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Thermal In-Situ Scheme Progress Report for 2014
Japan Canada Oil Sands Limited Hangingstone

Approval Nos. 8788 (Demo) & 11910 (Expansion Project)

Presented on February 17, 2015

Vision. Integrity. Stability.

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1. Background - Hangingstone

➢ Demonstration	Enzo Pennacchioli
➢ Expansion	Enzo Pennacchioli

2. Subsurface

➢ Geosciences	Leigh Skinner
➢ Well Design & Instrumentation	Bob Park
➢ Reservoir Performance	Luong Doan

3. Surface Operations

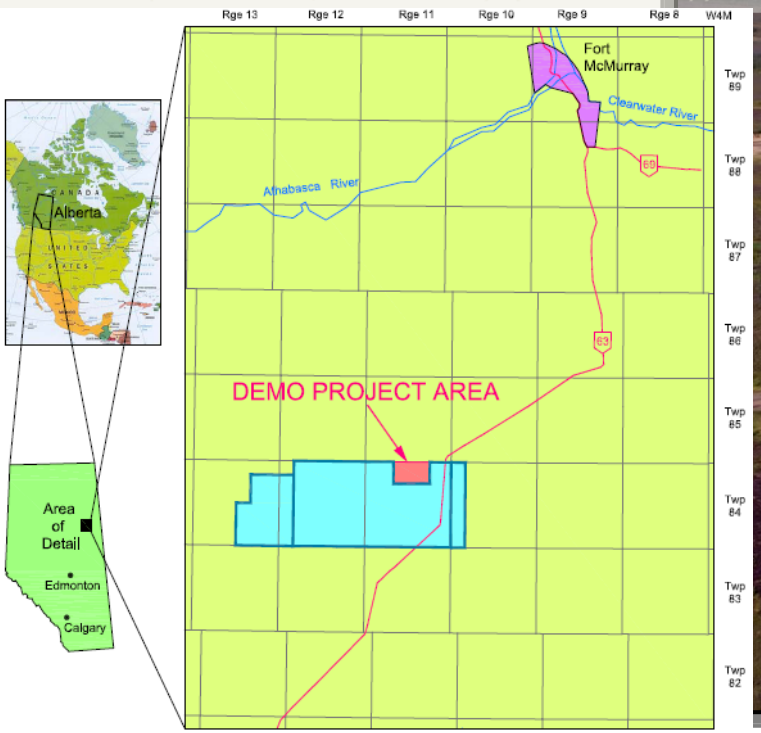
➢ Facility Design	Bob Park
➢ Facility Performance	"
➢ Measurement & Reporting	"
➢ Water:	"
➢Source	
➢Disposal	
➢ Other wastes	Bob Park
➢ Sulphur emissions	"
➢ Environmental (included but not presented)	
➢ Compliance Statement & Approvals	Enzo Pennacchioli
➢ Future Plans	Enzo Pennacchioli

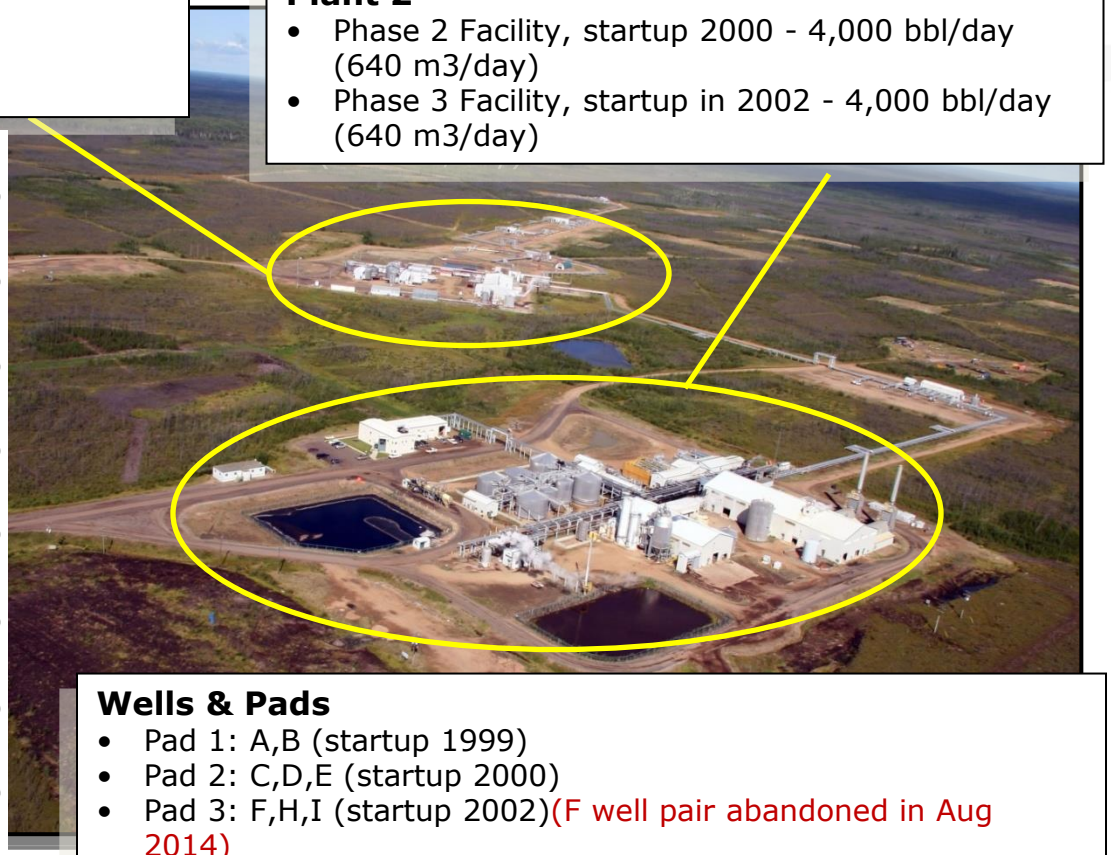
4. Discussion

Demo Scheme No. 8788 Background

Plant 1
- On original PCEJ CSS Site
- Startup 1999 – 2,000 bbl/day (320 m3/day)

Plant 2
- Phase 2 Facility, startup 2000 - 4,000 bbl/day (640 m3/day)
- Phase 3 Facility, startup in 2002 - 4,000 bbl/day (640 m3/day)



