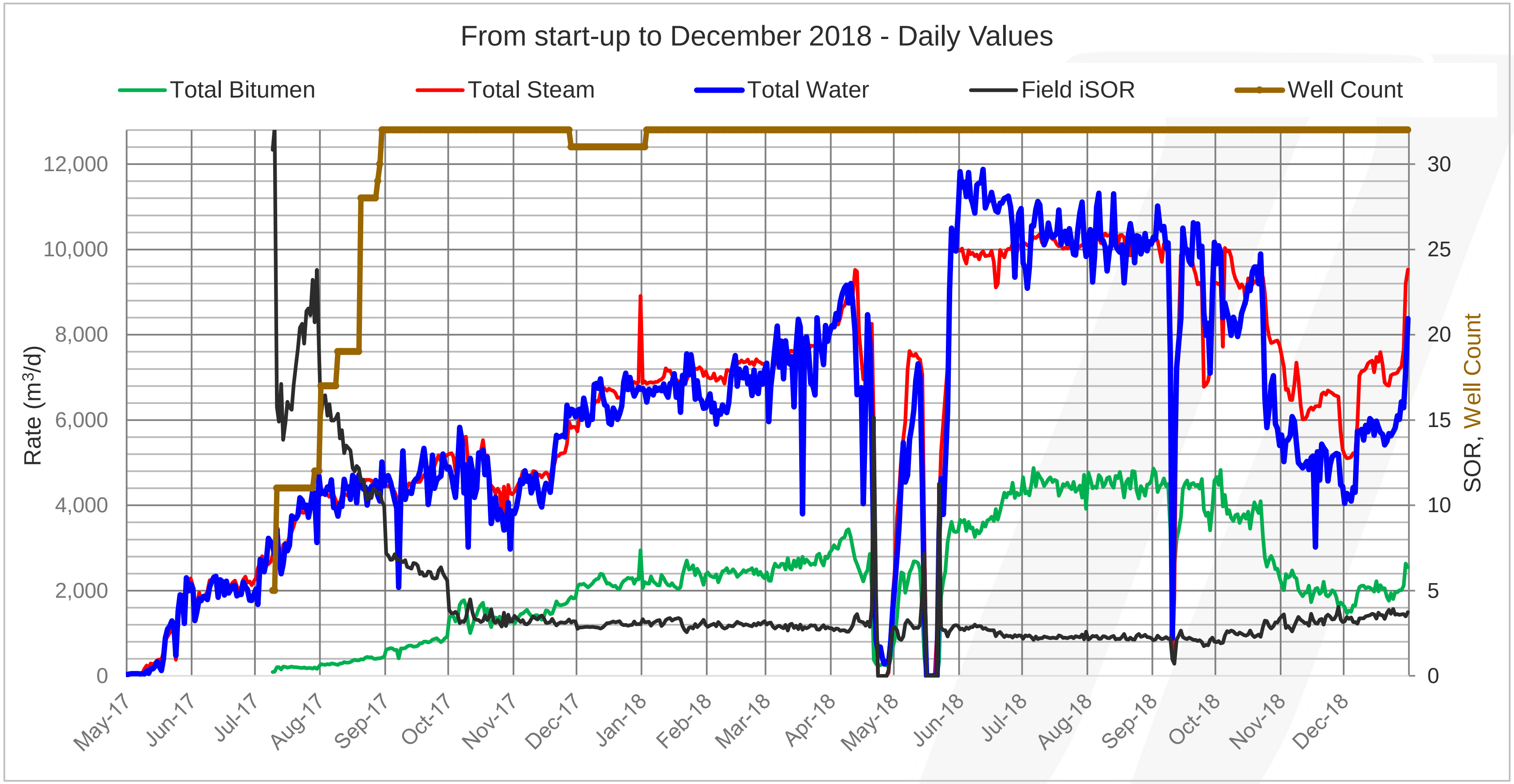
Reservoir

HE Phase 1 Reservoir Performance Summary

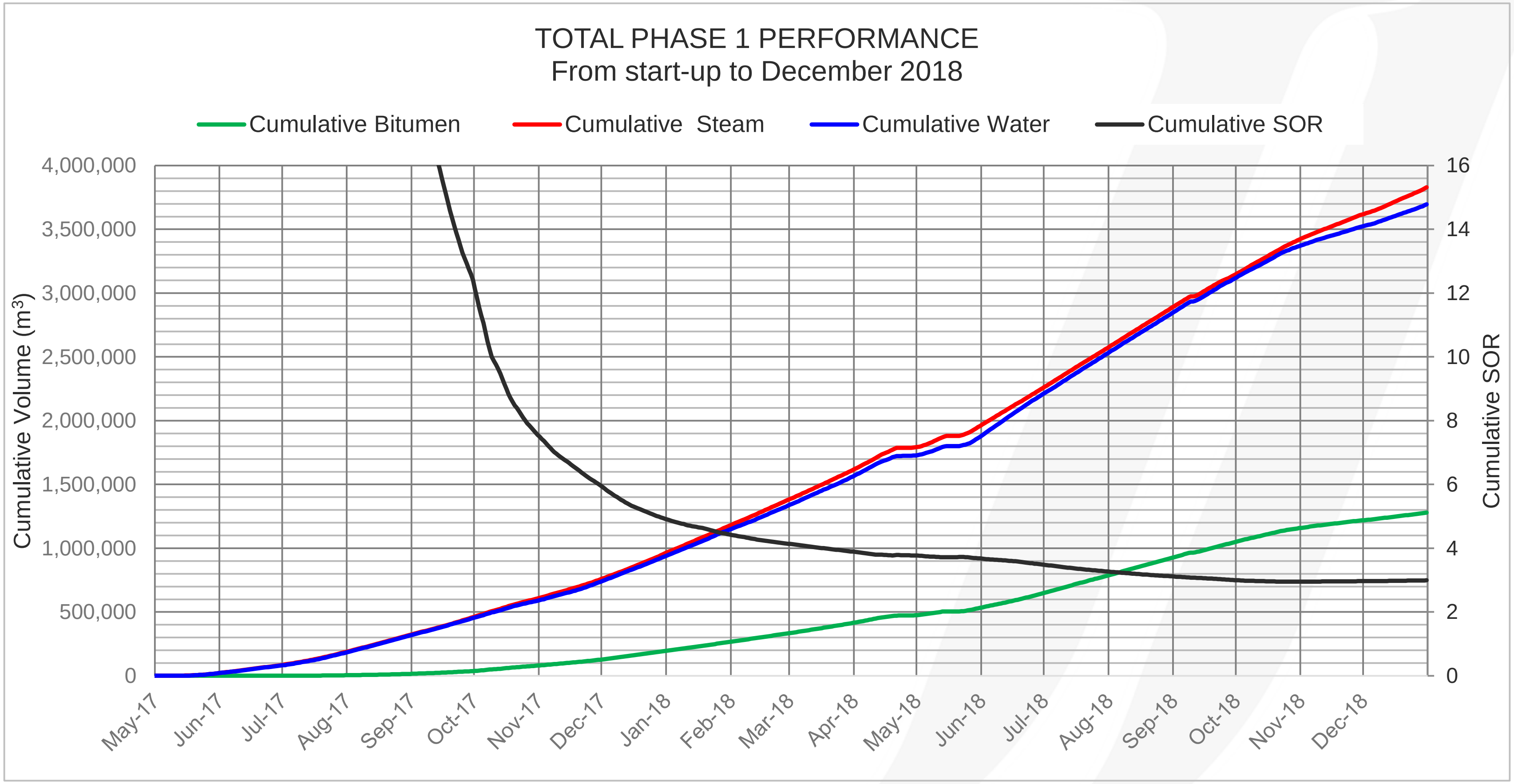
- SAGD mode achieved on all 32 Phase 1 well pairs by April 2018
- Successful ramp-up to monthly peak rate of 28.5 Mbbl/d (4.5 Mm^3/d) was achieved in August
- 2018 average bitumen rate of 18.7 Mbbl/d (3.0 Mm^3/d)
- Peak production rate of 30.7 Mbbl/d (4.9 Mm^3/d) on July 6, 2018
- Cumulative bitumen produced from project start-up to December 31, 2018 of 8.0 MMbbl (1.3 MMm^3)
- Cumulative SOR on December 31, 2018 = 3.0
- OBIP for the developed area is 98 MMbbl (15.6 MMm^3)
- Recoverable bitumen for Pads 1-6 is estimated at 60 MMbbl (9.5 MMm^3) and 61% Ultimate Recovery

HE Phase 1 Field Performance



- Planned shutdown in April for plant turn-around activities
- Unplanned shutdown in May caused by electrical breaker failure
- Rate reductions in October→December 2018 in response to poor market economics

HE Phase 1 Cumulative Volumes



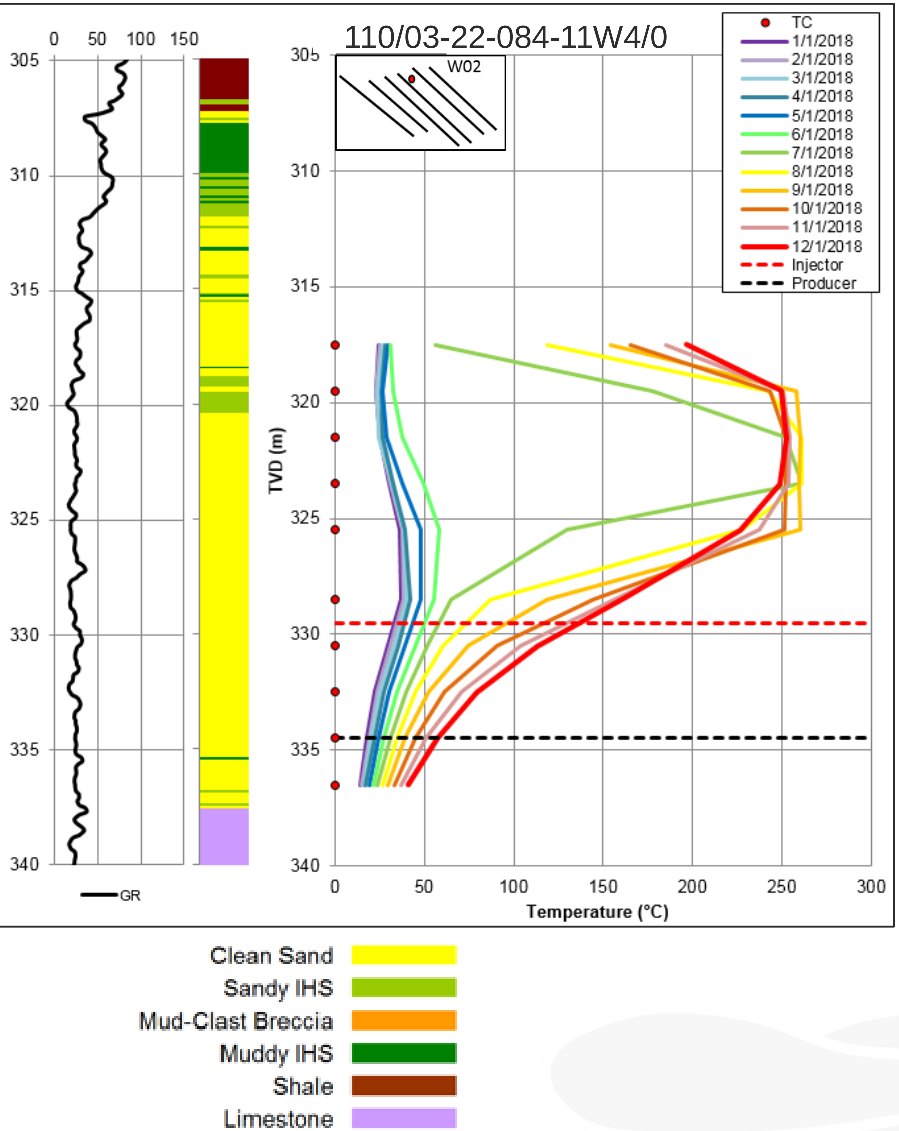
Injection Wellhead Pressures and Temperature

Well	Average 2018 Injection Pressure (kPa)	Average 2018 Injection Temperature (°C)
W01-01	4,257	248
W01-02	4,160	248
W01-03	4,220	249
W01-04	4,168	248
W01-05	4,210	248
W02-01	4,312	249
W02-02	4,289	251
W02-03	4,325	250
W02-04	4,357	251
W02-05	4,330	251
W02-06	4,334	250
W03-01	4,407	250
W03-02	4,388	250
W03-03	4,364	250
W04-01	4,262	248
W04-02	4,344	249
W04-03	4,348	249
W04-04	4,342	249
W04-05	4,310	249
W05-01	4,297	247
W05-02	4,399	248
W05-03	4,216	246
W05-04	3,915	219
W05-05	4,202	247
W05-06	4,285	248
W05-07	4,268	235
W05-08	4,302	249
W05-09	4,415	251
W06-01	4,276	250
W06-02	4,142	247
W06-03	4,209	248
W06-04	4,291	251

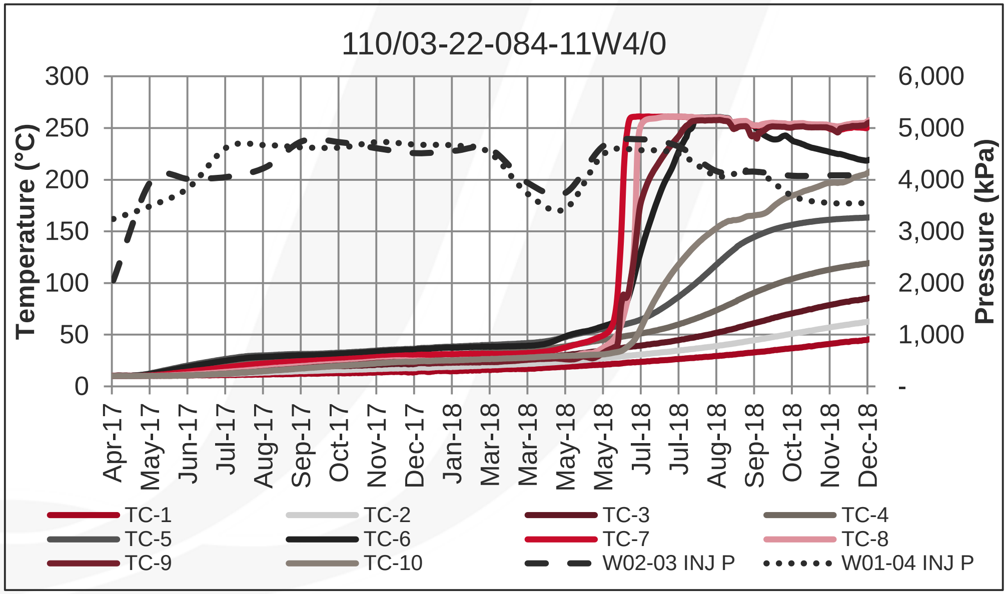
Assumption is 100% steam quality at the well head.

All well pads have steam traps at the inlet.

Steam Chamber - Observation Well



- As of December 31, only one (1) observation well out of six (6) is showing steam temperatures, indicating steam chamber development. The others do show some heating.
- The well is located 4.2 m away from the build section of well pair W01-04 and 18 m NE of the W02-03 well pair horizontal section.
- Temperature profile is shown to change as the injection pressures of W02-03 and W01-04 are reduced in August 2018



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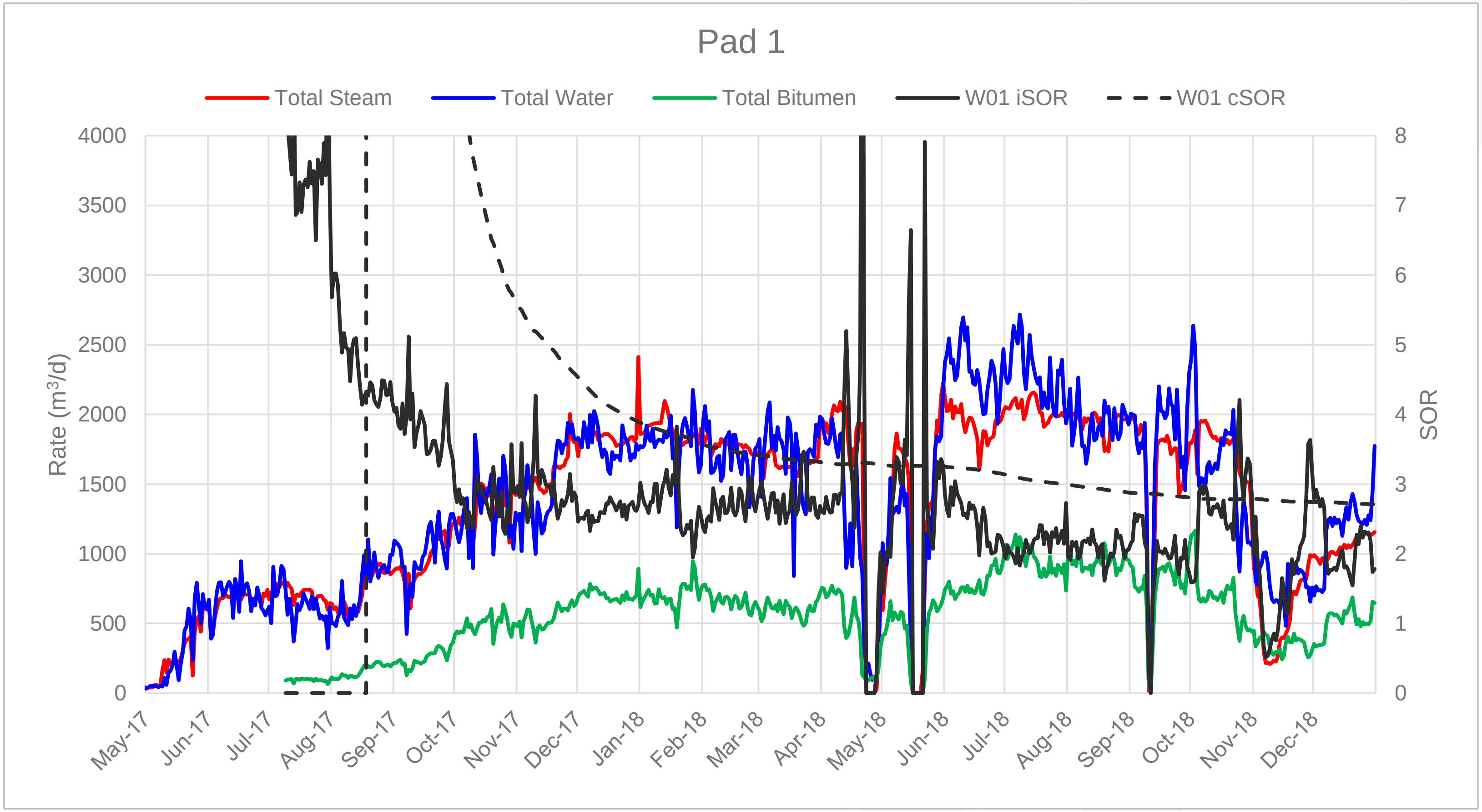
HE Phase I - 2018 Well Pad Recovery

Pad	Well	OBIP (MMm^3)	Cum Bitumen (Mm^3)	Ultimate Recovery (%)	Current Recovery (%)
Pad 1	W01-01 W01-02 W01-03 W01-04 W01-05	2.62	306.6	61.3	11.7
Pad 2	W02-01 W02-02 W02-03 W02-04 W02-05 W02-06	3.14	235.7	61.4	7.5
Pad 3	W03-01 W03-02 W03-03	1.49	34.0	58.7	2.3
Pad 4	W04-01 W04-02 W04-03 W04-04 W04-05	2.72	237.5	62.8	8.7
Pad 5	W05-01 W05-02 W05-03 W05-04 W05-05 W05-06 W05-07 W05-08 W05-09	3.53	350.8	59.4	9.9
Pad 6	W06-01 W06-02 W06-03 W06-04	2.11	114.8	64.1	5.5
Total		15.6	1,279	61.3	8.2

PAD Performance – HIGH – Pad 1

- Five of five well pairs have been on SAGD mode since 2017
- cSOR: 2.7
- 2018 Average SOR: 2.4
- Average bitumen rate per well of 822 bbl/d (131 m^3/d)
- High reservoir quality for all five well pairs
- Pad 1 is estimated to be the most mature pad at HE with current recovery at 11.7%
- Collecting information about future low pressure operation
- Based on well fluid and pressure balances, it is expected that steam chambers are not in communication

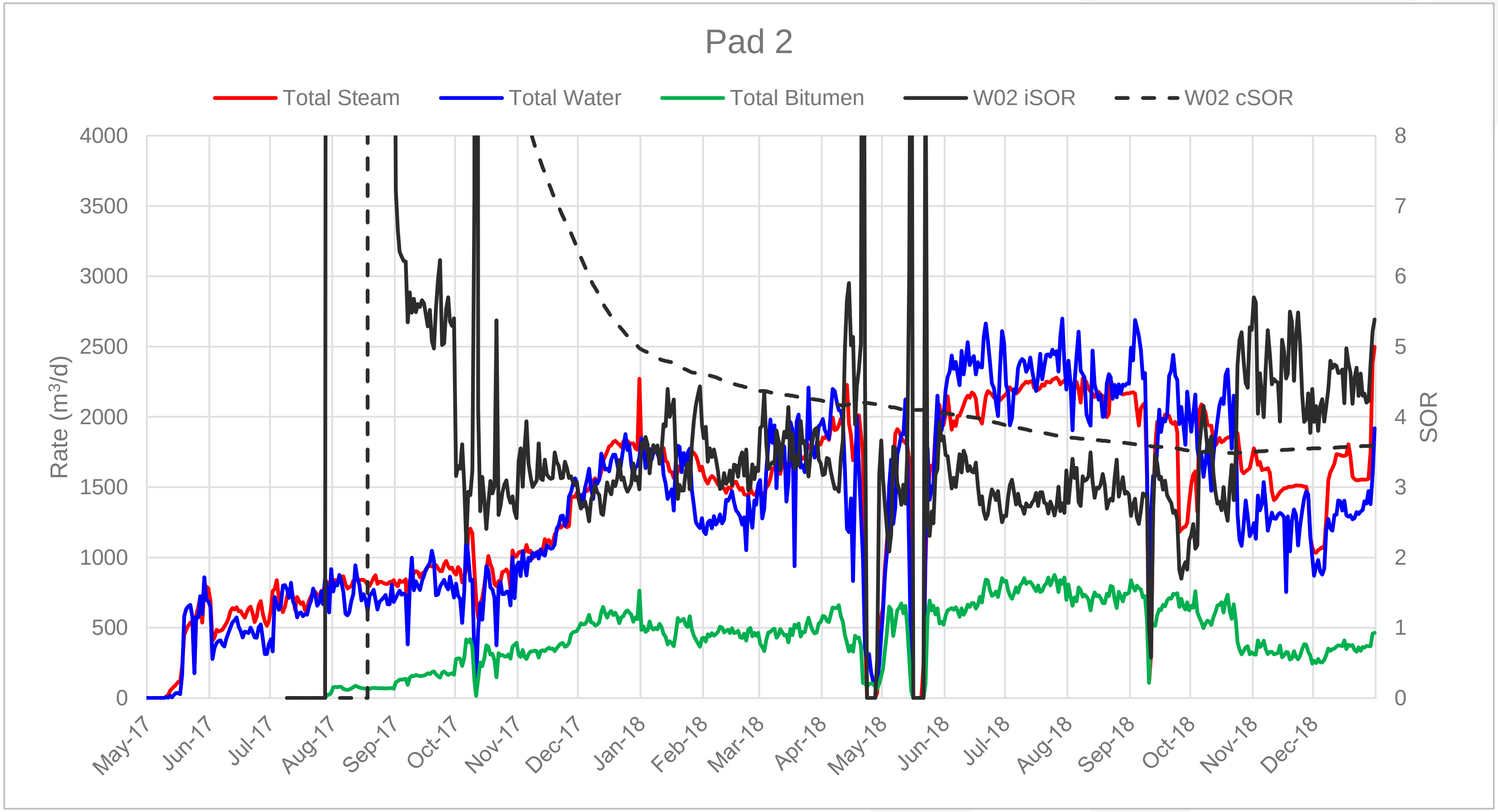
HIGH Performer Example – Pad 1



PAD Performance – MEDIUM – Pad 2

- Five of six well pairs have been on SAGD mode since 2017, one of six well pairs began SAGD mode in 2018
- cSOR: 3.6
- 2018 Average SOR: 3.5
- Average bitumen rate per well of 549 bbl/d (87 m^3/d)
- Three of the five well pairs have good reservoir quality, with the two outer wells being more heterogenous toward the reservoir edge
- Based on well fluid and pressure balances, it is expected that steam chambers are not in communication

