JACOS
Japan Canada Oil Sands Limited

Thermal In-Situ Scheme Progress Report for 2017
Japan Canada Oil Sands Limited Hangingstone

Approval No. 11910 (Expansion Project)

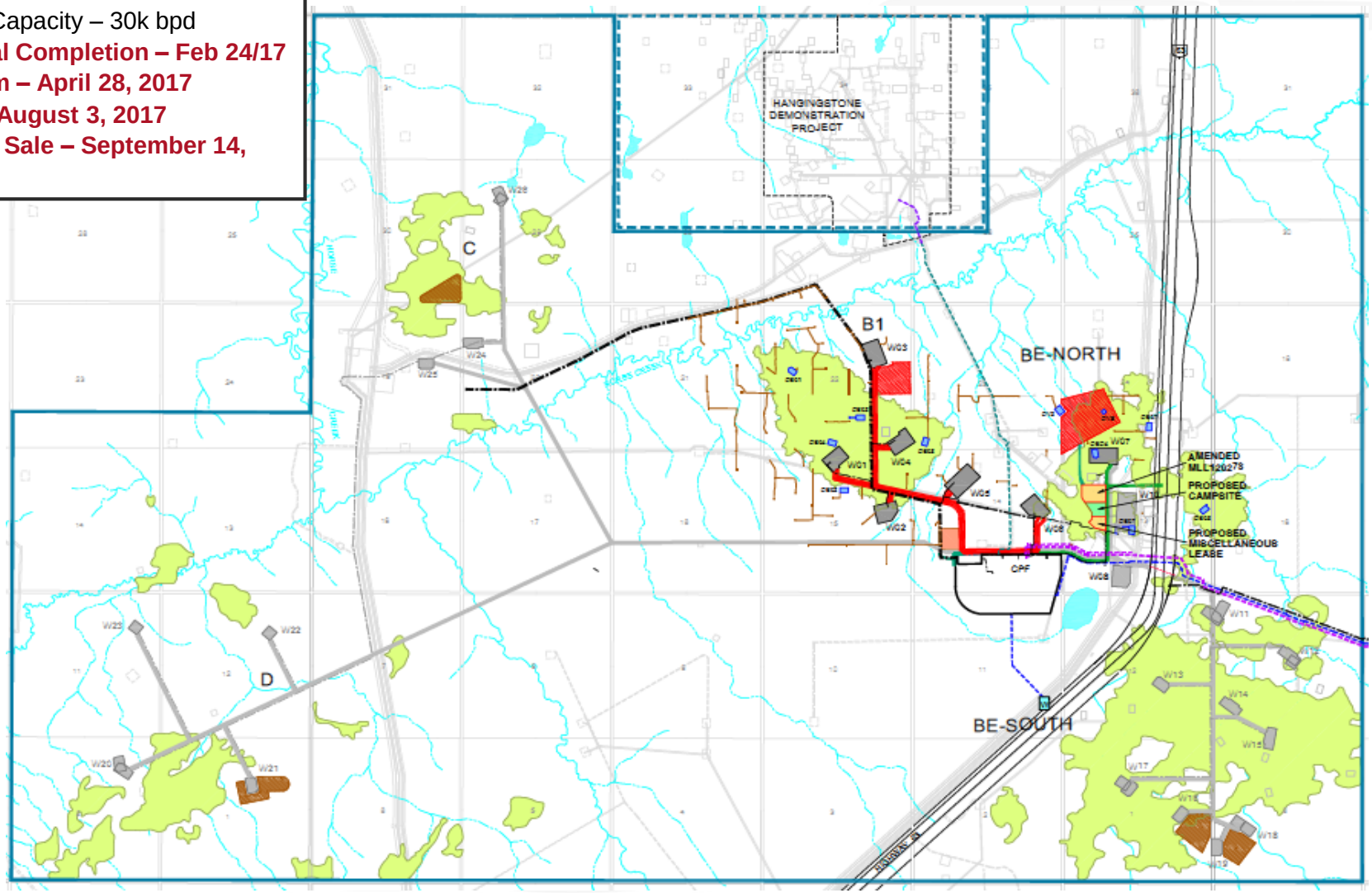
Presented on February 28, 2018

Agenda

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

- Scheme Approval: 11910 – Nov/12
- EPEA Approval: 153105 – Jan/13
- Approved Capacity – 30k bpd
- **Mechanical Completion – Feb 24/17**
- **First Steam – April 28, 2017**
- **First Oil – August 3, 2017**
- **First Dilbit Sale – September 14, 2017**



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Subsurface

Geosciences

Net Pay

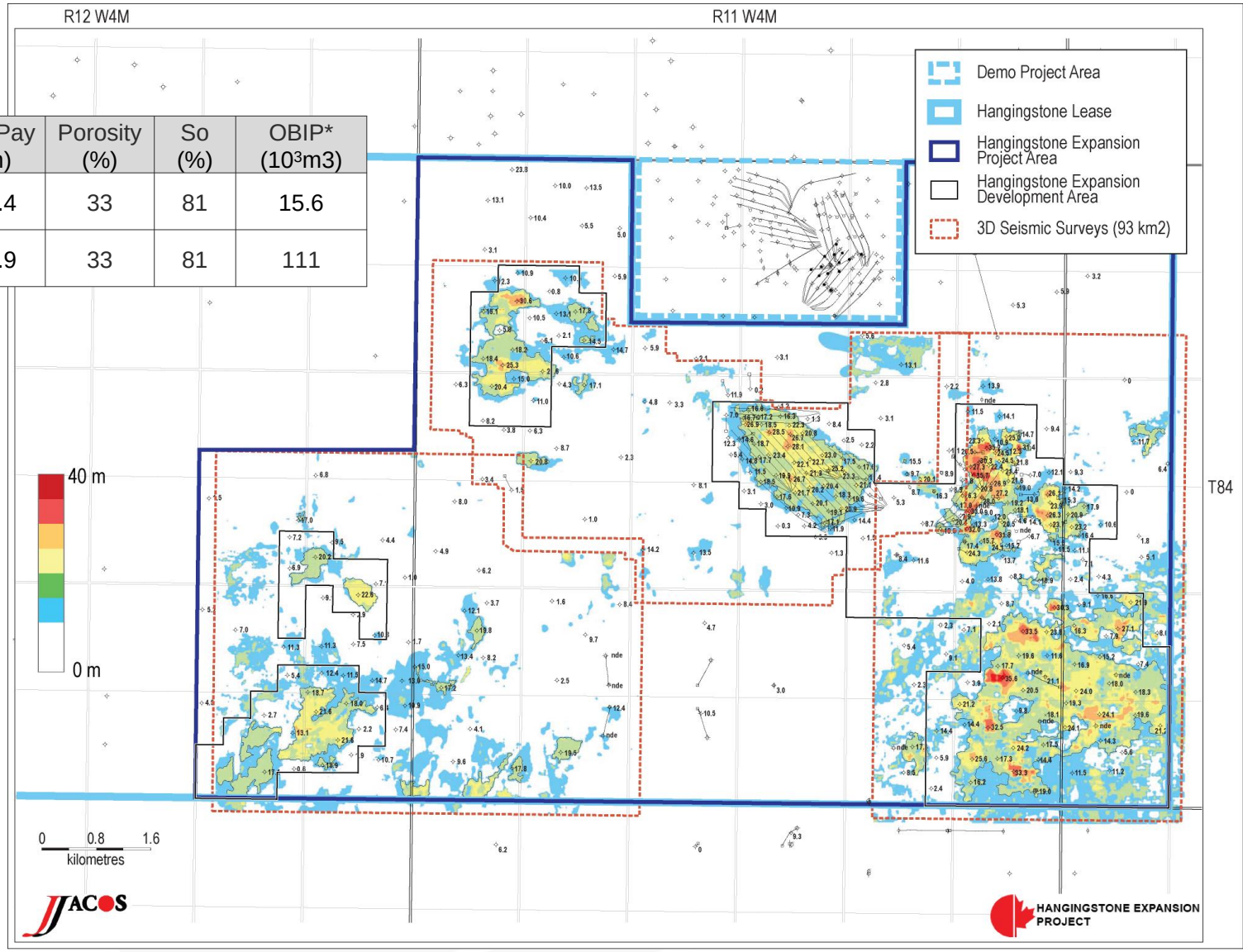
	Area (km²)	Net Pay (m)	Porosity (%)	So (%)	OBIP* (10³m3)
Operating Area	2.6	22.4	33	81	15.6
Approval Area	100.4	16.9	33	81	111

*10m net pay cutoff

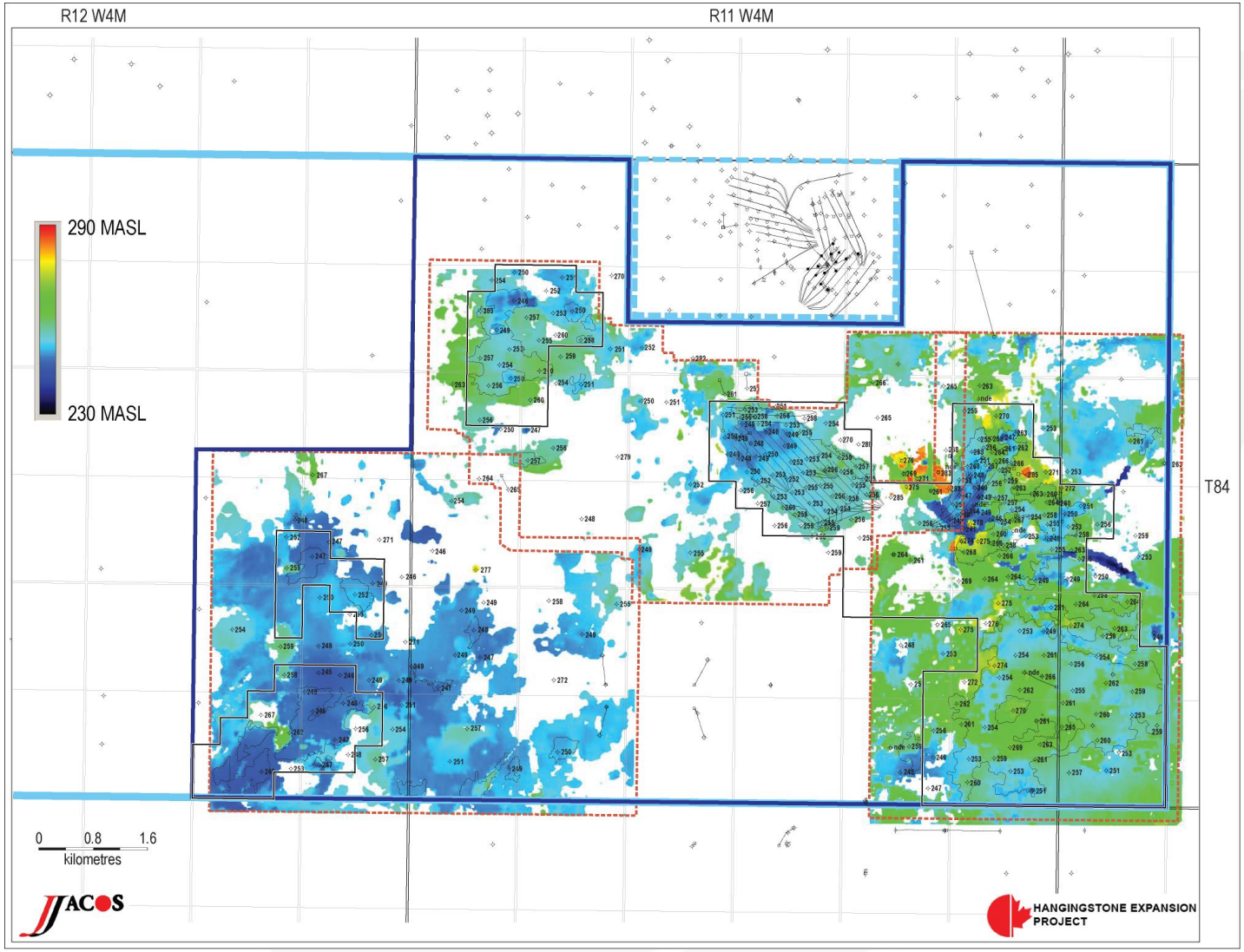
OBIP = RV * Por * So * FVF

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

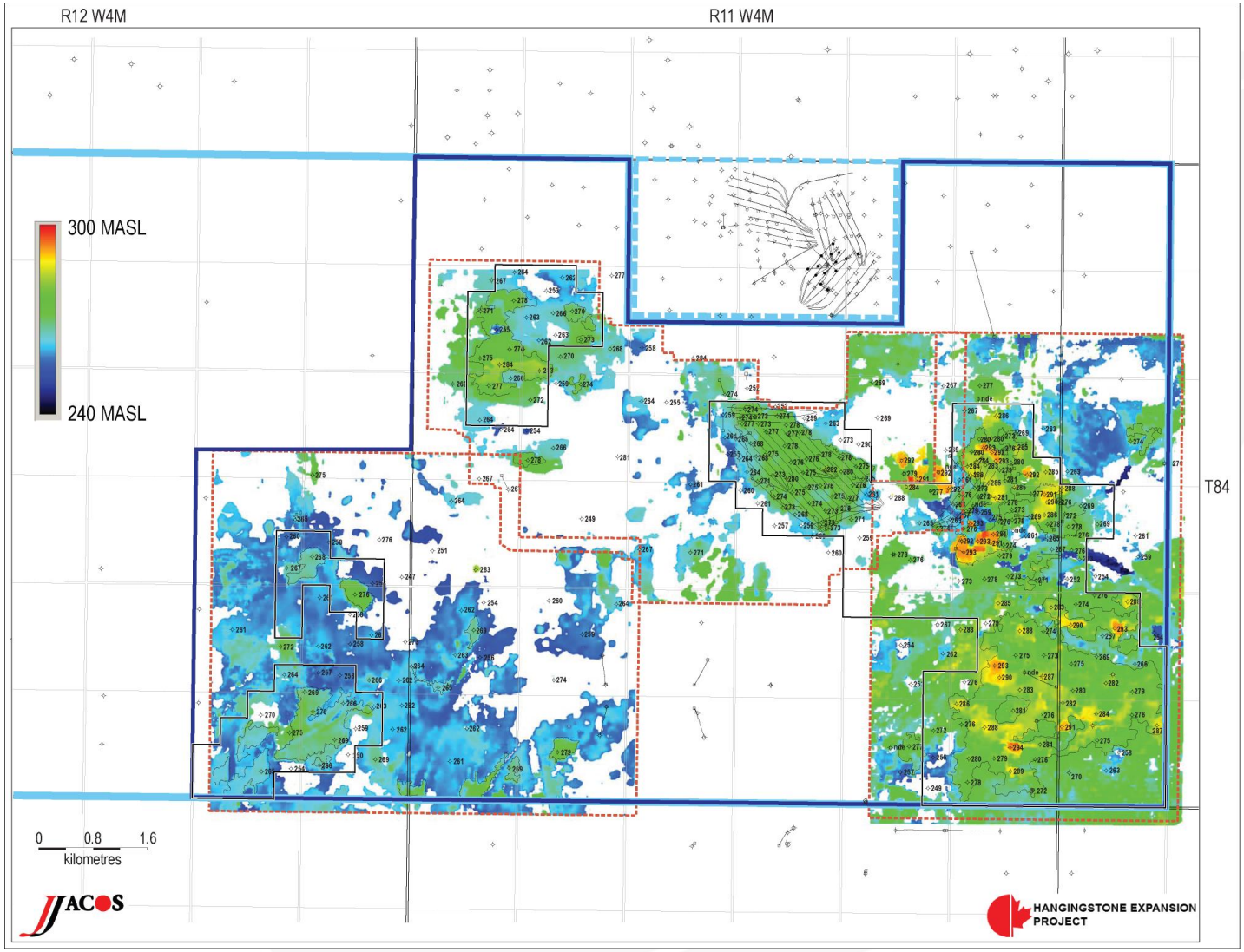
Avg. Kv: 4050 mD
Avg. Kh: 5800 mD
Avg. Depth: 340 m



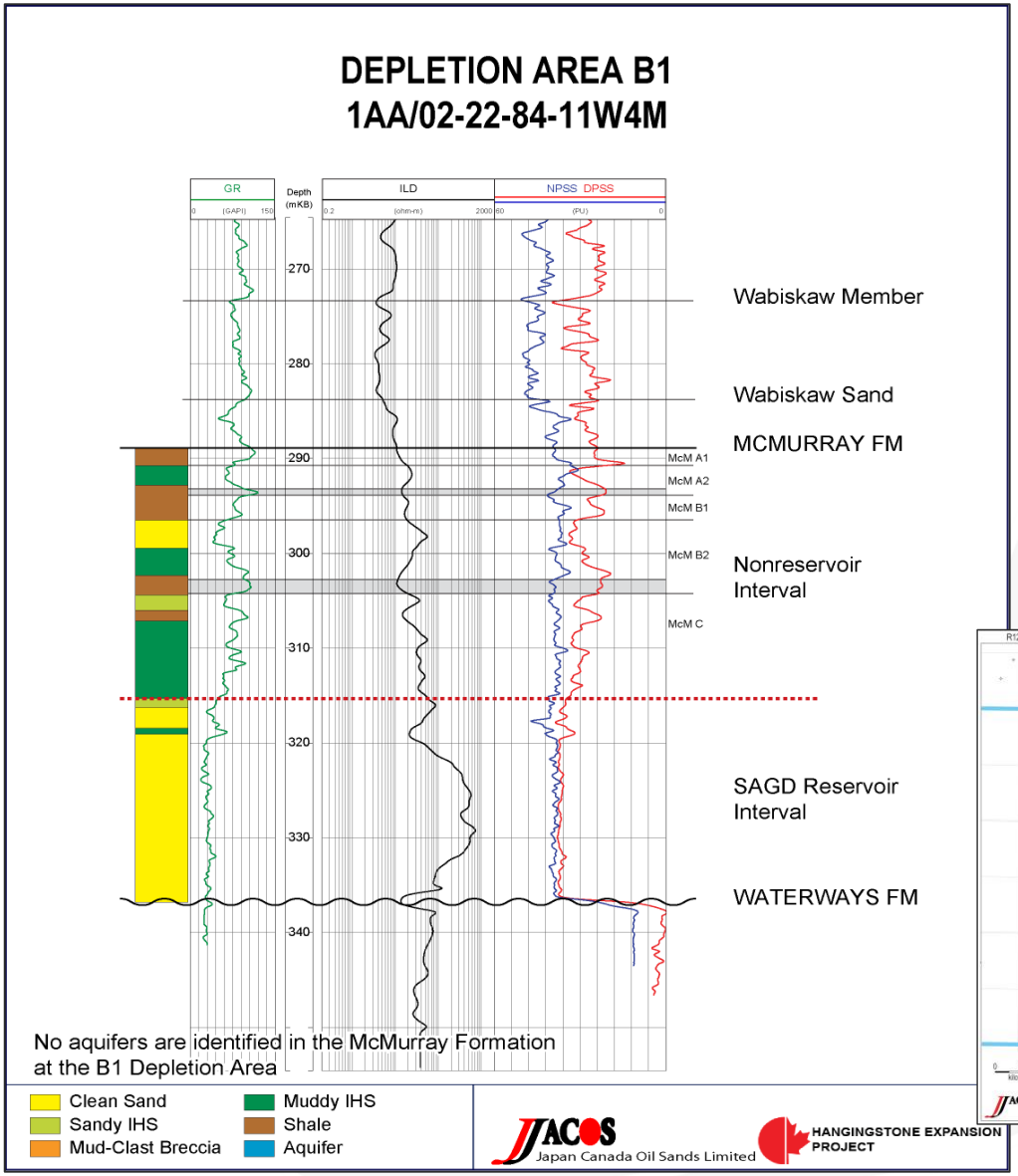
Base Reservoir Structure



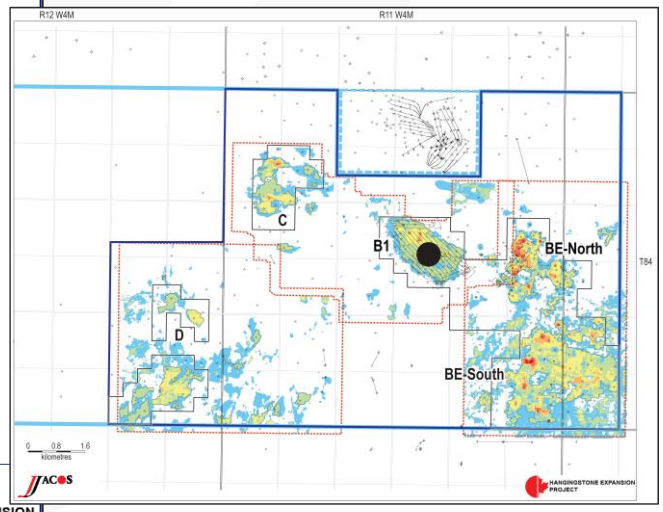
Top Reservoir Structure



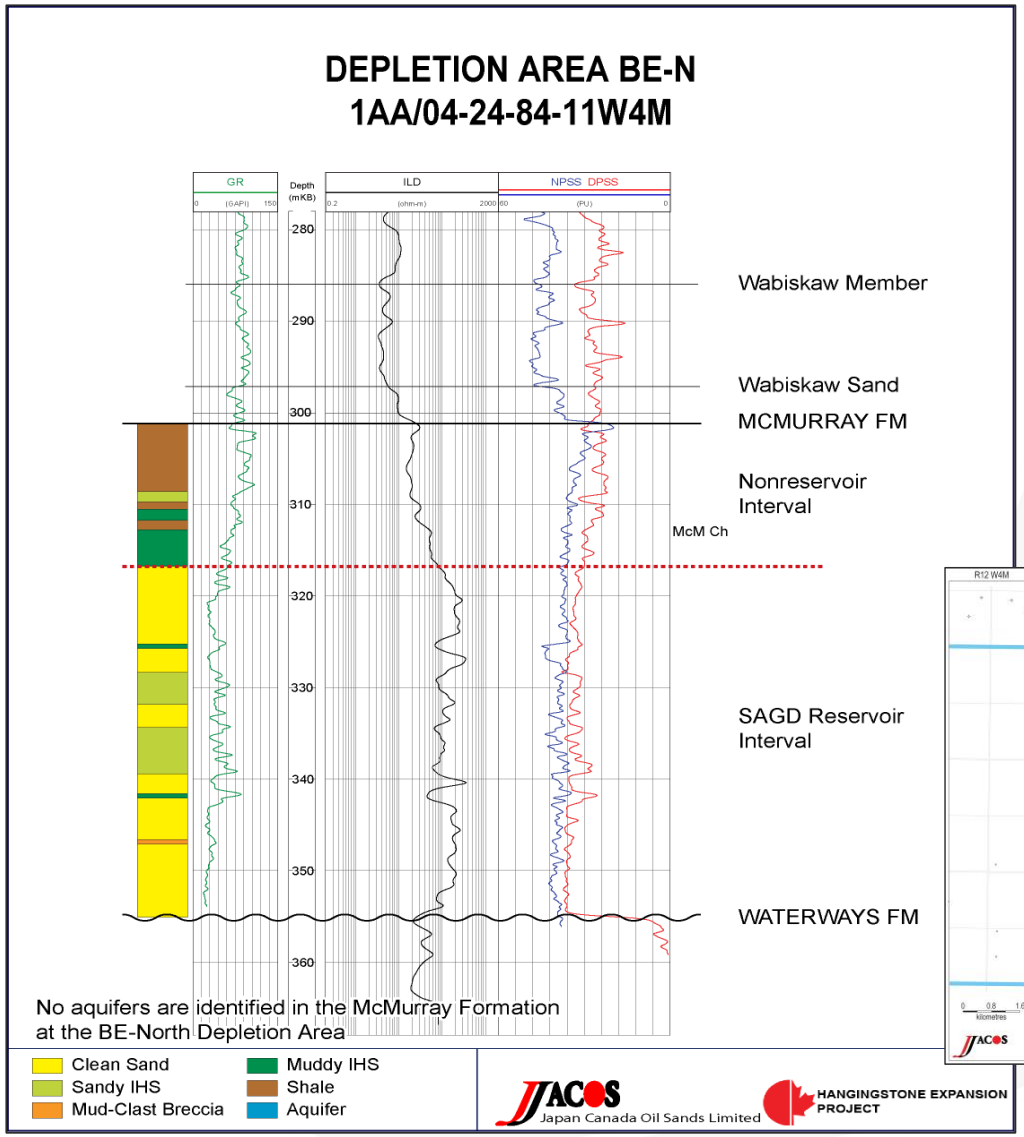
Hangingstone Expansion Composite Well B1 Area