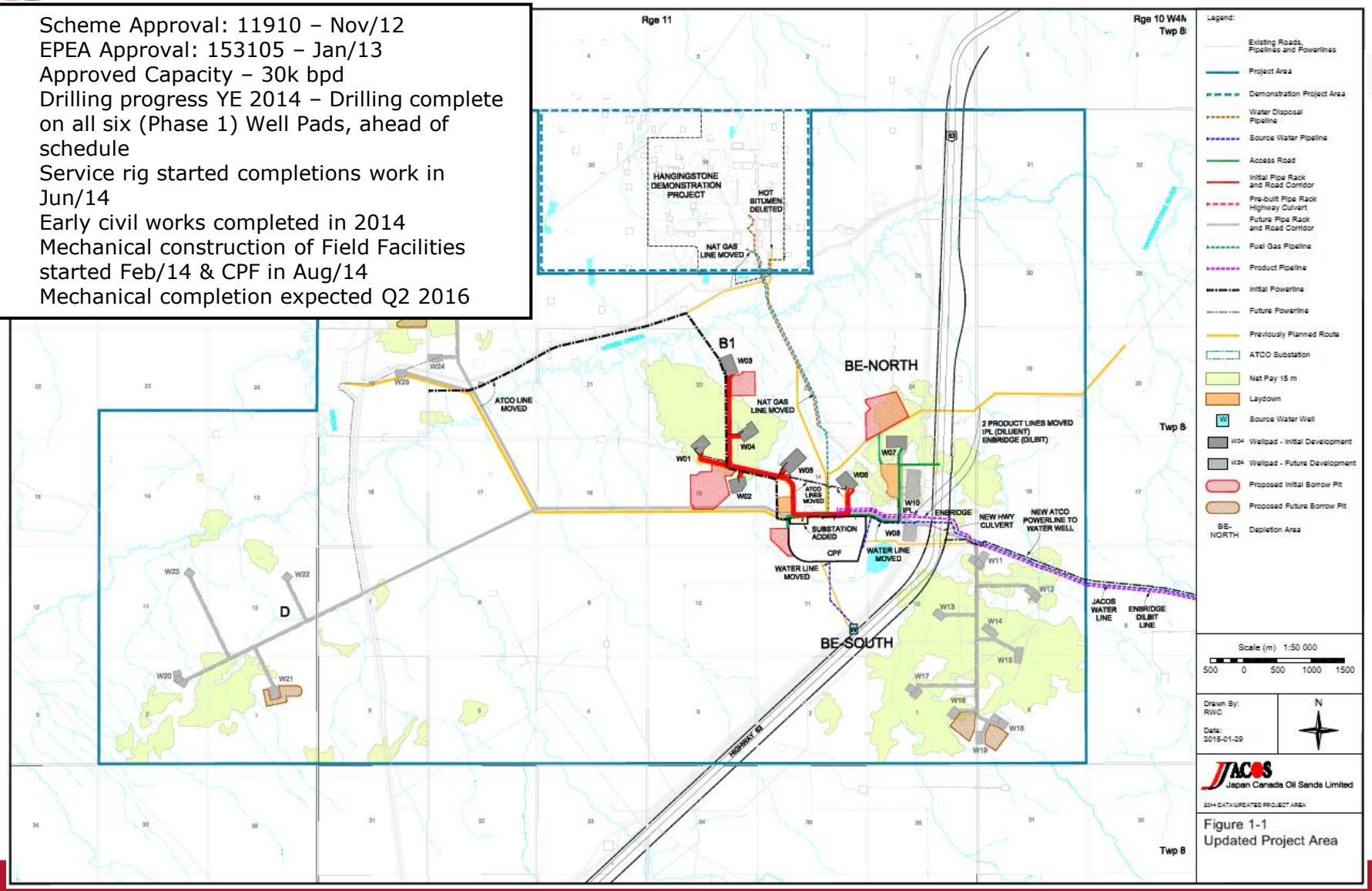


- Project located 50 km south of Fort McMurray
- Approved demonstration project area: 3.75 sections
- Approved production capacity: 11,000 bbl/day (1,760 m3/day)

Wells & Pads
- Pad 1: A,B (startup 1999)
- Pad 2: C,D,E (startup 2000)
- Pad 3: F,H,I (startup 2002)(F well pair abandoned in Aug 2014)
- Pad 4: J,K,L,M,N,O,P,Q (startup 2003 – 2005) (Z startup 2008)
- Pad 5: T (startup 2007); R,S (2008); U startup Nov 2010; V&W drilled in 2011; (W started circulation in May 2013 and put on SAGD in August 2013)
- Pad 6: X started in May 2010 (ESP started in Dec); Y started circulation Nov/11 (Y well ESP started in Feb 2013)

Expansion Scheme No. 11910 Background

- Scheme Approval: 11910 – Nov/12
- EPEA Approval: 153105 – Jan/13
- Approved Capacity – 30k bpd
- Drilling progress YE 2014 – Drilling complete on all six (Phase 1) Well Pads, ahead of schedule
- Service rig started completions work in Jun/14
- Early civil works completed in 2014
- Mechanical construction of Field Facilities started Feb/14 & CPF in Aug/14
- Mechanical completion expected Q2 2016



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Subsurface

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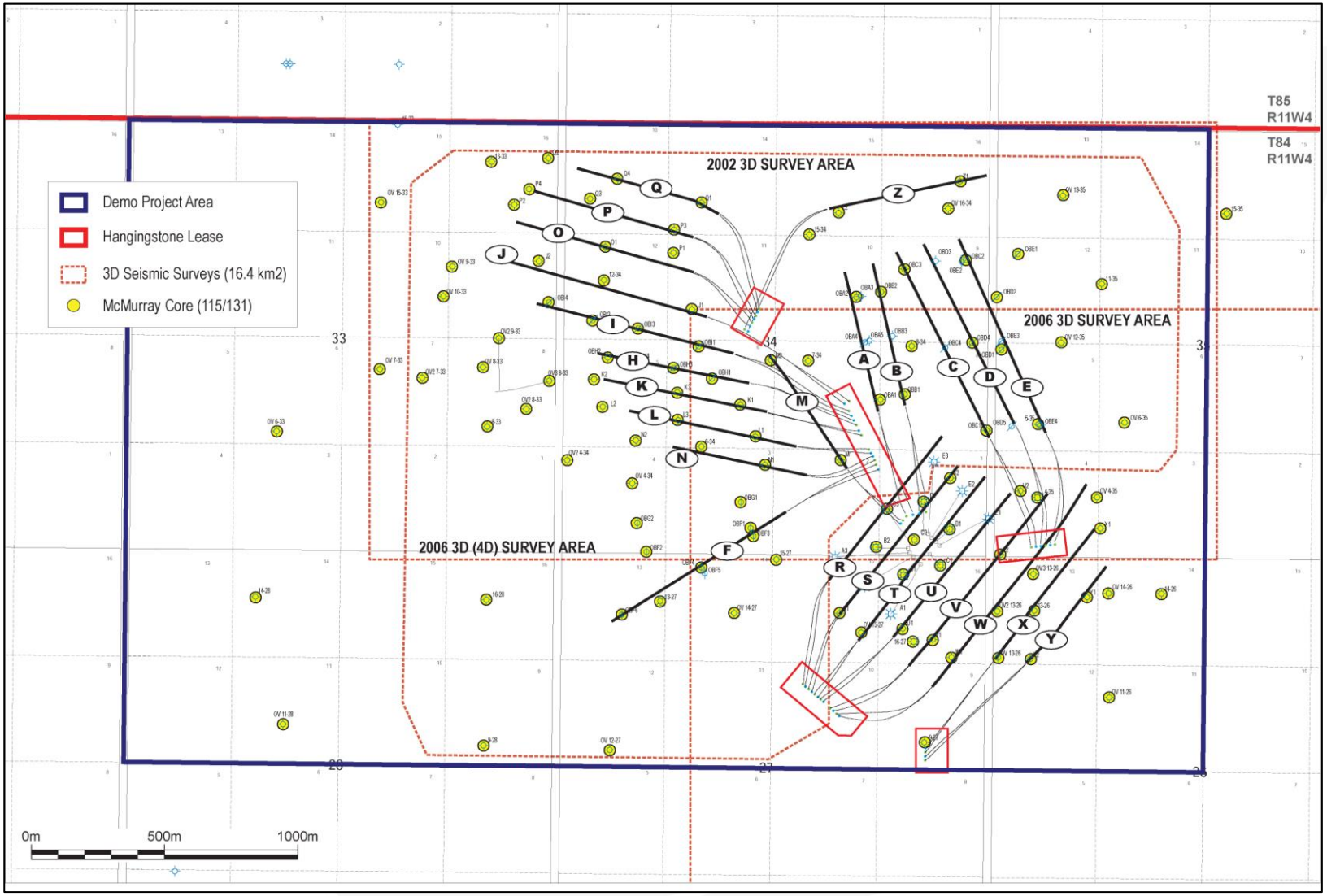
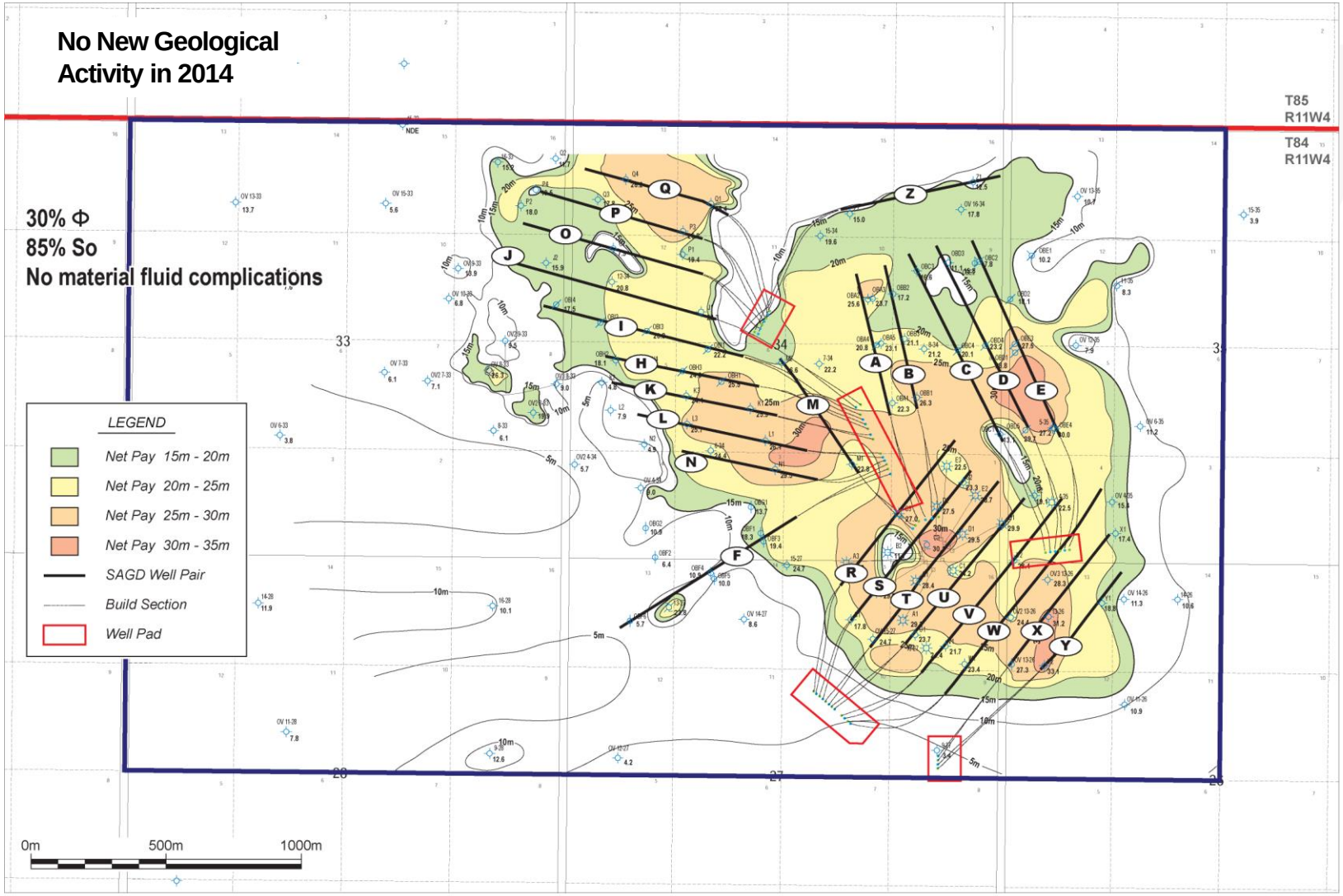
Geosciences