MEDIUM Performer Example – Pad 2



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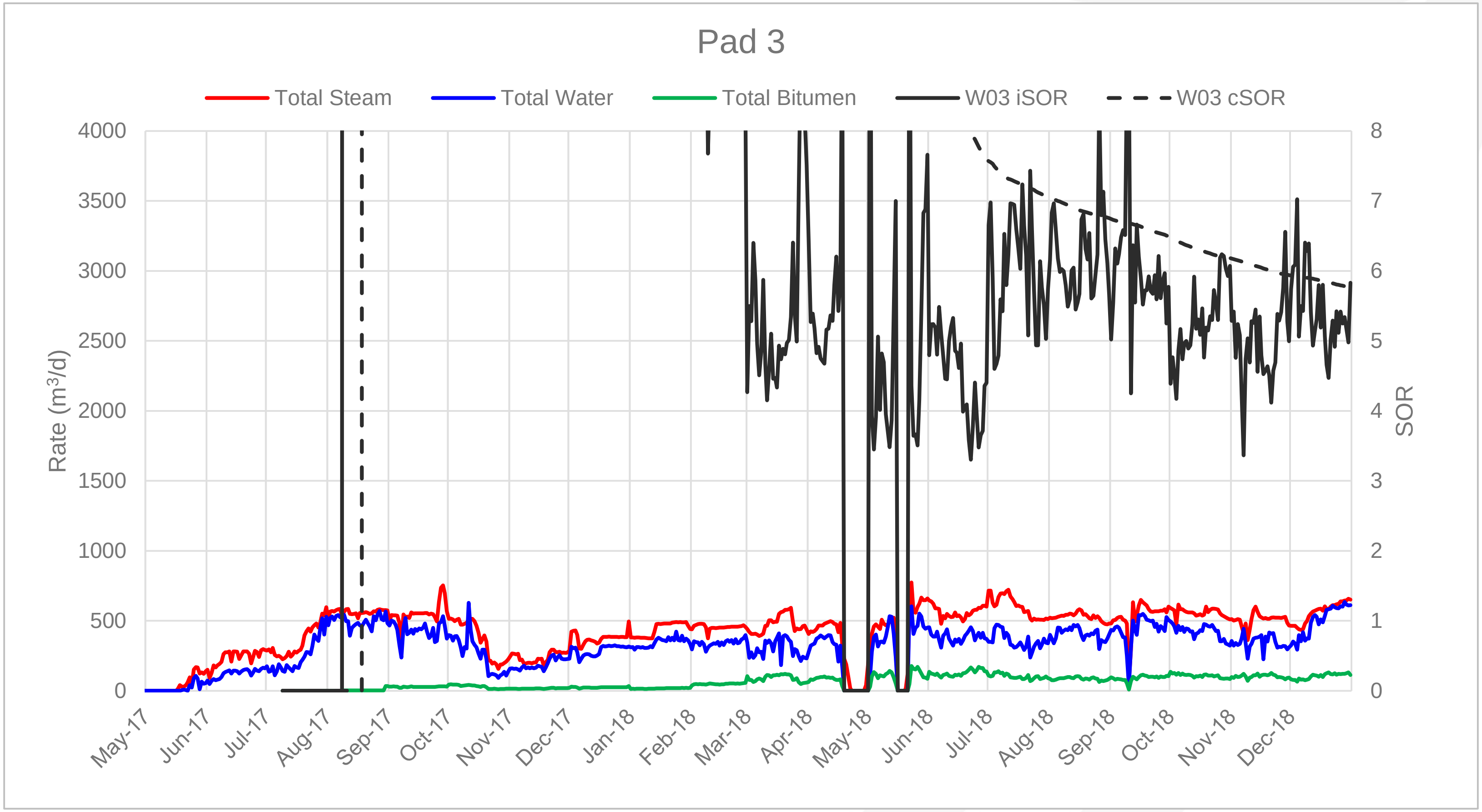
PAD Performance – LOW – Pad 3

- Three of three well pairs began SAGD mode in 2018
- cSOR: 5.8
- 2018 Average SOR: 5.8
- All three well pairs are located in higher heterogeneity area
- Average bitumen rate per well of 177 bbl/d (28 m^3/d)
- Due to heterogeneity encountered along the producer's wellbore, these well pairs have performed poorly and show limited temperature conformance along the horizontal section
- Based on well fluid and pressure balances, it is expected that steam chambers are not in communication

LOW Performer Example – Pad 3



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Summary of Key Learnings 2018

- Excellent temperature conformance created during the circulation stage resulted in exceeding our operating expectations for:
  - Total field oil production rates
  - Well pair peak oil rates
  - Field SORs
- Water cut fluctuations were observed from the increased fluid levels after turnarounds and reduced production periods
- Demonstrated that natural lift is possible on Pad 1 at pressures below 4000 kPa
- Dilation tests during circulation stage showed no observable benefits at this point

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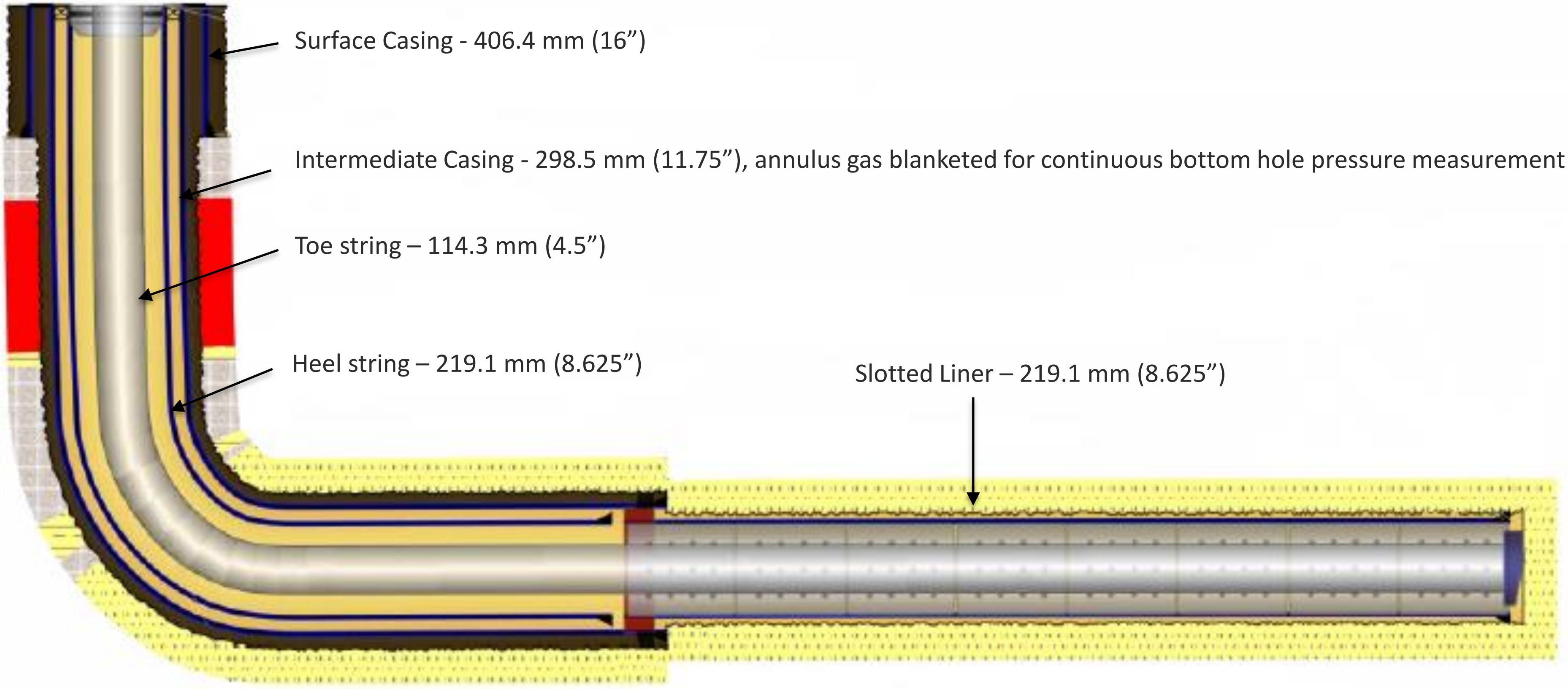
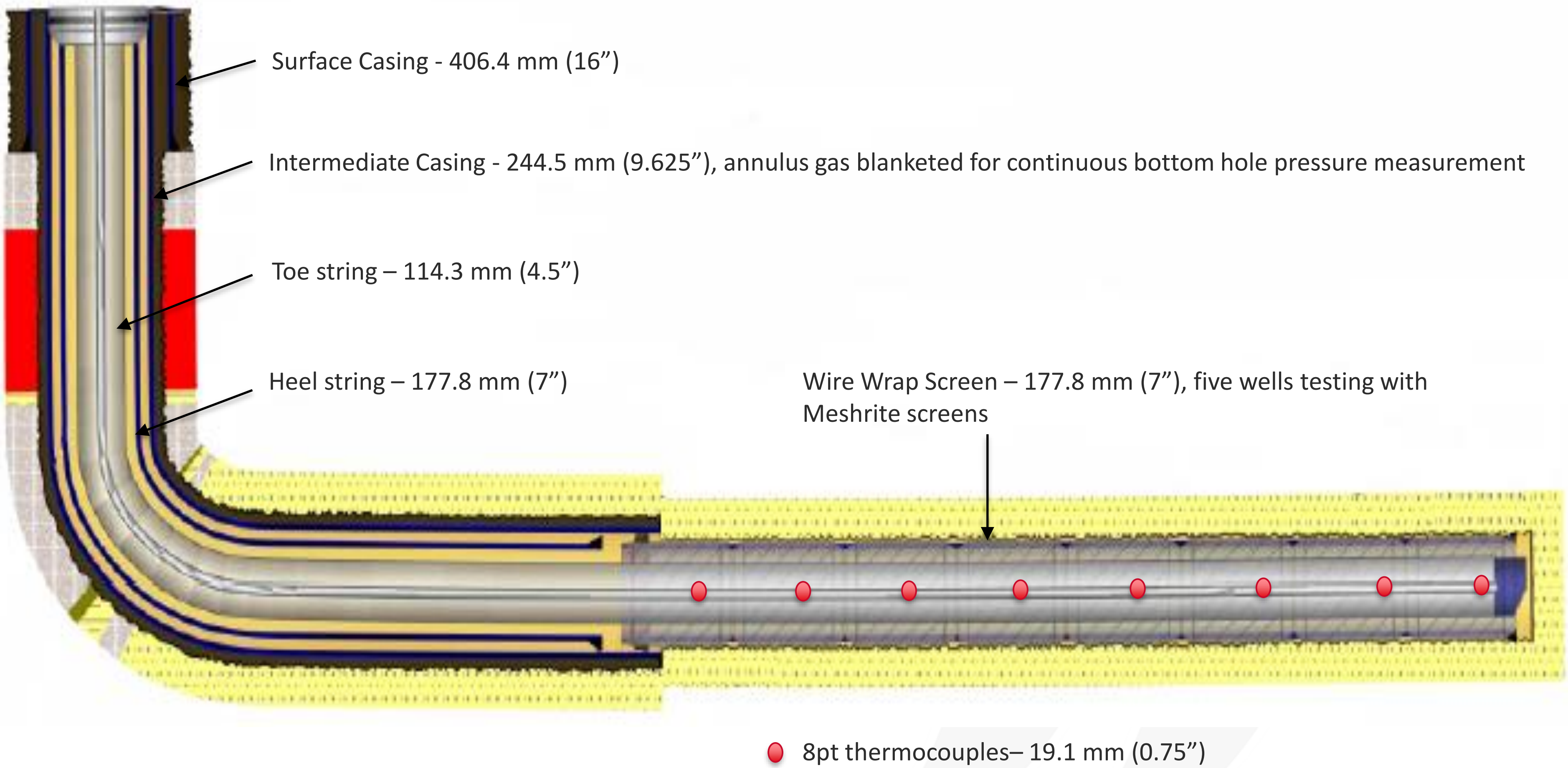
Well Design and Instrumentation

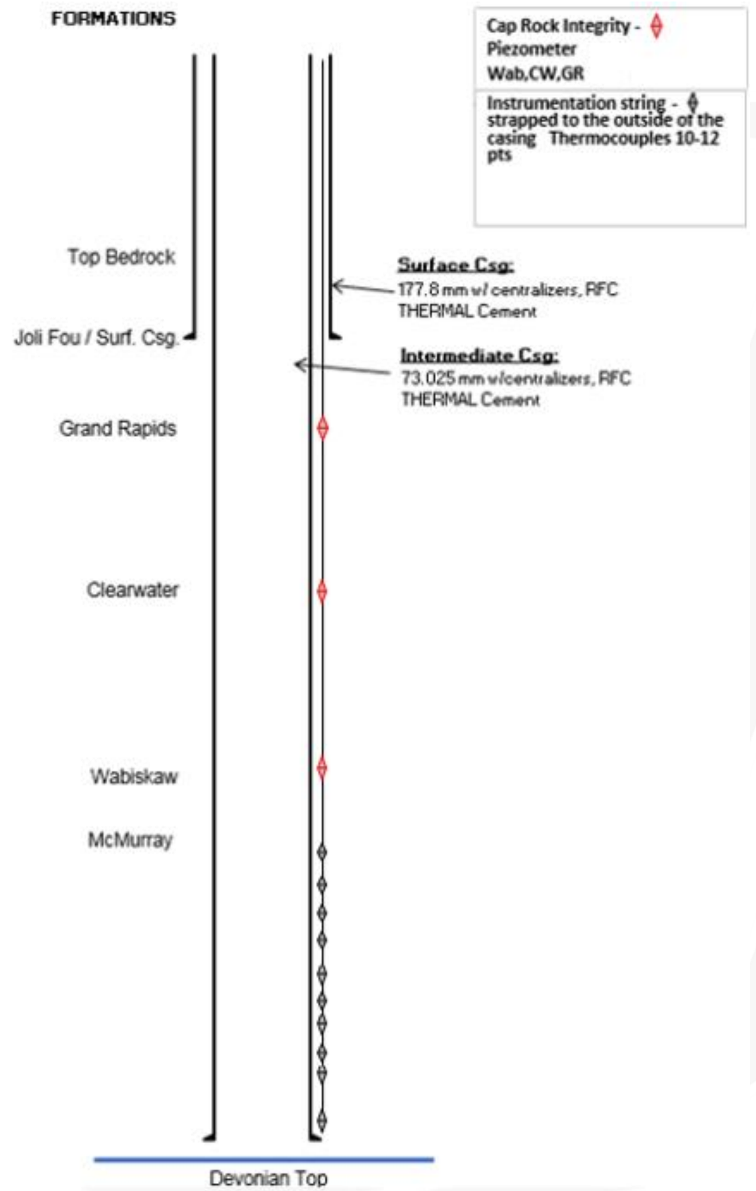
Typical HE SAGD Injector Well Schematic



Typical HE SAGD Producer Well Schematic



HE Observation Well Completion



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SAGD Well Completions

- Hangingstone Expansion design – Slotted 8-5/8” liner on all injectors / Wire wrap 7” screens on producer wells with the exception of five producer wells with MeshRite screens (W01P01, W02P01, W02P06, W05P04, W06P03)
  - Excellent sand control from all producers
  - Low pressure differential drawdowns between injector and producer wells
- All 32 SAGD well pairs running, no well failures
- SCVF cold testing during planned outages (plant turnarounds), monitoring ongoing
- Three injector wells (W03I03, W06I02, W06I03) installed with shiftable outflow devices (current position – closed from original installation), two devices per well
- Two producer wells (W05P05, W05P07) installed with shiftable inflow devices (current position – closed from original installation), two devices per well

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Instrumentation

- SAGD steam injector
  - Blanket gas for pressure measurement on all wells
- SAGD producer
  - 8pt thermocouple string installed on all producer wells (32), inside 114.3 mm tubing toe string
  - DTS Fiber testing, strapped to outside 4.5” production tubing on three producers: W06P02/03 showing good results versus 8pt thermocouple (less temperature masking), W06P01 premature failure due to instrument cap line integrity (produce fluid ingress)
  - Blanket gas for pressure measurement on all wells
- Observations Wells
  - 10-12pt thermocouple strapped to outside 73-89 mm tubing
  - Caprock integrity- Piezometers monitoring Wab, CW, GR formations
  - Hanging piezometer design on one well, OV2R (04-24)

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Surface Operations

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Facility Design

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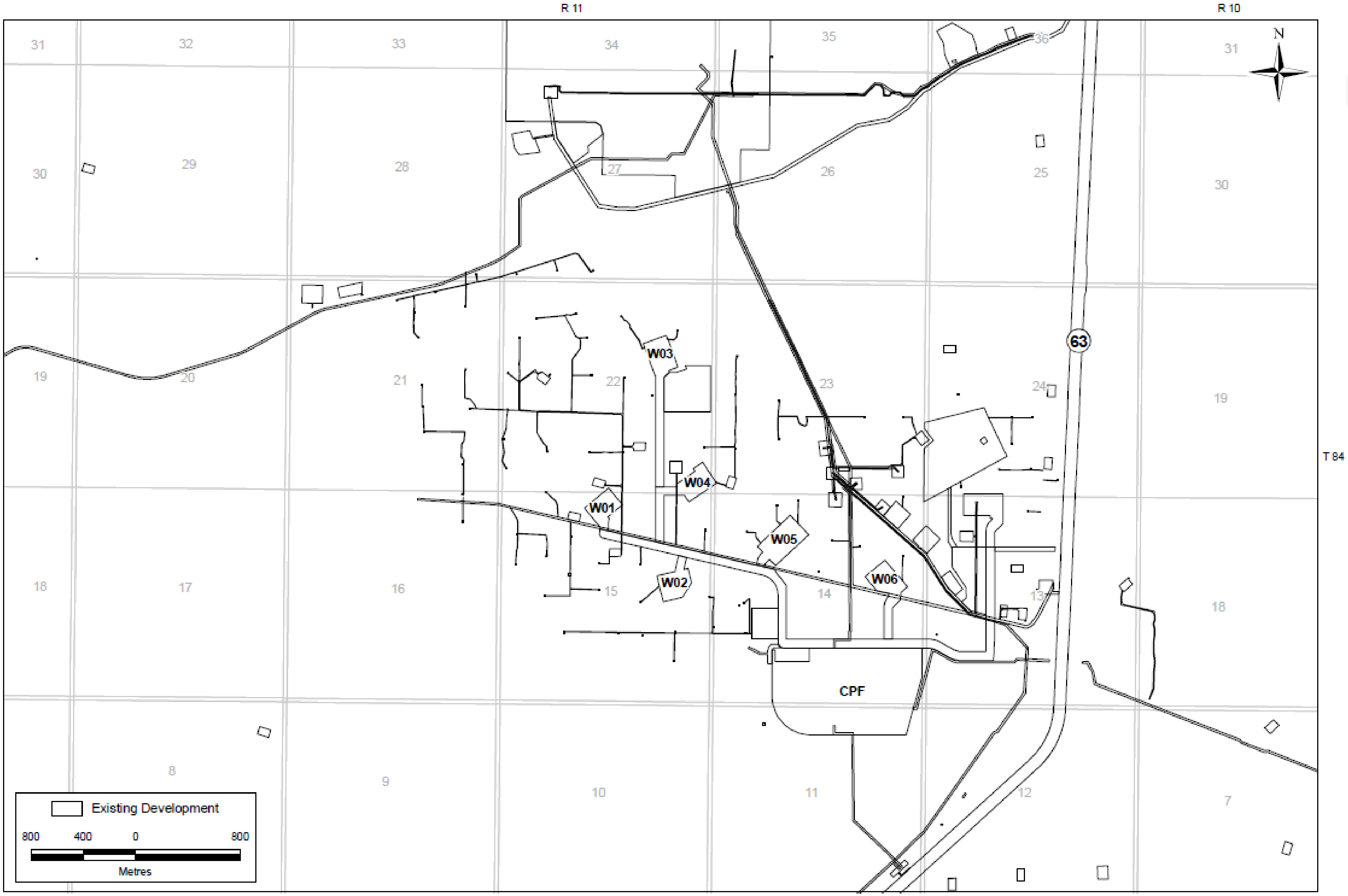
Site Plan



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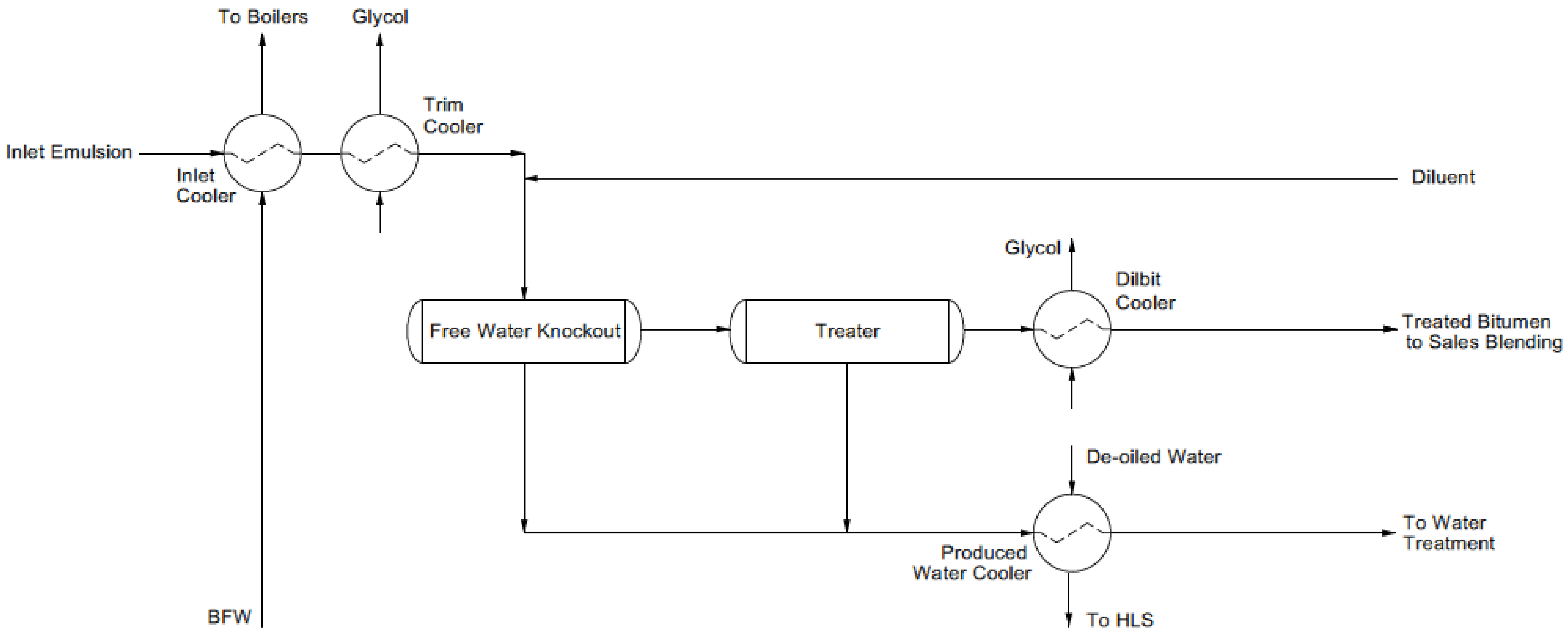
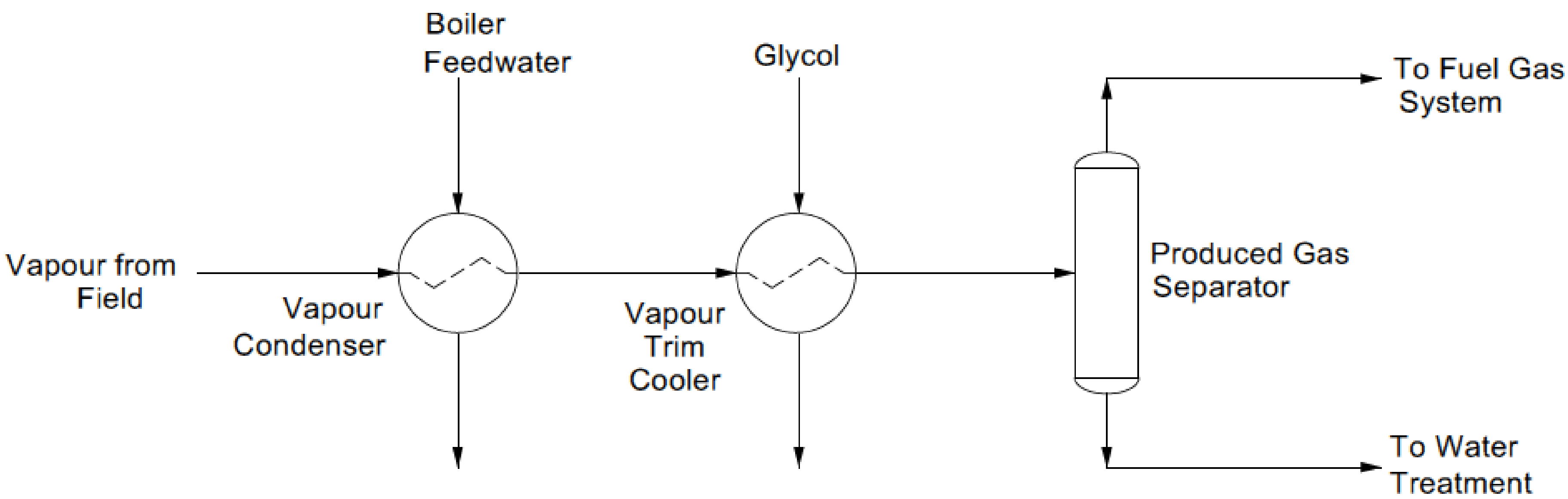
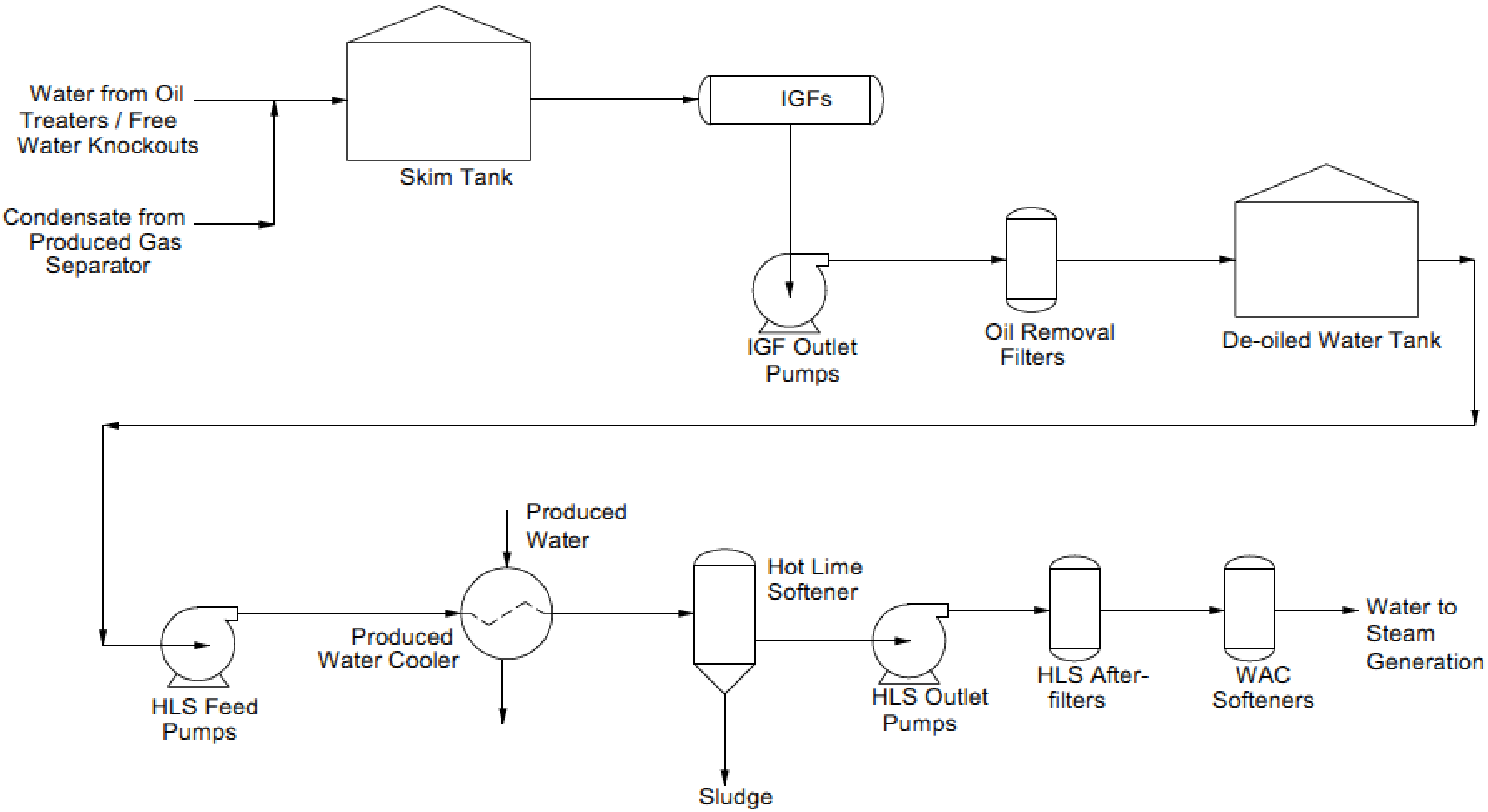
PFD – Bitumen Treating