petrographic analysis identified trace chlorite and smectite



Hangingstone Expansion Composite Well BE-North Area



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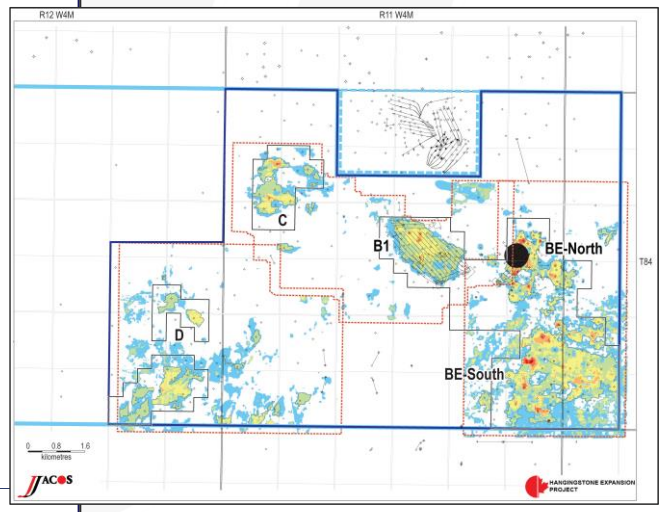
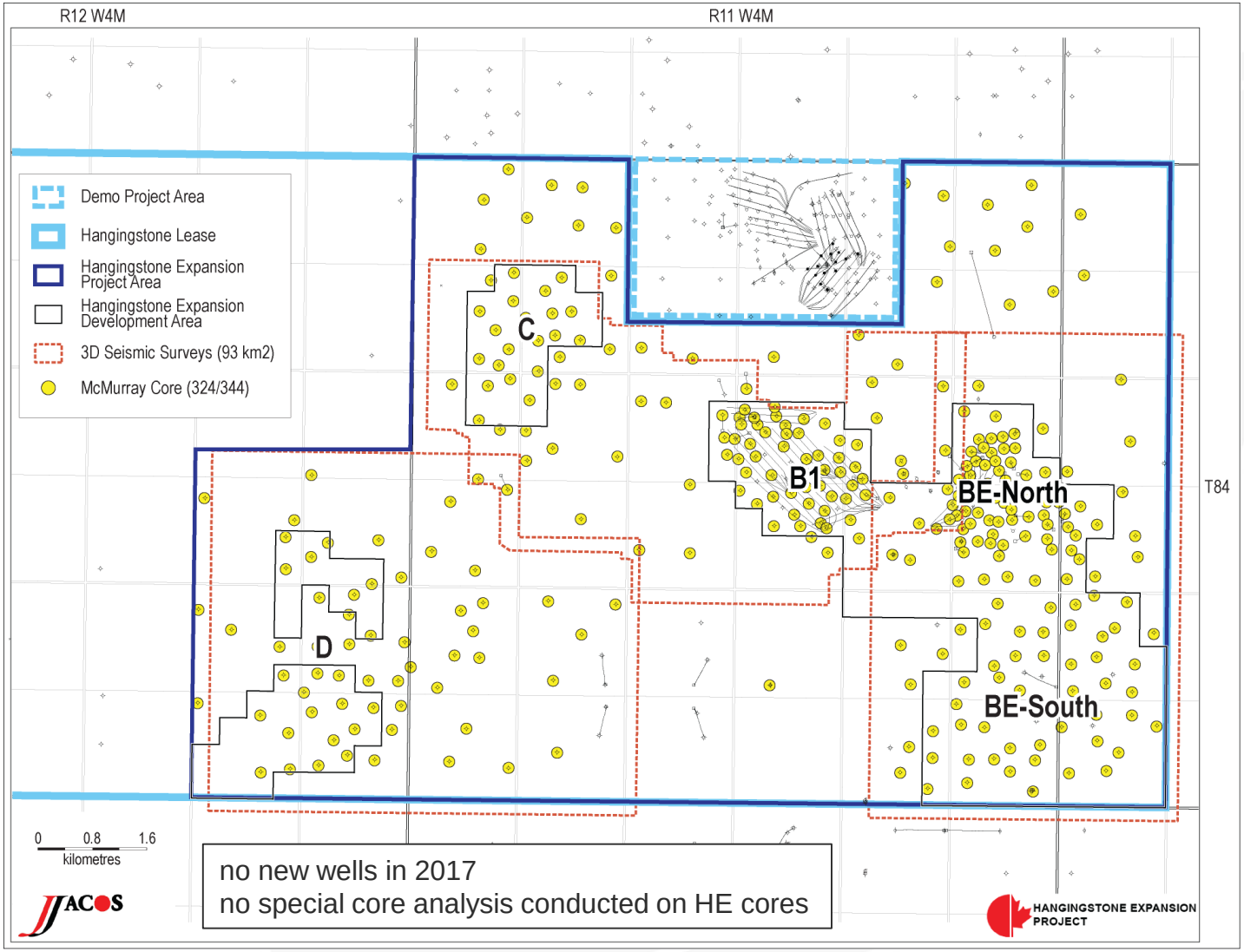
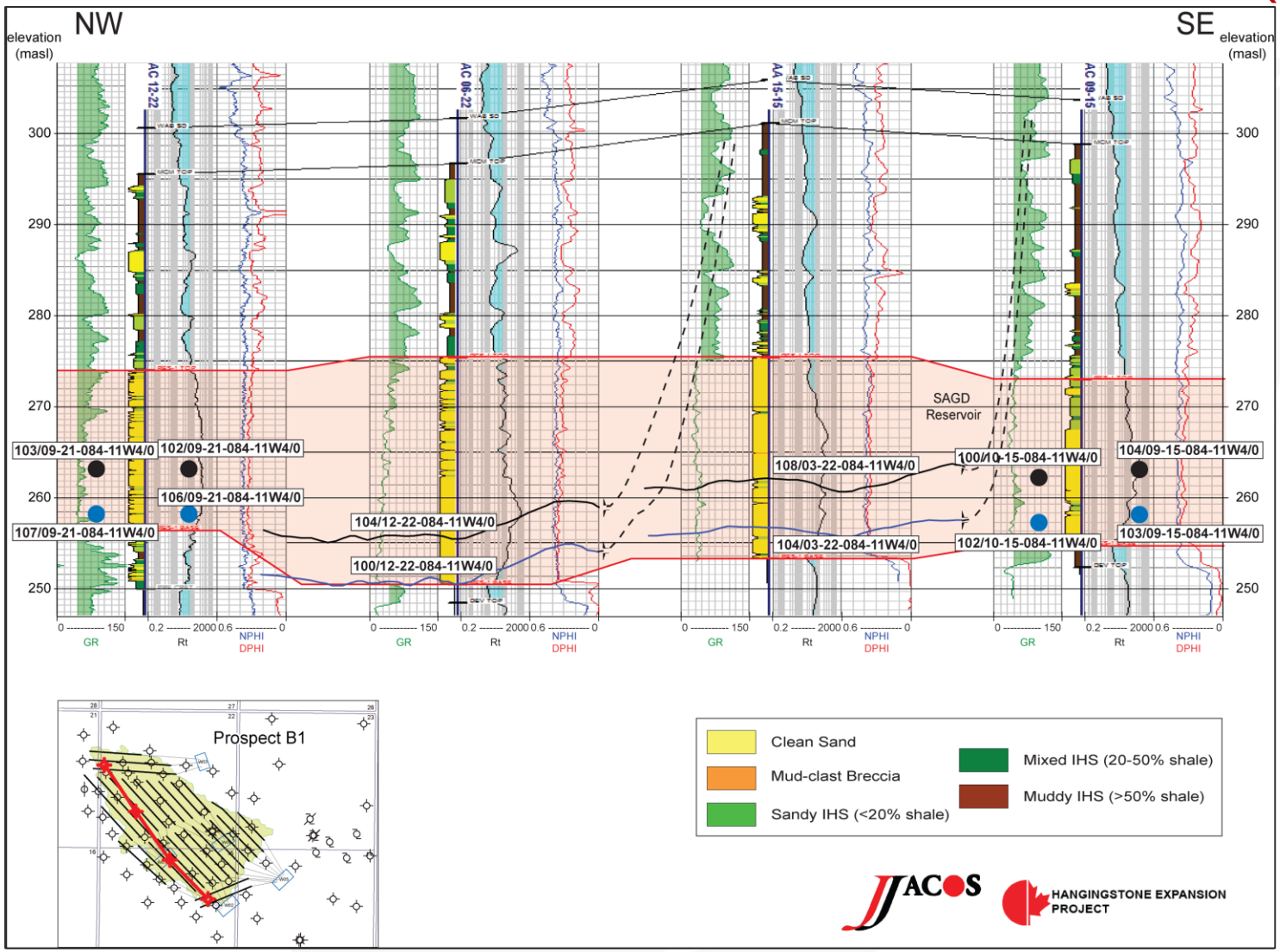


Database

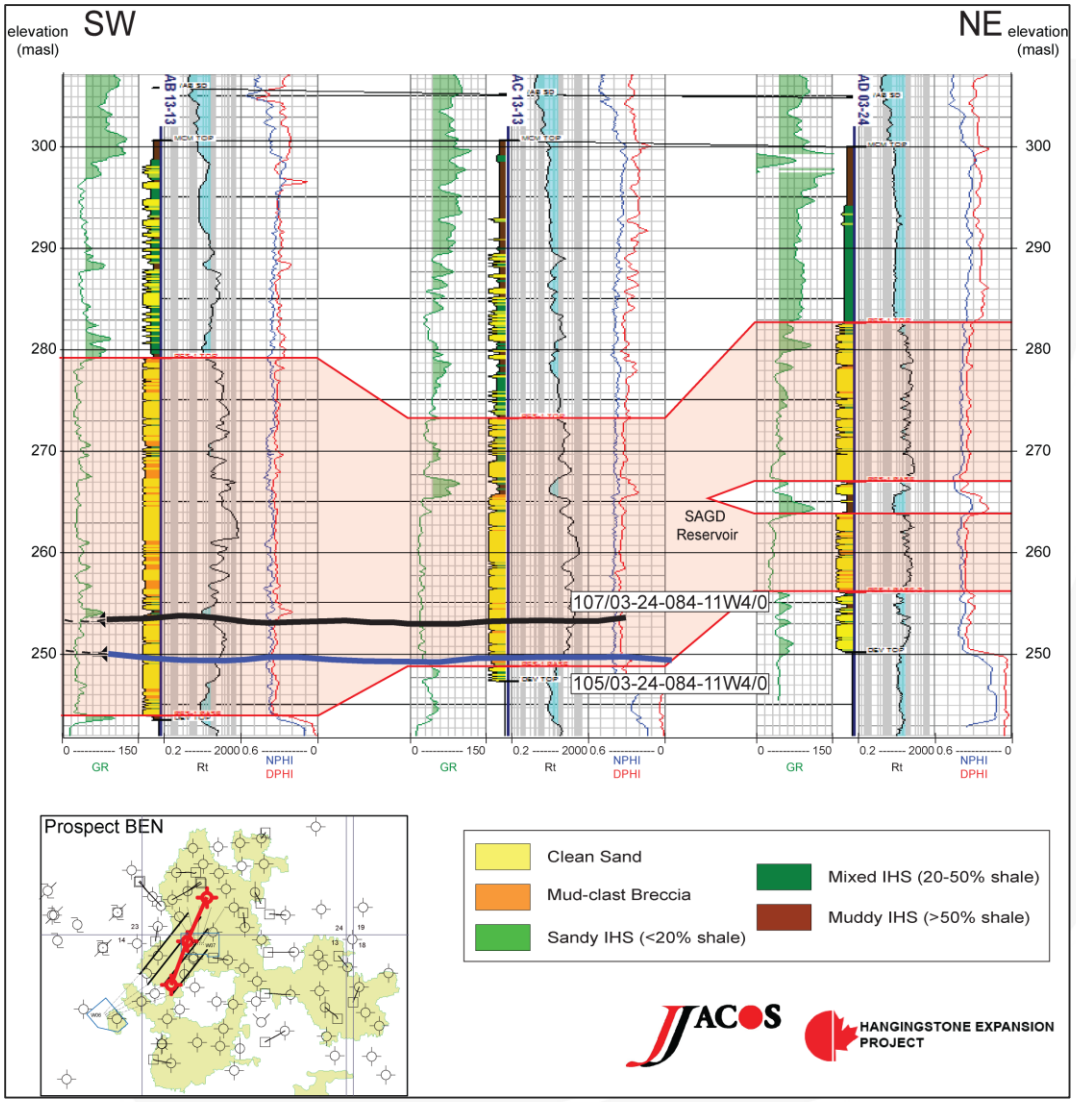


no new wells in 2017
no special core analysis conducted on HE cores

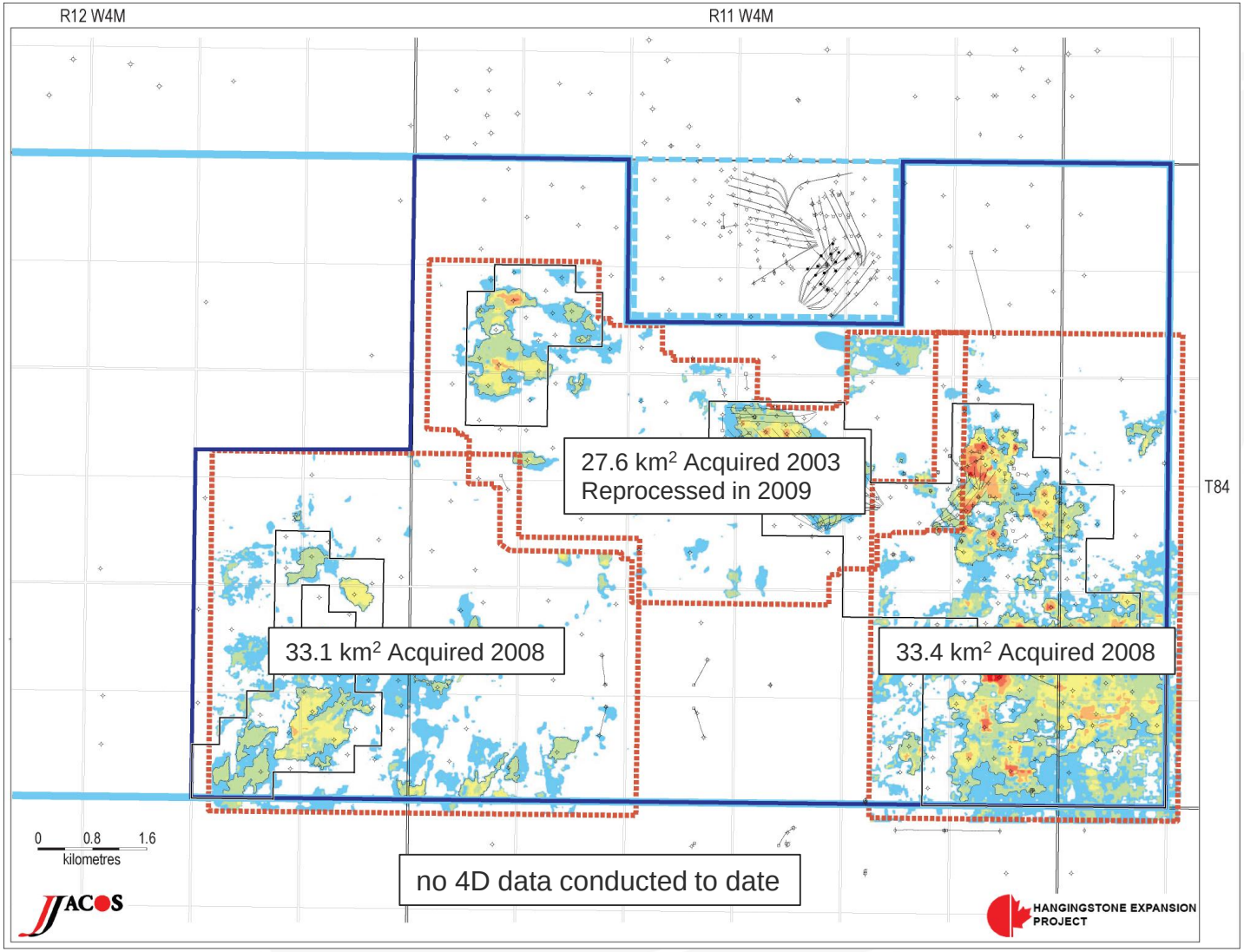
Hangingstone Expansion
Phase 1 Scheme Cross-Section (1)



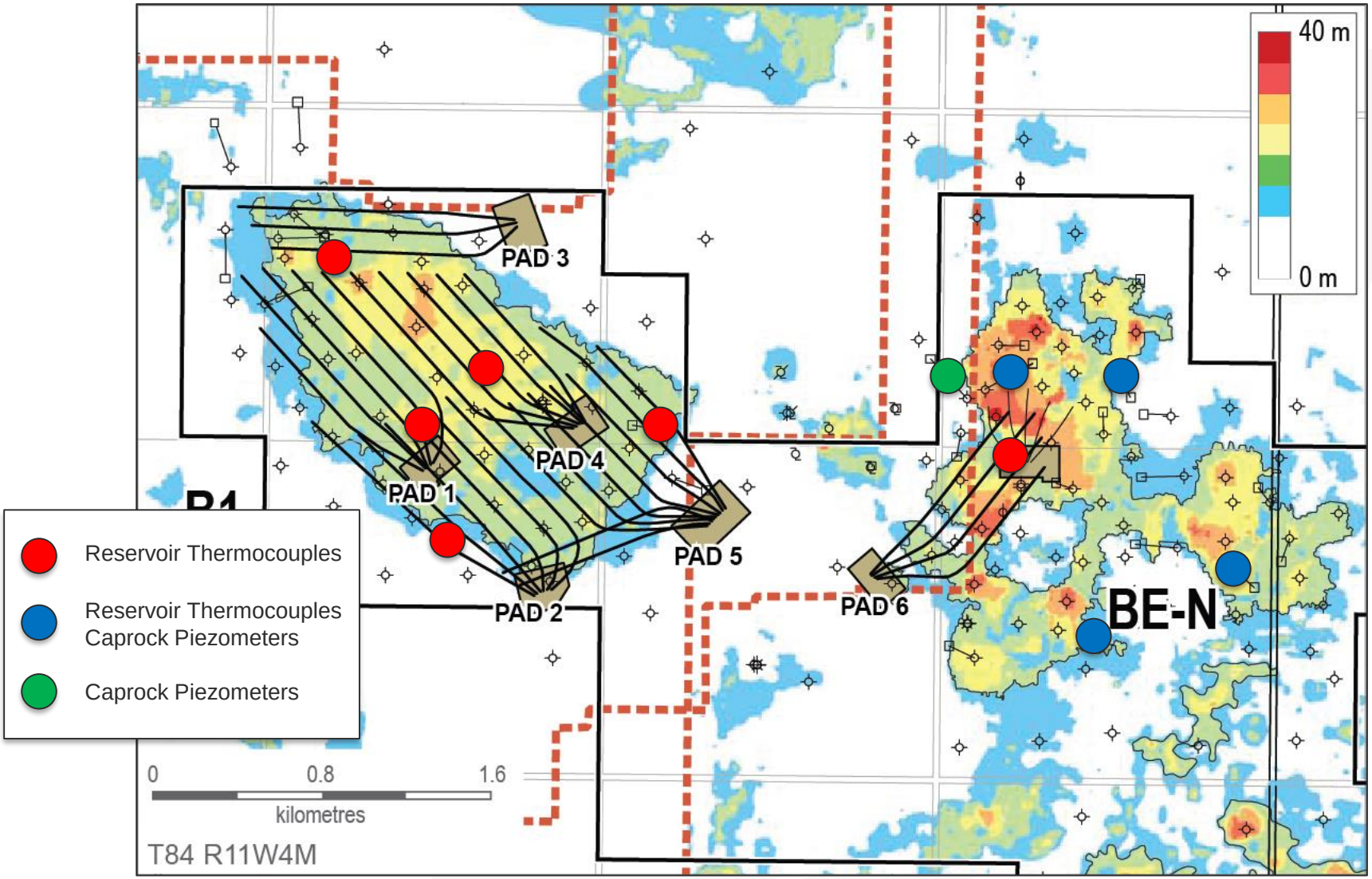
Hangingstone Expansion
Phase 1 Scheme Cross-Section (2)



3D Seismic Data



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

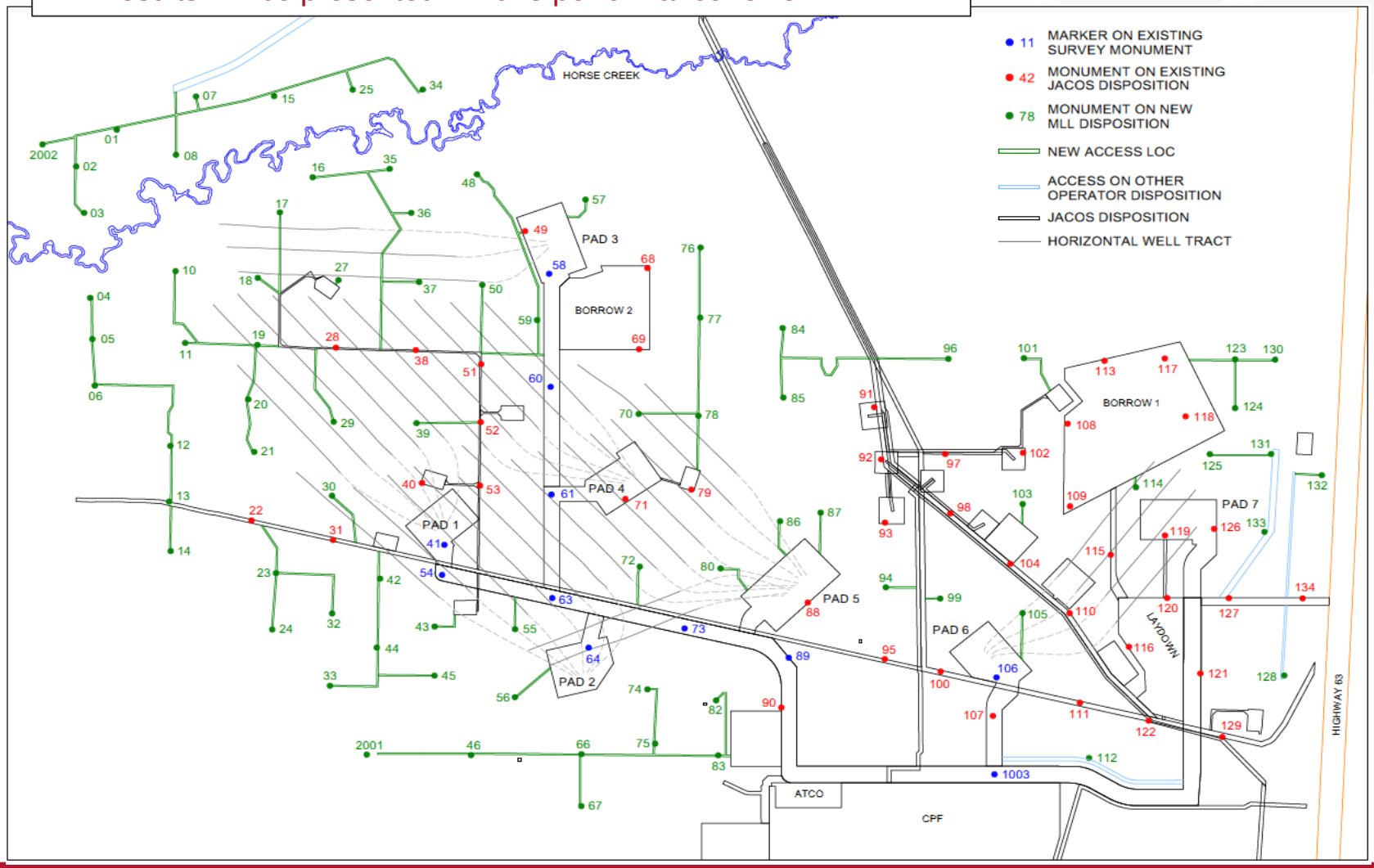
Cap Rock Integrity

- 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 anomalies

	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 (?)