Hangingstone Demo Database



Hangingstone Demo Net Pay



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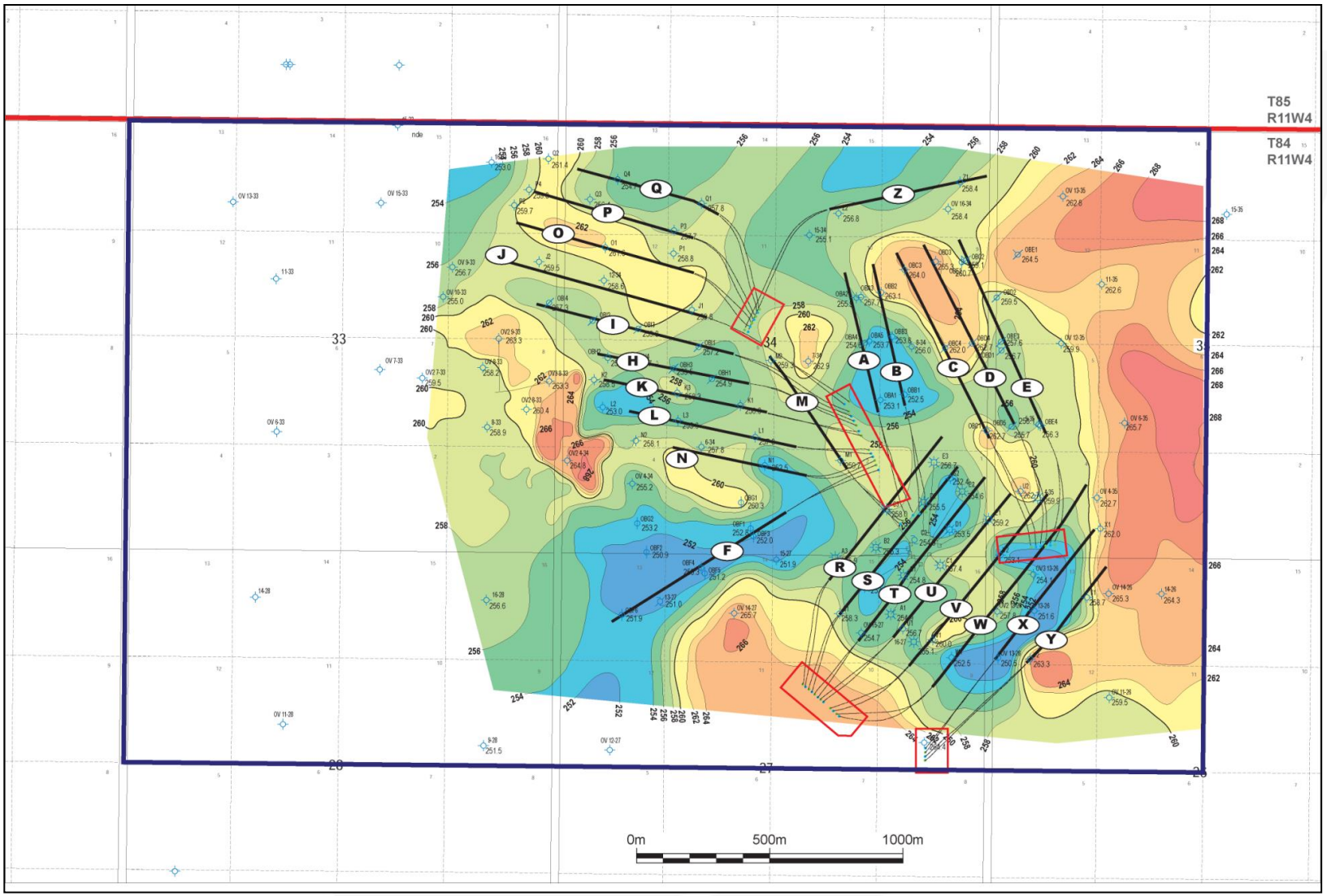
Hangingstone Demo Base Reservoir Structure