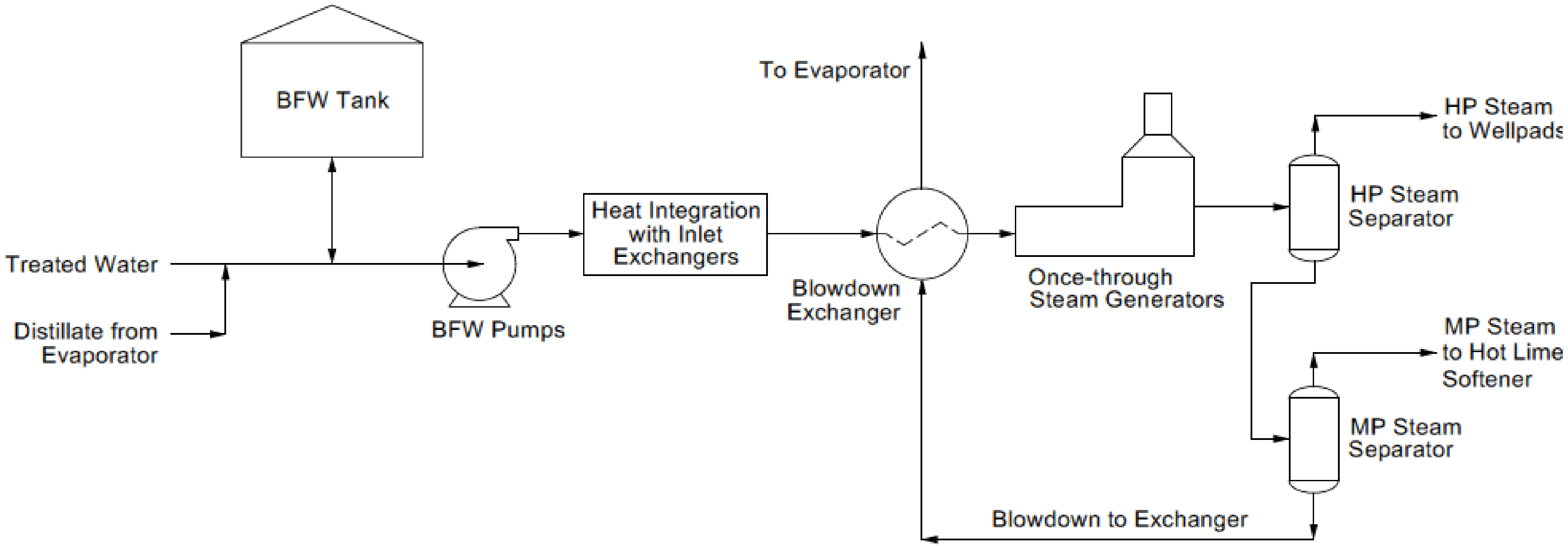
PFD – Produced Gas Recovery



PFD – Produced Water Treatment



PFD – Steam Generation



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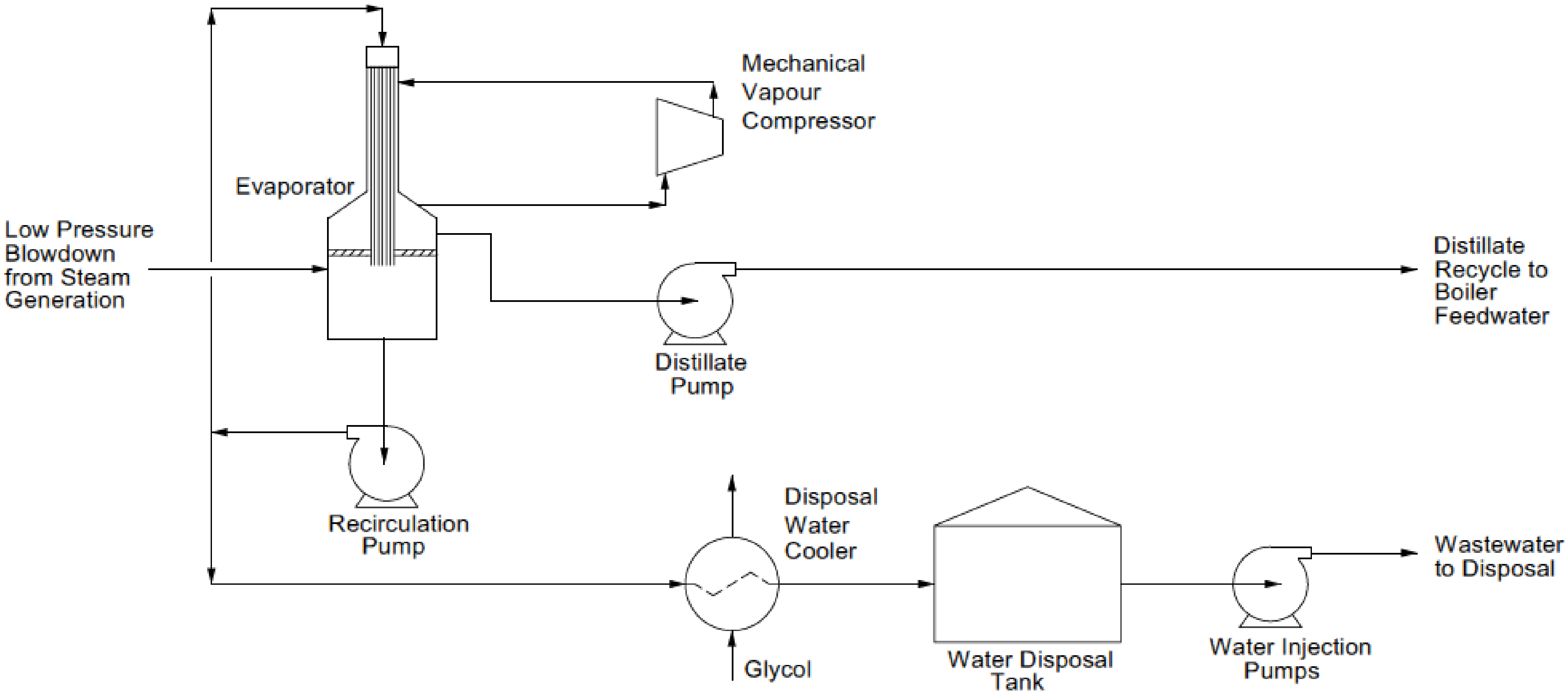
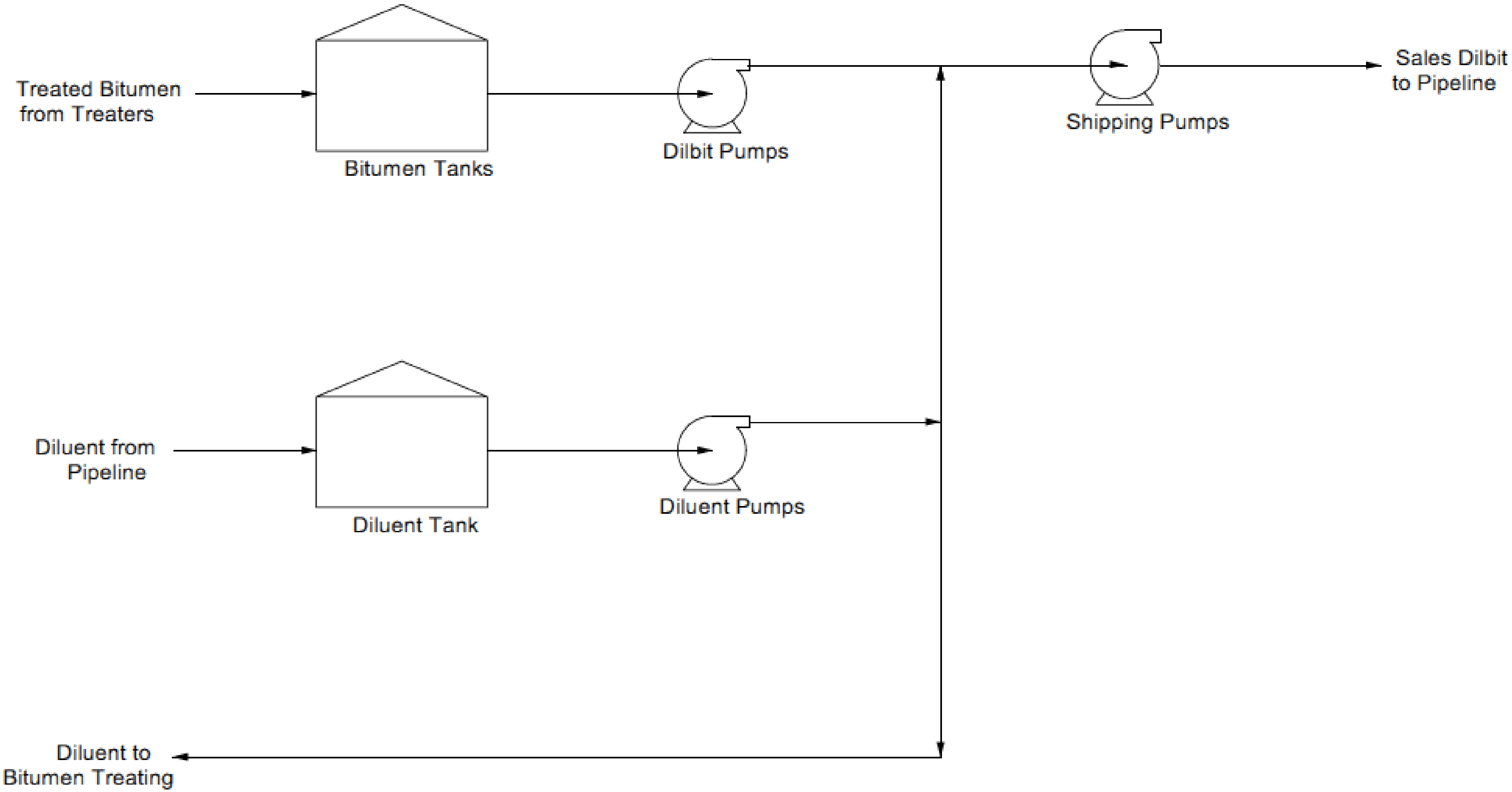
PFD – Boiler Blowdown



PFD – Bitumen Blending & Sales



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Operational Highlights – 2018

First full year of operations

- Ramp-up to designed production rate 20 Mbbl/d (3.2 Mm^3/d) within year of start-up
- Maintained 40% higher than designed production rates before cutbacks
- Production cutbacks in Q4 2018 due to poor economics
- A full plant outage occurred due to an electric breaker failure in the 4160 V system on May 15. Production resumed May 22
- On May 14, wild fires damaged some Fortis power poles, cutting off diluent supply for three days
- A leaking 16” steam valve, on the main steam header, was removed and replaced with a spool, with a full outage from April 22 to 28
- Significant civil damage occurred during a major storm; repaired

Facility Performance - Bitumen Treatment

- Design
  - Bitumen handling = 30 Mbbl/d (4.8 Mm^3/d)
  - Bitumen density – 1011 kg/m^3 (Demo Project)
  - Dilbit viscosity spec. – 350 cSt
- 2018 Performance
  - Project ramp-up complete after April/May turnaround
  - Maximum Rate in 2018: 30.7 Mbbl/d (4.9 Mm^3/d)
  - Maximum Monthly Average Rate (August): 28.5 Mbbl/d (4.5 Mm^3/d)
  - Bitumen samples have higher density (~1016 kg/m^3) than Demo project
  - Optimized bitumen treating to reduce diluent flashing – typically 2%; working on options to reduce further
  - Reduction in tight emulsions after initial production cleaned up wells; some ongoing slop management required

Facility Performance - Water Treatment

- Design
  - Designed water system for six 71.3 MW steam generators
  - Only four installed
  - Produced Water System: Surge Tk/Skim Tk/IGF/ORF/HLS/WAC
  - Blowdown to: MP Steam & Evaporator; Brine Trucked Off-Site
- 2018 Performance
  - Overall system is working well
  - BFW targets
    - Silica (~50 ppm), O&G (<1 ppm) and Hardness (<0.1%)
  - Periodic oil carry over to the produced water system
  - Surge and Skim Tank internals modified with improved operational results
  - Addressing recently (late-2018) identified raw water scale (high iron, phosphorous and calcium)

Steam Generation

- B-510/515/520/525
  - 71.3 MW (240 MMBtu/h)

2018	Steam Volume (m^3)	Steam Quality (%)
January	242,916	78.3
February	212,038	76.6
March	247,783	76.0
April	191,847	73.8
May	178,614	74.8
June	307,216	74.4
July	323,938	74.5
August	322,348	74.0
September	263,427	71.1
October	285,353	73.2
November	202,903	67.8
December	222,401	72.2
Total	3,000,784	73.9
Daily Average	8,221	
Design Capacity	11,440	80

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Power & Energy Intensity 2018

2018	Power (kWh)	Power (MW)	Natural Gas* (e^3m^3)	Bitumen (m^3)	Intensity (m^3/m^3)	Nat gas heating value (GJ/e^3m^3)	Intensity** (GJ/m^3)
January	7,633,356	10.3	16,388	70,472	233	40.6	9.4
February	7,138,525	10.6	14,824	67,393	220	40.2	8.9
March	8,030,273	10.8	16,636	81,342	205	40.8	8.3
April	7,109,430	9.9	13,247	60,267	220	40.6	8.9
May	6,422,496	8.6	12,049	57,709	209	40.9	8.5
June	8,376,646	11.6	19,516	114,196	171	41.0	7.0
July	8,700,596	11.7	20,070	138,728	145	40.9	5.9
August	9,192,181	12.4	19,759	140,246	141	41.1	5.8
September	8,117,923	11.3	17,403	121,652	143	40.8	5.8
October	8,636,701	11.6	19,702	110,750	178	41.0	7.3
November	7,660,995	10.6	15,160	59,945	253	41.1	10.4
December	7,839,341	10.5	16,496	60,927	271	41.1	11.1
Total	**94,858,463**	**10.8**	**201,251**	**1,083,627**	**186**	**40.9**	**7.6**

* - Total natural gas to plant

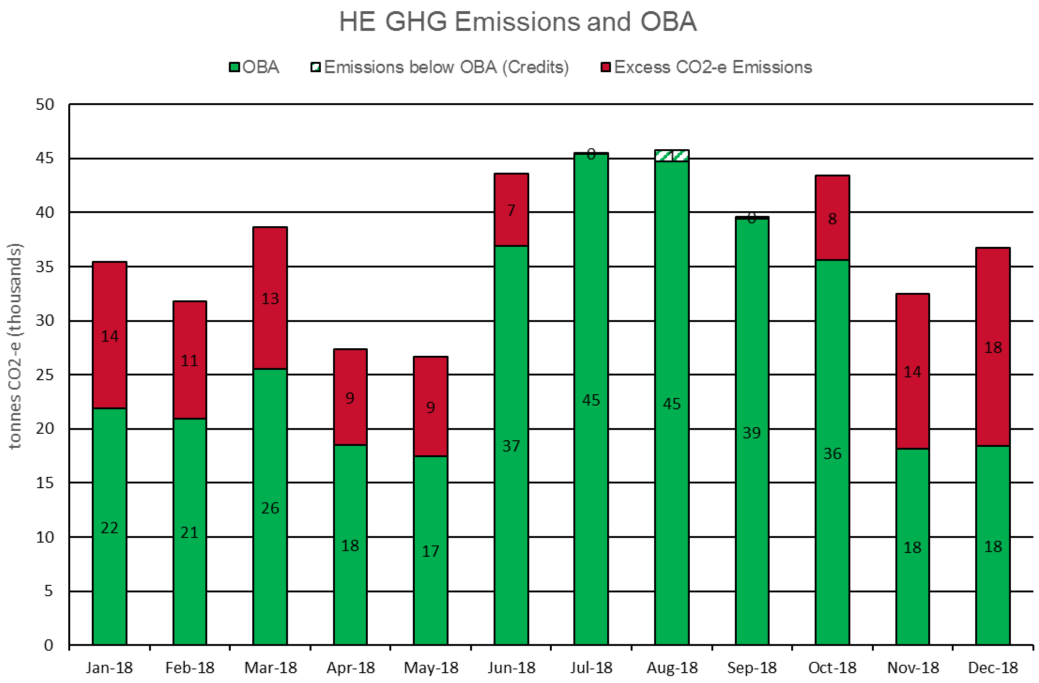
** - Using monthly nat gas heating values

Natural/Produced Gas Summary

2018	Purchased Gas (e^3m^3)	Produced Gas (e^3m^3)	Flared Gas (e^3m^3)	Produced Gas Recovery (%)
January	16,388	259.1	0.0	100.0
February	14,824	252.0	0.0	100.0
March	16,636	386.6	0.0	100.0
April	13,247	268.9	0.0	100.0
May	12,049	207.9	1.0	99.5
June	19,516	574.9	4.8	99.2
July	20,070	757.9	0.0	100.0
August	19,759	723.1	1.5	99.8
September	17,403	637.7	8.6	98.7
October	11,409	557.2	0.0	100.0
November	12,656	216.7	0.0	100.0
December	15,135	278.2	0.5	99.8
Total	189,092	5,120	16.4	99.7

Greenhouse Gas Emissions

- 2018 GHG Emissions: 445,649 tonnes CO2-e
- 2018 Output Based Allocation (OBA): 344,212 tonnes CO2-e
- Excess Emissions: 101,437 tonnes CO2-e



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Measurement & Reporting

HE MARP

- Measurement, Accounting and Report Plan (MARP) originally approved in January 2013
- 2018 MARP revision submitted
- 2019 MARP revision will be completed by February 28, 2019
  - Battery Bitumen Production calculation formula revision
  - Battery Produced Gas calculation formula revision
  - Battery Produced water calculation formula update with quench meter location revision
  - Process pond level transmitter addition
  - Diluent Inlet/Sales Dilbit meters status revision

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Optimization of Test Duration

- Optimization of test duration
  - Cycling through wells, at least two full day tests per well
  - Excess testing time beyond required is focused on dynamic/unstable wells
- Minimum test period: two days per month
- BS&W tests:
  - Manual cuts are used with quality controlled procedure
  - Online meters are in place, unable to perform reliable accuracy at this time

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HE Production / Injection

- 7 of 32 SAGD well pairs have individual metered wellhead separators, where produced fluid rates are continuously measured and recorded. The remaining wells use a group/test setup
- Group/test setup by phase
  - Pad 1: five wells; one group, one test
  - Pad 2: six wells; one group, one test
  - Pad 3: three wells; individual well head separators
  - Pad 4: five wells; one group, one test
  - Pad 5: nine wells; one group, two test
  - Pad 6: four wells; individual well head separators
- Manual bitumen cut sampling
- Steam injection rates are continuously measured at each wellhead

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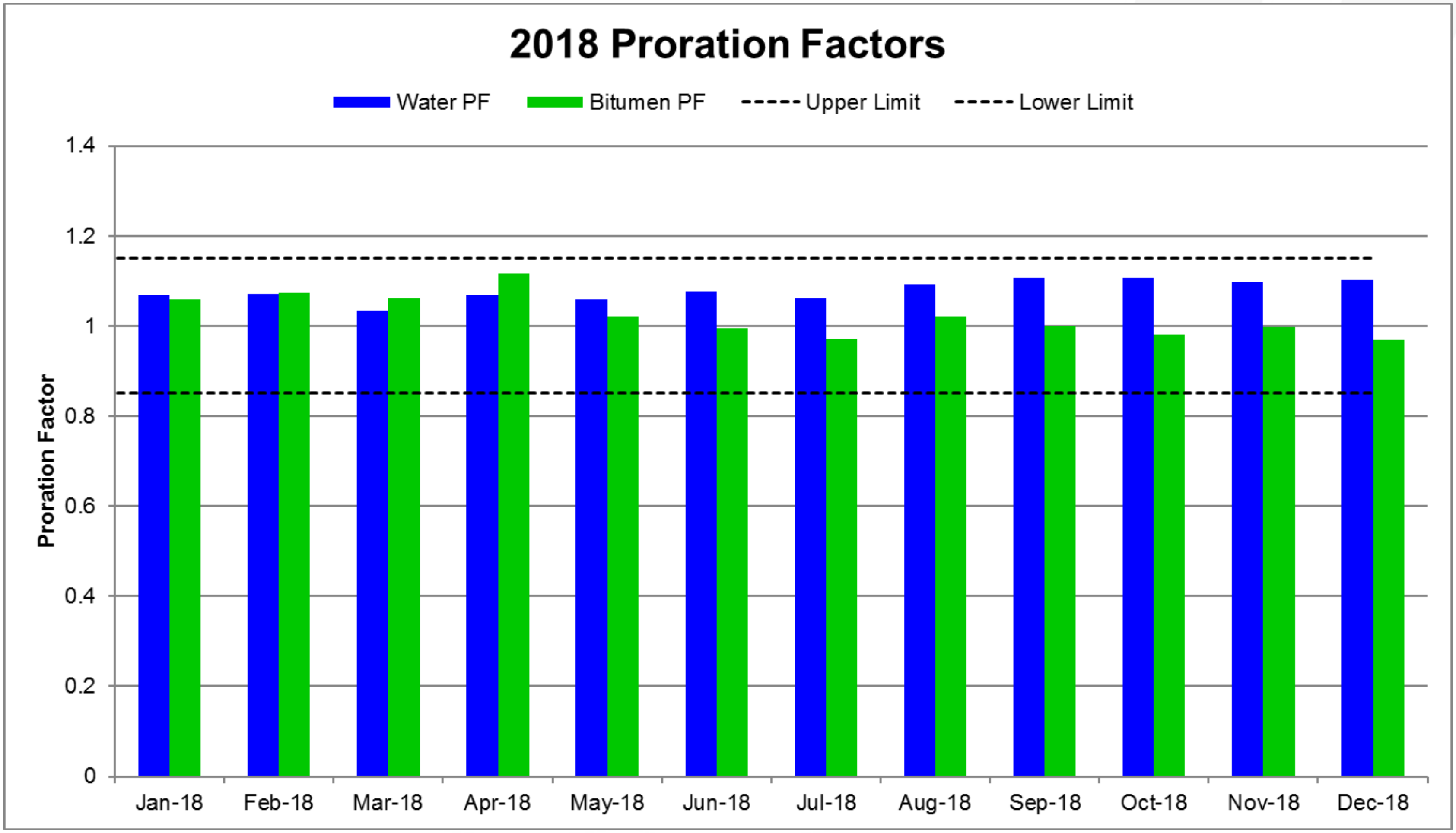
Reporting/Proration Method