Surface Heave Monument Program – As Built

- Monument baseline elevation survey completed – 2017
- First heave survey field work in progress
- Results will be presented in 2018 performance review



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Reservoir

HE Phase 1 Reservoir Performance Summary

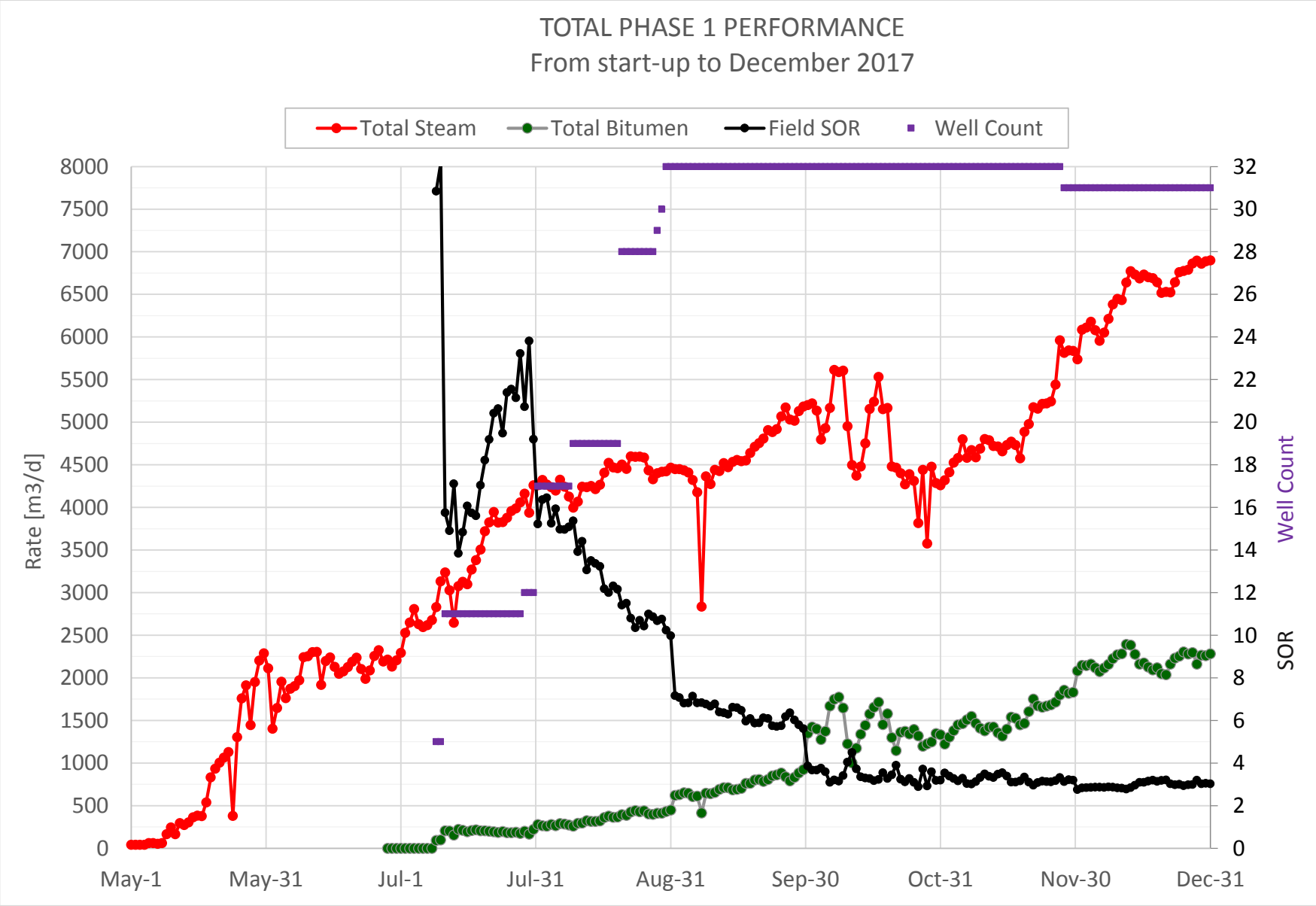
- First steam achieved on Apr 28, 2017, First oil Aug 3,2017
- Status at December 31, 2017:
  - 19 wells on SAGD Mode,
  - 9 wells transitioning from circulation to SAGD
  - 3 wells on circulation
  - 1 well carrying out workover at surface
- 2017 average bitumen rate ~ 6,954 bbl/day since first production (1,105 m3/day)
- Cumulative bitumen produced from project start-up to 12/31/2017 ~ 1.23 million bbl (195,232 m3)
- Cumulative SOR on 12/31/2017 = 4.92 iSOR (7 day average) = 3
- OBIP for the developed area is 98 million bbl
- Recoverable bitumen for Pads 1-6 is estimated at 60 million bbl (61% Ultimate Recovery)

Injection Wellhead Pressures and Temperature

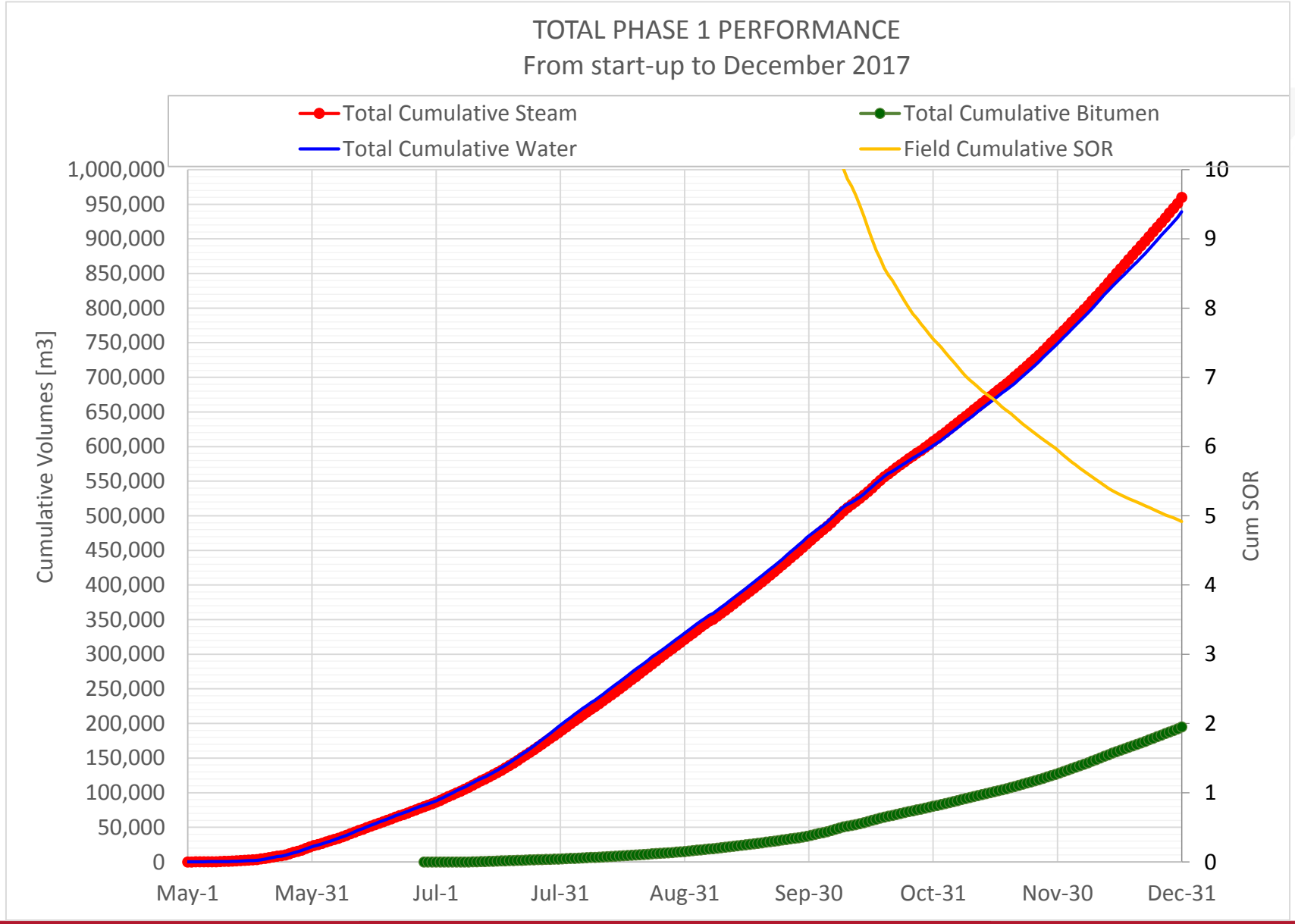
Well	Avg Injection Pressure (kPa)	Avg Injection Temperature (°C)
W01-01	4,812	263
W01-02	4,681	261
W01-03	4,717	262
W01-04	4,727	262
W01-05	4,795	263
W02-01	4,619	260
W02-02	4,700	262
W02-03	4,604	262
W02-04	4,714	263
W02-05	4,773	262
W02-06	4,594	260
W03-01	4,560	260
W03-02	4,458	258
W03-03	4,292	258
W04-01	4,511	260
W04-02	4,826	264
W04-03	4,699	262
W04-04	4,775	262
W04-05	4,723	262
W05-01	4,191	254
W05-02	4,516	259
W05-03	4,276	255
W05-04	2,481	108
W05-05	4,180	254
W05-06	4,510	259
W05-07	4,160	242
W05-08	4,526	250
W05-09	4,714	262
W06-01	4,550	260
W06-02	4,331	257
W06-03	4,835	263
W06-04	4,818	263

100% Steam Quality* @:Pad 1-6 * Steam Traps in all pads

HE Phase 1 Field Performance



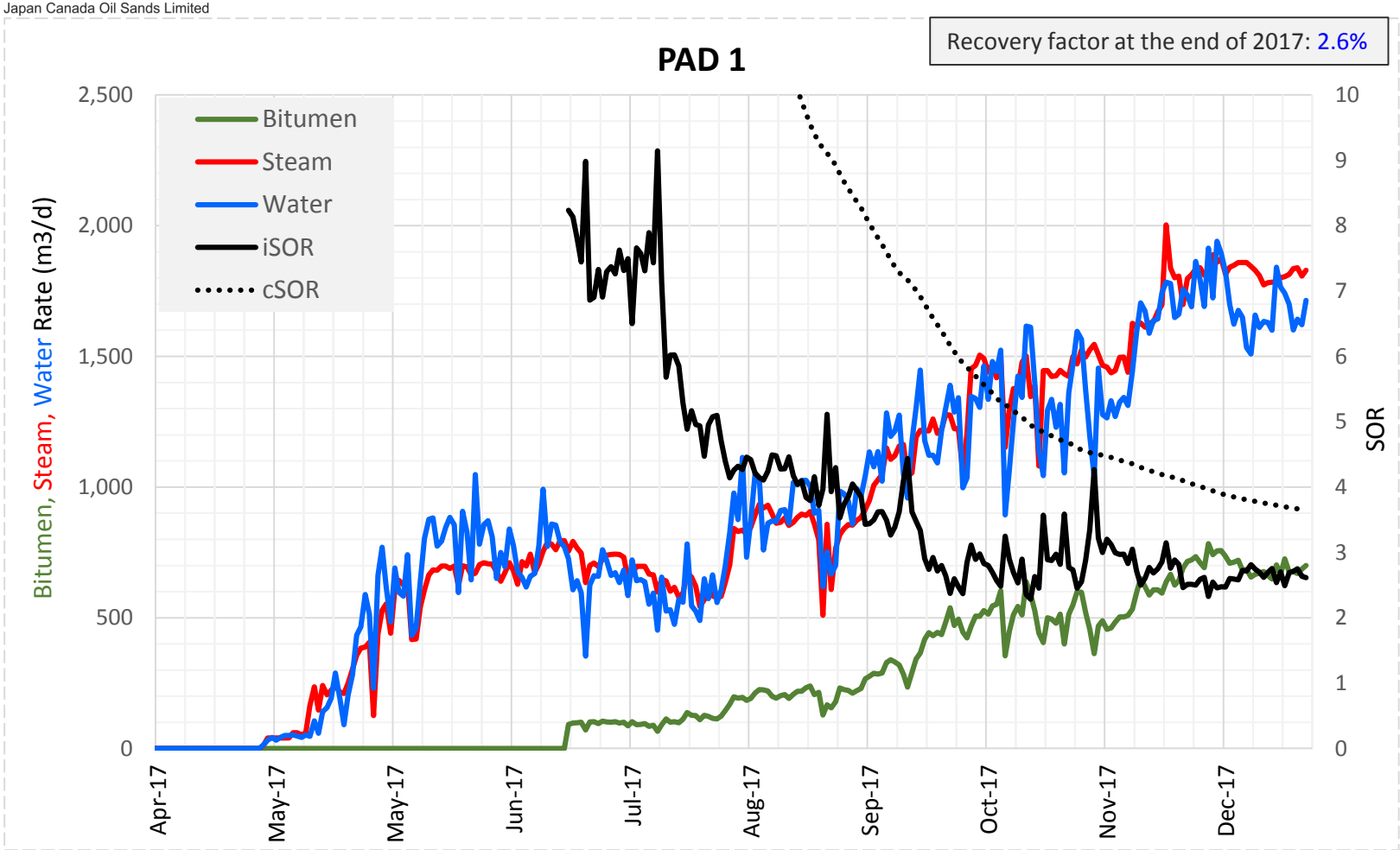
HE Field Cumulative Volumes



HE Phase I Well Pad Recovery Factor

Pad	Well	OBIP (Million m3)	Cum Prd Bitumen (m3)	Ultimate Recovery (%)	Current Recovery (%)
	W01-1		11,645		
	W01-2		14,525		
	W01-3		13,085		
	W01-4		13,157		
W01	W01-5	2.6	15,618	61	2.6
	W02-1		12,439		
	W02-2		13,319		
	W02-3		6,139		
	W02-4		5,401		
	W02-5		5,580		
W02	W02-6	3.1	1,680	61	1.4
	W03-1		1,103		
	W03-2		1,226		
W03	W03-3	1.5	780	59	0.2
	W04-1		4,027		
	W04-2		7,040		
	W04-3		11,783		
	W04-4		9,131		
W04	W04-5	2.7	8,936	63	1.5
	W05-1		1,226		
	W05-4		2,853		
	W05-5		845		
	W05-6		954		
	W05-7		871		
	W05-8		3,591		
W05NW	W05-9	2.8	5,902	60	0.6
	W05-2		1,507		
W05SW	W05-3	0.7	849	58	0.3
	W06-1		2,791		
	W06-2		2,160		
	W06-3		6,884		
W06	W06-4	2.1	8,184	64	1.0
Total Pads 1-6		15.6	195,232	61	1.3

Well Pad Performance Example



It is too early to select high, medium and low performers because: (1) HE wells are very new and in the process of ramping up, and: (2) Some plant constraints delayed the ramp up of several wells.

PAD 1 Highlights

- Pad 1 was the first well to start circulating
- 4 wells transitioned to SAGD in August and 1 in September
- Average bitumen Rate at the end of 2017 ~ 700 m3/d
- Average steam Rate at the end of 2017 ~ 1,821 m3/d
- Average SOR Rate at the end of 2017 ~ 2.6
- Cum Bitumen production at the end of 2017 ~ 68,000 m3
- Out of the 19 wells converted to SAGD in 2017, the 5 well sin pad 1 are the most mature in HE. With an average bitumen rate per well of ~140 m3/d

Pad 1 has been prioritized over other pads during plant constraints when cap on fluid production is required. This has allowed the pad more room to ramp up production and increase steam injectivity.

Several temperature fall off tests have been carried out in order to properly assess temperature conformance along the well length and adjust steam splits to avoid hot spots and promote a uniform growth chamber

Summary of Key learnings

- HE had a very successful start-up but there were issues with water treating, which affected both steam generation and fluid production. This played a big role in the number of wells start-ups.

- In the transition from circulation to SAGD, wells with stronger interwell communication were prioritized to receive more steam which significantly improved temperature conformance along the well and allowed faster ramp-up. This resulted in better SOR during steam shortages or production constraints

- Carrying out fall off tests before and shortly after transitioning to SAGD proved very valuable to determine steam splits and heel or toe production.

- High BHP allows natural lift, however, right after the transition to SAGD using steam lift is beneficial in order to help with fluid production, which in turns allows higher steam injection rates, and chamber growth.

Water Dilation Test

Trial Objective:

The main objective of this trial is to enhance the permeability and porosity around the wellbore area to promote higher water losses to the reservoir during circulation. It is expected that both the enhanced area can help with a more uniform temperature conformance along the well length, and reduce circulation time.

JACOS carried out a Water dilation trial on the following wells:

- W03-1
- W03-2

(IHS around producer)

- W06-1
- W06-2

(Clast around producer)

Well Selection:

- Focused on poor geology wells where low water losses are expected

Test Design and Results summary

Test Design:

Water dilation was carried out in the producer wells only. The strategy consisted of:

1) Increasing the Bottom-Hole Pressure (BHP) around the producer by injecting water at high pressure through a cement pumping truck.

2) Using the injector (upper well) to monitor bottom-hole pressure in order to have a second measurement to ensure that a safe test was being conducted. BHP was determined using the wellhead pressure by keeping a full liquid column in the wellbore.

The main parameters during this test were:

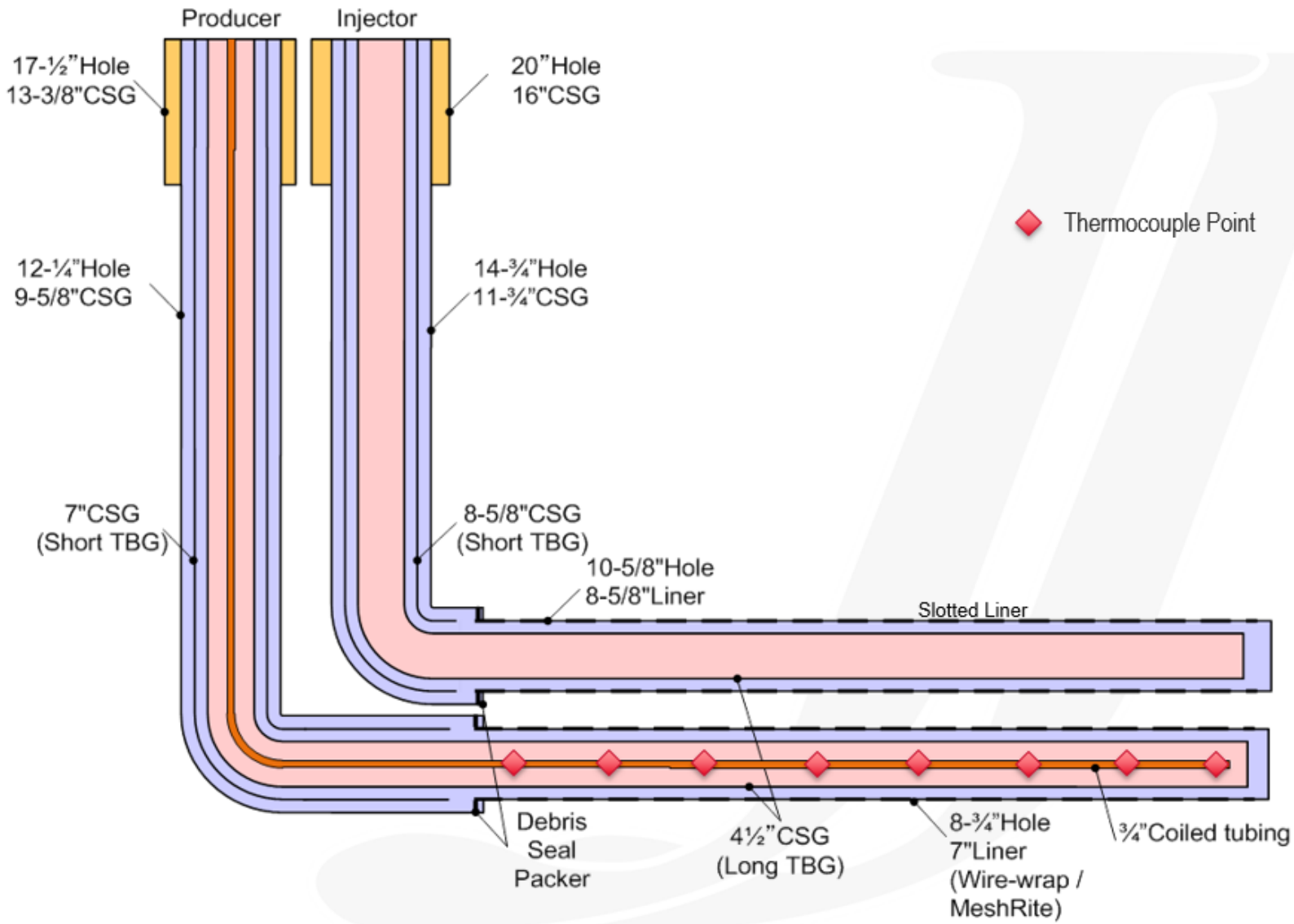
Injection rate (per well): Max 500 m^3/d
Cum Water Injected (per well pair): Max 600 m^3
Max BHP: 8 MPa
Max duration: 48 hours

Summary

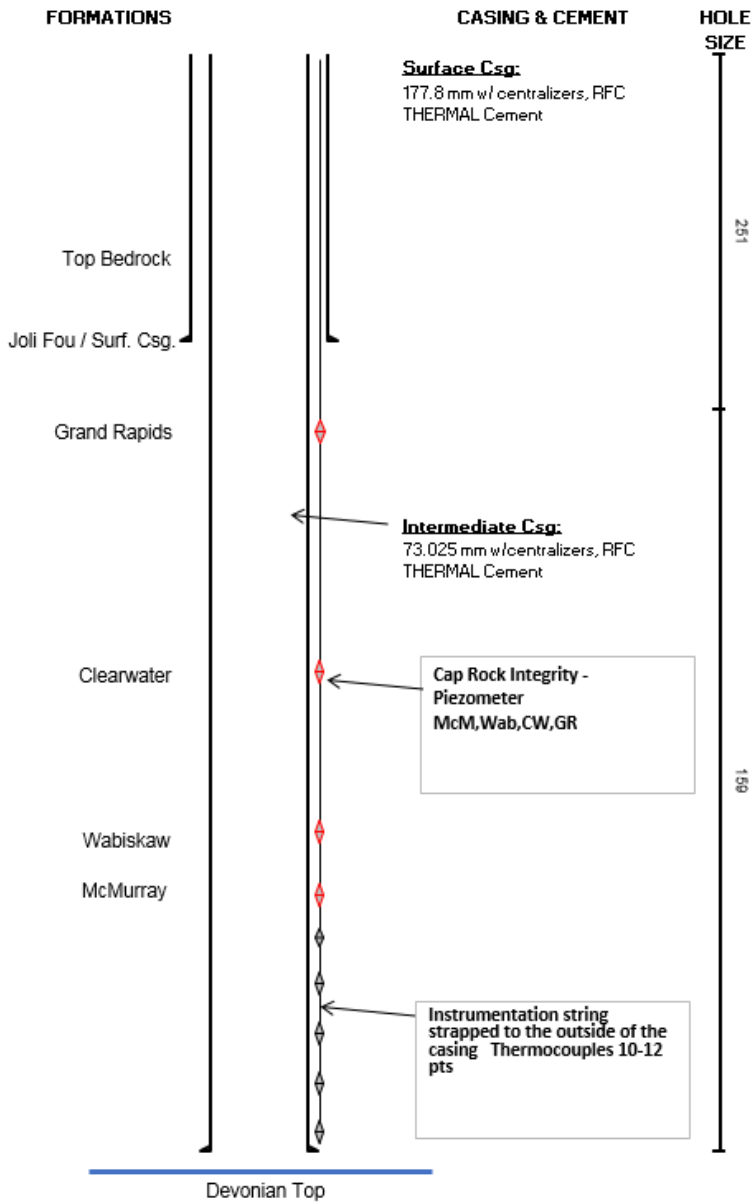
	TVD at ICP (m)	Max BHP achieved (Kpa)	Cum water (m3)	Duration (hours)
W03-01	328	7,800	48.8	45
W03-02	329	7,580	169	24
W06-01	370	7,250	58	8
W06-02	368	7,800	9.4	21

Well Design and Instrumentation

HE SAGD Well Completion Approval No. 11910



HE Observation Well Completion



SAGD Well Completions

- Hangingstone Expansion design – Straight cut slots on injectors / MeshRite or wire wrap on producers
- Three injector wells installed with shiftable outflow devices (current position - closed), two devices per well
- Two producer wells installed with shiftable inflow devices (current position - closed), two devices per well