Hangingstone Demo Top Reservoir Structure

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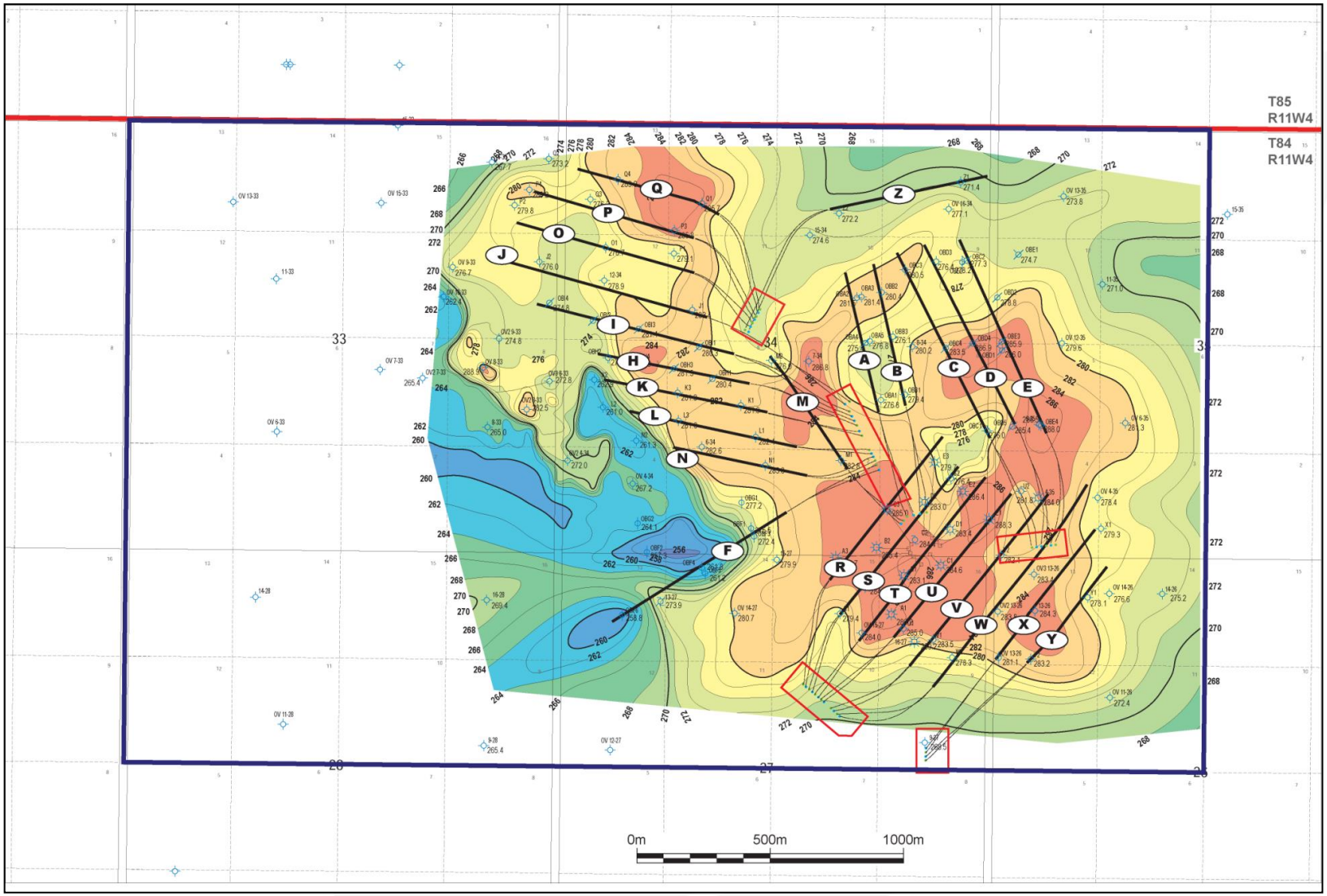
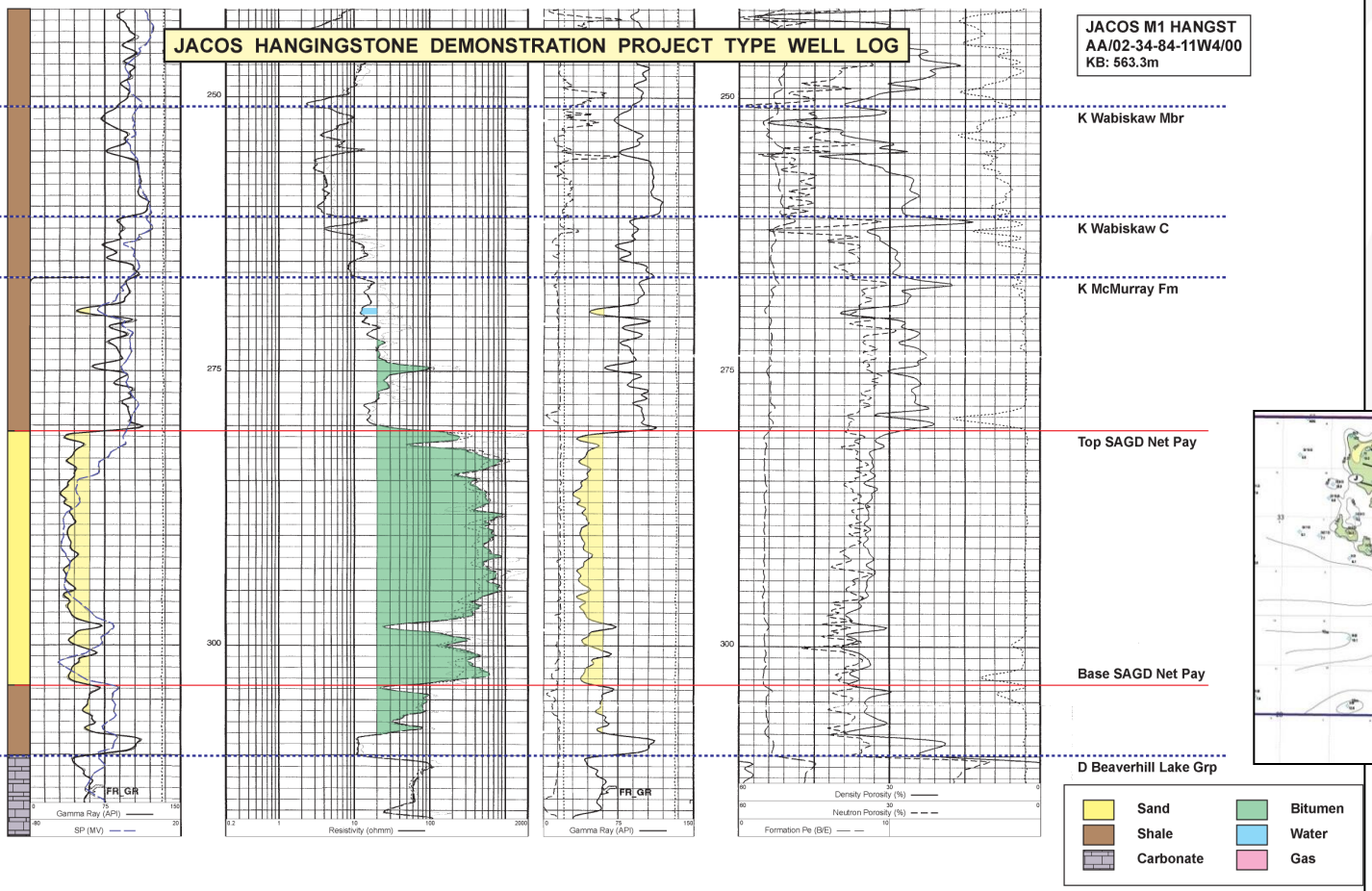
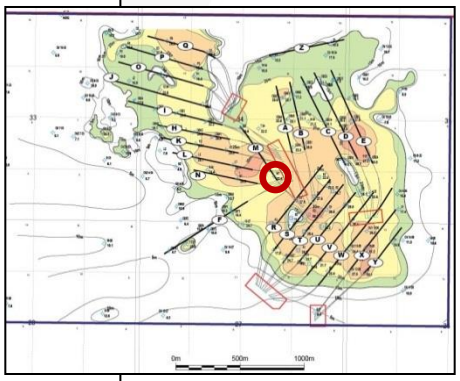