- Produced Bitumen
  - Plant bitumen is calculated using metered dilbit minus diluent receipts compensated for flashing
  - ∑ Individual wellhead bitumen is calculated (produced fluid x bitumen cut) and prorated to the plant bitumen production
- Produced Water
  - Produced water from each well is calculated with the following formula
    - Produced Water = Produced Fluid – Bitumen
    - Produced water from all the wells is prorated to the total metered de-oiled produced water
- Steam
  - Steam volumes are measured at the wellheads with individual vortex meters; steam traps exist at each well pad

Proration Factors

- The average 2018 proration factor
  - Bitumen: 1.022
  - Water: 1.079

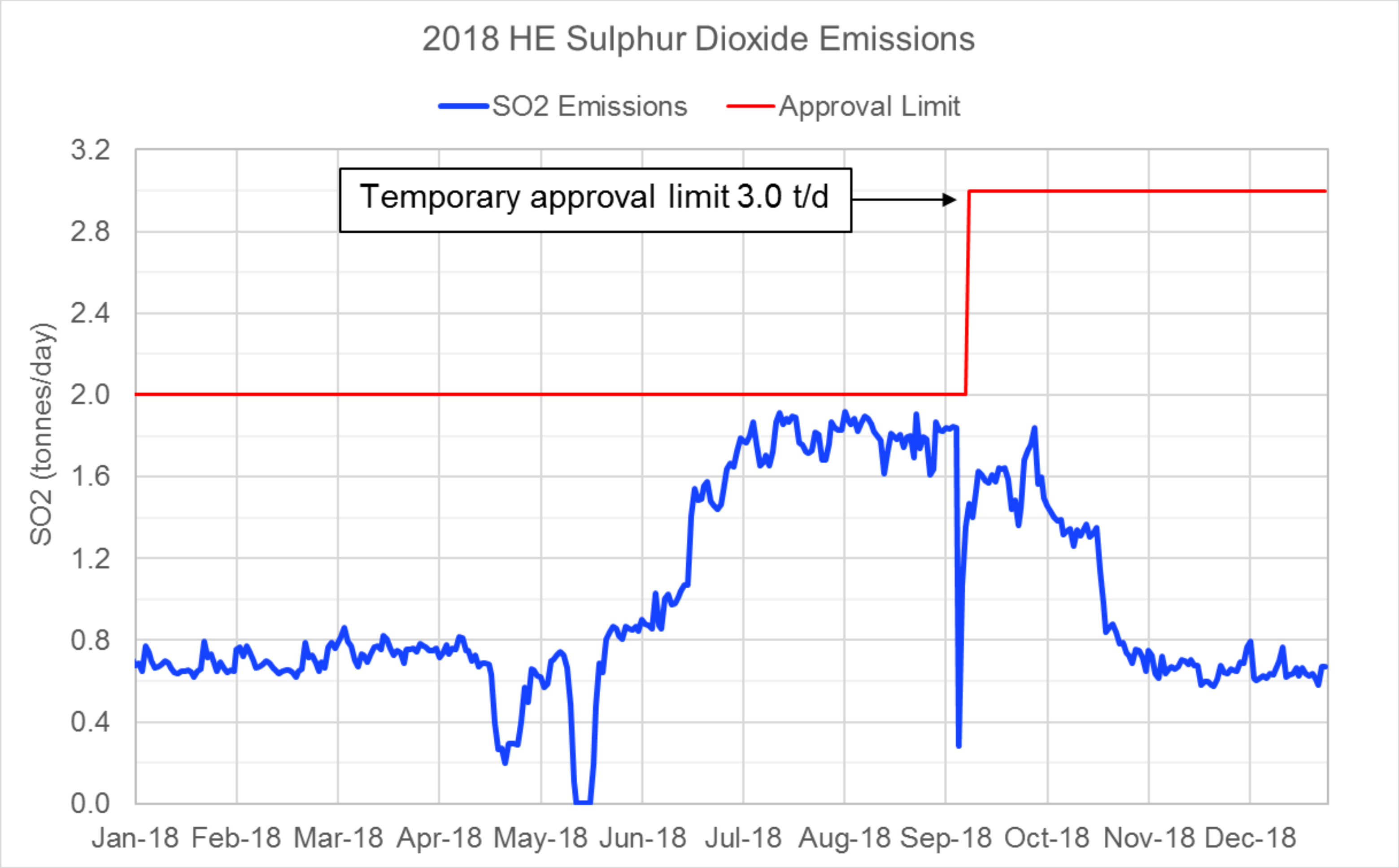


Water Balance at injection facility

(m³)	IN				OUT					(ABS) Δ(%)
	Produced Water (m³)	Raw Water (m³)	ΔINV (m³)	Total (m³)	Steam to Wells (m³)	Disposal to Truck out (m³)	Evaporation (m³)	ΔINV (m³)	Total (m³)	
January	209,311	27,724	40	236,995	217,431	2,736	7,763	-634	227,296	4.1
February	188,055	29,448	-42	217,545	201,929	2,679	3,657	-472	207,793	4.5
March	228,551	22,605	-54	251,211	234,075	3,001	10,479	1,318	248,873	0.9
April	165,032	31,094	-4,509	200,635	177,648	2,737	17,588	-1,207	196,767	1.9
May	146,363	44,753	4,386	186,730	168,404	1,918	14,218	3,962	188,502	0.9
June	333,953	13,517	26	347,445	296,077	4,191	31,120	-660	330,728	4.8
July	319,707	27,688	-816	348,211	314,816	4,734	23,868	-10,316	333,102	4.3
August	314,918	29,967	912	343,973	316,360	5,546	27,315	-2,960	346,261	0.7
September	272,180	20,688	-3,797	296,664	256,758	4,248	29,217	6,724	296,947	0.1
October	254,553	38,116	1	292,667	277,650	4,985	26,671	-8,137	301,170	2.9
November	152,885	59,134	3,381	208,638	195,089	3,733	15,304	684	214,810	3.0
December	174,676	61,637	90	236,223	214,004	2,988	8,914	161	226,067	4.3
Total	**2,760,184**	**406,369**	**-381**	**3,166,935**	**2,870,242**	**43,496**	**216,114**	**-11,537**	**3,118,315**	**1.5**

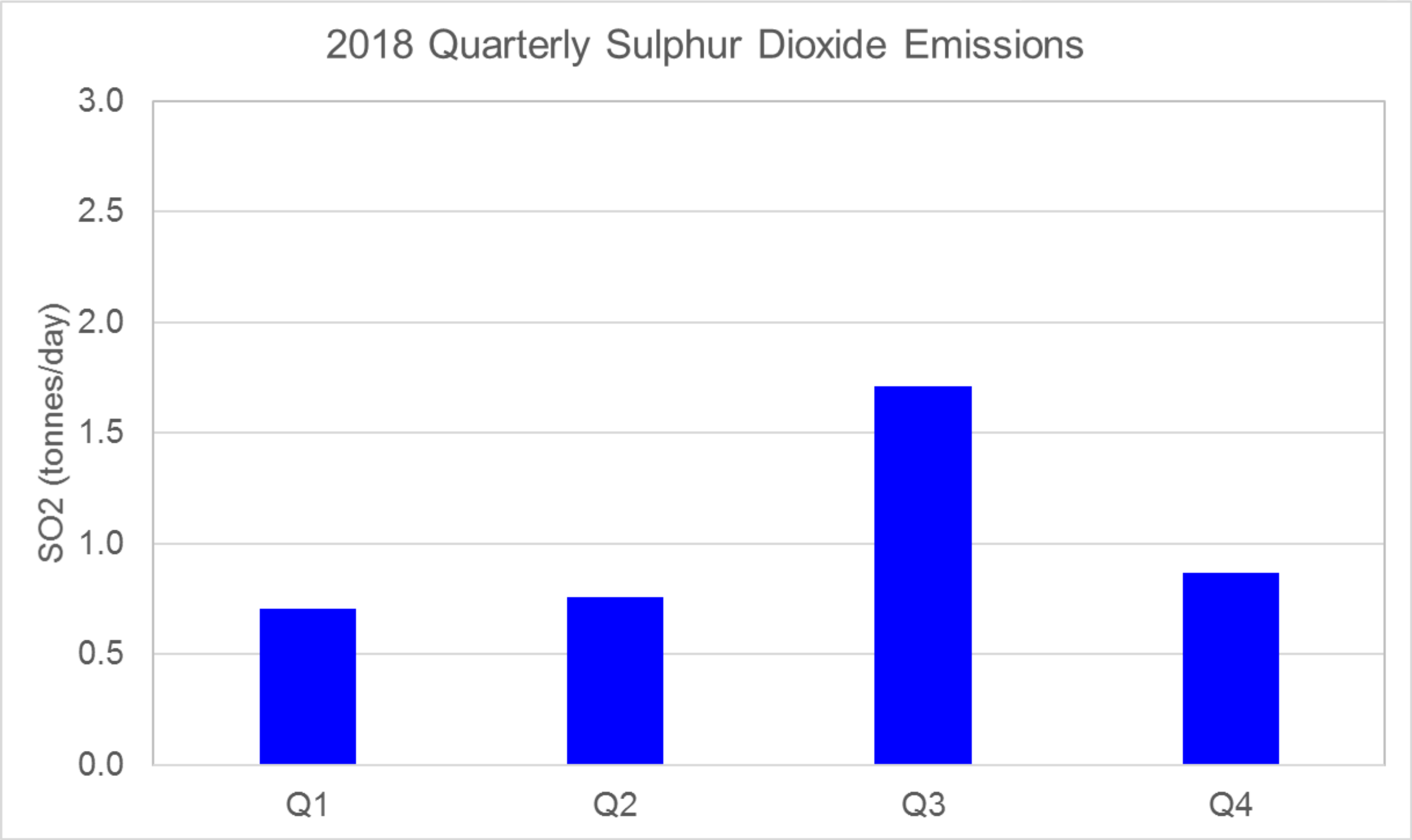
Nov/Dec – Production reduction, over injected into wells to maintain reservoir pressures (higher raw water rates)

Sulphur Production



Nov/Dec – Reduced production due to poor economics

Quarterly Sulphur Production



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Water: Source, Produced, Injection, Disposal

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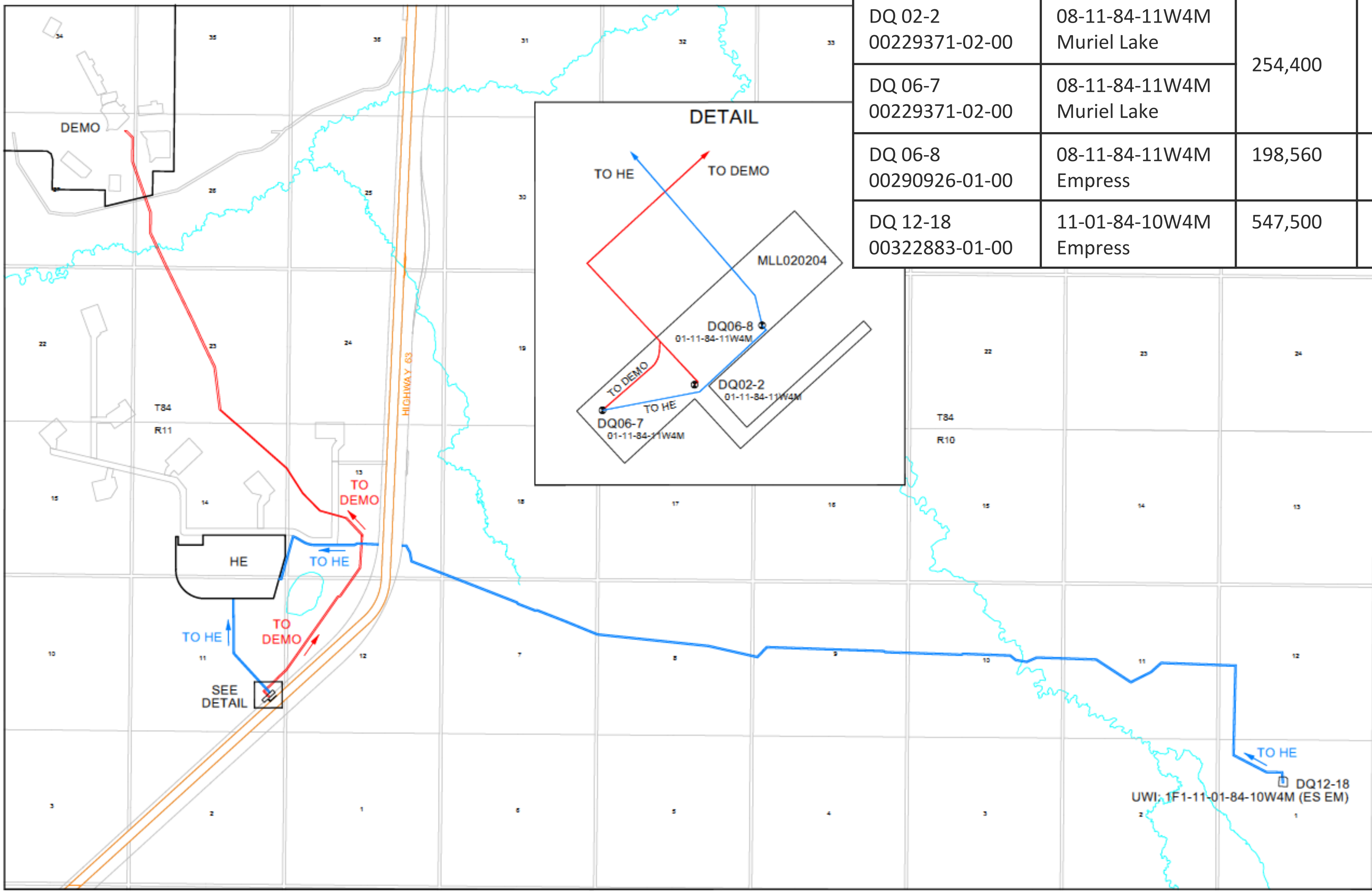
Water Source Wells

Well Name WA License No.	Location Aquifer	Alloc. (m³/yr)	Actual Used (m³)
DQ 02-2 00229371-02-00	08-11-84-11W4M Muriel Lake	254,400	4,450
DQ 06-7 00229371-02-00	08-11-84-11W4M Muriel Lake		
DQ 06-8 00290926-01-00	08-11-84-11W4M Empress	198,560	81,119
DQ 12-18 00322883-01-00	11-01-84-10W4M Empress	547,500	315,232



*DQ 02-2 and 06-7: Transferred to Greenfire Hangingstone Operating Corporation with asset transfer (Aug 2018)

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2018 Fresh Water Usage

(m^3)	Fresh Water Sources (m^3)				Total (m^3)
	DQ06-7	DQ06-8	DQ12-18	Surface Runoff	
January	0	7,103	20,621	0	27,724
February	0	5,330	24,117	0	29,448
March	0	1,134	21,471	0	22,605
April	0	8,384	22,710	0	31,094
May	4,450	9,178	25,556	5,569	44,753
June	0	5,854	7,663	0	13,517
July	0	699	26,989	0	27,688
August	0	2,102	27,865	0	29,967
September	0	139	20,549	0	20,688
October	0	8,594	29,522	0	38,116
November	0	16,197	42,937	0	59,134
December	0	16,405	45,232	0	61,637
Total	**4,450**	**81,119**	**315,232**	**5,569**	**406,369**
Max Annual Diversion	254,400	198,560	547,500	15,000	

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Directive 81: Disposal Limit vs. Actual

2018	Cumulative Produced Water (m^3)	Cumulative Fresh Water (m^3)	Cumulative Disposal Water (m^3)	YTD Disposal Limit (%)	YTD Disposal Actual (%)
January	209,311	27,724	2,736	9.2	1.2
February	397,366	57,172	5,415	9.1	1.2
March	625,917	79,776	8,416	9.2	1.2
April	790,949	110,871	11,153	9.1	1.2
May	937,313	155,624	13,071	9.0	1.2
June	1,271,266	169,141	17,262	9.2	1.2
July	1,590,973	196,829	21,996	9.2	1.2
August	1,905,891	226,796	27,542	9.3	1.3
September	2,178,071	247,483	31,790	9.3	1.3
October	2,432,623	285,599	36,775	9.3	1.4
November	2,585,508	344,733	40,508	9.2	1.4
December	2,760,184	406,369	43,496	9.1	1.4

$$Disposal\ Limit\ (\%) = \frac{(Produced\ Water * 0.1) + (Fresh\ water * 0.03) + (Brackish\ water * 0.35)}{Produced\ Water\ In + Fresh\ Water\ In + Brackish\ In} * 100\%$$

$$Disposal\ Actual\ (\%) = \frac{Well\ Disposal + Brine\ Trucking}{Produced\ Water + Fresh\ Water} * 100\%$$

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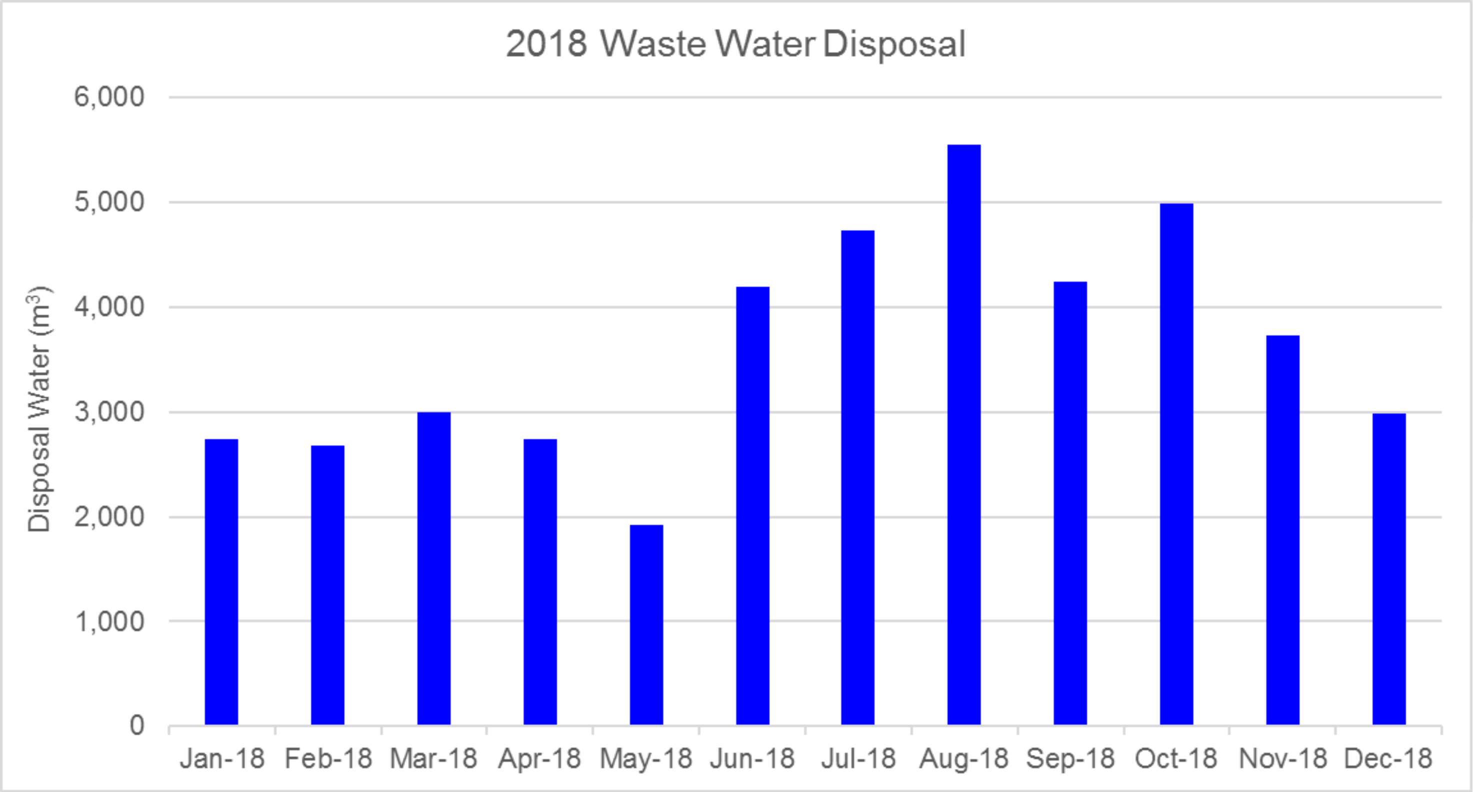
Waste Water Disposal Volumes 2018

- Offsite disposal – White Swan Environmental Ltd.
- Total 43,496 m^3 disposal water in 2018



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Other Wastes

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Oilfield Waste Management

Waste Receiver	Location	Waste Description	Quantity	Disposal Method
GFL Environmental	Onoway, AB	CAUS	1 m^3	Oilfield Waste Processing Facility
		EMTCON	4 m^3	
		GLYC	1 m^3	
		IEXRES	1 m^3	
		OILRAG	15 m^3	
		SAND	1 m^3	
RBW Waste Management	Nisku, AB	DOMWST	9 m^3	Oilfield Waste Processing Facility
		OILRAG	12 m^3	
		OILABS	2 m^3	
		SMETAL	1 m^3	
		SOILCO	10 m^3	
		SOILHM	7 m^3	
		WSTMIS	7 m^3	
Tervita	Janvier, AB	SOILCO	3 tonnes	Landfill
		SLGLIM	4451 tonnes	
White Swan Environmental Ltd.	Atmore, AB	BLBDWT	43,496 m^3	Oilfield Waste Processing Facility
		COEMUL	6366 m^3	
		HYDVCO	3 m^3	
		OILABS	2 m^3	
		SLGHYD	210 m^3	

Domestic Waste Management

- In 2018, Collective Waste Management recycled or disposed of:
  - 16,890 kg of metal
  - 85,290 kg of mixed industrial waste
  - 7,590 kg of concrete
  - 480 kg of cardboard

Environmental Monitoring Programs

Environmental Monitoring Programs

Groundwater Monitoring Program

- Groundwater monitoring events are completed every spring and fall, interim reports (internal) in spring and a comprehensive, triennial report is due to AER in 2019
- Exceedances identified in 2017 were determined to be naturally occurring

Wetlands Monitoring Program

- Comprehensive data analysis and report of the first three years of data was submitted on March 31, 2018

Rare Plant Monitoring

- 2018 surveys were only conducted for one site and additional plant individuals (Hairy Butterwort) were identified compared to previous years. All populations are now healthy; as well these species are no longer tracked in the Alberta Conservation Information Management System.

Environmental Monitoring Programs (cont.)