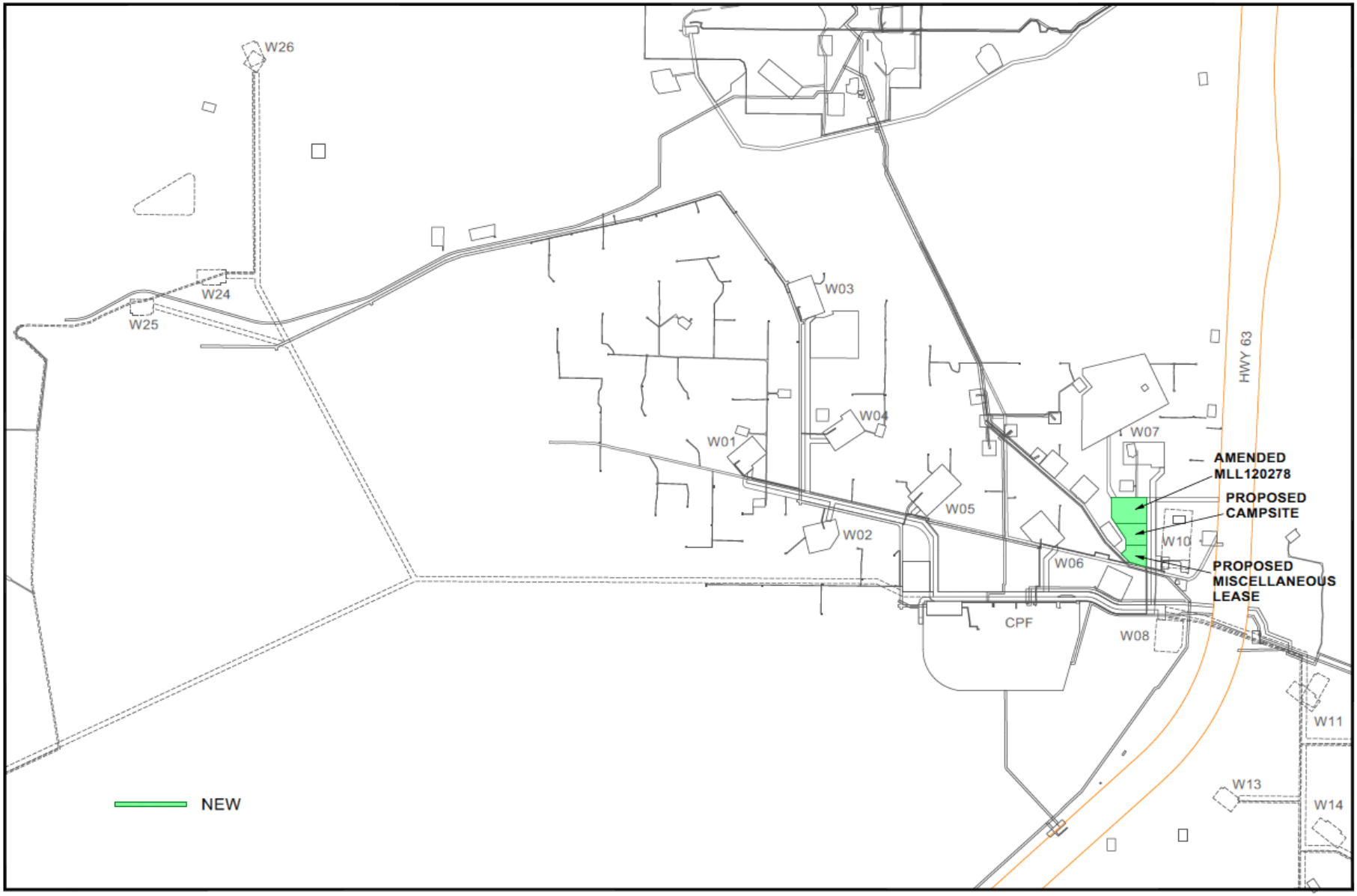
Instrumentation

- SAGD steam injector
  - No instrumentation on injection wells
  - Blanket gas for pressure measurement
- SAGD producer
  - 8 point thermocouple string installed on producer well(32), inside 114.3mm tubing
  - DTS Fiber testing, strapped to production tubing on three producers: W06P01,02,03
  - Blanket gas for pressure measurement
- Observations Wells
  - 10-12 point thermocouple strapped to outside 73-89mm tubing
  - Caprock integrity- Piezometers monitoring MCM, Wab, CW, GR formations

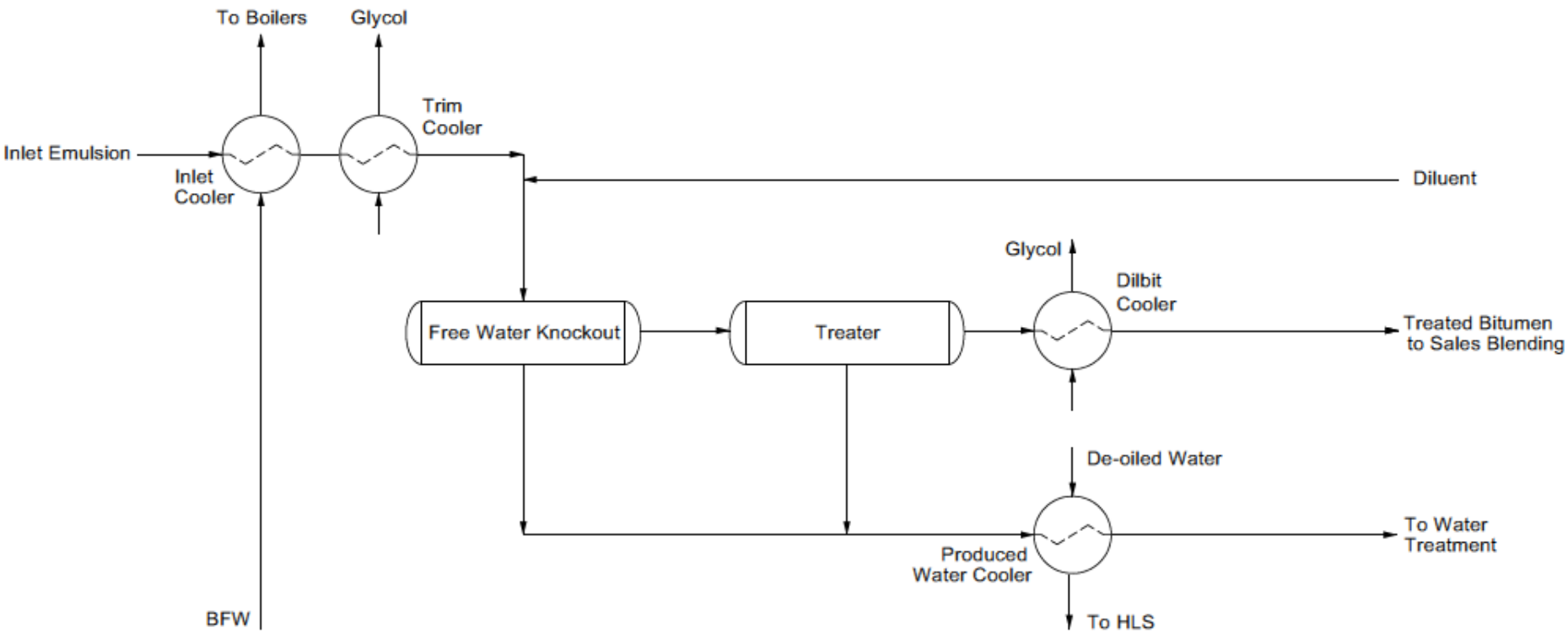
Surface Operations

Facility Design

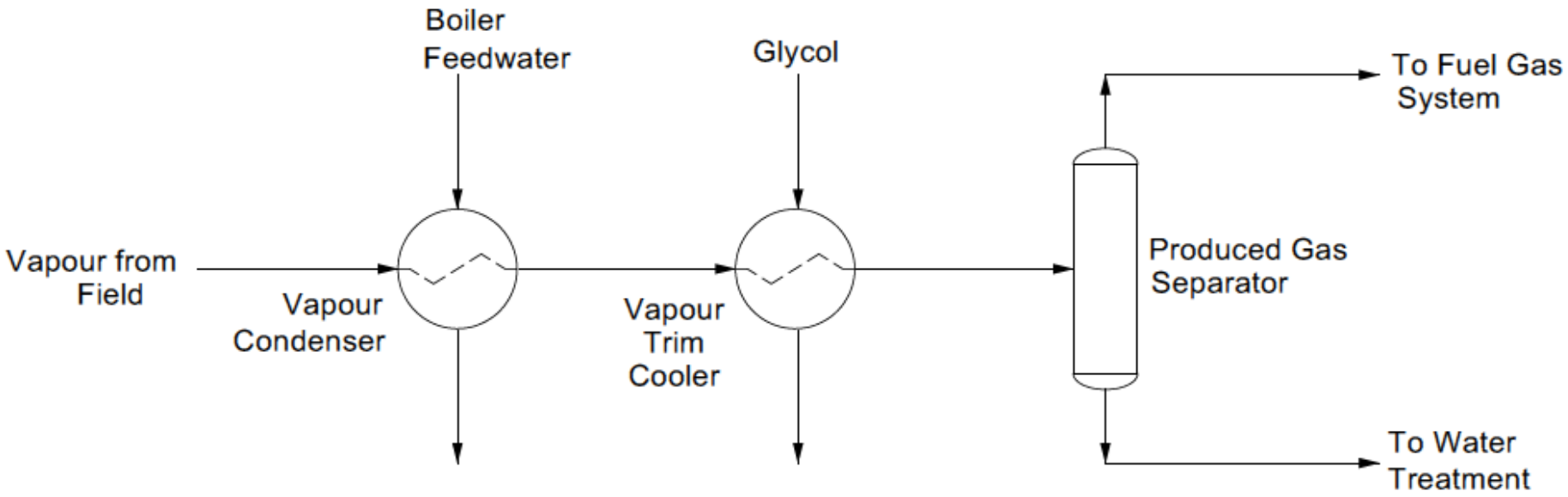
Site Plan


W26
W24
W25
W03
W04
W01
W05
W02
W06
W07
W10
W08
W11
W13
W14
CPF
HWY 63
AMENDED MLL120278
PROPOSED CAMPSITE
PROPOSED MISCELLANEOUS LEASE
NEW

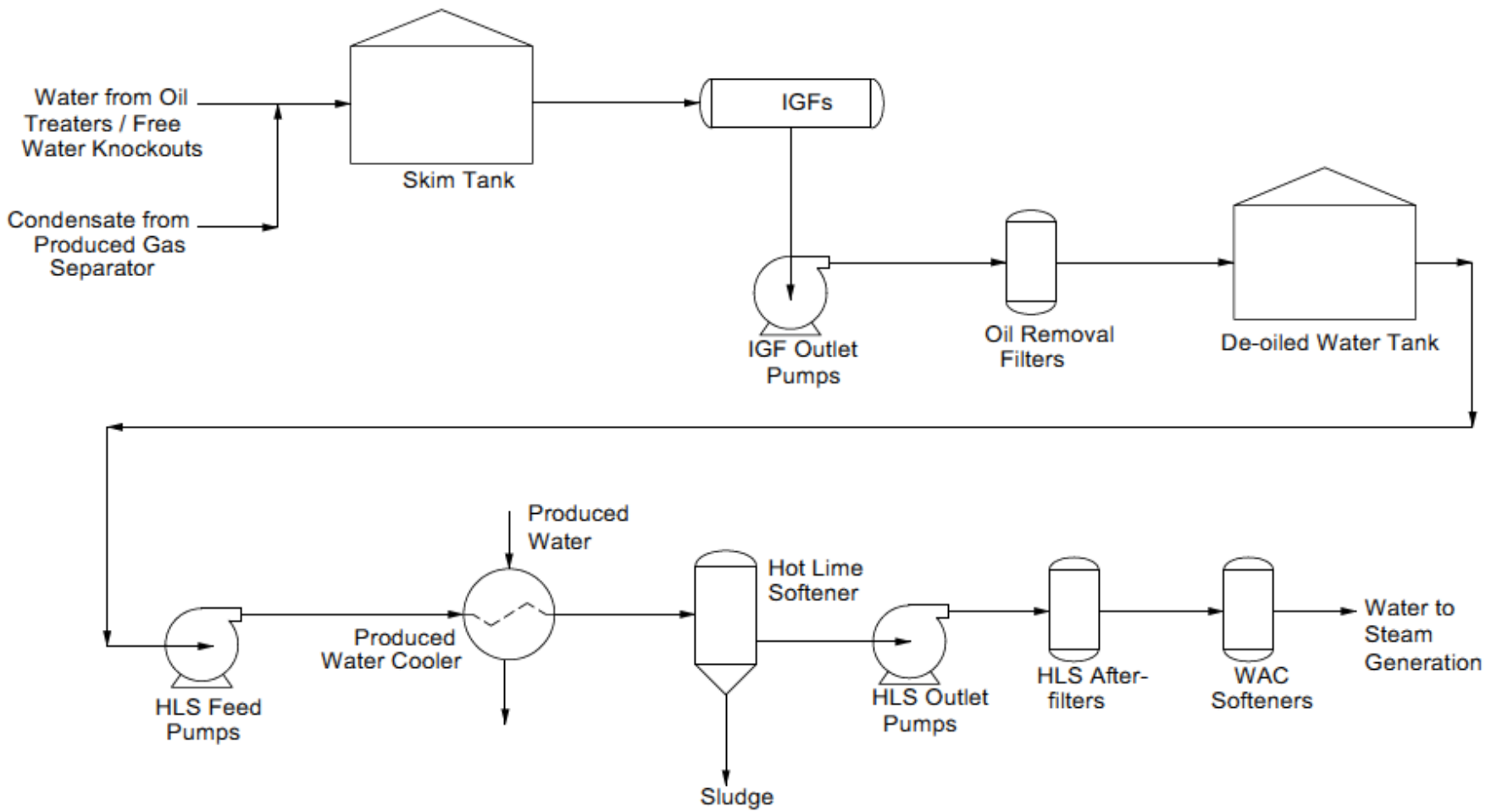
PFD – Bitumen Treating



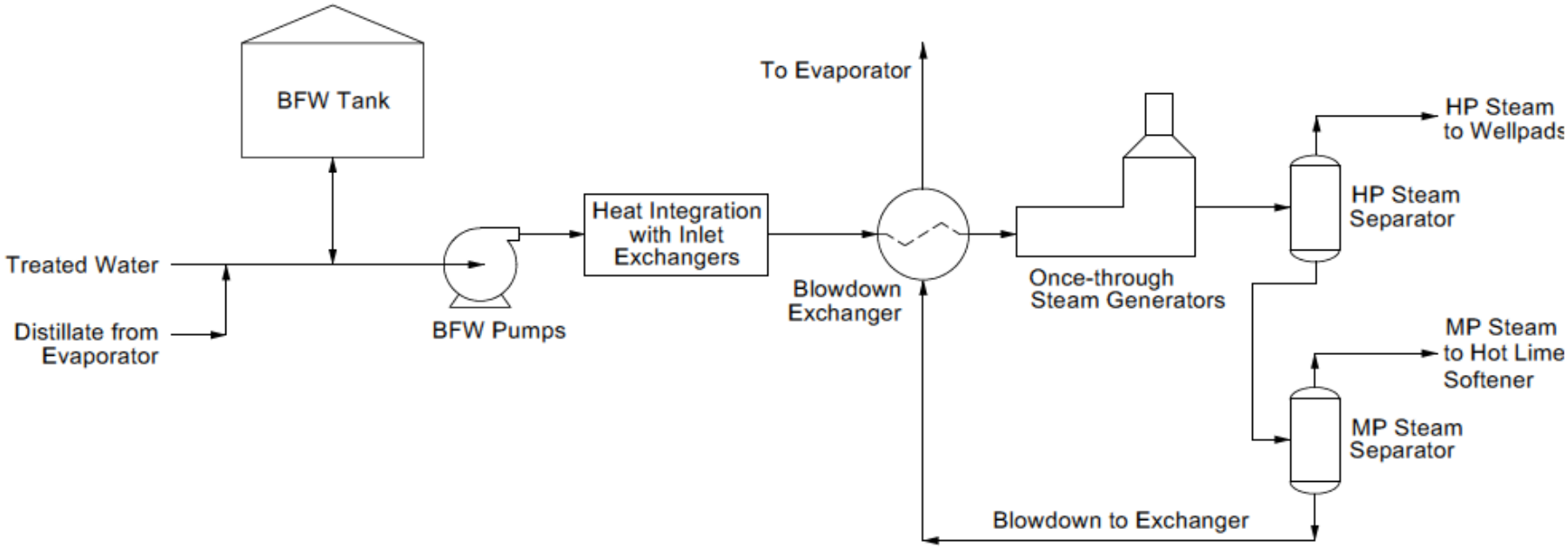
PFD – Produced Gas Recovery



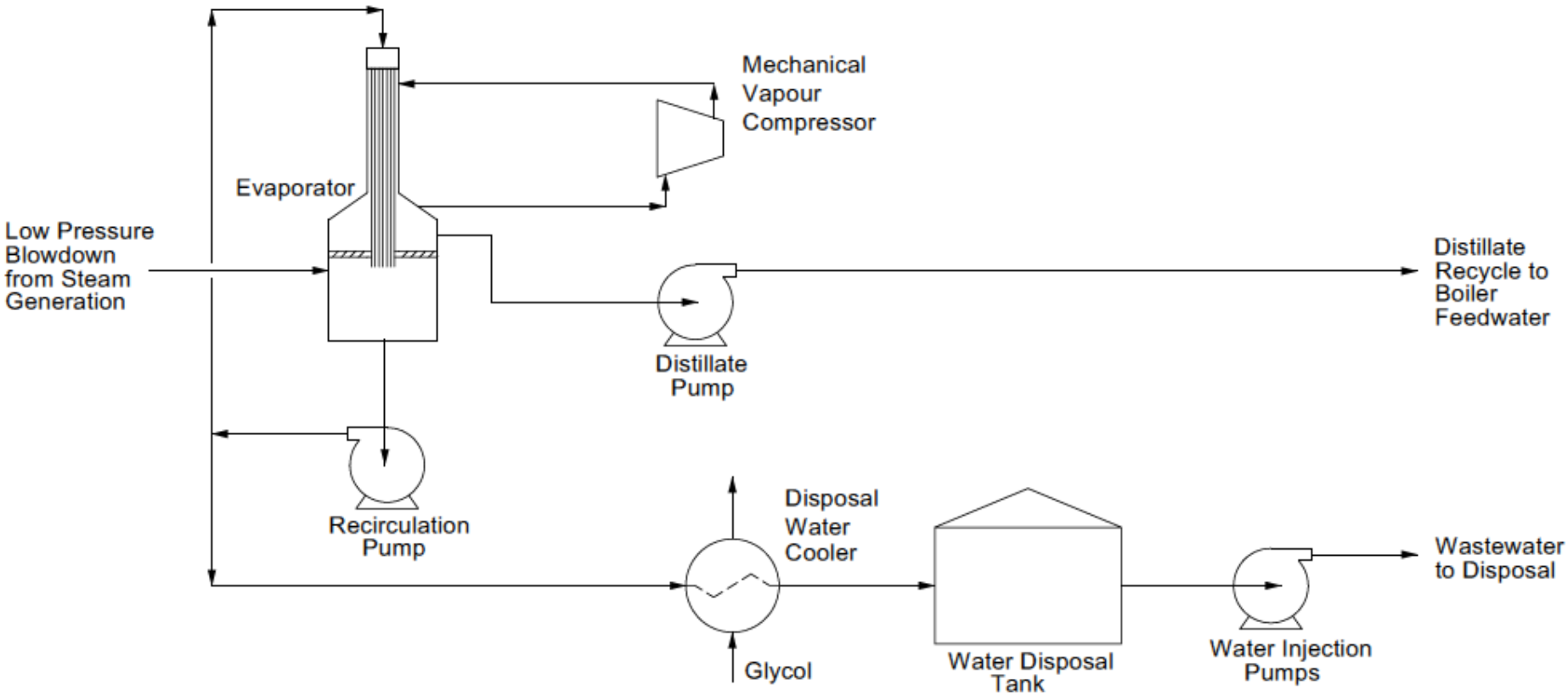
PFD – Produced Water Treatment



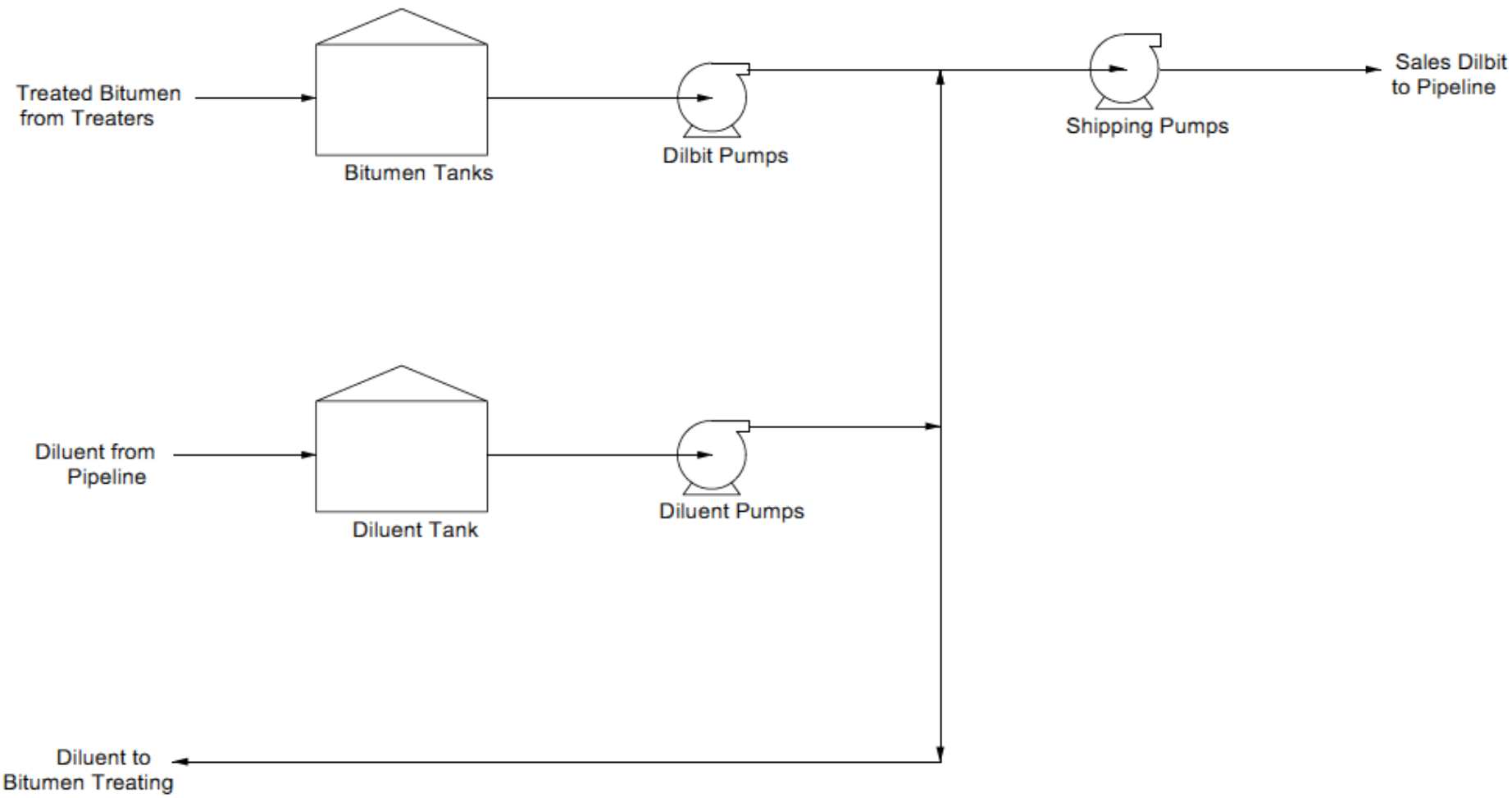
PFD – Steam Generation



PFD – Boiler Blowdown



PFD – Bitumen Blending & Sales



Operational Highlights– 2017

- “Mechanical Completion” – February 24
- First Steam Injection – April 28
- “First Bitumen” Production – August 3
- Dilbit Pipeline Testing – August 29-31
- First Dilbit Sales – September 13
- 1,000,000th Bitumen Barrel – December 15
- Average December Bitumen Rate – 14,000 bbl/d
- Average December SOR – 2.97
- 19/32 Well-pairs in SAGD Mode at Year End

Facility Performance - Bitumen Treatment

- Design
  - Bitumen Target Rate = 20,000 bbl/d
  - Bitumen Density - 1011 kg/m3 (Demo Project)
  - Dilbit Viscosity spec – 350cSt
- 2017 Performance
  - Project Still in Ramp-up; Maximum Rate in 2017: 17,000 bbl/d
  - Initial bitumen samples have higher density (~1018 kg/m3)
    - Believed to be heavier bitumen at bottom of reservoir
  - Optimizing bitumen treating to reduce diluent flashing
  - Observing tight emulsions due to residual drilling fluids and utilization of steam to start-up wells

Facility Performance - Water Treatment

Overall system is working well; did have to overcome some operational start-up challenges

- BFW within silica and TDS spec; below 50ppm
  - Hardness below 1 ppm
- Early challenges with de-oil train; experience some excursions resulting in oil carry over
- MVR evaporator working well; reached designed concentration, no blowdown recycle

Steam Generation - Water Treatment

Four 240MMBTU boilers are currently fully operational

- Generating steam at 75% quality; slightly below design
- Encountered some water quality excursions (oil carry over); pigged boiler tubes
- Steam hammer event occurred on steam header
  - Shutdown 2 steam generators for 3 weeks for investigation
  - Verified pipe integrity and structural impact
  - Modified procedures to mitigate risk of future reoccurrence
  - Restarted safely and maintained steady operations

Steam Generation

- B-510/515/520/525
  - 71.4MW (240MMBtu/h)