Hangingstone Demo Composite Well





Hangingstone Demo Scheme Cross-Section

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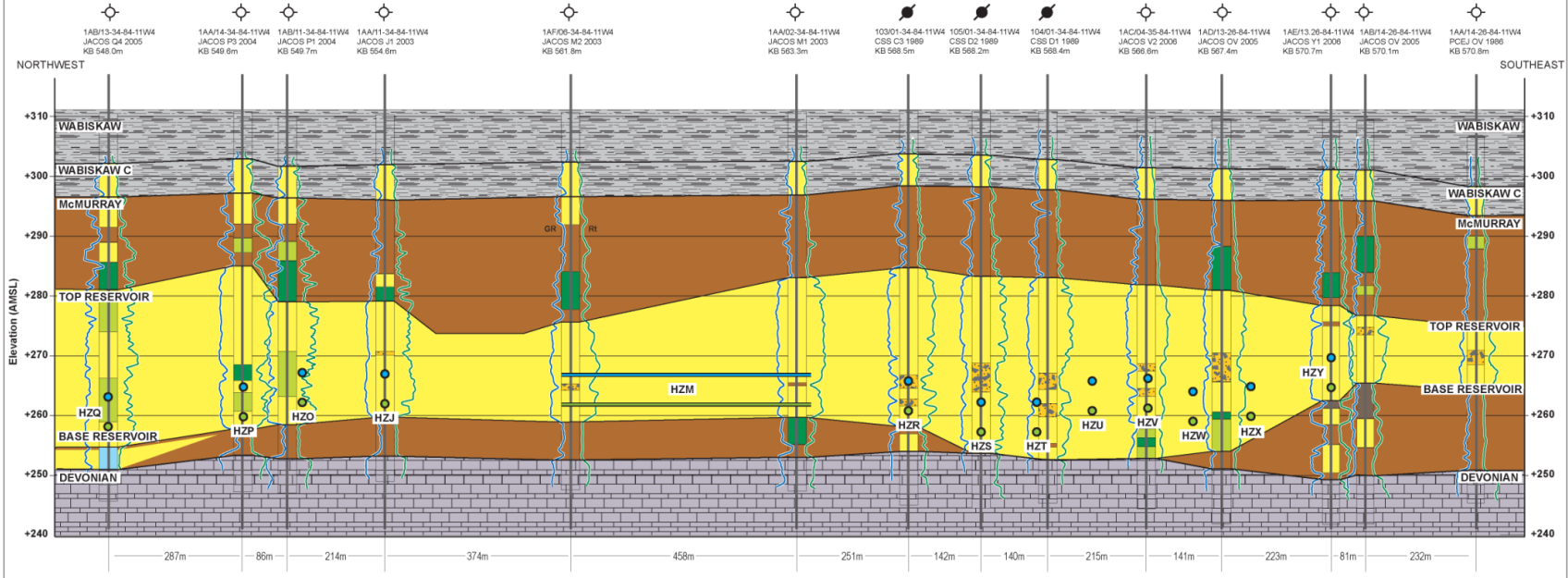

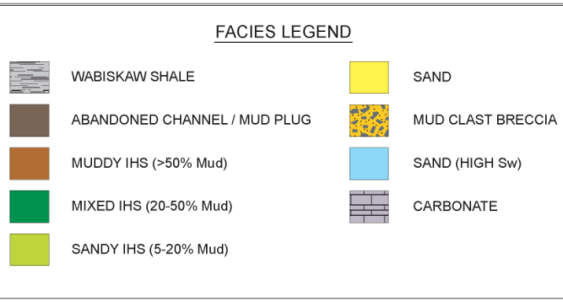

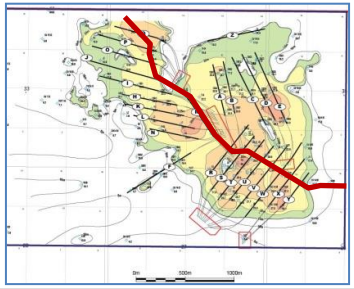

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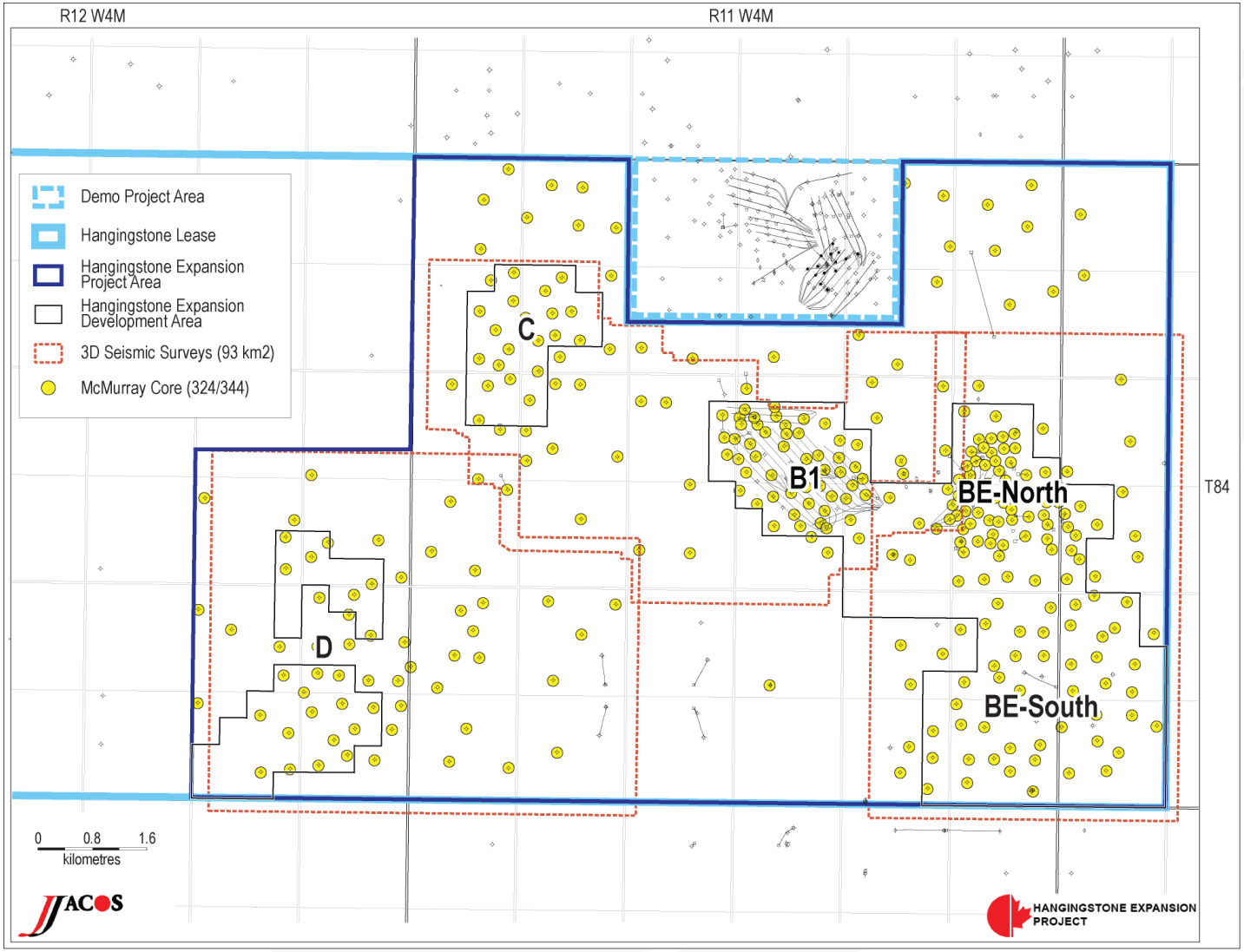
Hangingstone Expansion Database