Soil Monitoring Program

- No further work needed till next survey in 2020

Wildlife and Caribou Programs

- Established targets and metrics were met or exceeded over six-year (2012-2018) monitoring period. The second three-year comprehensive report was submitted in May 2018

Regional Monitoring Programs

- Involved through the Alberta Oil Sands Monitoring (OSM) programs
- Active member of CAPP and participation in the Caribou Working Group, the Species At Risk Working Group, Environmental Policy and Regulation Working Group, as well as Air Emissions and Climate working groups
- JACOS is a member of the Monitoring Participation Group of the Canadian Oil Sands Innovation Alliance (COSIA)

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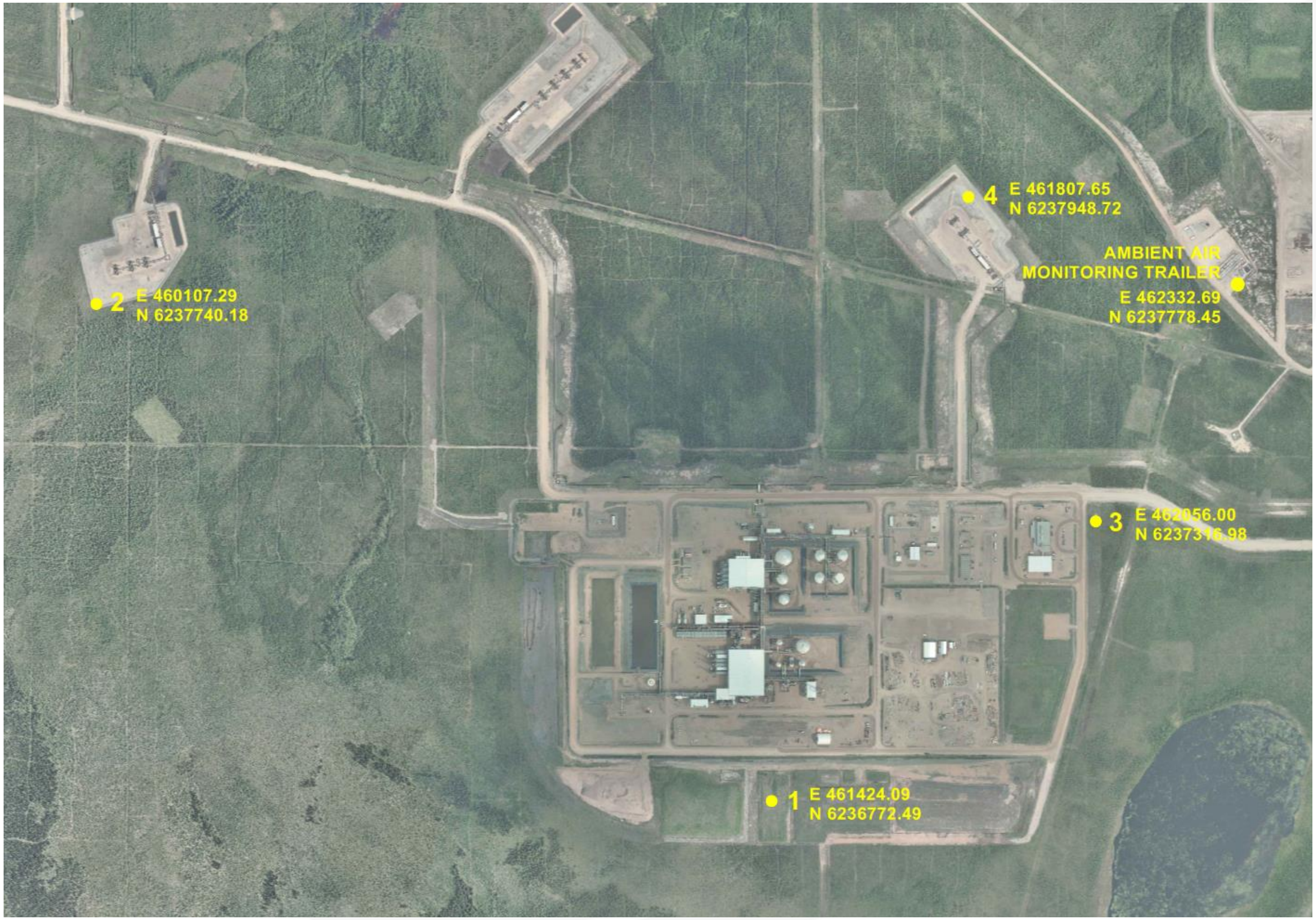
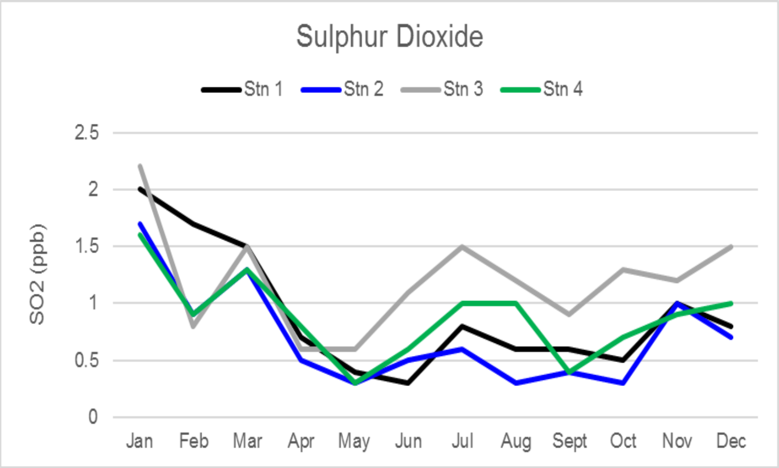
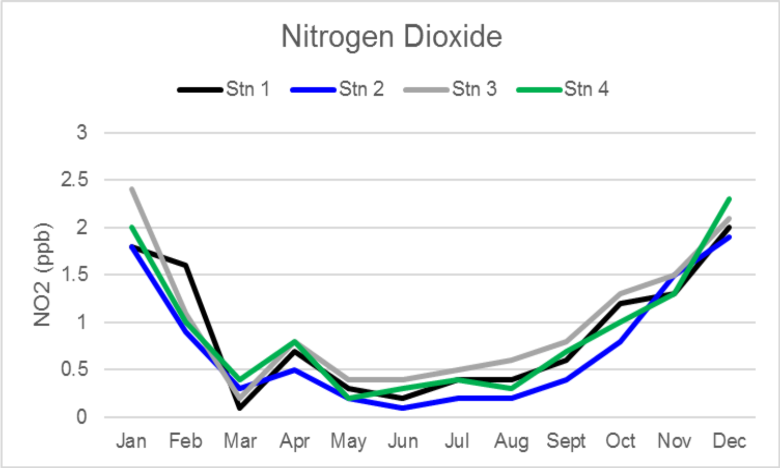
Environmental Monitoring – Air Quality

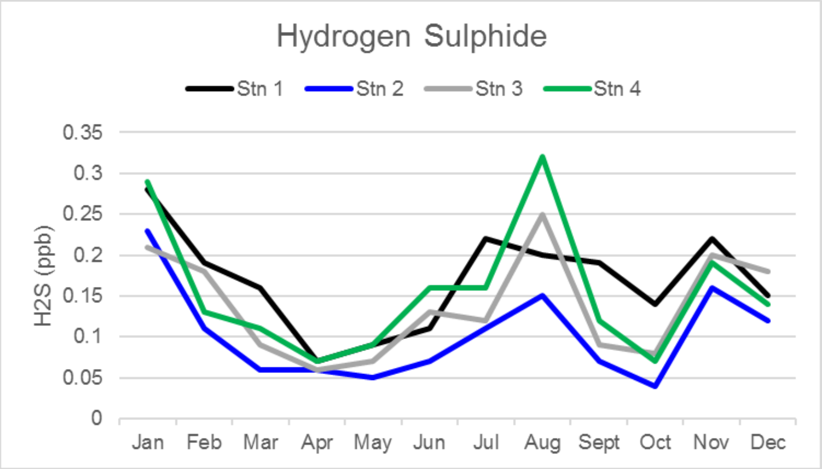
Air Monitoring Station Locations



Passive Exposure Stations Results 2018



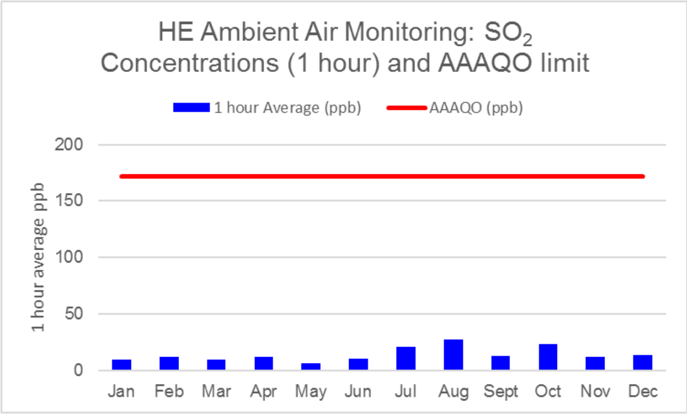


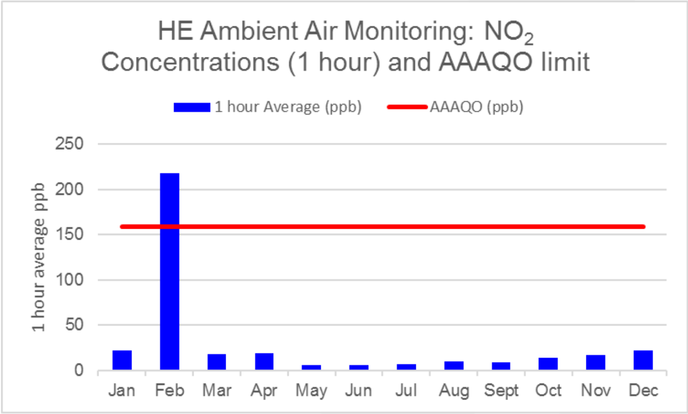


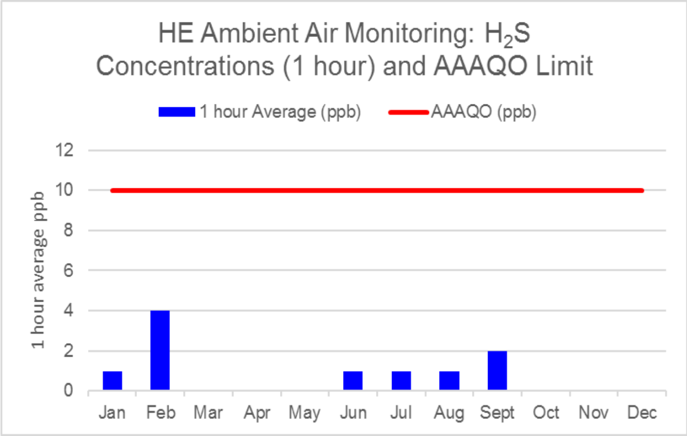
Ambient Air Monitoring - Summary

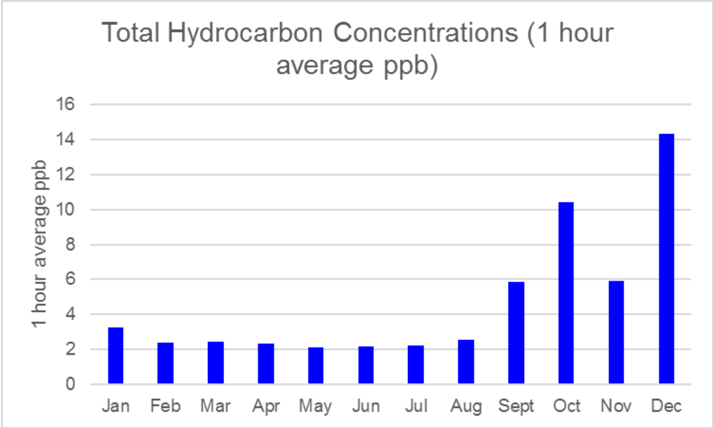
- One NO_2 AAAQO Exceedance was recorded on February 9 at 11:00am (CIC #334565)
  - The exceedance was caused by a vehicle left idling while parked next to the trailer
  - JACOS has installed “No Idling” signage near the trailer to prevent reoccurrence
- One Operational Time Contravention was reported in January (CIC #334612)

Ambient Air Monitoring Results 2018







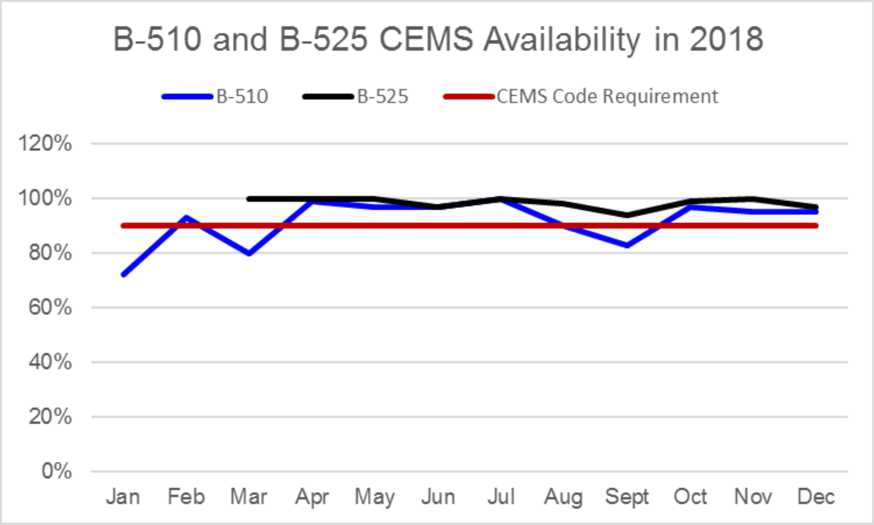


Source Air Emissions Monitoring

Air Emission Source	Parameter	Method	Result (kg/hr)	Limit (kg/hr)
OTSG B-510 (Mixed Fuel)	NO_x (as NO_2)	RATA – Feb 28, 2018	3.7	12.3
OTSG B-510 (Mixed Fuel)	NO_x (as NO_2)	SES/RATA – Dec 12, 2018	4.6	12.3
OTSG B-520 (Natural Gas)	NO_x (as NO_2)	SES – Dec 18, 2018	7.1	12.3
OTSG B-525 (Natural Gas)	NO_x (as NO_2)	SES/RATA – Feb 28, 2018	5.7	12.3
OTSG B-525 (Natural Gas)	NO_x (as NO_2)	SES/RATA – Dec 14, 2018	5.7	12.3
Glycol Heater H-721	NO_x (as NO_2)	SES – Mar 1, 2018	1.0	1.3

CEMS Performance Summary

- 2018 average Availability was greater than 90% for both systems.



Note: B-525 CEMS was certified in February 2018. 90% Availability requirement did not apply until March 2018.

Remediation and Reclamation Progress

- In Q1 of 2018 JACOS received Reclamation Certificates for five OSE programs. 15 former OSE sites were reassigned as MLLs, and reclamation initiatives are ongoing
- JACOS received 22 Reclamation Certificate for former control wells in Q2 of 2018
- In Q2 of 2018, JACOS received a Reclamation Certificate for the 13-13-84-11W4M former remote sump
- Fire break reclamation work was undertaken at select locations in 2018
- Vegetation management continued throughout the site
- Throughout 2018, JACOS maintained its involvement in iFROG (COSIA-JIP) and undertook Wetland Reclamation Research work on a JACOS disposition
- JACOS supported an upland reclamation research project (on existing JACOS dispositions) with the University of Waterloo

Japan Canada Oil Sands Limited

Environmental Issues, Compliance Statement, and Approvals

2018 Compliance Statement

JACOS is in compliance with all conditions of their approvals and regulatory requirements.

Self Disclosures

- April 19: Failure to install the required signage on wells (Pad 7)
- April 24: Process fluids were identified in the trench interstitial spaces of six buildings. JACOS worked throughout 2018 to test and repair the affected trenches and reported monthly updates to the AER Bonnyville Field Centre
- May 9: Missing tank inspection records for February, March, and April 2018

2018 Compliance Statement Summary (cont.)

Inactive Well Compliance Program (IWCP)

- Official program update is not released until March 31, but JACOS is compliant with the IWCP program quota

Program Year	Target Quota	Compliant Wells
1 (ending Mar 31, 2016)	7	12
2 (ending Mar 31, 2017)	5	6
3 (ending Mar 31, 2018)	5	13
4 (ending Mar 31, 2019)	1	1

2018 Applications and Approvals

- Application No. 00153105-004 (EPEA) to temporarily amend SO_2 emission limit from 2.0 to 3.0 tonnes/day until March 31, 2019. Application registered August 2, 2018
  - Approval No. 153105-00-03 issued September 13, 2018
- Application No. 1913325 - D56, Type D431, Facility NR - Tech for facility inlet sulphur rate amendment. Application registered September 13, 2018
  - Approval No. 45857 issued September 18, 2018
- Application No. 00153105-005 (EPEA) to extend temporary SO_2 emission increase until December 31, 2020. Application registered December 14, 2018
  - Approval pending processing of application

Future Plans – Compliance & Approvals (possible over next 1 – 2 year period)

- Application to increase approved duty of two glycol heaters (10 MW to 14 MW)
- Applications for WP 7, 8, and 10
- Application NCG Co-Injection
- Application for Highway Crossing (development east of Highway 63)
- Application for SA-SAGD Pilot

Demo Update

- Demo operations ceased June 2016
- Demo Asset Sale Agreement with Greenfire Hangingstone Operating Corporation was closed July 31, 2018
- AER approved the license transfer on August 3, 2018

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Appendices

Appendix 5.d.(v)

Average Injection Wellhead Pressure

Well	HE Phase 1 Average Injection Wellhead Pressures (kPa)											
	Jan-18	Feb-18	Mar-18	Apr-18	May-18	Jun-18	Jul-18	Aug-18	Sep-18	Oct-18	Nov-18	Dec-18
W01-01	4,818	4,813	4,661	3,730	3,834	4,500	4,623	4,602	4,149	4,176	3,659	3,520
W01-02	4,691	4,680	4,507	3,601	3,476	4,541	4,561	4,499	4,064	4,135	3,641	3,528
W01-03	4,714	4,721	4,578	3,787	3,691	4,519	4,504	4,460	4,181	4,246	3,689	3,552
W01-04	4,675	4,659	4,521	3,718	3,433	4,493	4,568	4,492	4,066	4,171	3,677	3,547
W01-05	4,786	4,756	4,615	3,670	3,543	4,527	4,525	4,514	4,115	4,199	3,712	3,553
W02-01	4,636	4,669	4,582	3,504	3,662	4,657	4,756	4,703	4,173	4,170	4,080	4,156
W02-02	4,700	4,700	4,618	3,816	3,364	4,580	4,638	4,609	4,133	4,146	4,107	4,054
W02-03	4,513	4,561	4,599	3,936	3,743	4,656	4,781	4,638	4,158	4,156	4,076	4,085
W02-04	4,724	4,775	4,775	3,932	3,663	4,612	4,678	4,608	4,170	4,131	4,132	4,083
W02-05	4,768	4,767	4,745	3,705	3,473	4,656	4,728	4,598	4,231	4,167	4,079	4,046
W02-06	4,618	4,772	4,759	3,970	3,702	4,365	4,432	4,560	3,872	4,254	4,329	4,373
W03-01	4,683	4,825	4,849	3,838	3,570	4,434	4,556	4,523	4,355	4,479	4,501	4,381
W03-02	4,620	4,698	4,813	3,954	3,804	4,463	4,380	4,344	4,252	4,471	4,502	4,517
W03-03	4,513	4,758	4,850	3,519	3,582	4,239	4,377	4,626	4,343	4,641	4,477	4,512
W04-01	4,422	4,679	4,347	3,405	3,309	4,632	4,776	4,683	4,181	4,306	4,184	4,222
W04-02	4,704	4,688	4,321	3,844	3,659	4,656	4,800	4,680	4,211	4,260	4,102	4,206
W04-03	4,695	4,758	4,740	3,773	3,336	4,627	4,802	4,710	4,137	4,191	4,206	4,201
W04-04	4,775	4,775	4,766	3,599	3,325	4,619	4,803	4,679	4,138	4,186	4,139	4,301
W04-05	4,734	4,750	4,731	3,463	3,280	4,504	4,683	4,685	4,087	4,188	4,296	4,322
W05-01	4,487	4,704	4,607	3,592	3,438	4,665	4,703	4,677	4,212	4,195	4,132	4,165
W05-02	4,495	4,636	4,677	3,658	3,803	4,542	4,751	4,743	4,448	4,420	4,371	4,268
W05-03	4,200	4,004	4,613	3,435	3,161	4,680	4,767	4,767	4,346	4,295	4,105	4,171
W05-04	1,994	3,578	4,464	3,625	3,547	4,535	4,481	4,486	3,733	4,012	4,010	4,101
W05-05	4,092	3,989	4,573	3,496	3,553	4,640	4,685	4,672	4,275	4,181	4,038	4,132
W05-06	4,611	4,735	4,734	3,536	2,900	4,573	4,660	4,684	4,324	4,286	4,173	4,251
W05-07	4,500	4,740	4,702	3,425	2,980	4,654	4,709	4,684	4,321	4,206	4,135	4,245
W05-08	4,650	4,737	4,694	3,624	3,110	4,642	4,656	4,700	4,329	4,201	4,078	4,207
W05-09	4,731	4,742	4,730	3,826	3,193	4,611	4,704	4,710	4,359	4,295	4,567	4,510
W06-01	4,753	4,712	4,691	3,739	3,613	4,537	4,489	4,220	3,964	4,142	4,334	4,125
W06-02	4,423	4,700	4,581	3,890	3,886	4,528	4,483	4,203	3,934	4,114	3,686	3,286
W06-03	4,838	4,819	4,809	4,141	3,677	4,388	4,497	4,222	3,963	4,126	3,695	3,332
W06-04	4,836	4,833	4,816	3,816	3,477	4,506	4,473	4,206	3,953	4,111	4,305	4,164

Assumption is 100% Steam Quality for Pads 1 through 6 * Steam Traps in all pads

Highlighted cells correspond to tubing pressure as there is not yet injection to the casing. The heel still had a gas blanket.

Average Injection Wellhead Temperature

Well	HE Phase 1 Average Injection Temperatures (°C)											
	Jan-18	Feb-18	Mar-18	Apr-18	May-18	Jun-18	Jul-18	Aug-18	Sep-18	Oct-18	Nov-18	Dec-18
W01-01	263	263	261	212	213	259	260	260	244	254	247	245
W01-02	261	261	259	209	214	259	260	259	244	254	247	245
W01-03	262	262	260	213	218	259	259	259	244	256	247	245
W01-04	261	261	259	213	218	259	260	259	244	255	247	245
W01-05	263	262	260	213	212	259	259	259	245	255	248	245
W02-01	260	261	260	206	214	261	262	261	248	254	253	254
W02-02	262	262	261	214	218	260	261	260	248	255	254	253
W02-03	259	260	260	214	219	261	263	260	248	254	253	253
W02-04	262	263	263	214	219	260	261	261	248	254	254	253
W02-05	262	262	262	218	220	261	262	260	250	254	253	252
W02-06	260	263	262	210	222	257	258	260	238	256	257	258
W03-01	261	263	263	195	216	258	260	260	252	259	259	258
W03-02	260	261	262	197	221	258	256	257	249	258	259	259
W03-03	259	262	263	197	220	258	257	261	251	261	259	259
W04-01	255	261	257	192	210	261	263	261	248	256	255	255
W04-02	262	262	257	193	210	261	263	262	250	256	254	255
W04-03	262	263	262	194	212	261	263	262	248	255	255	255
W04-04	262	262	262	194	213	260	263	261	248	255	254	256
W04-05	262	262	262	195	215	259	261	261	248	255	256	256
W05-01	259	262	260	201	186	261	262	261	248	255	254	254
W05-02	259	260	261	201	191	257	262	262	252	258	257	256
W05-03	255	252	261	202	185	261	262	262	250	256	253	254
W05-04	110	213	258	201	218	259	206	259	223	180	252	253
W05-05	254	252	261	200	207	261	262	261	250	255	253	254
W05-06	258	262	262	202	190	260	261	261	250	256	255	256
W05-07	244	230	243	172	181	231	241	261	249	254	253	255
W05-08	261	262	261	205	210	261	261	261	250	255	253	255
W05-09	262	262	262	205	211	260	262	262	252	256	260	259
W06-01	262	262	261	210	218	259	259	255	247	254	257	254
W06-02	258	262	260	208	220	260	259	255	246	254	248	239
W06-03	263	263	263	214	217	257	259	255	246	254	247	241
W06-04	263	263	263	215	218	259	258	255	247	254	256	254

Assumption is 100% Steam Quality for Pads 1 through 6 * Steam Traps in all pads

Highlighted cells correspond to tubing temperature as there is not yet injection to the casing.