2017	Steam Volume (m^3)	Steam Quality
May	50,185	70%
June	83,783	74%
July	131,601	73%
August	155,812	75%
September	153,757	74%
October	165,279	76%
November	169,865	77%
December	224,434	75%
Total	1,134,714	75%
Daily Average	4,631	
Design Capacity	11,440	80%

Power & Energy Intensity 2017

2017	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)
May	3,658,845	4.9	4,314	0	-	40.66	-
Jun	4,107,353	5.7	7,146	0	-	40.61	-
Jul	6,321,577	8.5	10,034	4,304	2332	40.61	94.7
Aug	6,262,058	8.4	11,370	10,809	1052	40.31	42.4
Sep	6,682,496	9.3	10,364	21,905	473	40.15	19.0
Oct	7,359,676	9.9	11,409	43,395	263	40.70	10.7
Nov	6,573,270	9.1	12,656	46,066	275	40.23	11.1
Dec	7,441,117	10.0	15,135	68,753	220	40.43	8.9
TOTAL	**48,406,392**	**8.2**	**82,427**	**195,232**	**422**	**40.43**	**17.1**

* - Total natural gas to plant

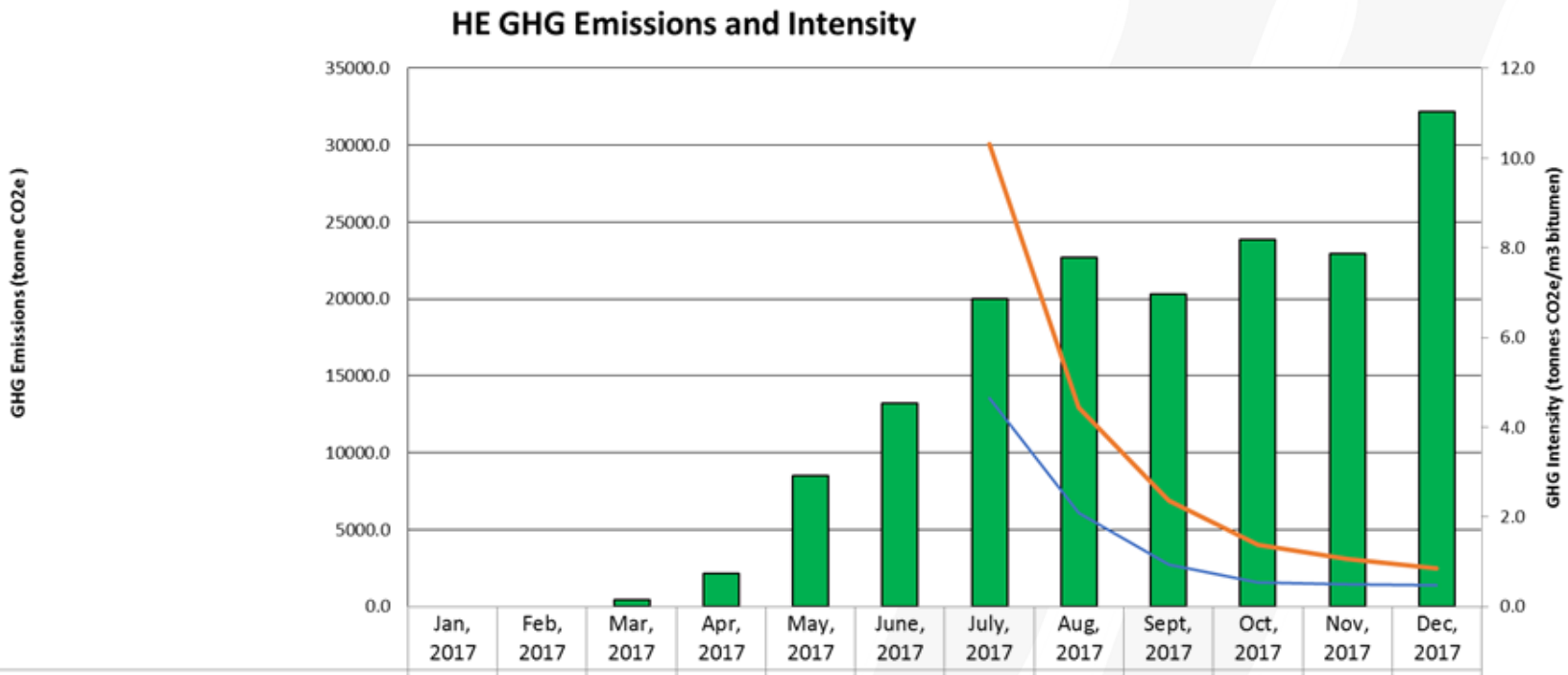
** - Using monthly nat gas heating values

Natural/Produced Gas Summary

(e^3m^3)	Purchased Gas	Produced Gas	Flared Gas	Produced Gas Recovery
May	4314	0.0	0.0	-
June	7146	0.0	0.0	-
July	10034	38.7	38.7	-
August	11370	97.3	97.3	-
September	10364	153.3	21.3	86.1%
October	11409	303.7	40.1	86.8%
November	12656	322.5	174.1	46.0%
December	15135	412.5	0.0	100.0%
TOTAL	82,427	1,328	372	72.0%

- Lower Produced Gas Recovery
  - Produced gas recovery system started in September
  - Mixed fuel gas boilers issue in October/November
  - Full recovery in December

Greenhouse Gas



	Jan, 2017	Feb, 2017	Mar, 2017	Apr, 2017	May, 2017	June, 2017	July, 2017	Aug, 2017	Sept, 2017	Oct, 2017	Nov, 2017	Dec, 2017
Monthly GHG Emissions (tonnes CO2e)	0.0	0.0	454.5	2146.7	8539.1	13256.6	20009.8	22711.3	20341.0	23866.6	22968.9	32182.9
YTD GHG Emissions Intensity (tonnes CO2e/m3 bitumen)							10.3182	4.4411	2.3626	1.3844	1.0618	0.8527
Monthly GHG Emissions Intensity (tonnes CO2E/m3 bitumen)							4.6494	2.1011	0.9286	0.5500	0.4986	0.4681

Measurement & Reporting

HE MARP

- Measurement, Accounting and Report Plan (MARP) originally approved in January 2013
- 2014 MARP update was submitted, SIRs received and corrected MARP submitted and approved
- MARP audited in Q4 2015 and additional deficiencies noted
- Revised MARP submitted on February 25, 2016
- AER MARP audit site visit on October 3, 2017, follow up items identified
- MARP revision submitted (due date – January 31, 2018)

Optimization of Test Duration

- Optimization of test duration
  - Cycling through wells, at least 2 full day tests per well
  - Excess testing time beyond required is focused on dynamic/unstable wells
- Minimum test period: 2 days per month
- BS&W tests: online water cut meters
  - During startup, performing frequent manual cuts to verify the online meters

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
  - W01: 5 wells; 1 group, 1 test
  - W02: 6 wells; 1 group, 1 test
  - W03: 3 wells; Individual well head separators
  - W04: 5 wells; 1 group, 1 test
  - W05: 9 wells; 1 group, 2 test
  - W06: 4 wells; Individual well head separators
- Bitumen cut to be determined by online cut meter (Phase Dynamics) for all phases
- Steam injection rates are continuously measured at each wellhead and prorated to high-pressure steam meters

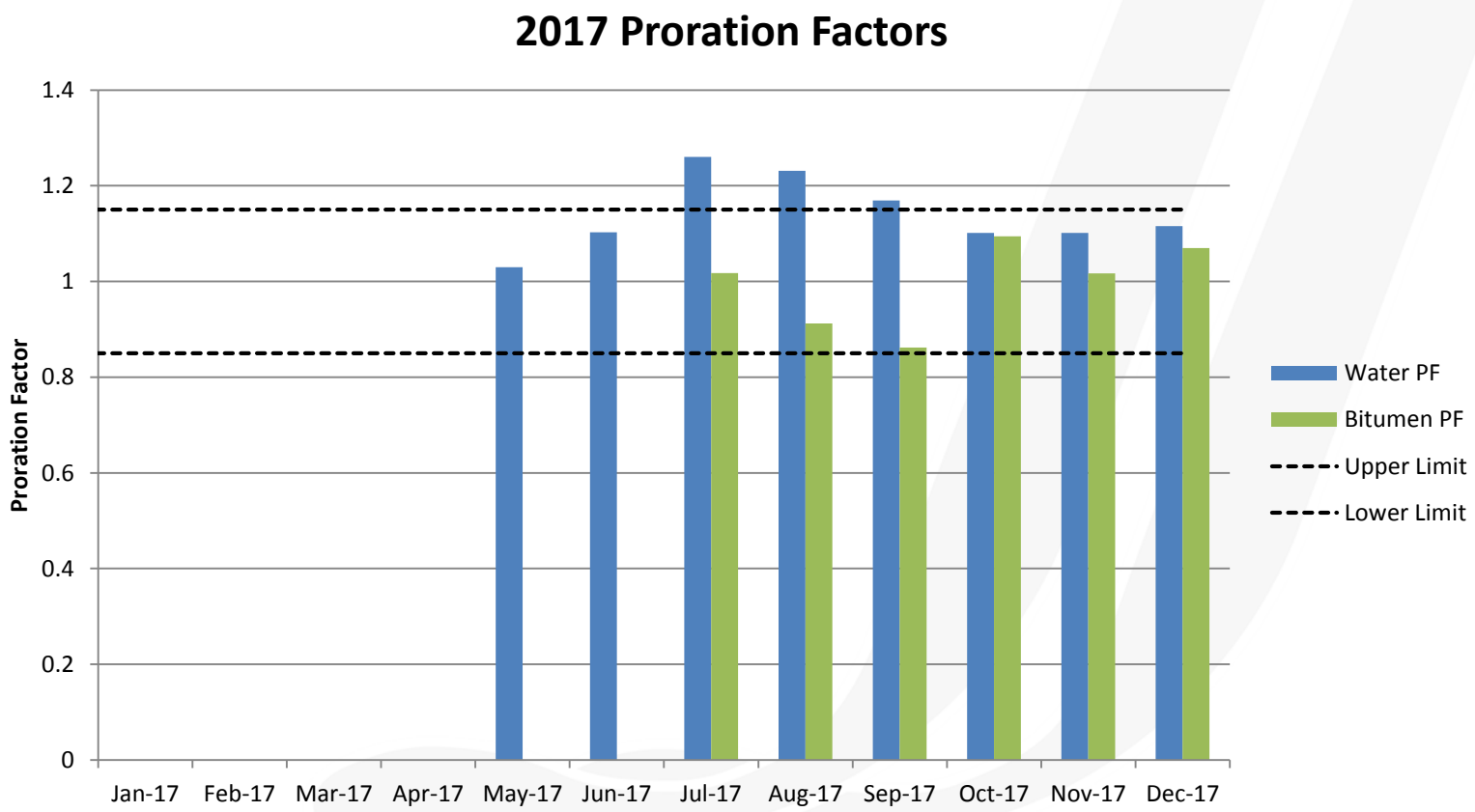
Reporting/Proration Method

- Produced Bitumen
  - Plant bitumen is calculated using metered dilbit minus diluent receipts and flashing
  - ∑ Individual wellhead bitumen is measured/calculated 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

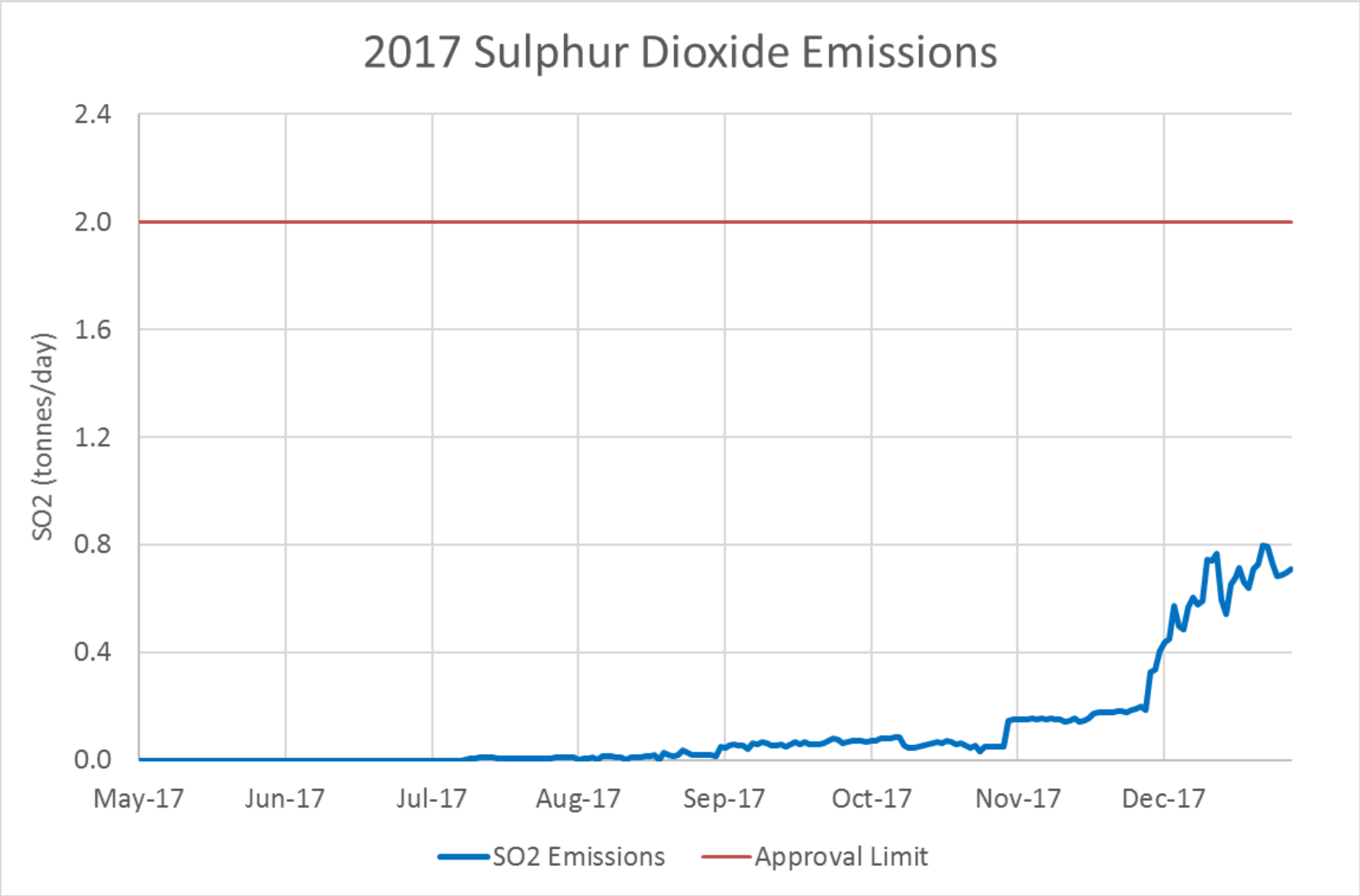
- The average 2017 proration factor
  - Bitumen: 0.995
  - Water: 1.140



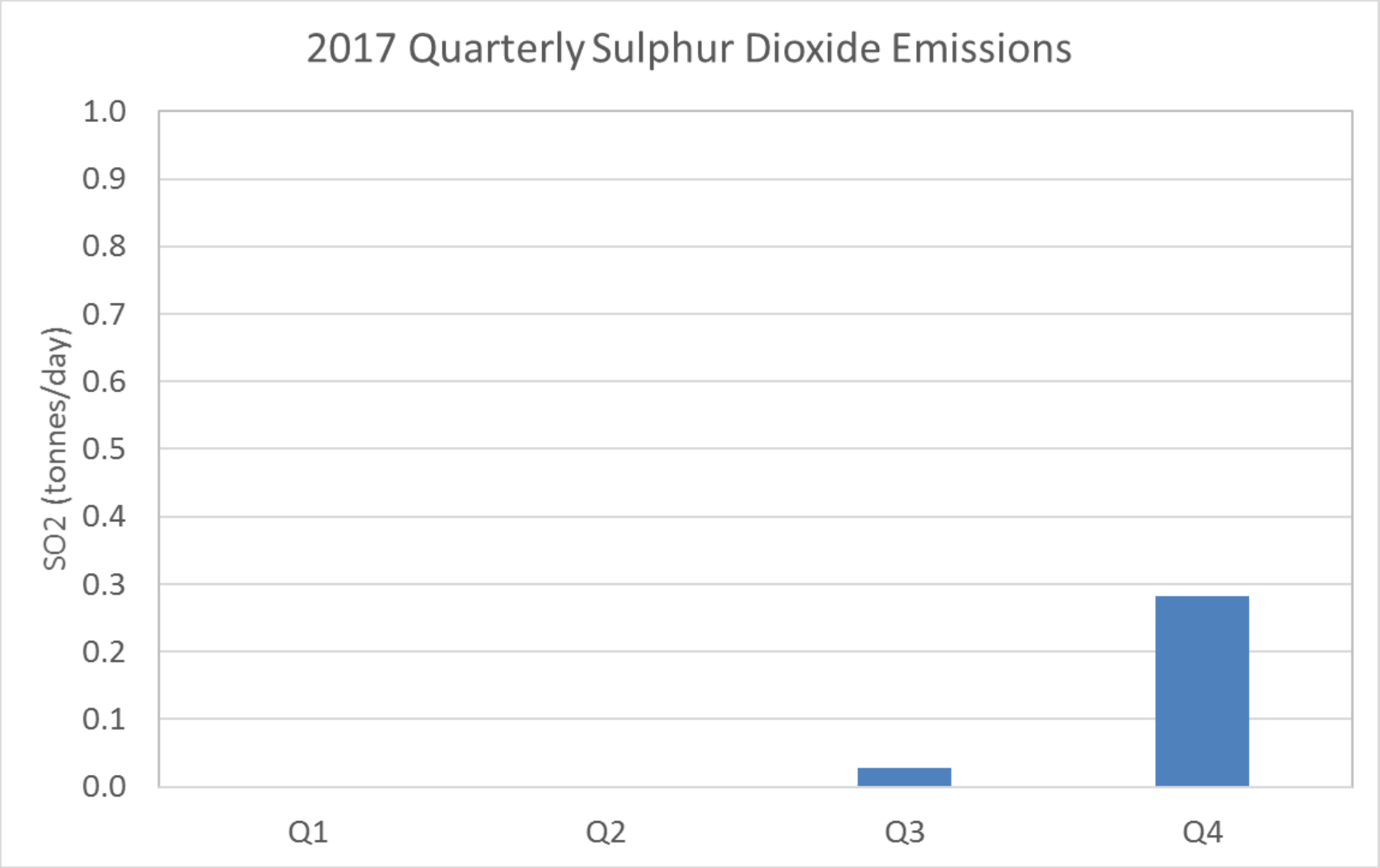
Water Balance at injection facility

(m^3)	IN					OUT							(ABS) Δ(%)
	Produced Water	Raw Water	Water from Other	ΔINV	Total	Steam to Wells	Disposal to Truck out	Utility Water	Evaporation	Water to Well	ΔINV	Total	
May	21,282	24,290	450	-3,304	42,718	21,718	0	83	23,071	208	-1,029	44,051	3.1%
June	58,989	23,963	0	-4,855	78,097	62,397	0	90	12,673	285	8,601	84,046	7.6%
July	102,082	14,667	0	-202	116,548	102,530	2,165	144	29,201	14	-9,257	124,798	7.1%
August	134,527	17,686	0	199	152,412	134,935	1,869	141	22,334	0	564	159,842	4.9%
September	135,866	14,794	88	167	150,915	138,000	1,482	123	17,605	0	-2,534	154,677	2.5%
October	136,234	19,253	0	-270	155,217	147,754	1,573	130	5,465	0	-195	154,727	0.3%
November	147,837	26,433	0	-101	174,169	148,446	1,966	117	8,410	0	2,316	161,255	7.4%
December	201,771	21,196	0	9	222,977	204,238	2,736	124	8,183	0	-2,371	212,909	4.5%
Total	938,588	162,282	538	-8,356	1,093,052	960,017	11,790	953	126,942	507	-3,905	1,096,305	0.3%

Sulphur Production



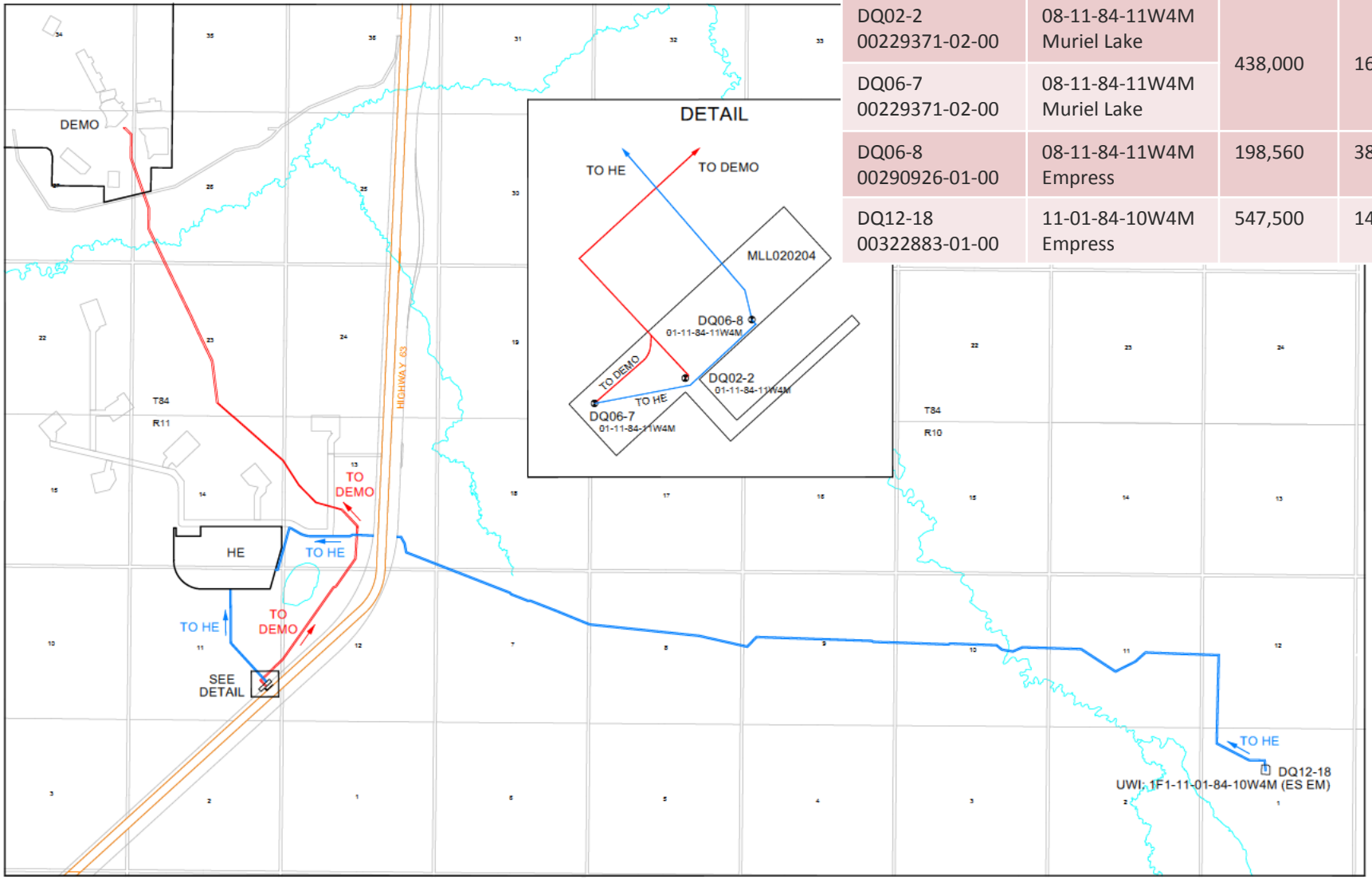
Quarterly Sulphur Production



Water: Source, Produced, Injection, Disposal

Water Source Wells

Well Name WA License No.	Location Aquifer	Alloc. (m3/yr)	Actual Used (m3)
DQ02-2 00229371-02-00	08-11-84-11W4M Muriel Lake	438,000	16,556
DQ06-7 00229371-02-00	08-11-84-11W4M Muriel Lake		
DQ06-8 00290926-01-00	08-11-84-11W4M Empress	198,560	38,489
DQ12-18 00322883-01-00	11-01-84-10W4M Empress	547,500	141,089



Vision. Integrity. Stability.