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Hangingstone Expansion Project Cross-Section

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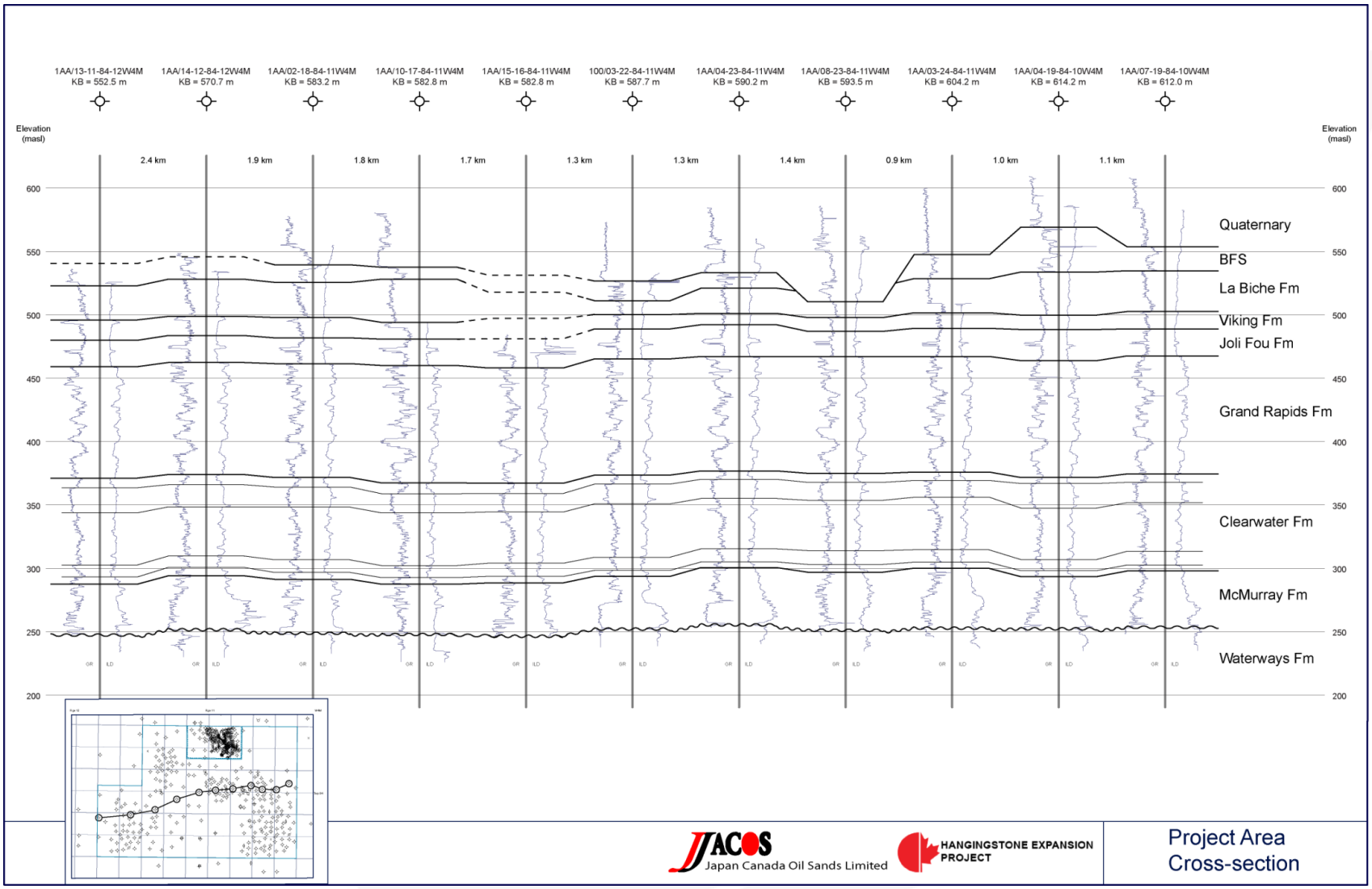

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HANGINGSTONE EXPANSION PROJECT

Project Area
Cross-section

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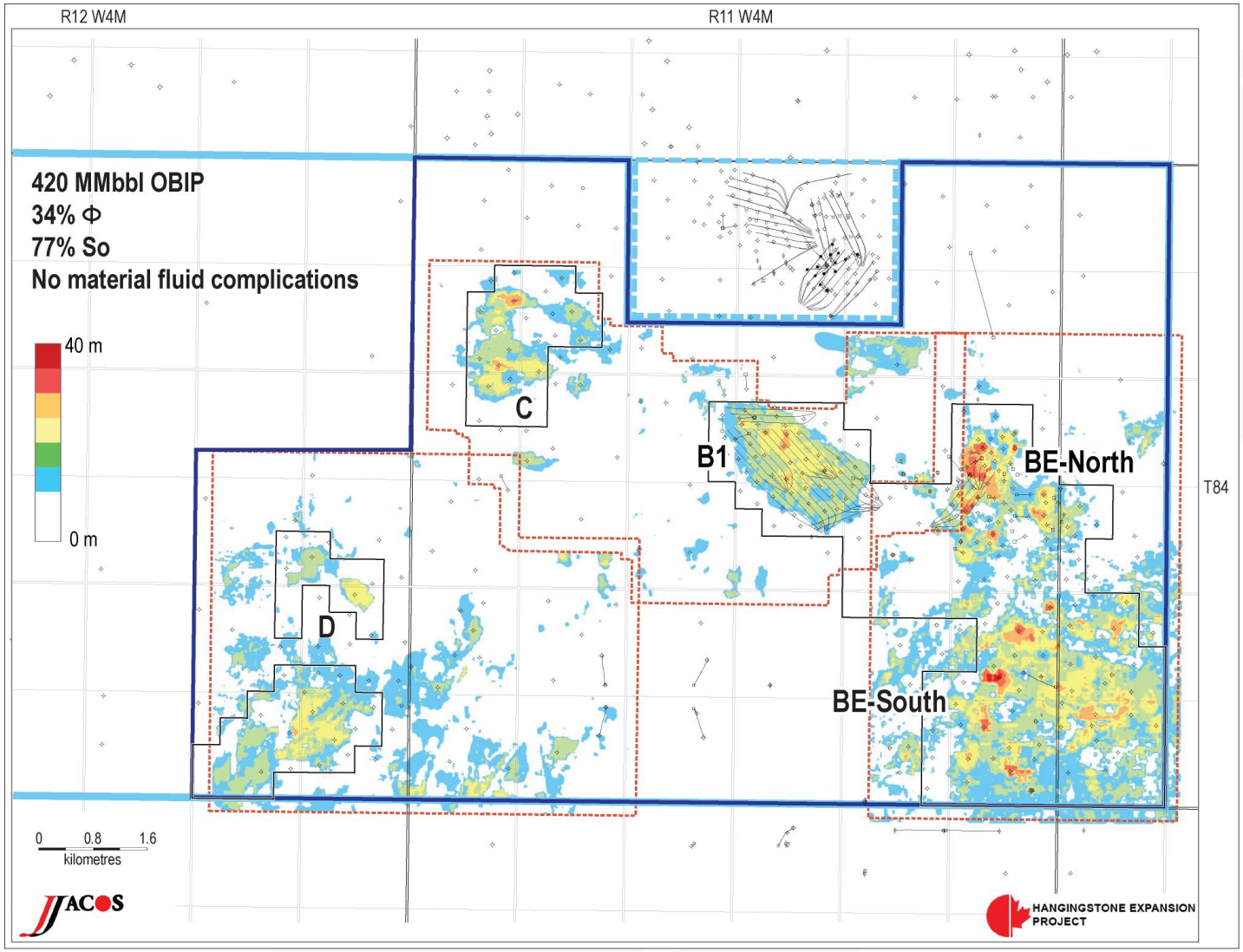
Hangingstone Expansion Net Pay