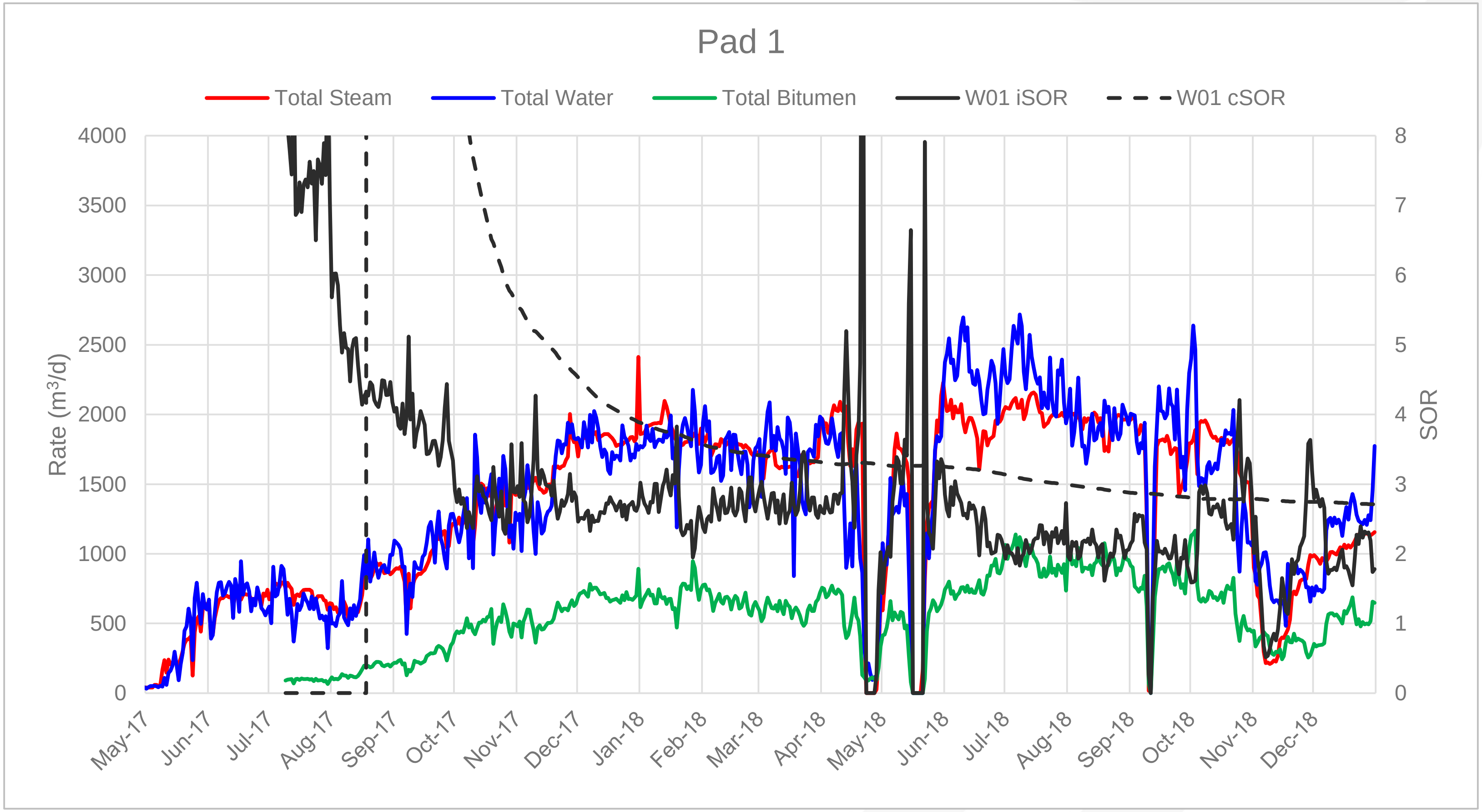
Monthly Well Pressures (Gas Blanket)

Well	HE Phase 1 Average Bottom Hole Pressure (kPa)											
	Jan-18	Feb-18	Mar-18	Apr-18	May-18	Jun-18	Jul-18	Aug-18	Sep-18	Oct-18	Nov-18	Dec-18
W01-01	4,814	4,775	4,629	4,526	4,171	4,448	4,578	4,555	4,293	4,126	3,664	3,516
W01-02	4,528	4,508	4,379	4,433	4,098	4,381	4,444	4,381	4,171	4,011	3,624	3,480
W01-03	4,628	4,617	4,452	4,411	3,984	4,335	4,403	4,356	4,190	4,102	3,663	3,492
W01-04	4,502	4,466	4,337	4,392	4,001	4,292	4,380	4,337	4,165	4,057	3,648	3,486
W01-05	4,679	4,638	4,531	4,438	4,025	4,350	4,377	4,370	4,238	4,060	3,701	3,524
W02-01	4,453	4,556	4,468	4,357	3,905	4,405	4,517	4,528	4,251	4,023	4,027	4,054
W02-02	4,593	4,624	4,555	4,426	3,941	4,387	4,457	4,433	4,216	4,010	4,026	4,012
W02-03	4,438	4,462	4,520	4,436	4,048	4,490	4,611	4,543	4,273	4,092	4,071	4,059
W02-04	4,664	4,759	4,757	4,456	4,164	4,564	4,673	4,605	4,349	4,126	4,126	4,053
W02-05	4,751	4,750	4,704	4,553	4,105	4,580	4,648	4,529	4,348	4,129	4,060	4,007
W02-06	4,619	4,245	4,754	4,501	4,332	4,369	4,444	4,576	4,175	4,263	4,341	4,387
W03-01	4,683	4,825	4,849	4,321	4,124	4,450	4,575	4,546	4,480	4,498	4,522	4,392
W03-02	4,620	4,698	4,813	4,531	4,343	4,478	4,368	4,360	4,399	4,486	4,517	4,539
W03-03	4,513	4,758	4,850	4,343	4,145	4,394	4,489	4,621	4,505	4,637	4,475	4,508
W04-01	4,380	4,675	4,301	4,269	3,981	4,520	4,676	4,581	4,244	4,124	4,063	4,017
W04-02	4,635	4,602	4,363	4,408	4,004	4,552	4,727	4,639	4,317	4,196	4,059	4,114
W04-03	4,576	4,707	4,679	4,398	3,941	4,461	4,690	4,630	4,282	4,134	4,143	4,198
W04-04	4,741	4,746	4,738	4,490	3,902	4,490	4,738	4,628	4,274	4,142	4,108	4,300
W04-05	4,663	4,729	4,683	4,250	3,968	4,413	4,572	4,564	4,140	4,057	4,152	4,216
W05-01	4,487	4,620	4,480	4,132	3,830	4,416	4,490	4,485	4,250	4,026	4,006	4,039
W05-02	4,495	4,604	4,635	4,277	4,235	4,470	4,678	4,676	4,579	4,391	4,348	4,250
W05-03	4,200	4,004	4,613	4,292	4,354	4,621	4,698	4,692	4,458	4,216	4,051	4,107
W05-04	1,994	3,578	4,464	4,258	4,237	4,511	4,469	4,457	4,209	3,977	3,963	4,040
W05-05	4,092	3,989	4,573	4,208	4,094	4,502	4,545	4,568	4,388	4,105	3,998	4,103
W05-06	4,611	4,735	4,718	4,240	3,316	4,438	4,528	4,526	4,411	4,183	4,135	4,238
W05-07	4,500	4,740	4,622	4,272	3,614	4,501	4,616	4,604	4,410	4,113	4,085	4,196
W05-08	4,578	4,694	4,647	4,394	3,676	4,497	4,526	4,565	4,405	4,113	4,028	4,149
W05-09	3,884	4,696	4,704	4,224	3,703	4,563	4,673	4,675	4,479	4,245	4,525	4,488
W06-01	4,753	978	4,436	4,523	4,292	4,530	4,484	4,216	4,123	4,142	4,290	4,112
W06-02	4,423	4,700	4,587	4,415	4,346	4,538	4,499	4,213	4,117	4,131	3,719	3,313
W06-03	4,819	4,802	4,793	4,645	4,233	4,341	4,472	4,192	4,086	4,092	3,690	3,318
W06-04	4,830	4,833	4,813	4,639	4,176	4,456	4,451	4,185	4,080	4,083	4,282	4,167

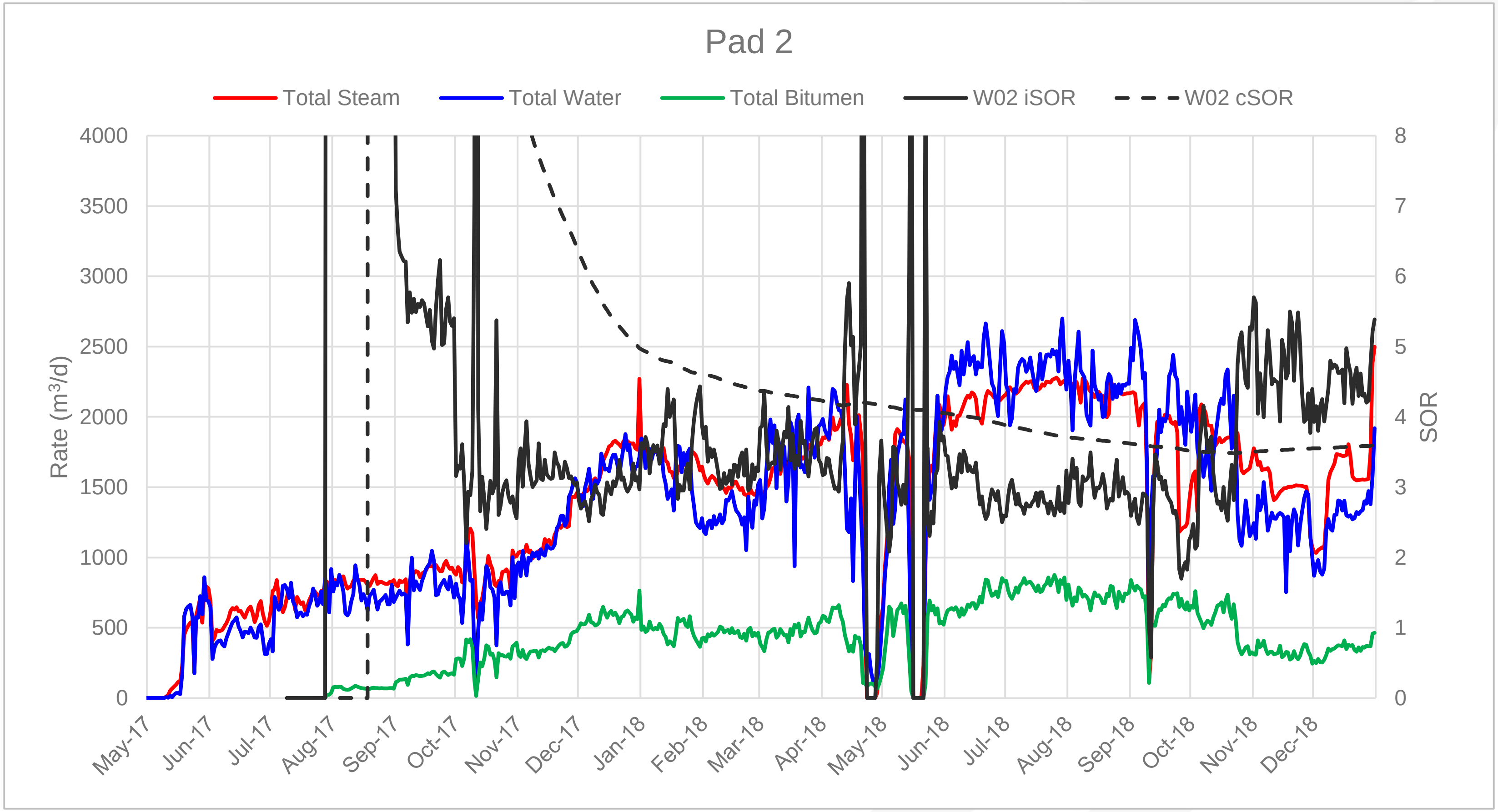
Highlighted cells indicates gas blanket it taken from the 8 5/8”. Following circulation, when 8 5/8" is used for steam injection, BHP is taken from the 11 3/4" string.

Appendix 7(h)

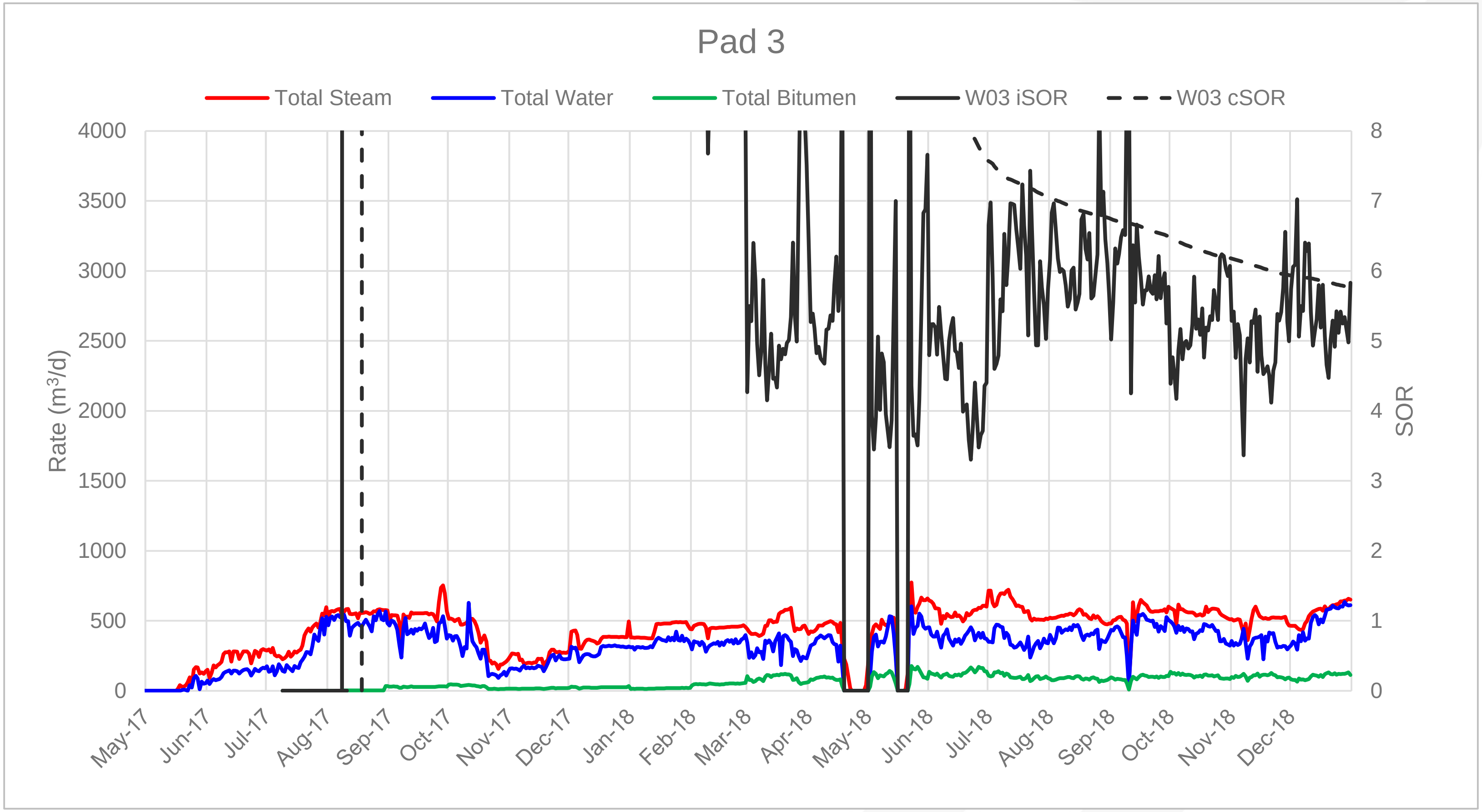
HE Phase 1 Pad Basis Performance – Pad 1



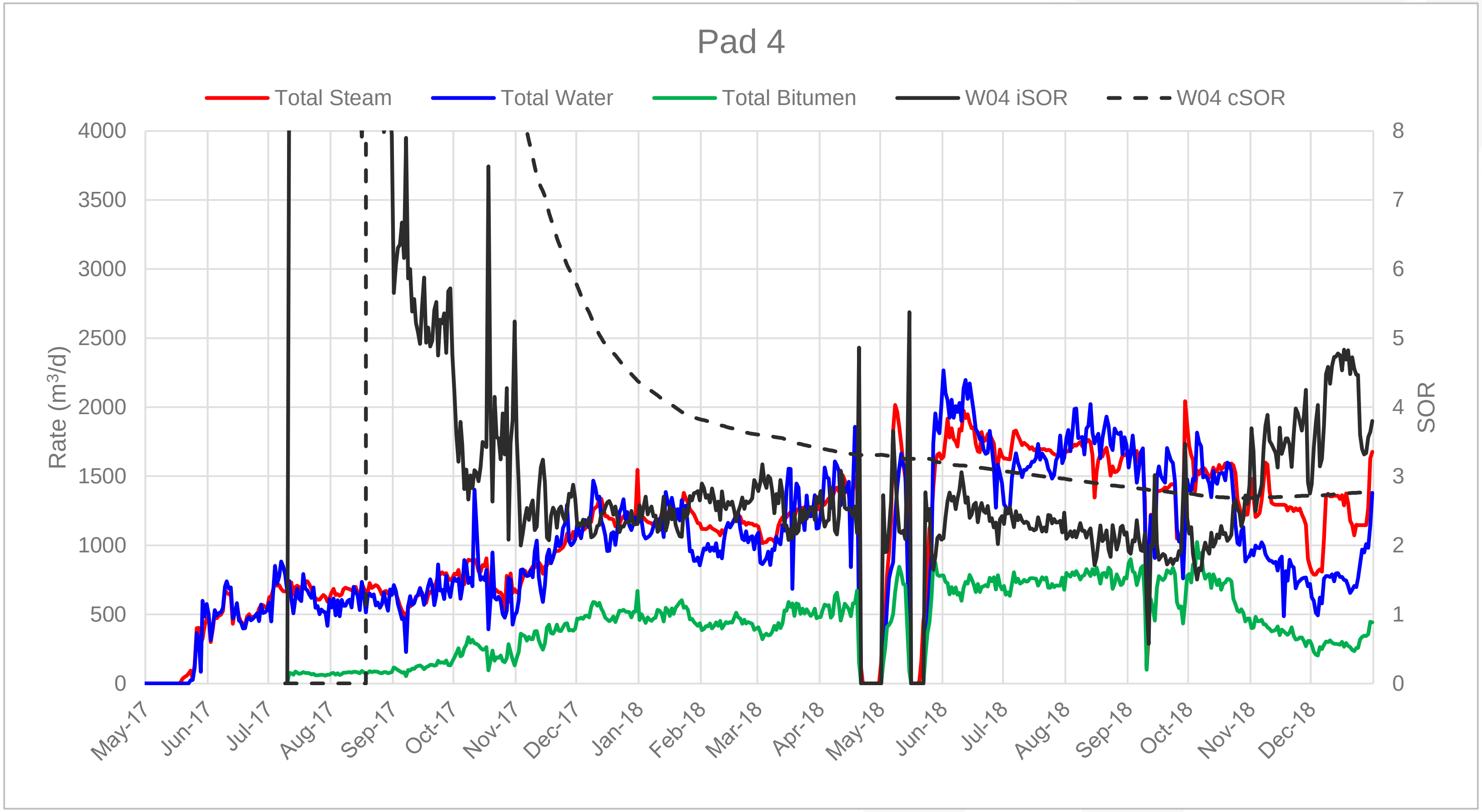
HE Phase 1 Pad Basis Performance – Pad 2



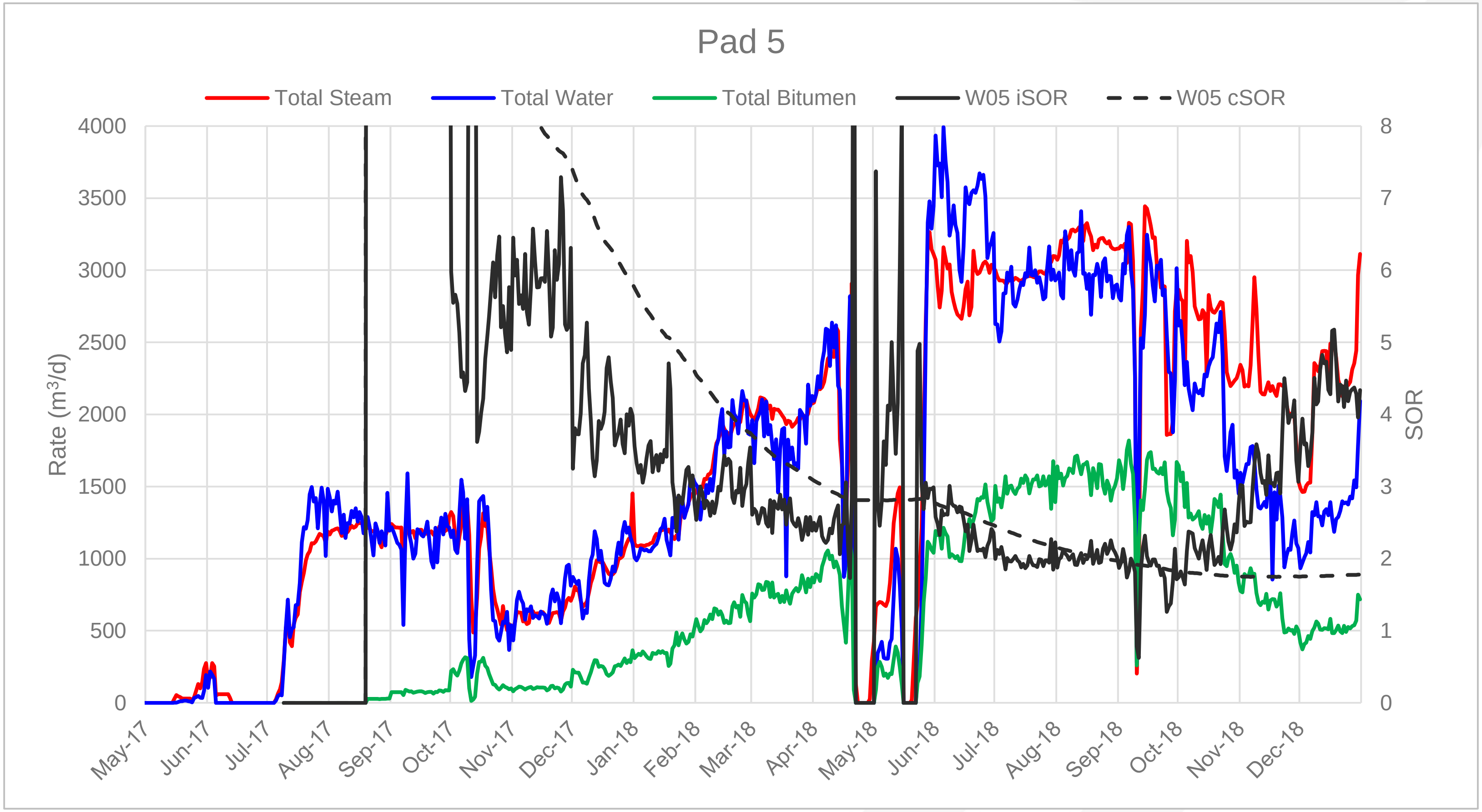
HE Phase 1 Pad Basis Performance – Pad 3



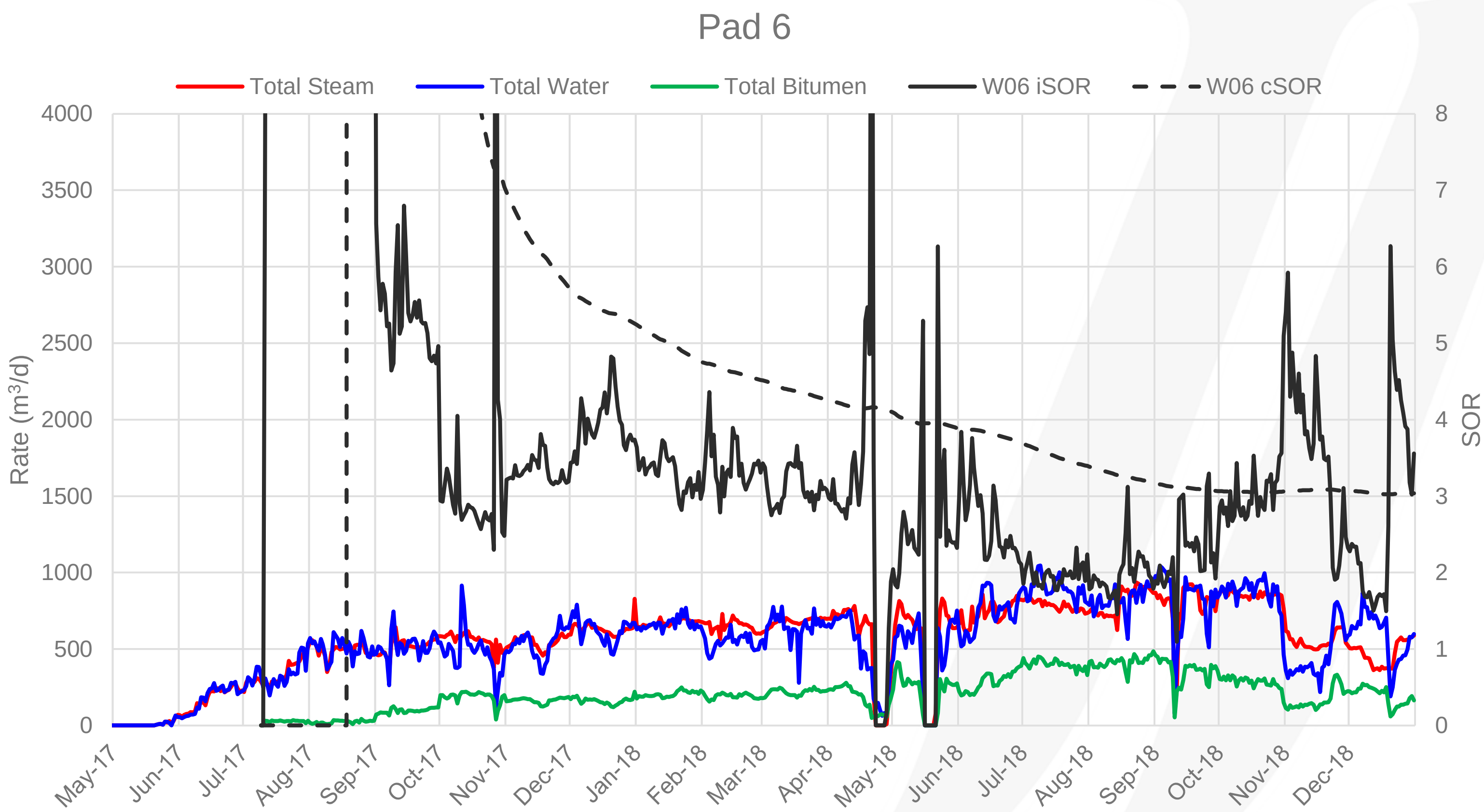
HE Phase 1 Pad Basis Performance – Pad 4