2017 Fresh Water Usage

(m^3)	Fresh Water Wells			Total
	DQ06-7	DQ06-8	DQ12-18	
January	0	0	0	0
February	0	0	0	0
March	4,809	853	4,360	10,021
April	6,753	3,858	13,544	24,155
May	2,641	8,367	13,283	24,290
June	887	8,246	14,830	23,963
July	0	0	14,667	14,667
August	1,466	1,786	14,434	17,686
September	0	3,517	11,189	14,706
October	0	1,619	17,634	19,253
November	0	5,542	20,891	26,433
December	0	4,702	16,258	20,960
Total	16,556	38,489	141,089	196,133
Max Annual Diversion	438,000	198,560	547,500	

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Directive 81: Disposal Limit vs. Actual

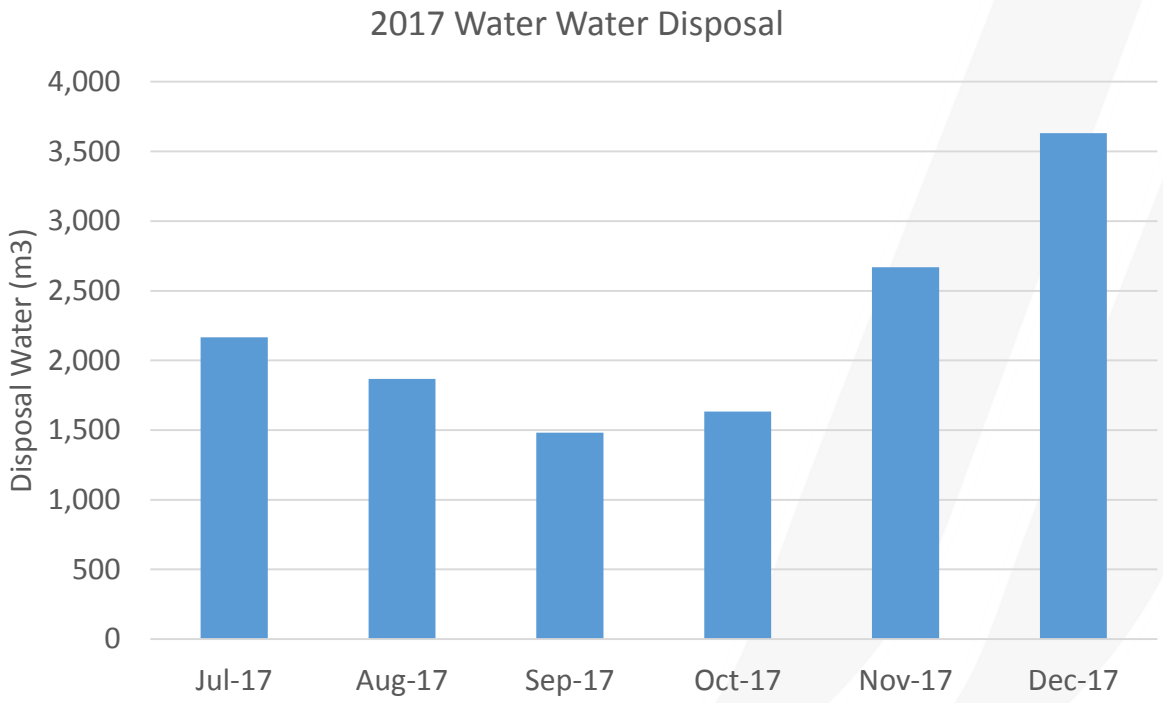
	Cumulative Produced Water (m3)	Cumulative Fresh Water (m3)	Cumulative Disposal Volume (m3)	YTD Disposal Limit	YTD Disposal Actual
Jan	0	0	0	N/A	N/A
Feb	0	0	0	N/A	N/A
Mar	0	10021	0	3.00%	0.00%
April	88	37140	0	3.02%	0.00%
May	20751	61880	0	4.76%	0.00%
June	85997	85843	0	6.50%	0.00%
July	195261	100510	2165	7.62%	0.73%
August	331885	118196	4034	8.16%	0.90%
September	469914	132990	5516	8.46%	0.91%
October	603096	152243	7148	8.59%	0.95%
November	736062	178675	9818	8.63%	1.07%
December	929457	199872	13449	8.76%	1.19%

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

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

Waste Water Disposal Volumes 2017

- OFFSITE DISPOSAL - WhiteSwan (Lease#2-14-84-11)
- Total 13,449m3 disposal water in 2017



Other Wastes

Waste Management

Waste Receiver	Location	Waste Description	Quantity	Disposal Method
Stony Mountain	RMWB (16-21-88-09 W4M)	Wood	160,650 kg	Landfilled
		Industrial Waste	212,580 kg	
		Construction Debris	29,770 kg	
		Cardboard	13,580 kg	
		Domestic Waste	5,924 kg	
		Concrete Waste	4,600 kg	
Stony Mountain	Sunset Recycle and Sale	Metals	113,090 kg	Processed and recycled
Clear Glycol	4607-41 Street, Stettler AB	Glycol	4.8 m^3	Treated and recycled
GFL Environmental	4208 84th AVE NW, Edmonton	BATT(NDOW)	1 bag	Processed and recycled
		EMTCON	9.7 m^3	
		EMTCON	206 kg	
		FILSWT	1.2 m^3	
		OILABS	8.1 m^3	
		OILRAG	12 m^3	
		SLGHYD	1.62 m^3	
Newalta Clearwater	02/03-05-084-06w4/0	COEMUL	6 m^3	Deep well disposal (Class 1b)
		WWOFLD	20 m^3	
Tervita - Janvier	SE 1/4 03-081-06w4	SLGLIM	1,642 tonnes	Landfill
		SOILCO	194.1 tonnes	
White Swan Environmental	Atmore 11-23-67-18-W4M	BLBDWT	13,449 m^3	Disposed of at Disposal Well
		COEMUL	149 m^3	
		DRWSGC	75 m^3	
		WATER	38 m^3	
		WWOFLD	40 m^3	
RBW Waste Management	3280-10 Street Edmonton	WSTFLQ	4 m^3	Processed and Recycled
		ORGCHM	4 m^3	

Environmental Monitoring Programs

Environmental Monitoring Programs

- **Groundwater Monitoring Program:** Groundwater monitoring events are now completed in spring and fall, interim reports (internal) in spring and comprehensive, triennial report due to AER in 2019. In 2017, we identified significant increases in EC, SO4, and TDS at a CPF monitoring well, this is under further investigation.
- **Wetlands Monitoring Program:** Wetlands and surface monitoring data now collected for 2015, 2016, 2017. Interim report and comprehensive data analysis and report due March 31, 2018.
- **Rare Plant Monitoring:** Four rare species were identified prior to construction, 1 was relocated and 3 were proximal to development. Surveys in 2015 determined 3 species were healthy and thriving, and a 2016 survey confirmed the presence of the 4th. 2017 surveys confirmed 3 healthy individuals of the 4th species.
- **Soil Monitoring Program:** Done in 2015 to provide baseline data to determine whether contaminants exist. Report submitted to the AER on January 29, 2015. No further work needed till next survey in 2020.
- **Wildlife and Caribou Programs:** Targets and metrics established and met or exceeded over 3 year 2012-2014 monitoring period when first comprehensive report was submitted in May 2015. JACOS has also established 30 remote cameras and 16 auditory recording units to monitor wildlife in summer 2014; to date, 22 cameras remain as 6 have been stolen and 2 damaged by other operations in the area. The next 3 year comprehensive report is due in May 2018.
- **Regional Monitoring Programs:** Involved in programs through the Alberta Environmental Monitoring, Evaluation and Reporting Agency (AEMERA). 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 participating member of the Monitoring Working Group of the Canadian Oil Sands Innovation Alliance (COSIA).

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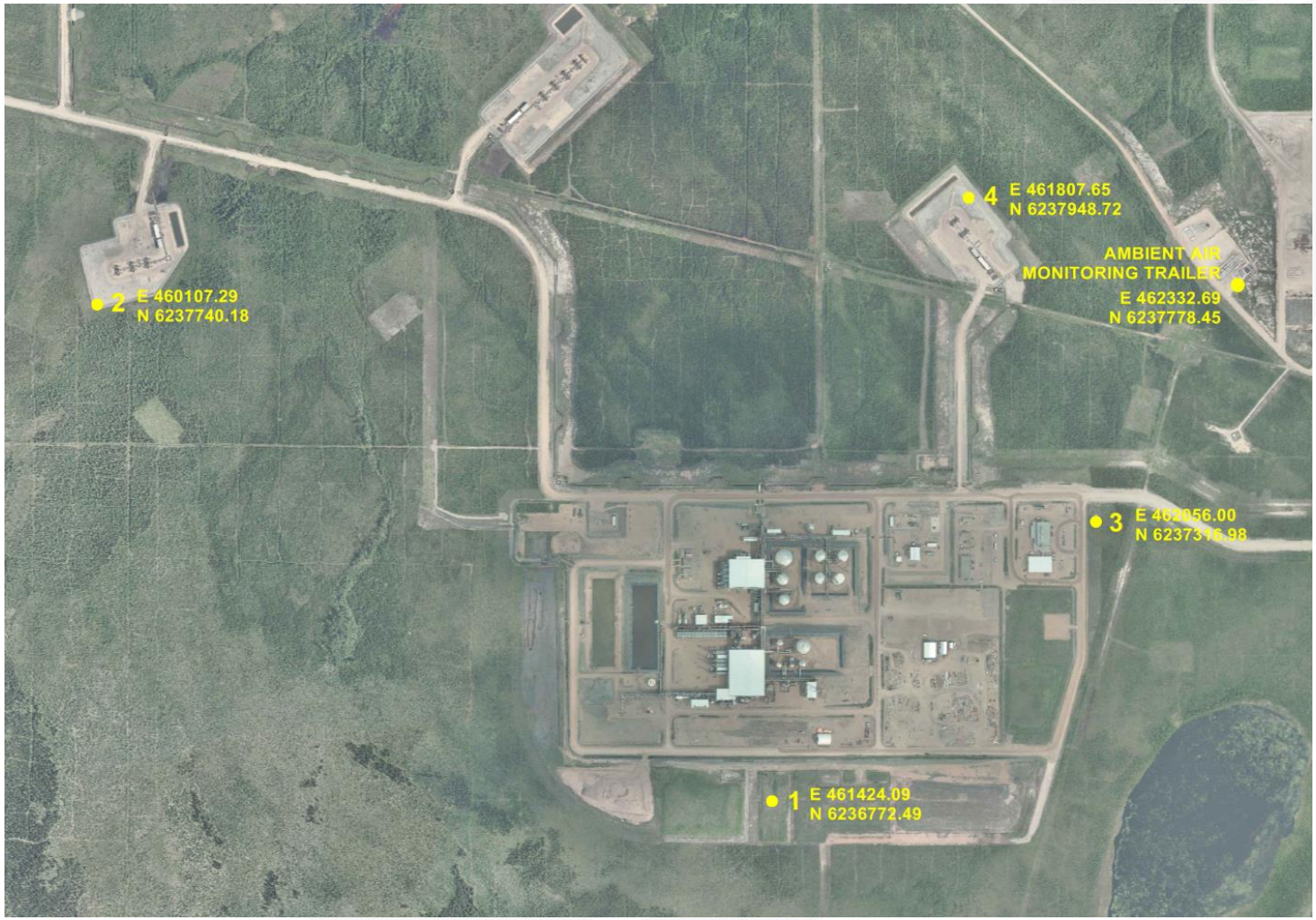
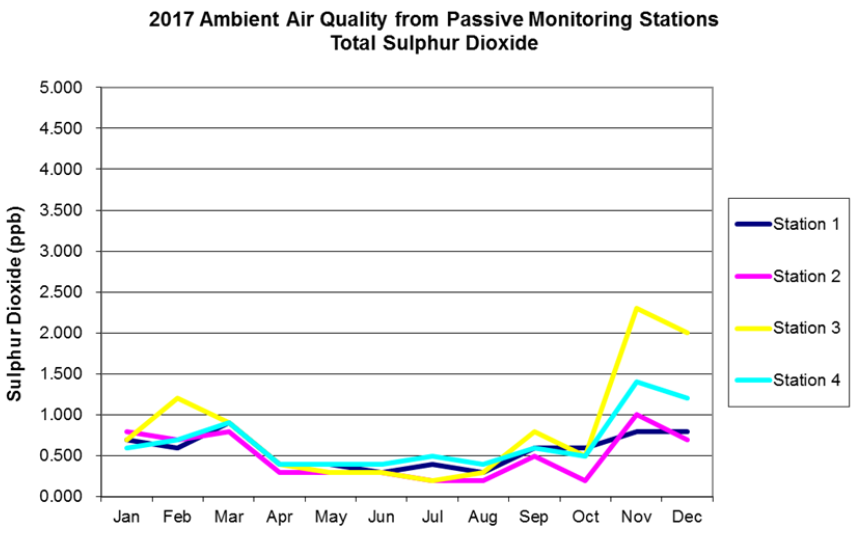
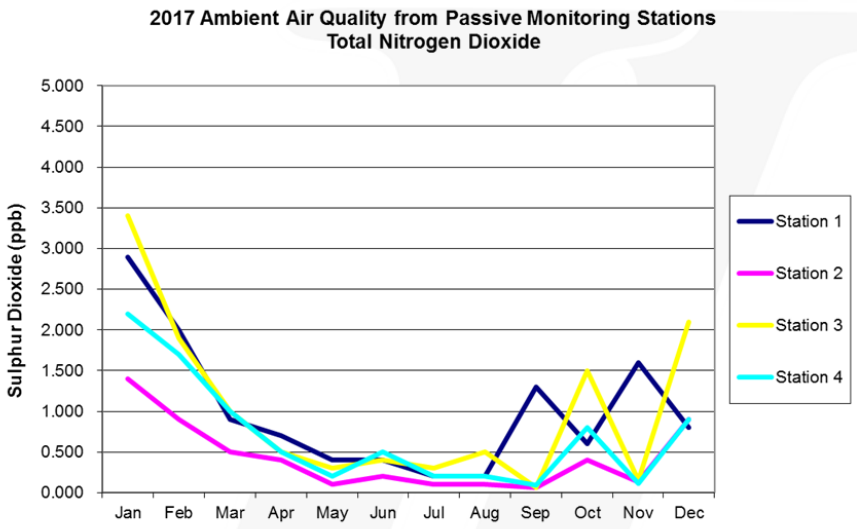
Environmental Monitoring – Air Quality

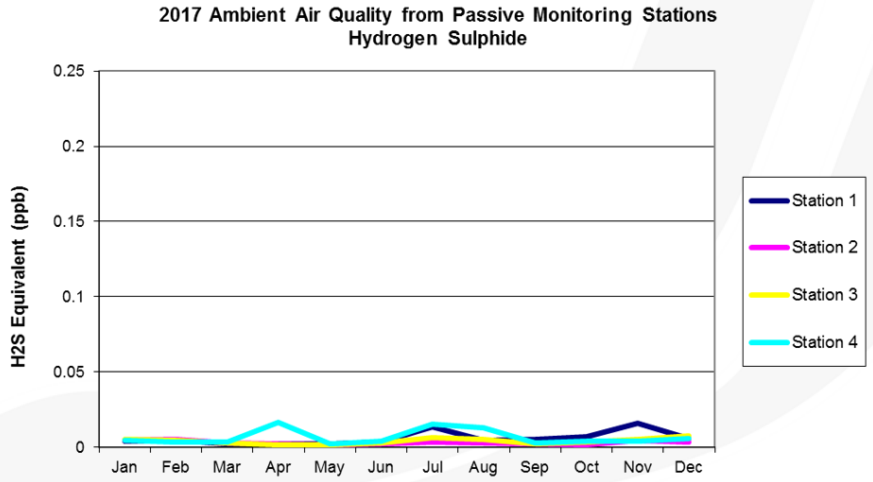
Air Monitoring Station Locations



Passive Exposure Stations Results 2017



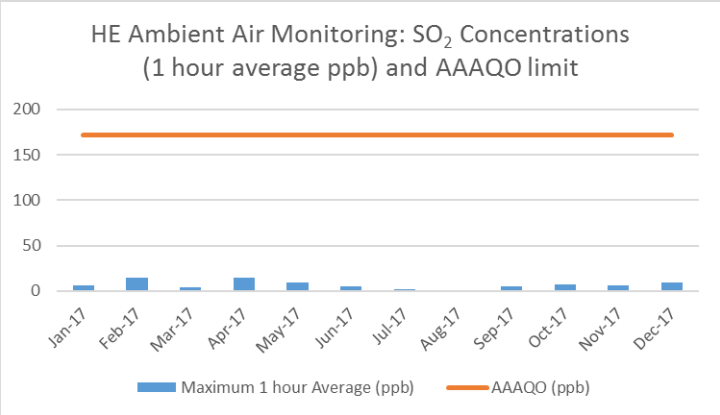


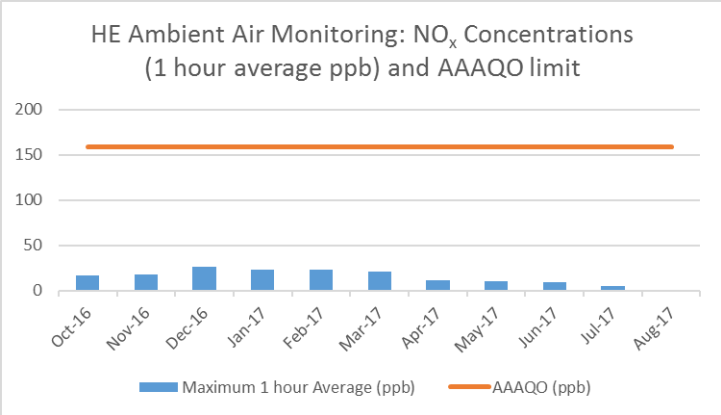


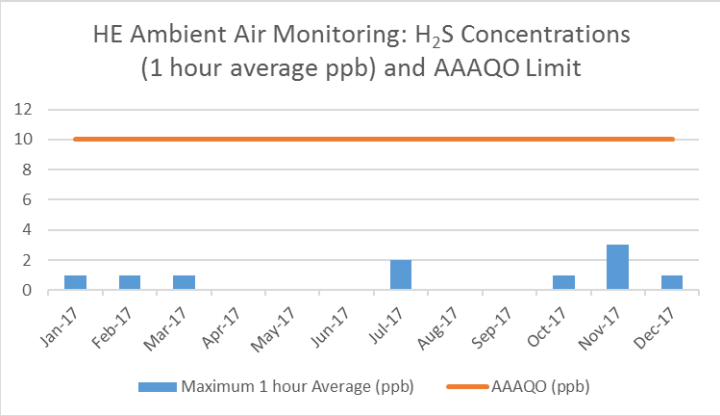
Ambient Air Monitoring - Summary

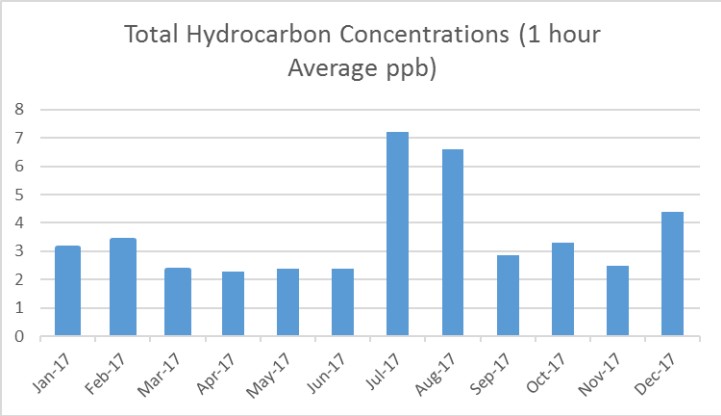
- AEP Audit on February 8th, 2017 found data quality issues with THC, NO_2, and SO_2 analyzers.
- Trailer changed out in March 2017 following authorization from AER.
- No exceedances were recorded in 2017.
- Operational Time Contraventions were reported in January, February, and December.

Ambient Air Monitoring Results 2017









Source Air Emissions Monitoring

Air Emission Source	Parameter	Method	Result	Limit
OTSG B-510 (Mixed Fuel)	NO_x (as NO_2)	Manual Stack Survey/RATA	2.79 kg/hr	12.3 kg/hr
OTSG B-515 (Mixed Fuel)	NO_x (as NO_2)	Manual Stack Survey	3.78 kg/hr	12.3 kg/hr
OTSG B-520 (Natural Gas)	NO_x (as NO_2)	Manual Stack Survey	4.44 kg/hr	12.3 kg/hr
OTSG B-525 (Natural Gas)	NO_x (as NO_2)	Manual Stack Survey/RATA	To be completed in March 2018	12.3 kg/hr
Glycol Heater H-721	NO_x (as NO_2)	Manual Stack Survey	0.758 kg/hr	1.3 kg/hr
Glycol Heater H-726	NO_x (as NO_2)	Manual Stack Survey	0.892 kg/hr	1.3 kg/hr

CEMS Certification Summary

B-510 (Mixed Fuel Steam Generator)

- First fired: April 10, 2017 - Certification required by October 9, 2017 (CEMS code)
  - CEMS Commissioning: Aug 4
  - Introduction of mixed fuel: Sept 4
  - Conditioning Test Period (CTP): Aug 29 – Sept 4
  - Operational Test Period (OTP): Sept 16 – 22
  - Relative Accuracy Test Audit (RATA): Sept 26

B-525 (Natural Gas Steam Generator)

- First fired: September 10, 2017 - Certification required by March 11, 2018
  - CEMS Commissioning: Aug 4
  - CTP: Feb 12 – 18, 2018
  - OTP: Feb 20 – 26, 2018
  - RATA: Feb 27, 2018

B-510 CEMS Performance Summary

- November:
  - There was an unplanned outage of B-510 from October 27 – November 18 which caused the Flowsic (velocity) probe to freeze. As a result the CEMS was not available until modifications were undertaken and the probe was calibrated on November 22.
- All Months:
  - Continued challenges on wet oxygen analysis which is required to calculate NO_x Mass Rate. Sample lines become plugged every two – four weeks. JACOS continues to work on a solution to the issue.

Remediation and Reclamation Progress

- In 2017 remediation work continued on the 5 remaining OSE programs. JACOS will submit RecApps for the 5 programs in Q1 of 2018.
- Vegetation management continued throughout the site, and fire breaks.
- Detailed Site Assessment conducted at former remote sumps 13-13-84-11 W4M and 16-14-84-11 W4M. RecApps to be submitted in Q1 of 2018.
- Throughout 2017, JACOS maintained its involvement in iFROG (COSIA-JIP).

Environmental Issues, Compliance Statement, and Approvals

2017 Compliance Statement

JACOS is in compliance with conditions of their approval subject to the following:

- Liner integrity issue in the Process Pond Sump Building – OSCA
- Ingress of groundwater into the Hydrocarbon Drain Vault in BU-101 - OSCA
- CEMS availability below 90% - EPEA Approval

2017 Compliance Statement (cont.)

CIC Reference Number	Date	Description
320482	January 28	1m3 Glycol spill from an in line heater into secondary containment.
321264	January 22	Ambient Air Trailer SO2 Analyzer did not met 90% Operational Time.
321263	February 20	1.2 m3 of glycol spilled from valve malfunction. Mostly contained inside the VRU skid, but 10L of glycol was released to the environment.
320822	February 4	Ambient Air Trailer H2S Analyzer did not met 90% Operational Time.
322912	April 7	0.5m3 glycol spill from pipe tree next to blowdown tank.
329384	June 7	Flare knock out overflow and flare pilot light outage resulting in black smoke and liquid droplets out the top of flare.
325794	June 15	Contravention of Water Diversion Limit (WA 290926-01-00) – Exceeded diversion limit of 750m3/day for 3 days in April. (777 m3, 860 m3, and 843 m3)

2017 Compliance Statement Summary (cont.)

CIC Reference Number	Date	Description
326605	July 6	Overfill of lime sludge tank resulted in spill of 2.0 m3 of lime sludge into secondary containment.
329660	September 13	10 m3 of produced water spilled into secondary containment during filter backwash.
330099	September 26	Failure to obtain a Produced Gas sample as per Table 3.2 of EPEA Approval.
332224	October 18	B-510 CEMS Availability below 90%.
332047	November 19	B-510 CEMS Availability below 90%.
333027	December 4	Overfill of sump and trench caused bitumen to enter the hydrocarbon drain vessel vault.
334109	December 31	B-510 CEMS Availability below 90%.
333720	December 31	Ambient Air Trailer NO2 Analyzer did not meet the 90% Operational time.

2017 Compliance Statement Summary (cont.)

- **Inactive Well Compliance Program (IWCP) update:** Official program update is not released until Mar 31, but JACOS is compliant with the IWCP program.

Year of Program	Target	Actual
1 (ending Mar 31, 2016)	7	10
2 (ending Mar 31, 2017)	5	6

Approvals

- Application No. 1878445 for Alternative Storage Approval for Lime and MagOx Slurry Tanks submitted on January 26. Approval was issued on March 2.
- Application No. 1885660 for dilation start up submitted April 24, 2017. Disposition issued on May 25, 2017 for Scheme Approval No. 11910C
- Application No. 1902605 for permanent operations camp submitted November 14, 2017. Disposition issued on January 4, 2018. No Scheme Approval amendment required.