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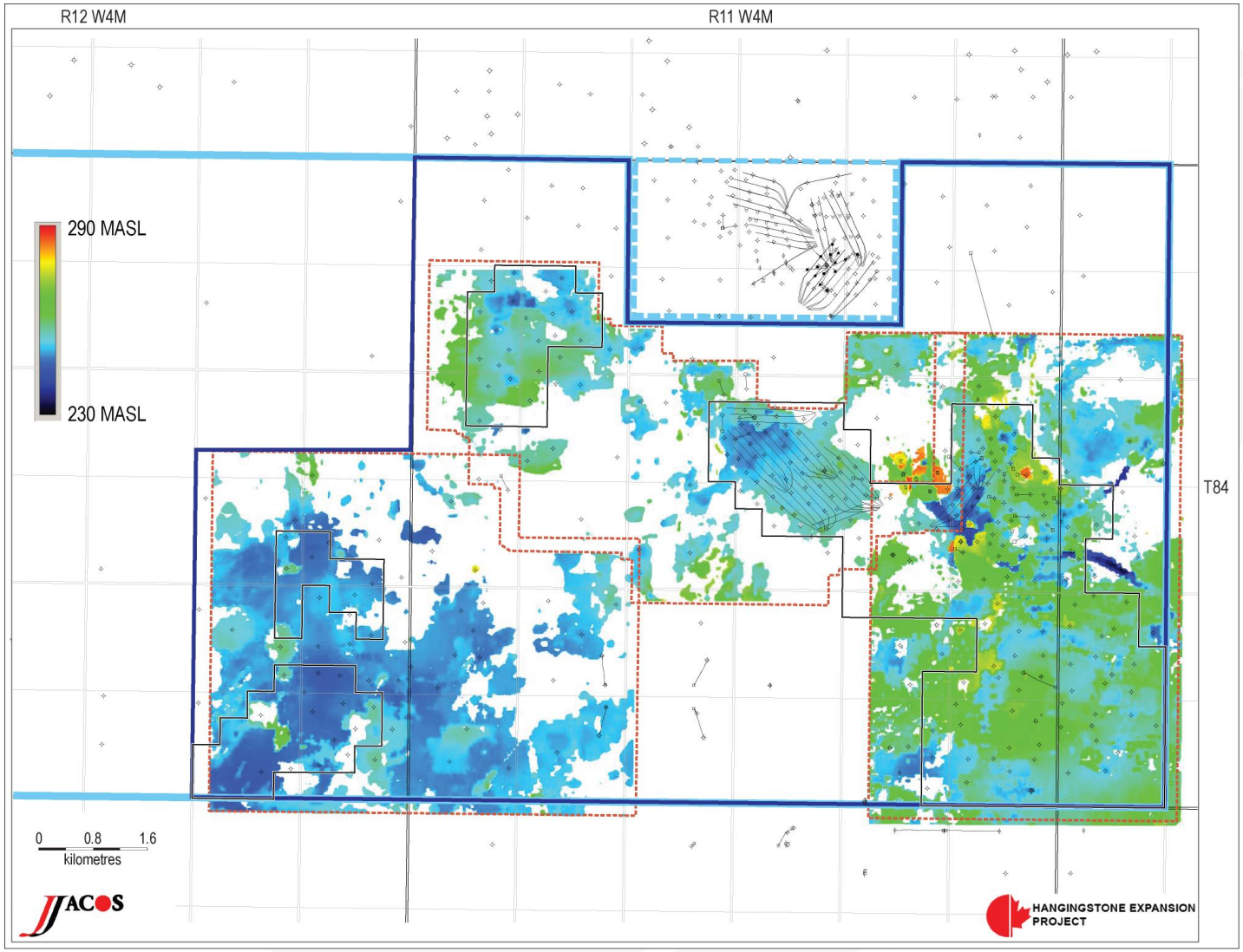
Hangingstone Expansion
Base Reservoir Structure



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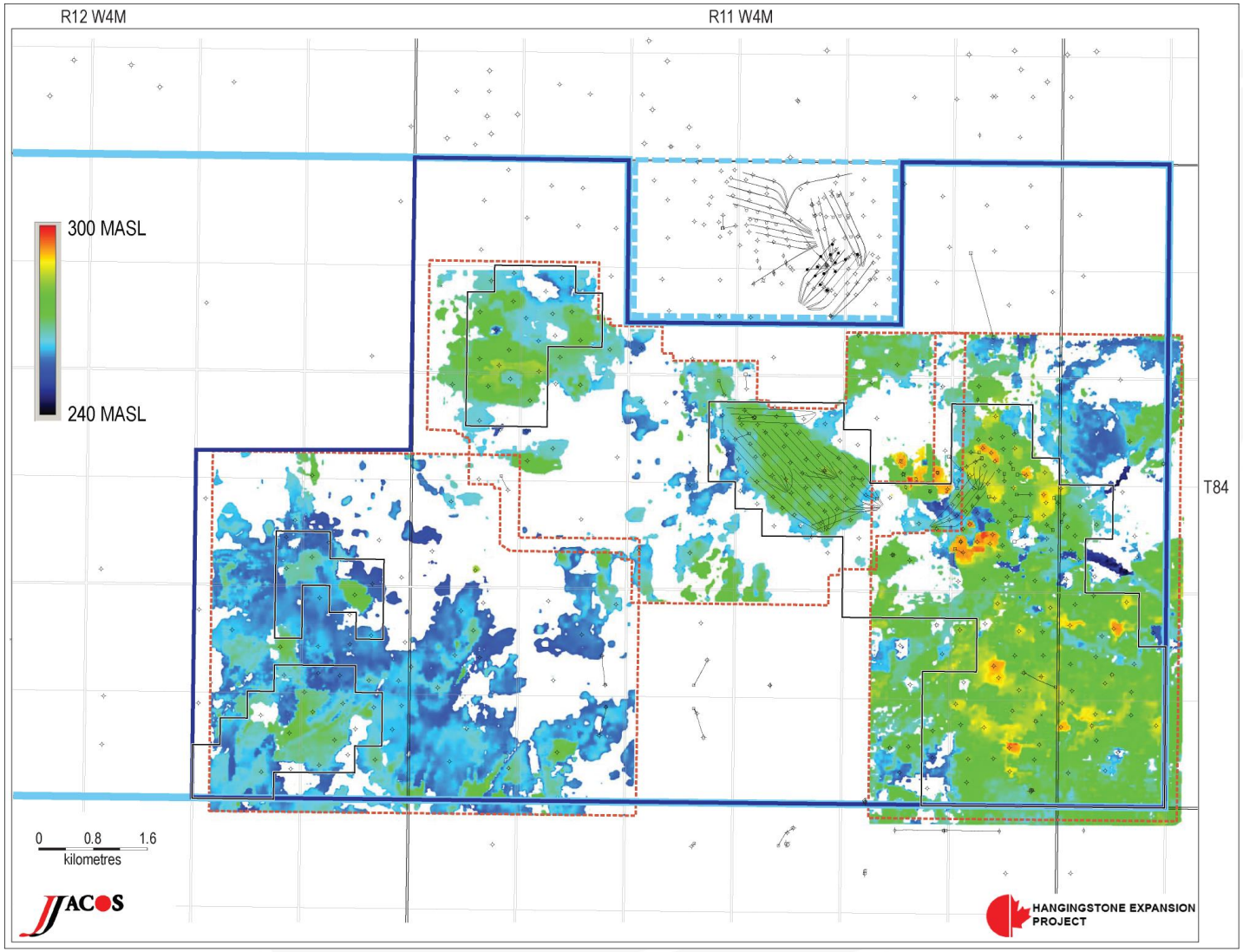
Hangingstone Expansion
Top Reservoir Structure