HE Phase 1 Pad Basis Performance – Pad 5

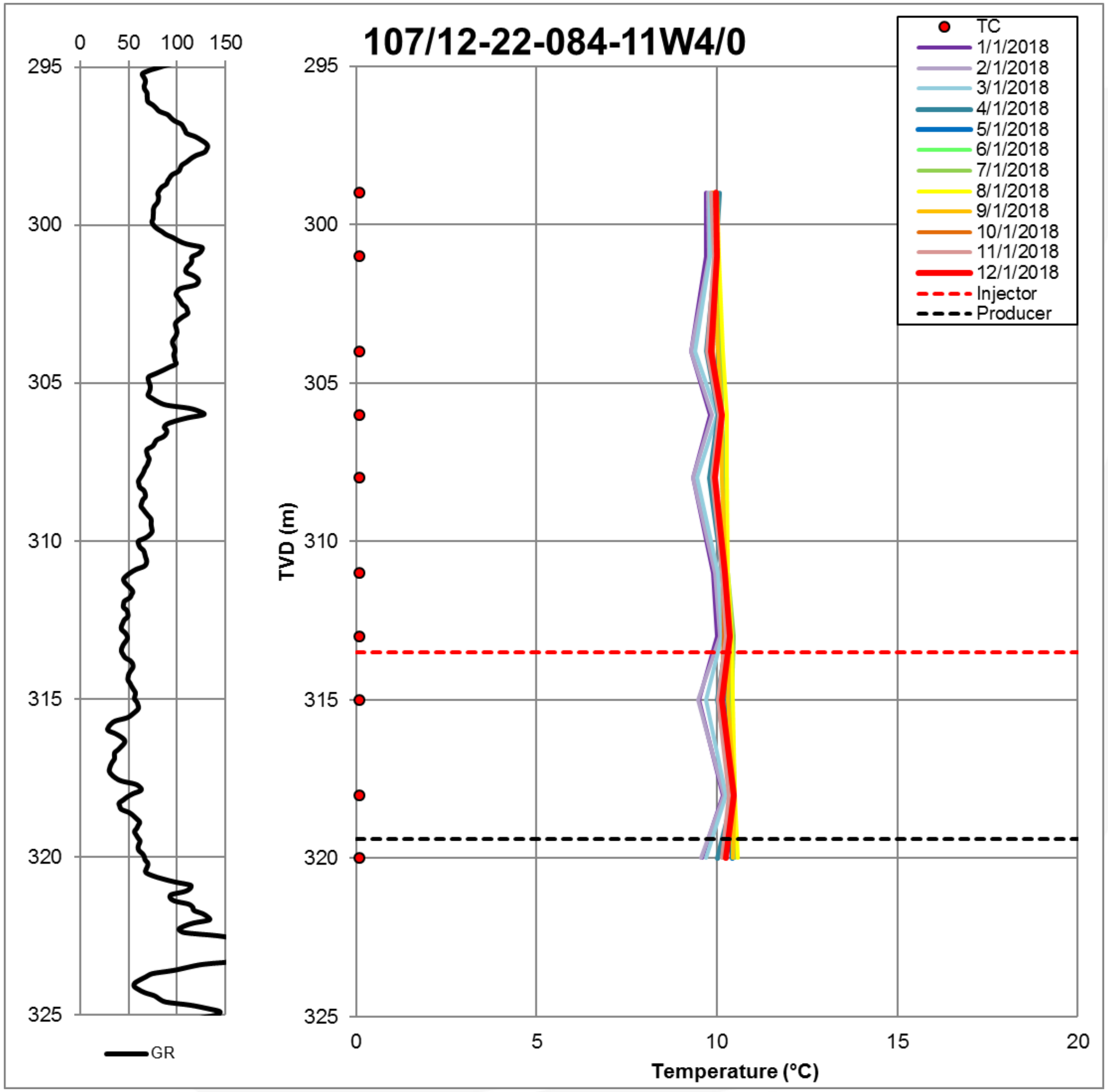


HE Phase 1 Pad Basis Performance – Pad 6



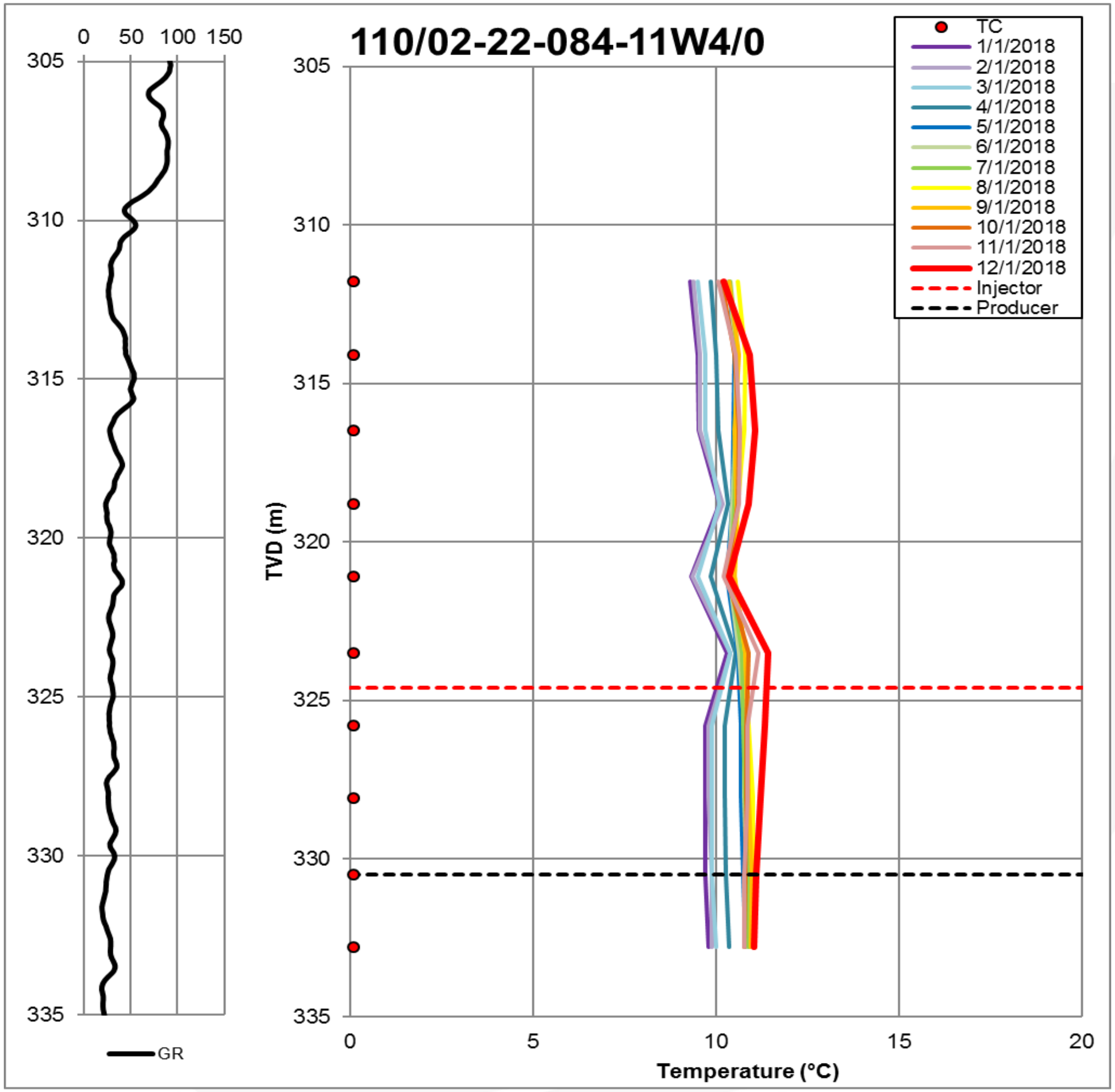
Appendix 5(b)

HE Phase 1 Observation Wells

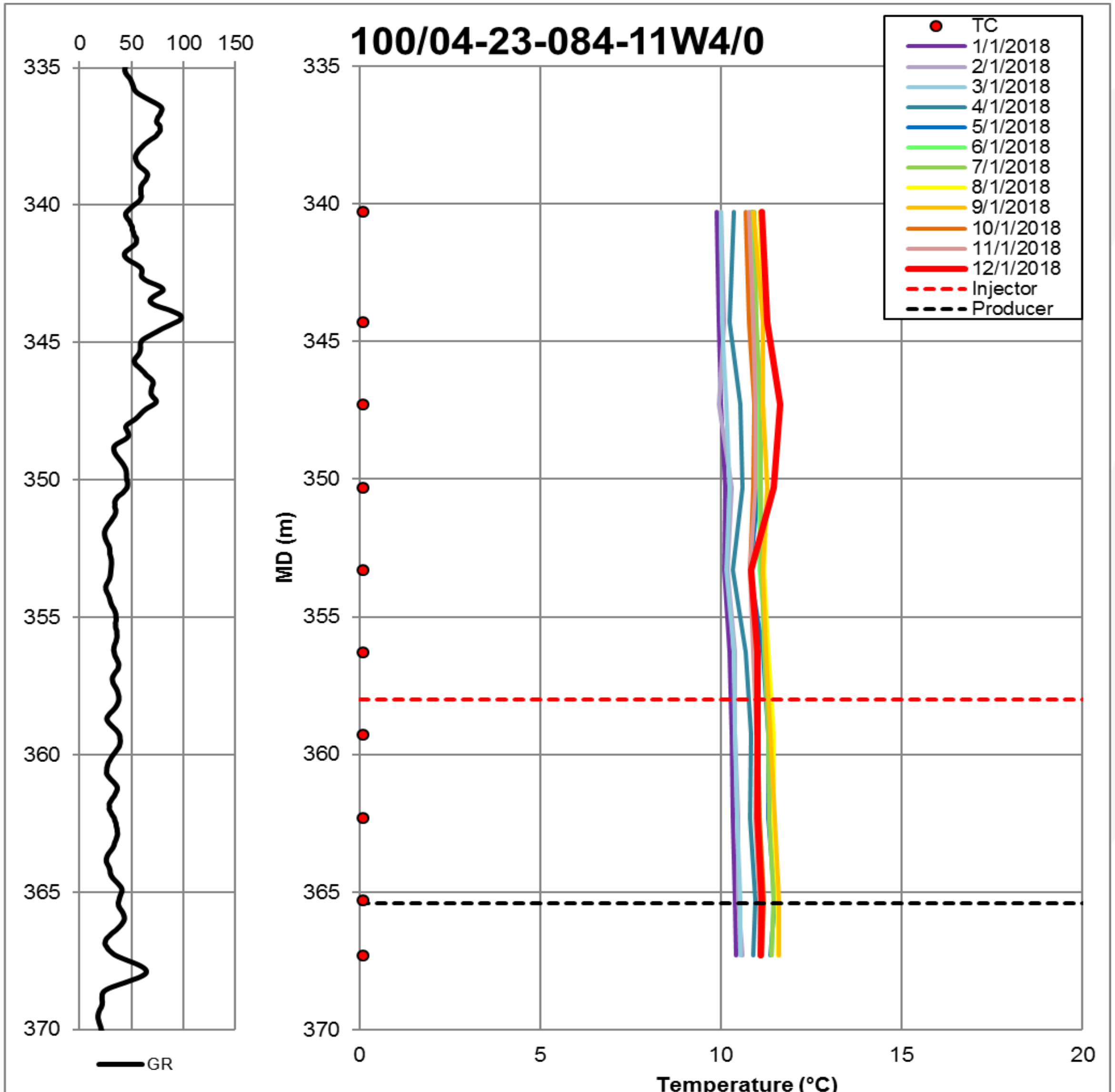


Vision. Integrity. Stability.

HE Phase 1 Observation Wells



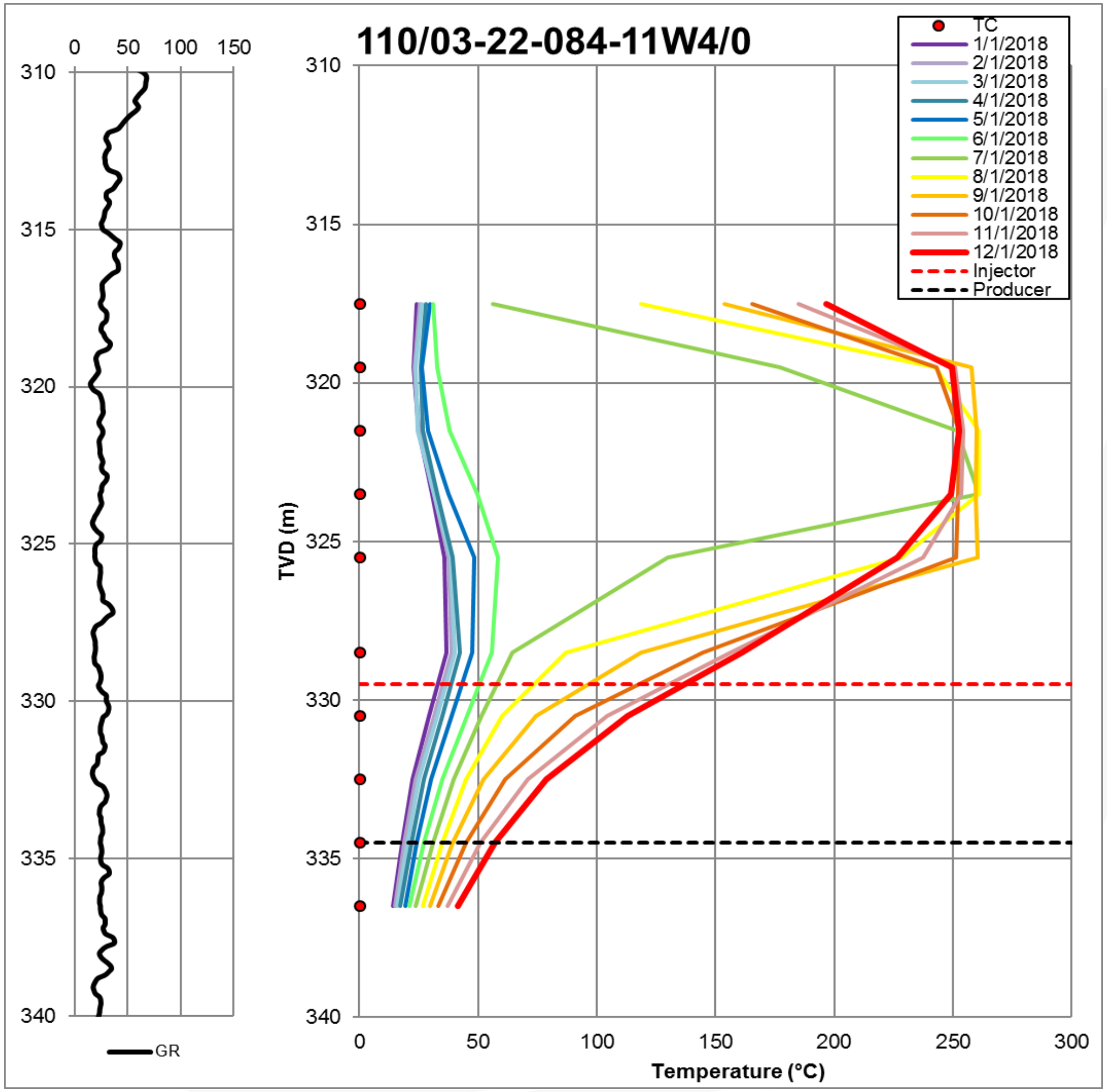
HE Phase 1 Observation Wells



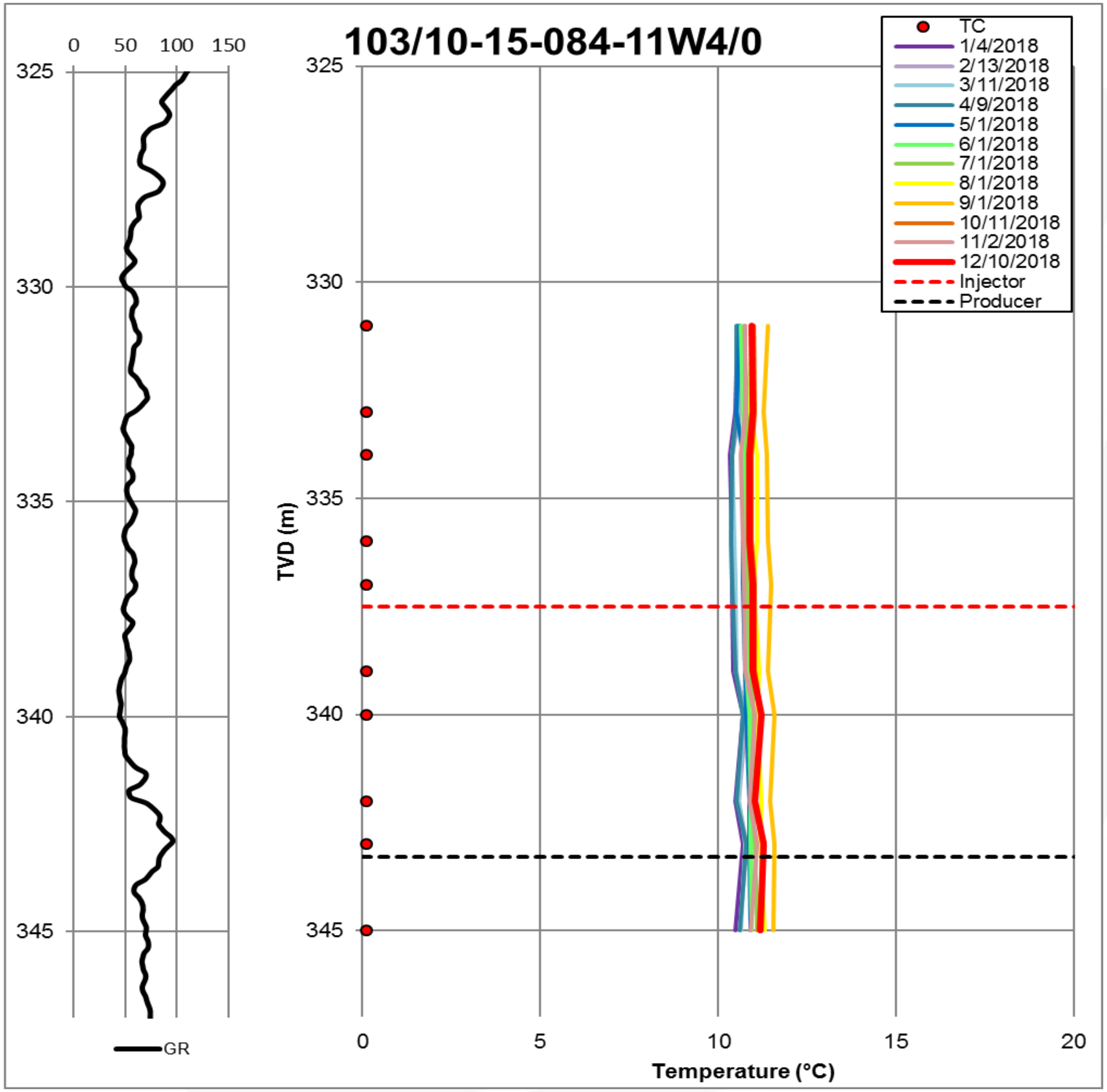
*Well is deviated. MD shown.

Vision. Integrity. Stability.

HE Phase 1 Observation Wells

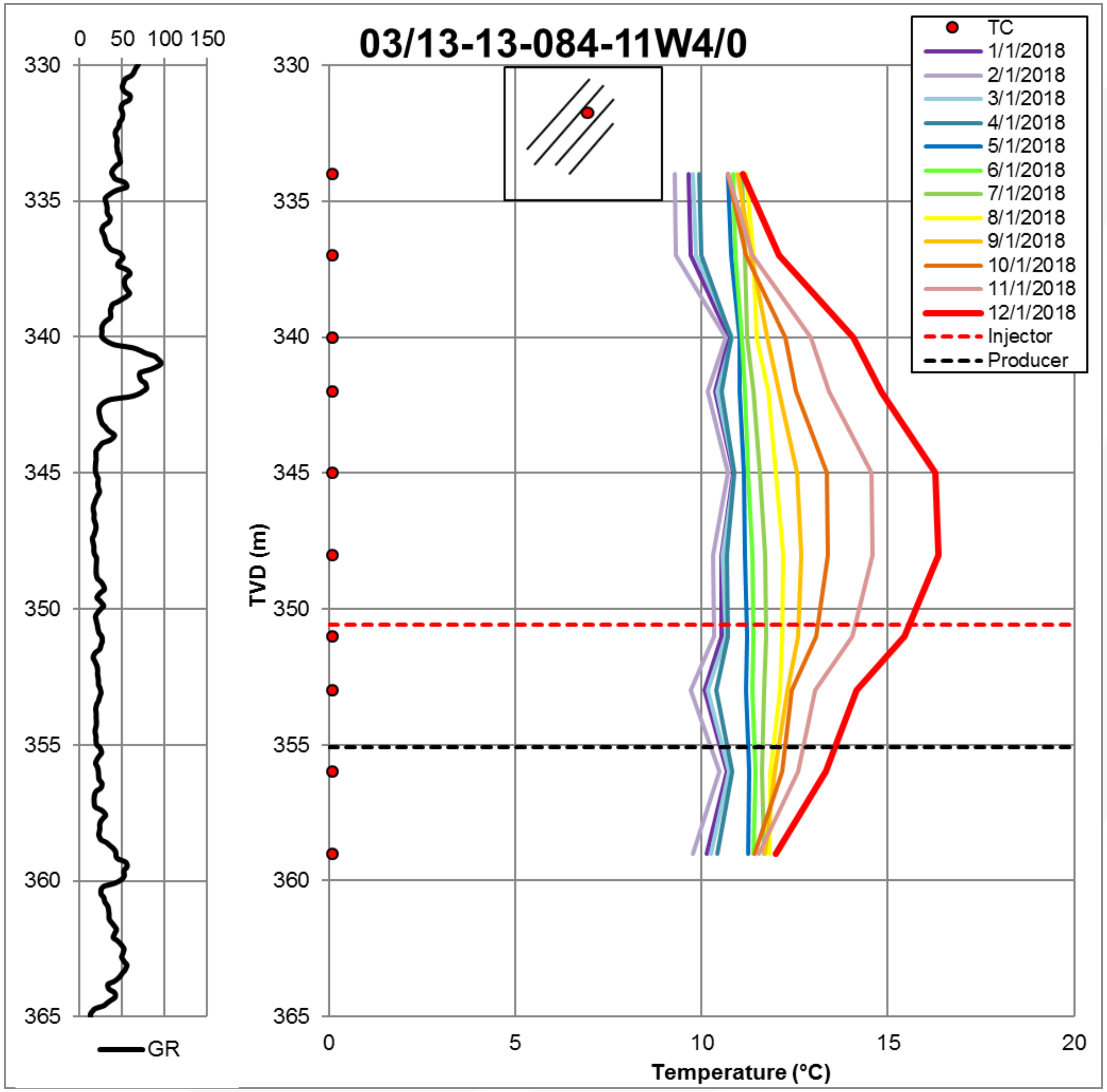


HE Phase 1 Observation Wells



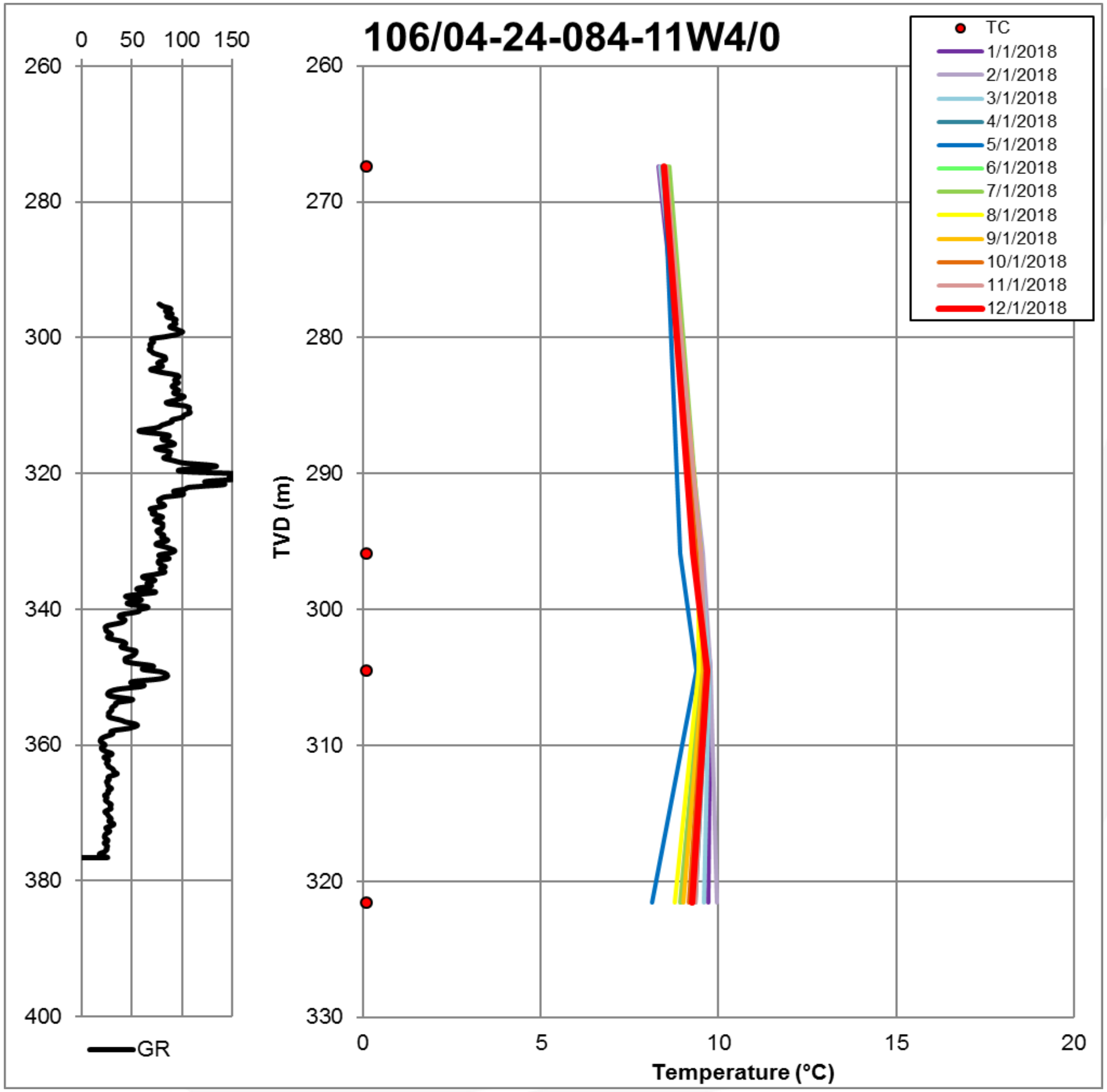
RTU issues on the first of the month for all months except May, June, July, August and September.