Future Plans – Compliance & Approvals

- Application(s) for WP 7, 8, 10
- Application SA-SAGD pilot
- Application for HE wastewater disposal into depleted Demo Project steam chambers (Demo scheme approval amendment)

Appendices

Appendix 5.d.(v)

Injection Wellhead Pressures and Temperature

Well	HE Phase 1 Average Injection Wellhead Pressures (kPa)								HE Phase 1 Average Injection Temperatures (°C)							
	May-17	Jun-17	Jul-17	Aug-17	Sep-17	Oct-17	Nov-17	Dec-17	May-17	Jun-17	Jul-17	Aug-17	Sep-17	Oct-17	Nov-17	Dec-17
W01-01	2,896	3,415	3,935	4,695	4,805	4,746	4,641	4,812	176	242	251	261	262	262	261	263
W01-02	2,861	3,779	3,824	4,350	4,676	4,697	4,580	4,681	177	249	250	258	262	261	260	261
W01-03	2,804	3,683	3,808	4,582	4,693	4,590	4,663	4,717	175	248	250	260	261	260	261	262
W01-04	3,237	3,498	3,845	4,628	4,667	4,622	4,620	4,727	215	245	250	262	262	261	261	262
W01-05	3,312	3,746	4,090	4,483	4,640	4,627	4,659	4,795	237	249	254	255	261	260	261	263
W02-01	2,001	3,898	3,723	4,093	4,388	4,701	4,617	4,619	157	18	(58)	230	255	261	260	260
W02-02	2,006	3,887	3,847	4,345	4,617	4,631	4,437	4,700	157	250	250	257	260	261	258	262
W02-03	2,051	3,996	4,015	4,054	4,240	4,749	4,722	4,604	156	252	251	253	255	261	262	262
W02-04	2,037	3,948	3,658	3,941	4,328	4,737	4,703	4,714	155	251	231	251	256	262	262	263
W02-05	2,440	3,964	4,089	4,216	4,424	4,709	4,727	4,773	161	251	253	255	257	262	262	262
W02-06	2,180	4,006	3,948	4,140	4,331	4,726	4,746	4,594	164	252	241	254	256	262	262	260
W03-01	75	33	1,250	4,299	4,229	4,596	4,249	4,560	15	16	105	257	255	260	250	260
W03-02	382	356	1,284	4,130	4,440	4,658	4,338	4,458	58	29	106	254	257	260	256	258
W03-03	1,685	4,075	4,160	4,281	4,442	4,542	4,224	4,292	116	253	254	255	257	258	255	258
W04-01	1,016	3,969	3,574	3,906	4,122	4,557	4,717	4,511	92	252	220	250	254	260	262	260
W04-02	862	3,950	3,781	4,010	4,516	4,706	4,725	4,826	90	252	249	253	259	242	262	264
W04-03	972	3,811	3,874	3,879	4,483	4,701	4,733	4,699	95	250	250	247	258	262	262	262
W04-04	1,015	3,794	3,734	4,170	4,166	4,750	4,722	4,775	99	235	247	253	254	262	262	262
W04-05	896	3,515	3,852	4,317	4,689	4,758	4,734	4,723	92	245	250	256	261	262	262	262
W05-01	363	331	2,972	4,174	4,291	4,625	4,363	4,191	29	18	187	255	257	260	256	254
W05-02	433	479	2,794	4,166	4,034	4,709	4,547	4,516	29	19	181	255	253	262	260	259
W05-03	604	697	1,857	4,163	4,171	4,617	4,185	4,276	30	19	115	255	255	260	255	255
W05-04	916	2,083	3,564	4,075	3,736	4,706	3,887	2,481	113	108	217	254	248	261	203	108
W05-05	401	1,506	3,059	4,170	4,200	4,411	4,040	4,180	58	106	192	255	255	215	252	254
W05-06	337	1,908	3,123	4,020	4,280	4,735	4,389	4,510	59	107	190	252	256	246	257	259
W05-07	471	2,264	3,117	4,176	4,179	4,653	4,210	4,160	61	92	161	224	201	243	210	242
W05-08	505	1,531	3,374	4,133	4,253	4,668	4,455	4,526	101	106	216	254	256	249	258	250
W05-09	548	2,262	3,585	4,238	4,282	4,674	4,475	4,714	105	108	218	256	256	250	259	262
W06-01	130	46	1,002	4,137	4,396	4,603	4,311	4,550	28	29	97	254	257	260	256	260
W06-02	218	399	980	4,406	4,385	4,569	4,396	4,331	26	28	96	258	257	260	258	257
W06-03	644	3,801	3,657	4,186	4,718	4,796	4,828	4,835	78	249	247	255	261	262	263	263
W06-04	633	3,717	3,730	4,080	4,674	4,759	4,820	4,818	80	250	248	243	260	262	263	263

100% Steam Quality* @:Pad 1-6 * Steam Traps in all pads

Temperatures in red correspond to tubing temperatures as heel still has a gas blanket

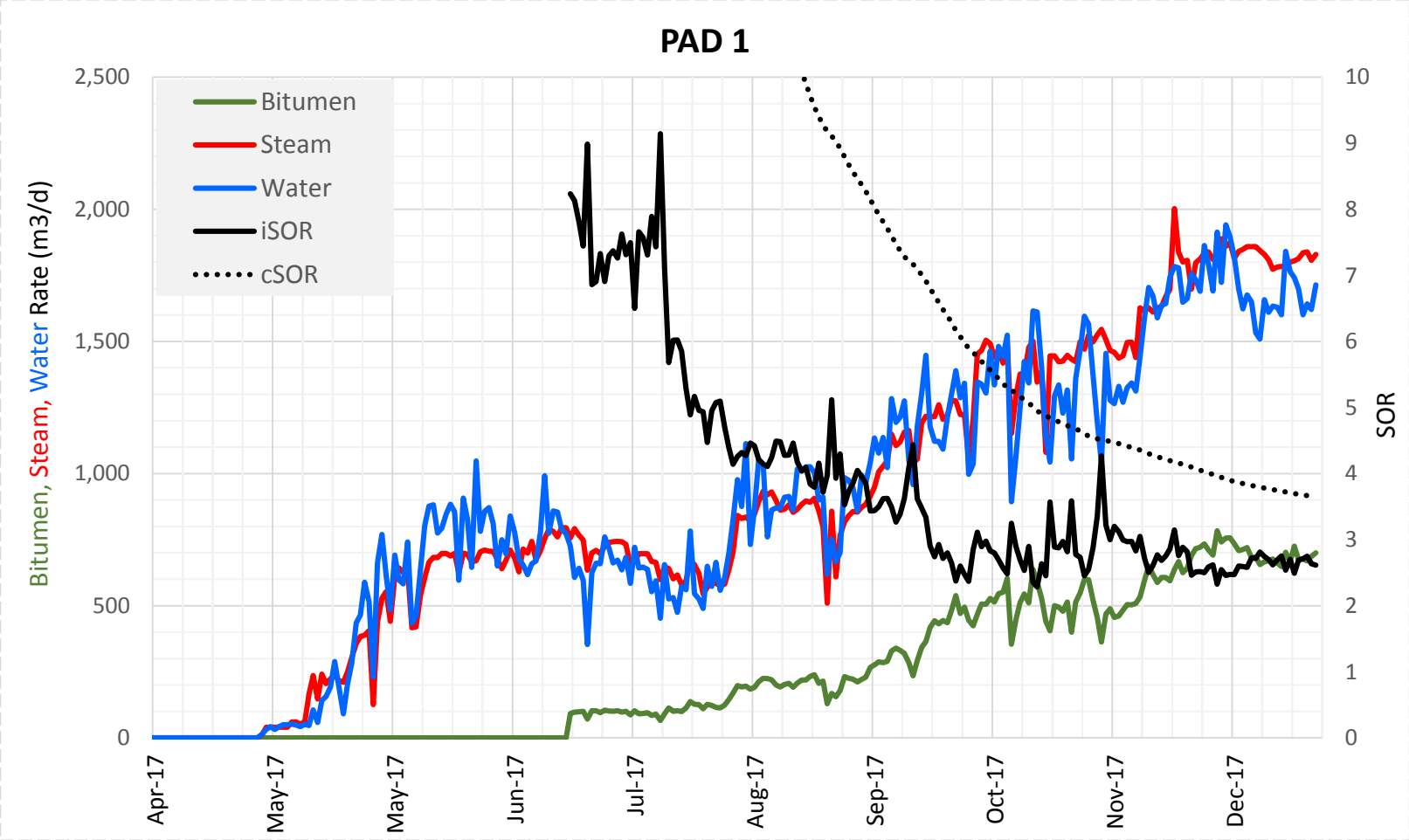
Monthly Well Pressures (Gas Blanket)

HE Phase 1 Average Heel Pressures (kPa) (Gas blankets)								
Well	**May-17**	**Jun-17**	**Jul-17**	**Aug-17**	**Sep-17**	**Oct-17**	**Nov-17**	**Dec-17**
W01-01	3,317	3,376	3,907	4,133	4,817	4,753	4,650	4,810
W01-02	3,275	3,727	3,778	4,291	4,594	4,628	4,435	4,519
W01-03	3,240	3,636	3,760	4,544	4,539	4,479	4,573	4,632
W01-04	3,505	3,435	3,795	4,553	4,598	4,499	4,517	4,591
W01-05	3,393	3,703	4,055	4,468	4,530	4,486	4,558	4,714
W02-01	2,071	3,851	3,691	4,058	3,897	4,695	4,578	4,416
W02-02	2,051	3,884	3,831	4,337	4,525	4,604	4,379	4,590
W02-03	2,126	3,969	4,019	4,030	4,225	4,761	4,679	4,468
W02-04	2,082	3,912	3,763	3,905	4,306	4,721	4,665	4,628
W02-05	2,870	3,924	4,086	4,196	4,313	4,704	4,725	4,766
W02-06	2,347	3,972	4,045	4,106	4,327	4,729	4,766	4,596
W03-01	103	50	1,194	4,267	4,200	4,584	4,291	4,538
W03-02	646	658	1,228	4,095	4,428	4,661	4,319	4,444
W03-03	2,056	4,075	4,143	4,265	4,445	4,574	4,193	4,150
W04-01	1,022	3,903	3,766	3,862	4,090	4,540	4,689	4,476
W04-02	828	3,886	3,728	3,965	4,490	4,665	4,711	4,805
W04-03	994	3,746	3,847	3,883	4,413	4,657	4,682	4,586
W04-04	1,029	3,824	3,715	4,166	3,384	4,732	4,689	4,742
W04-05	864	3,451	3,819	4,319	4,680	4,729	4,695	4,643
W05-01	720	650	3,107	4,111	4,259	4,560	4,473	3,656
W05-02	516	619	2,858	4,147	4,023	4,480	4,561	4,532
W05-03	745	708	1,777	4,149	4,160	4,629	4,203	4,353
W05-04	1,052	2,722	3,762	4,027	3,697	4,693	4,247	2,378
W05-05	391	1,747	3,167	4,145	4,171	4,661	4,072	4,263
W05-06	370	2,422	3,349	4,004	4,277	4,599	4,395	4,523
W05-07	479	2,899	3,418	4,150	4,177	4,680	4,258	4,161
W05-08	420	1,557	3,405	4,078	4,221	4,339	4,427	4,378
W05-09	461	2,273	3,645	4,220	4,277	4,275	2,236	
W06-01	182	90	967	4,110	4,393	4,602	4,311	4,508
W06-02	361	750	936	4,393	4,396	4,551	4,395	4,340
W06-03	808	3,762	3,633	4,175	4,558	4,794	4,821	4,821
W06-04	805	3,526	3,681	4,112	4,147	4,725	4,780	4,801

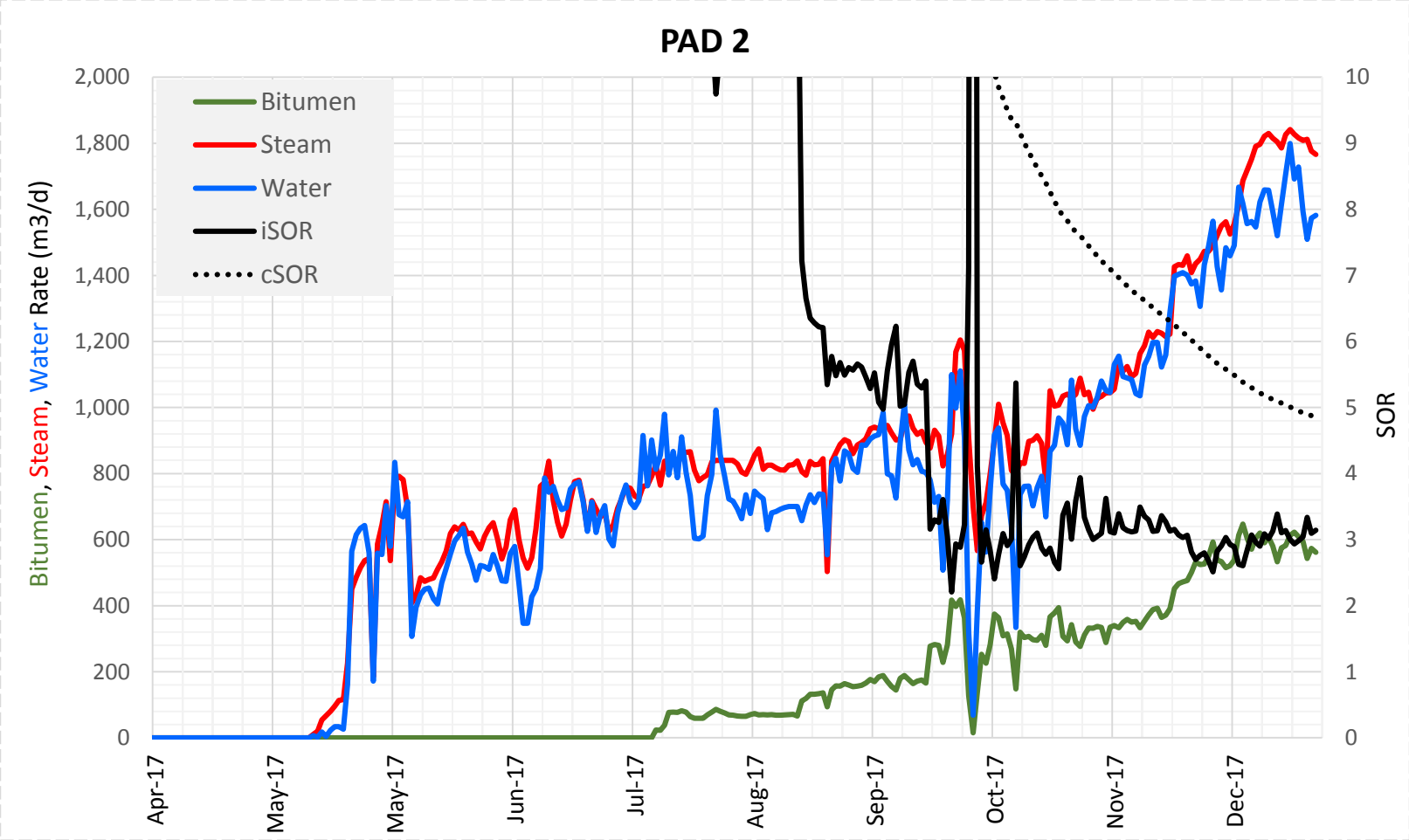
* Gas blanket pressures highlighted in yellow correspond to change from tieback casing to the 11 ¾” casing. This change is made when steam is added to the heel.

Appendix 7(h)

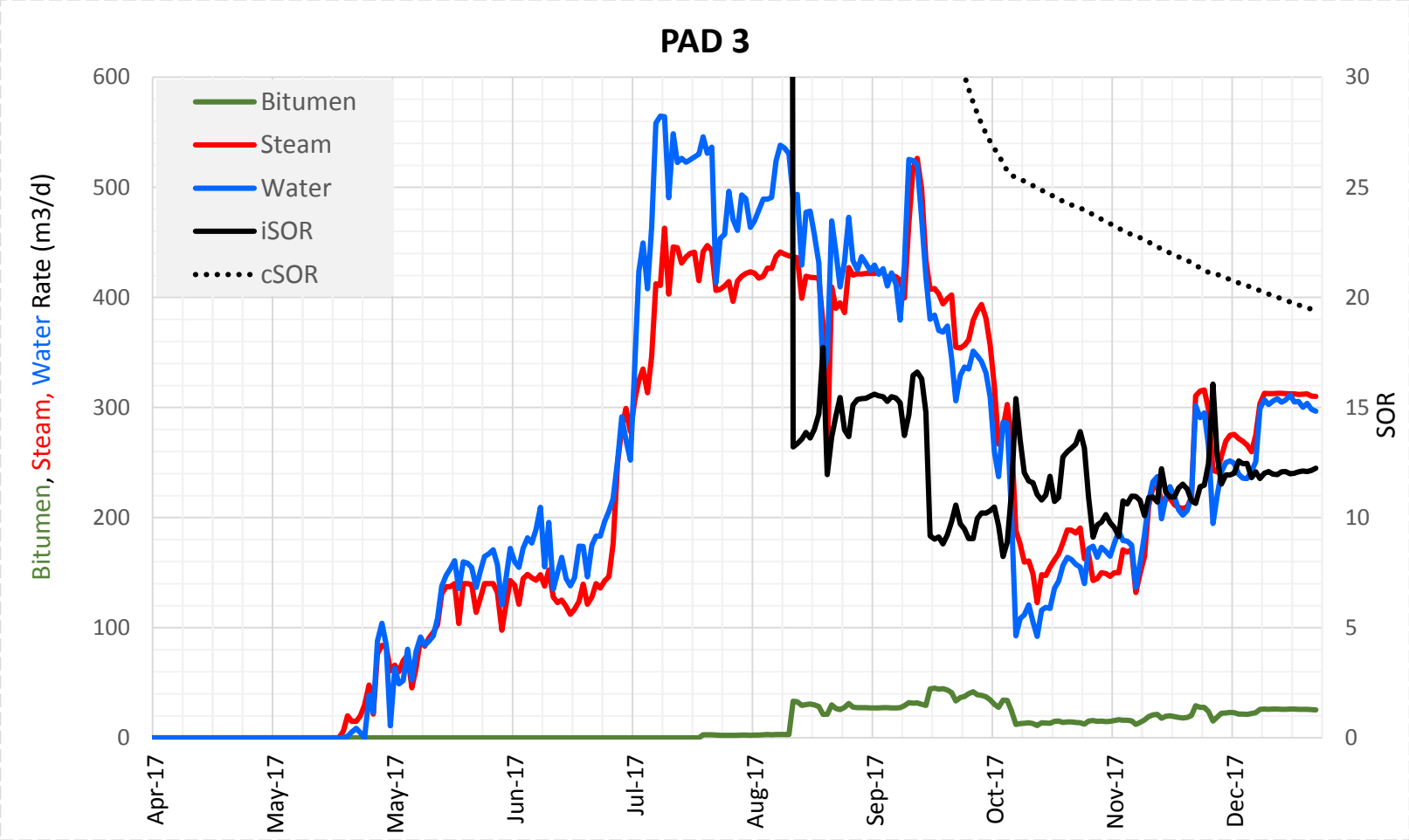
HE Phase 1 Pad Basis Performance



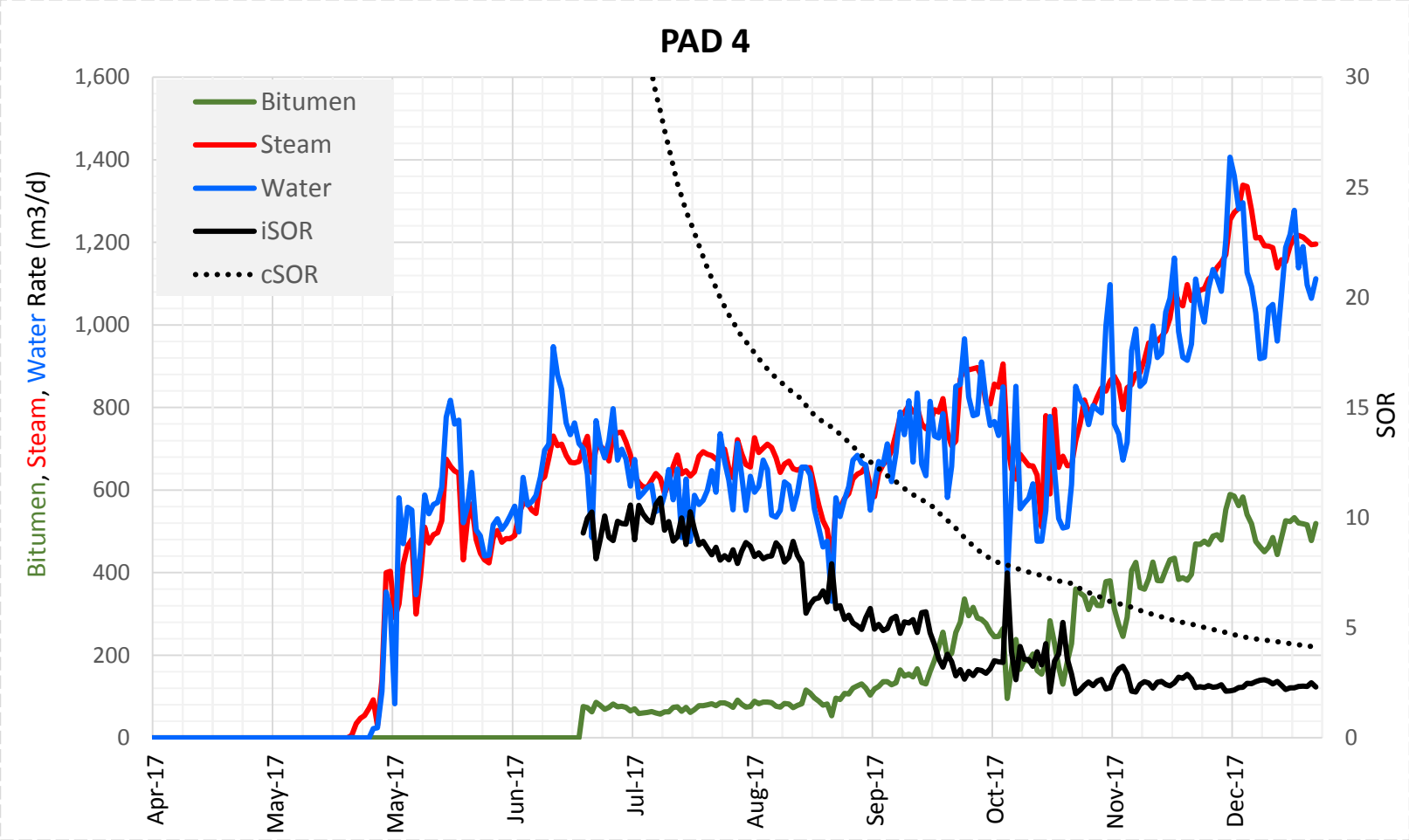
HE Phase 1 Pad Basis Performance



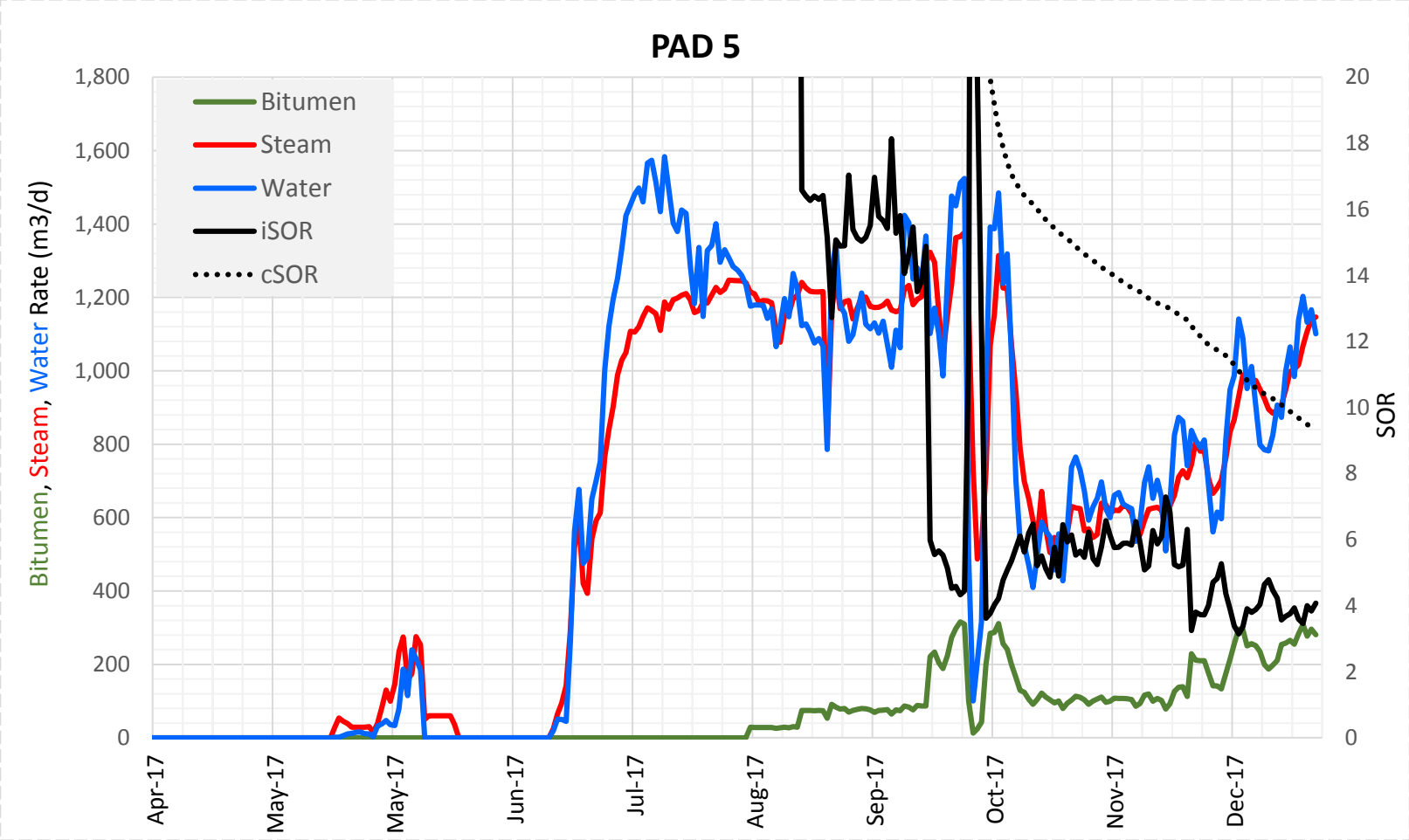
HE Phase 1 Pad Basis Performance



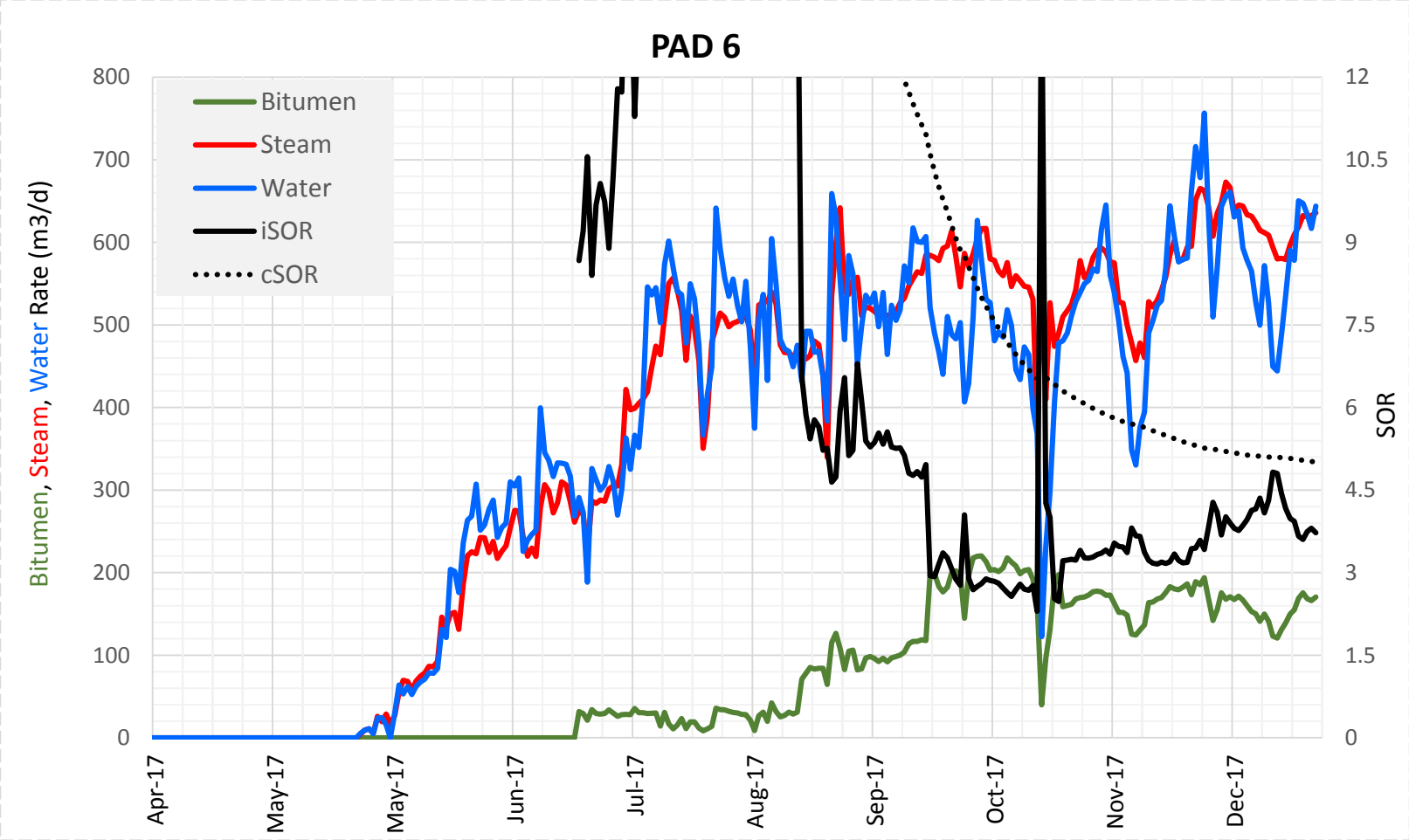
HE Phase 1 Pad Basis Performance



HE Phase 1 Pad Basis Performance

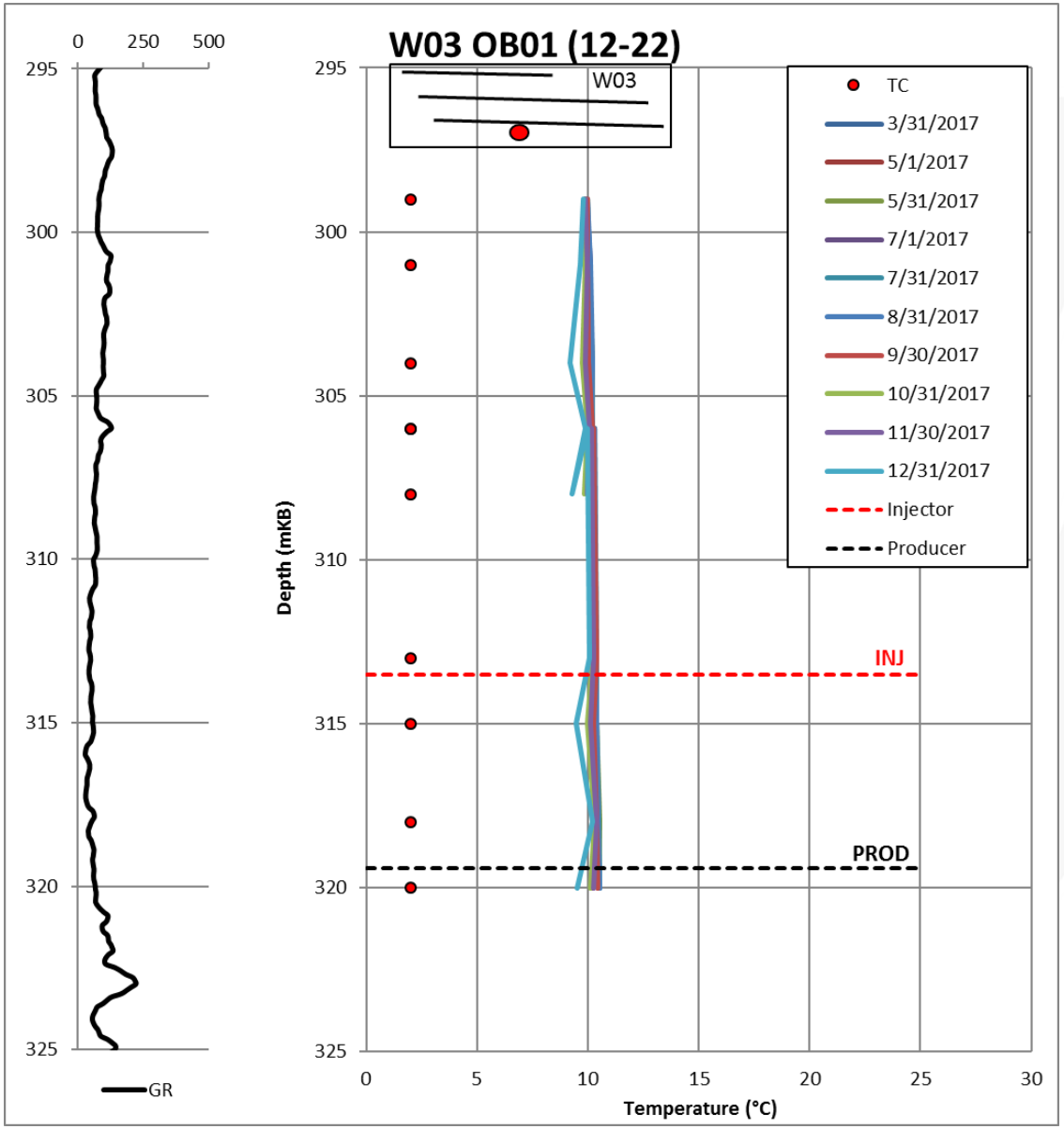


HE Phase 1 Pad Basis Performance

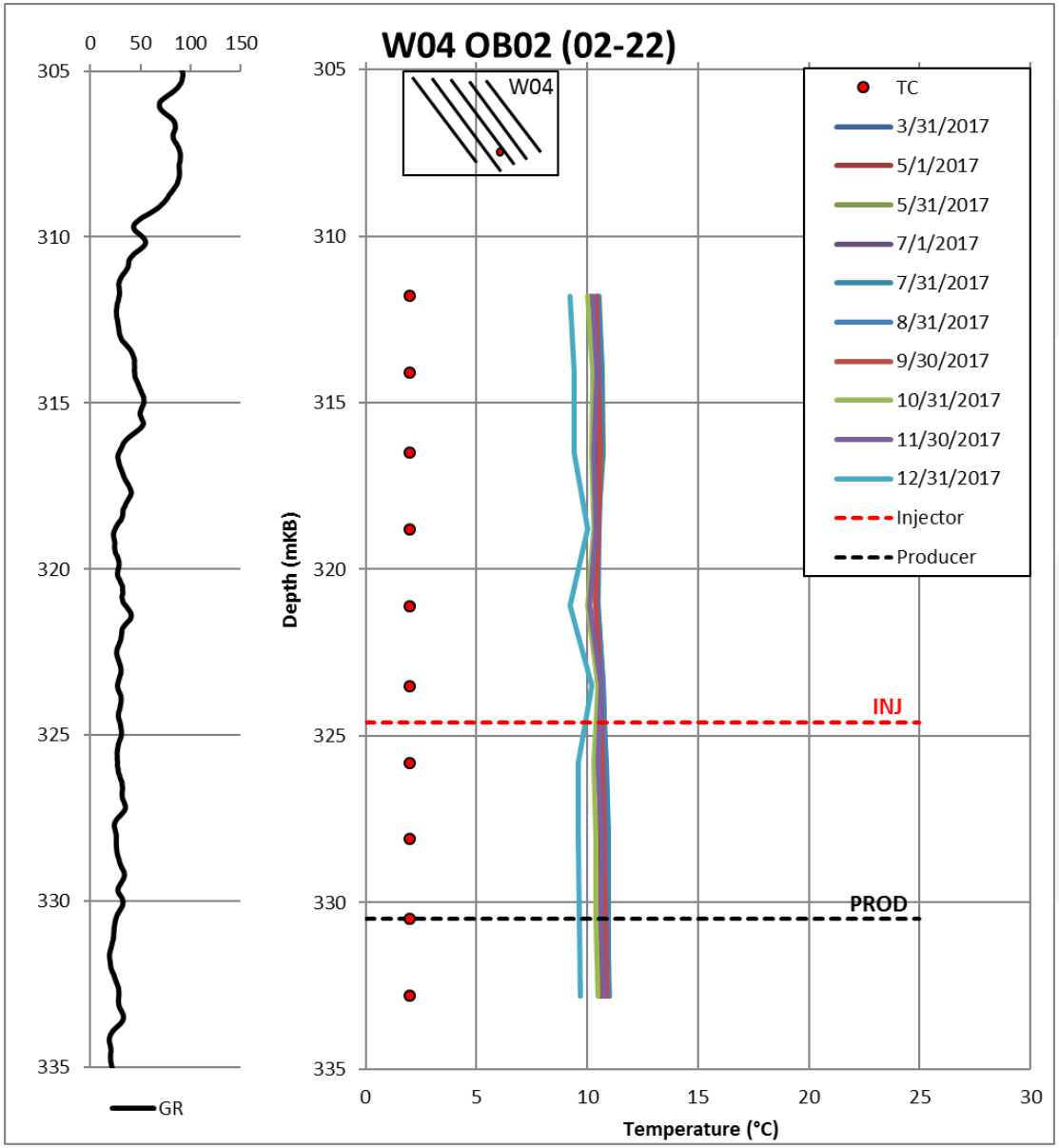


Appendix 5(b)

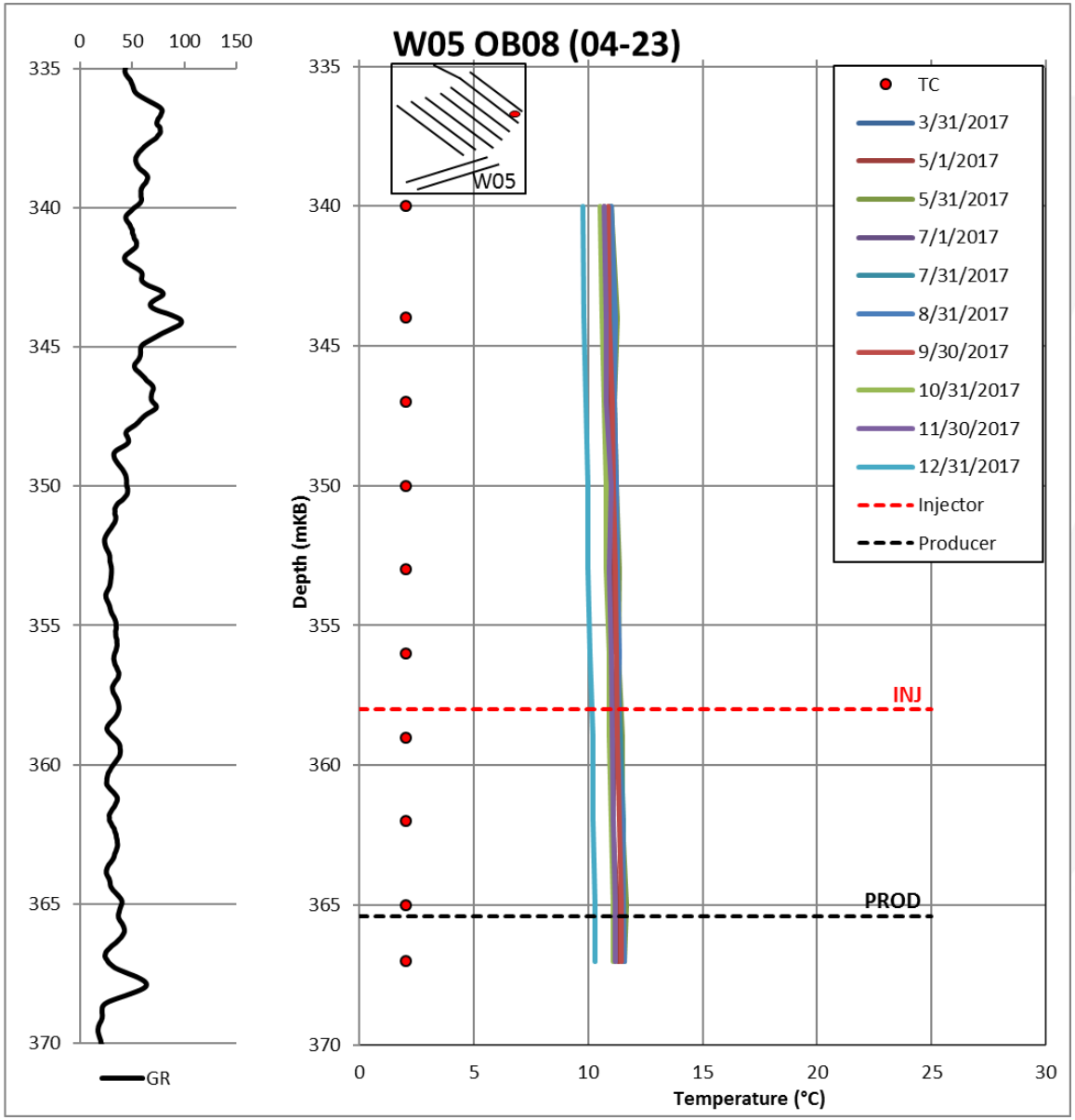
HE Phase 1 Observation Wells



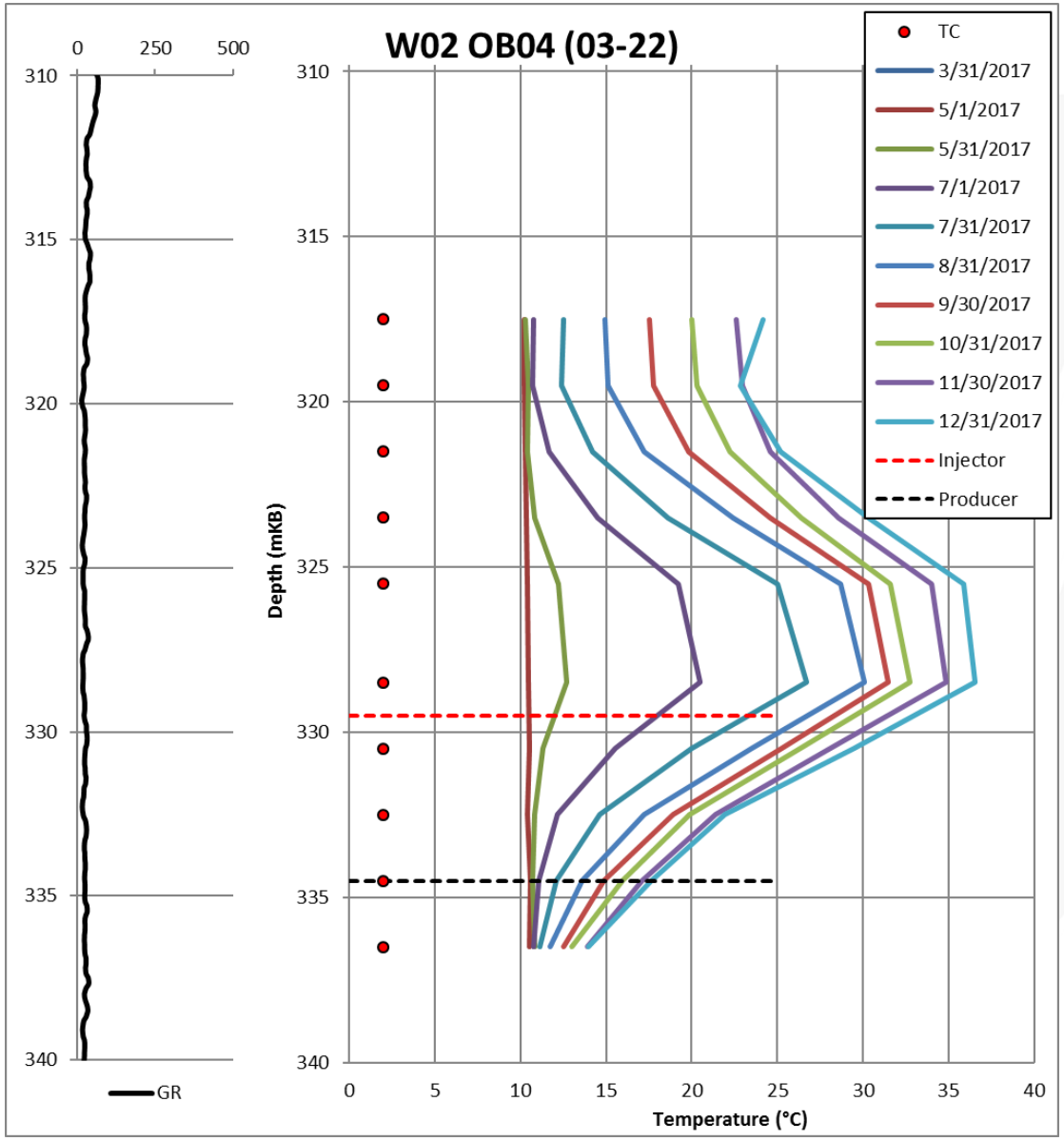
HE Phase 1 Observation Wells



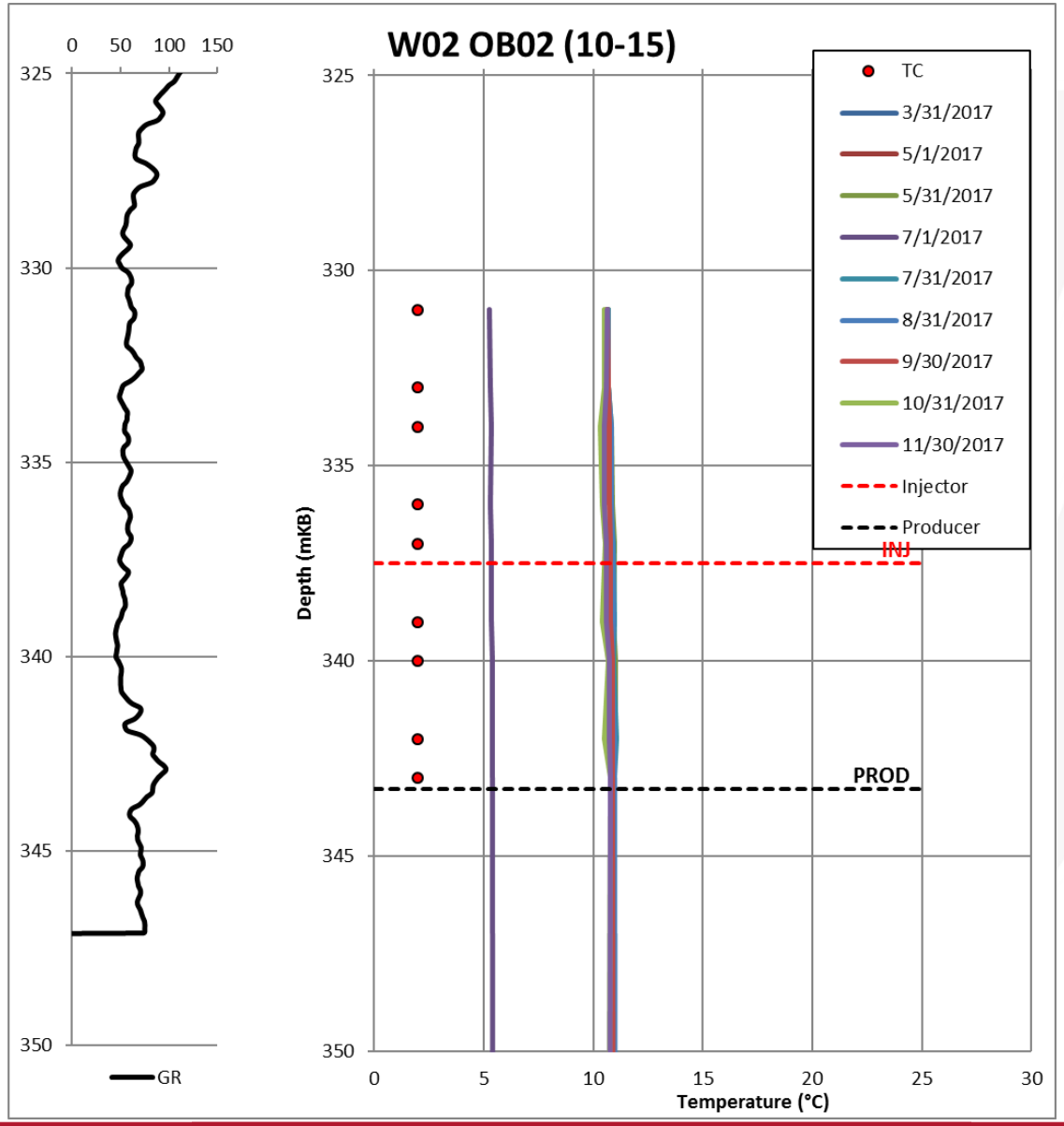
HE Phase 1 Observation Wells



HE Phase 1 Observation Wells



HE Phase 1 Observation Wells



HE Phase 1 Observation Wells