HE Phase 1 Observation Wells

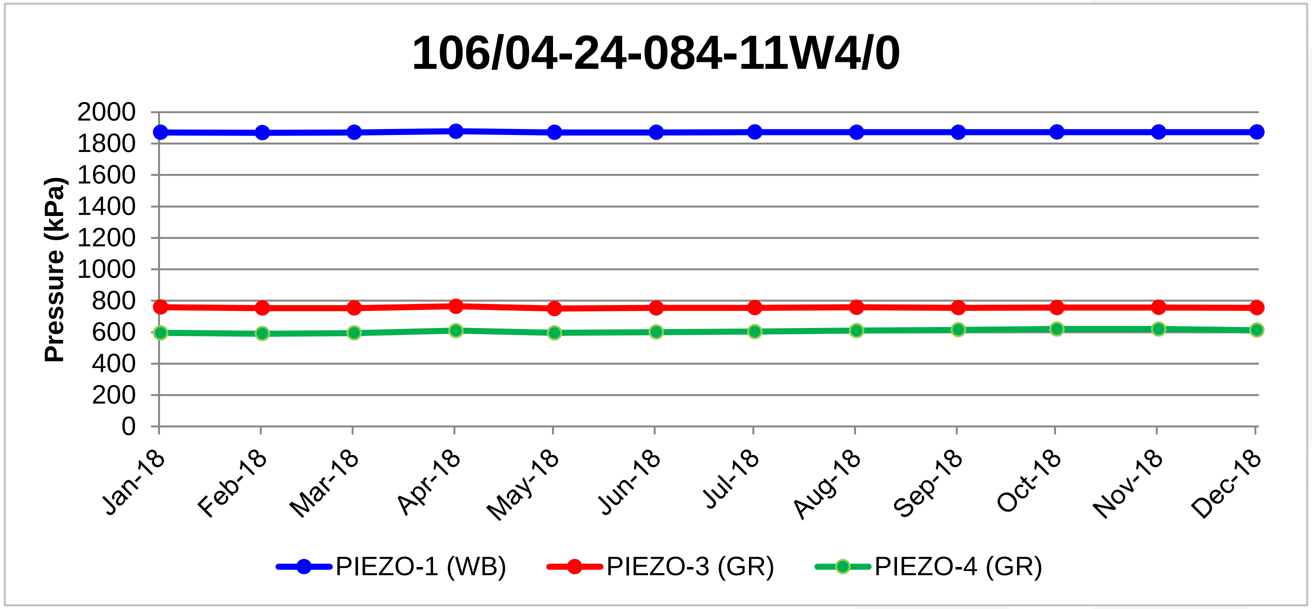


JACOS Japan Canada Oil Sands Limited

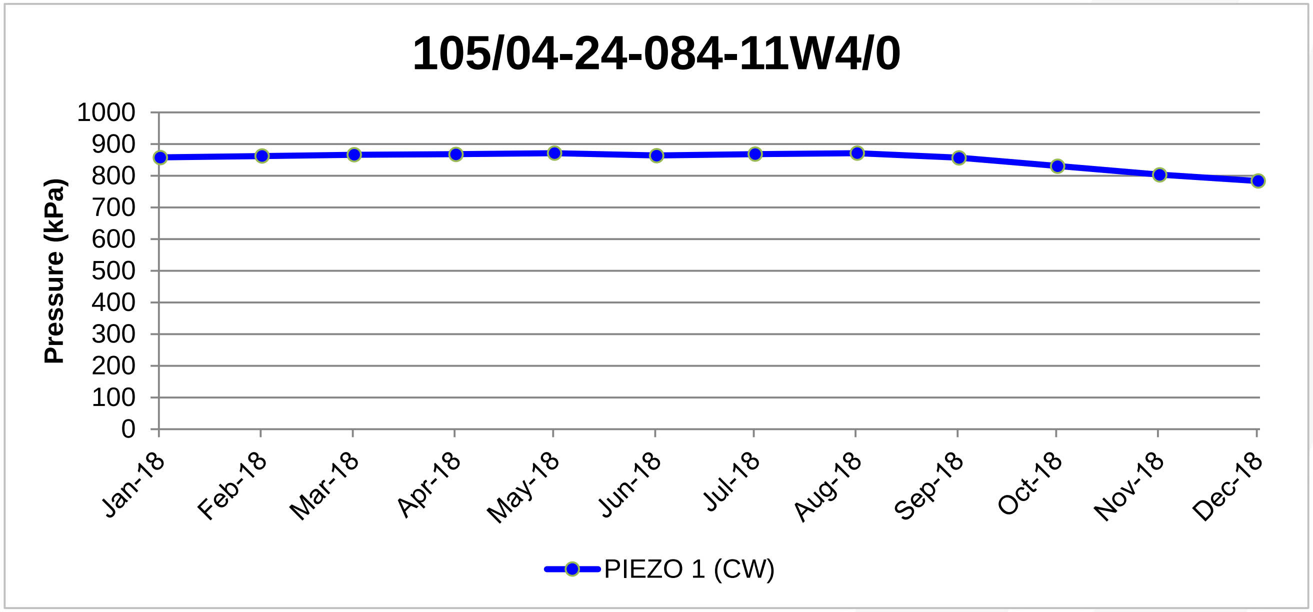
HE Phase 1 Observation Wells



HE Phase 1 Observation Wells

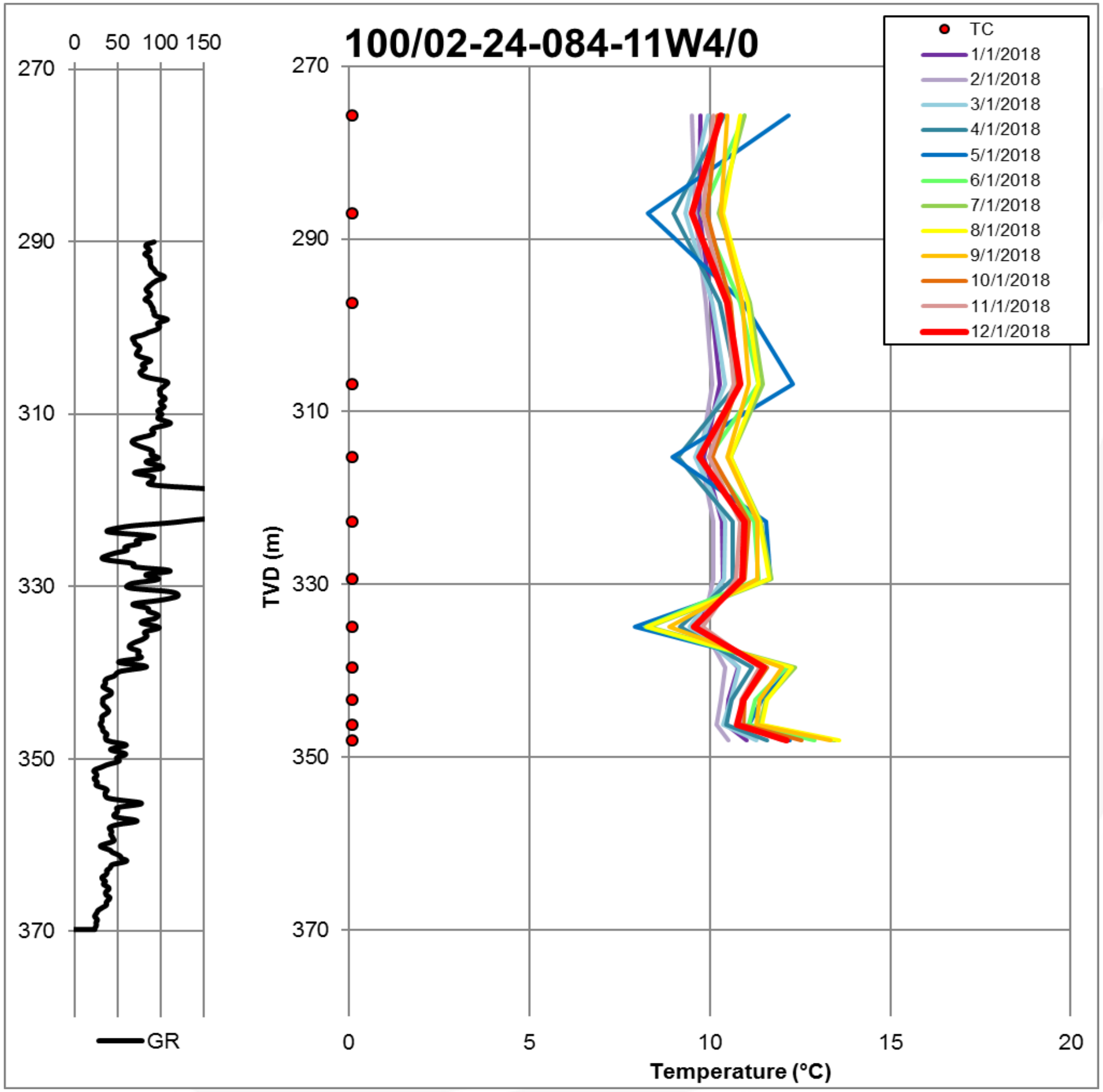


HE Phase 1 Observation Wells

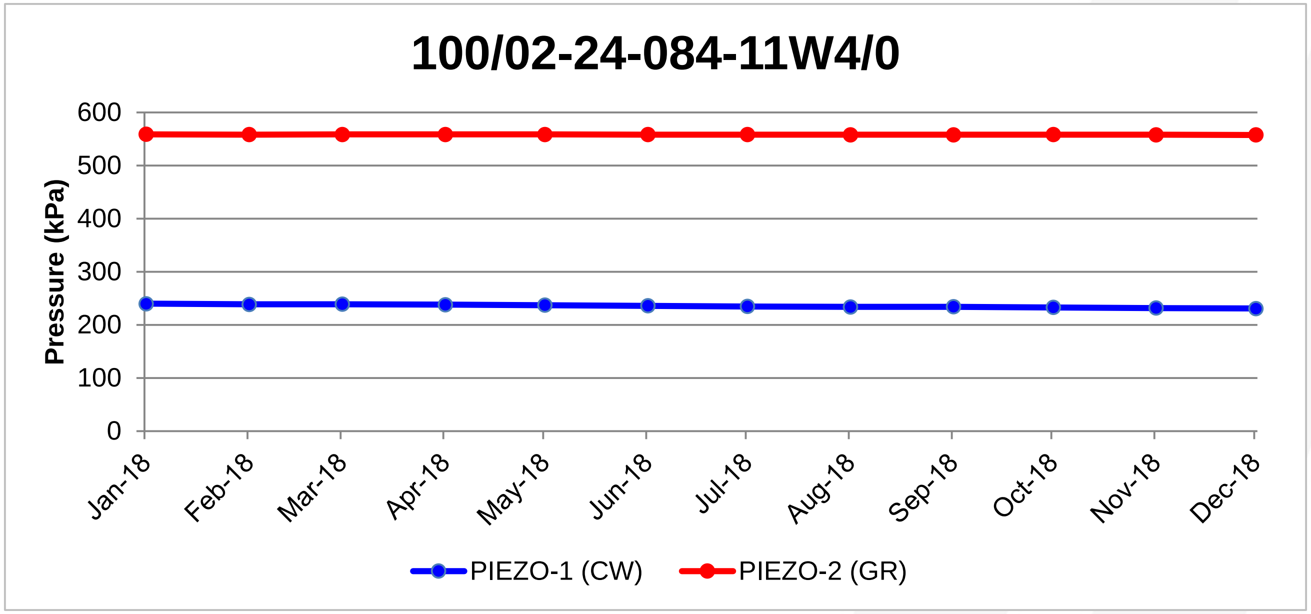


Well is deviated and has a hanging piezometer. Depth matches GR, but measures CW.

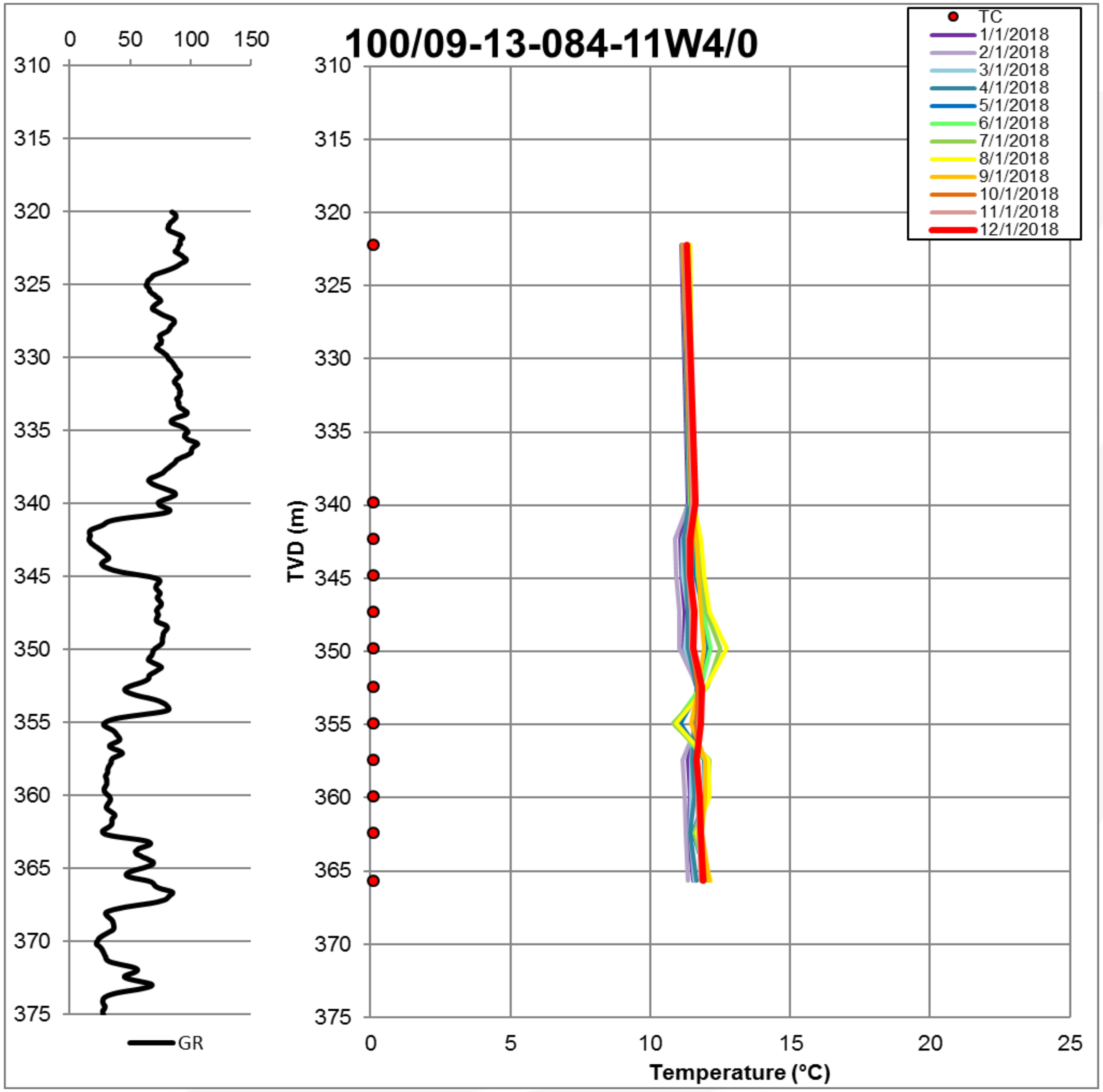
HE Phase 1 Observation Wells



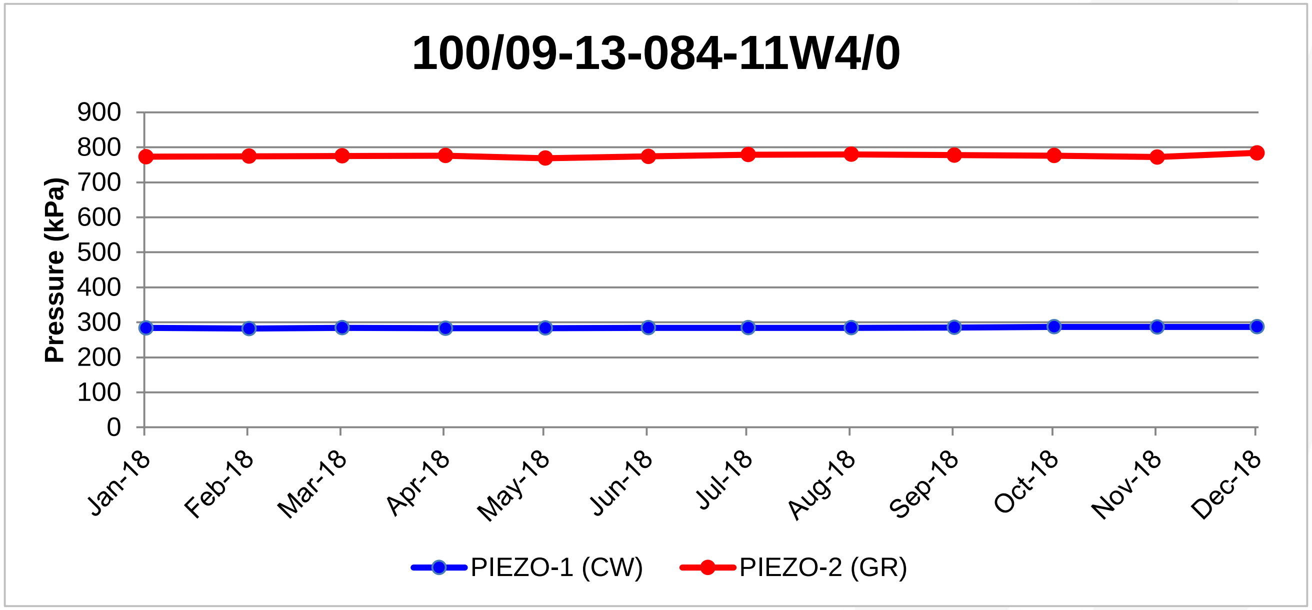
HE Phase 1 Observation Wells



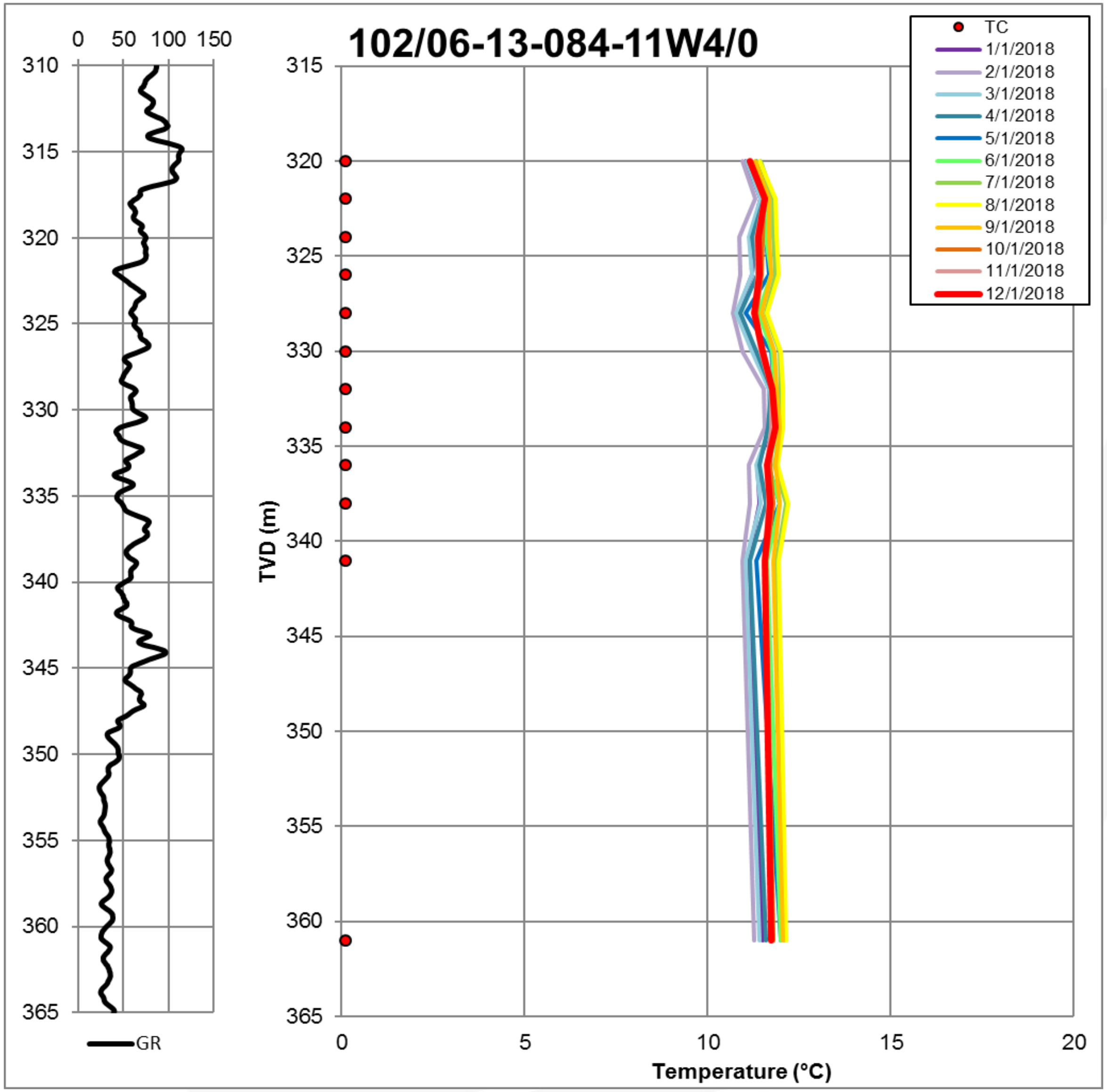
HE Phase 1 Observation Wells



HE Phase 1 Observation Wells



HE Phase 1 Observation Wells



HE Phase 1 Observation Wells