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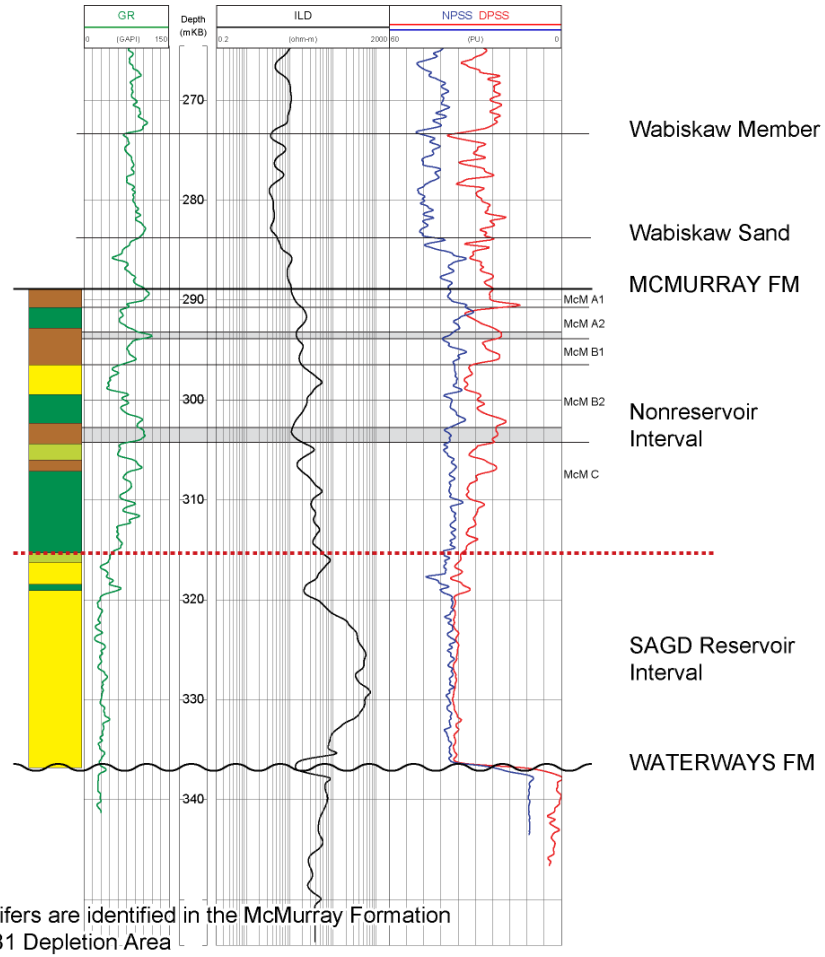
Hangingstone Expansion
Composite Well
B1 Area

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



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

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

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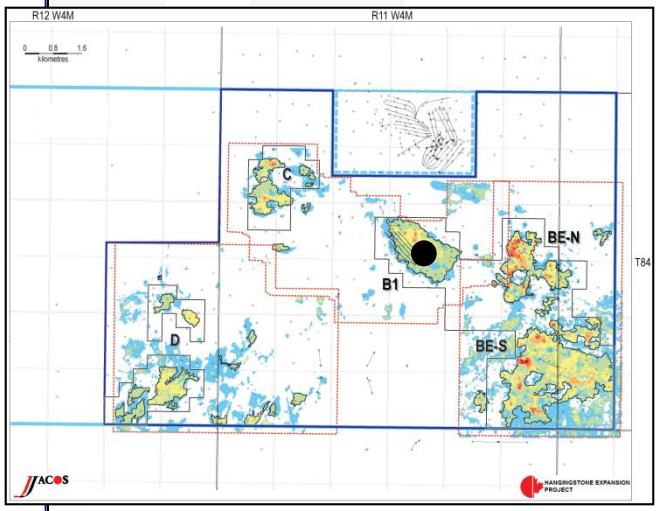
HANGINGSTONE EXPANSION PROJECT



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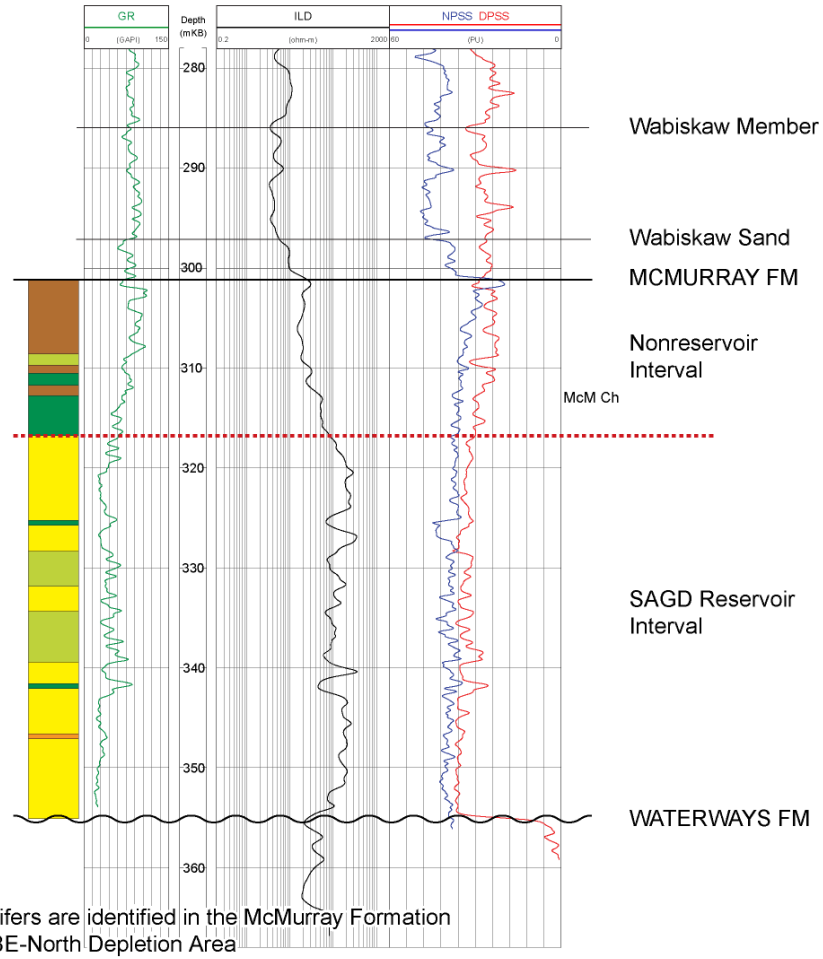
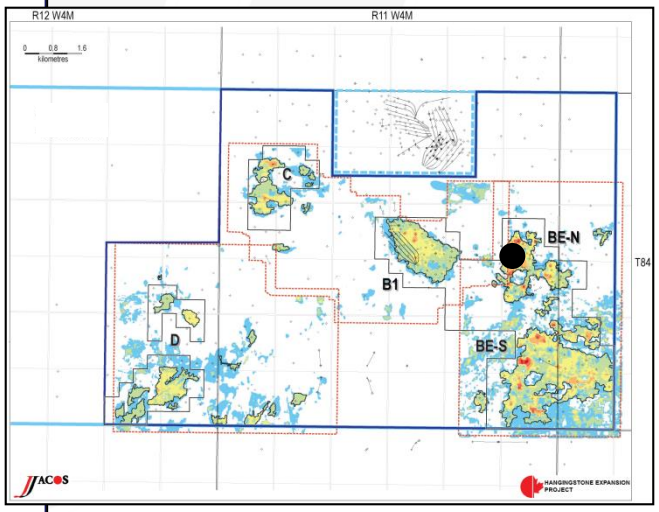
Hangingstone Expansion Composite Well BE-North Area

DEPLETION AREA BE-N
1AA/04-24-84-11W4M



No aquifers are identified in the McMurray Formation at the BE-North Depletion Area

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



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HANGINGSTONE EXPANSION PROJECT

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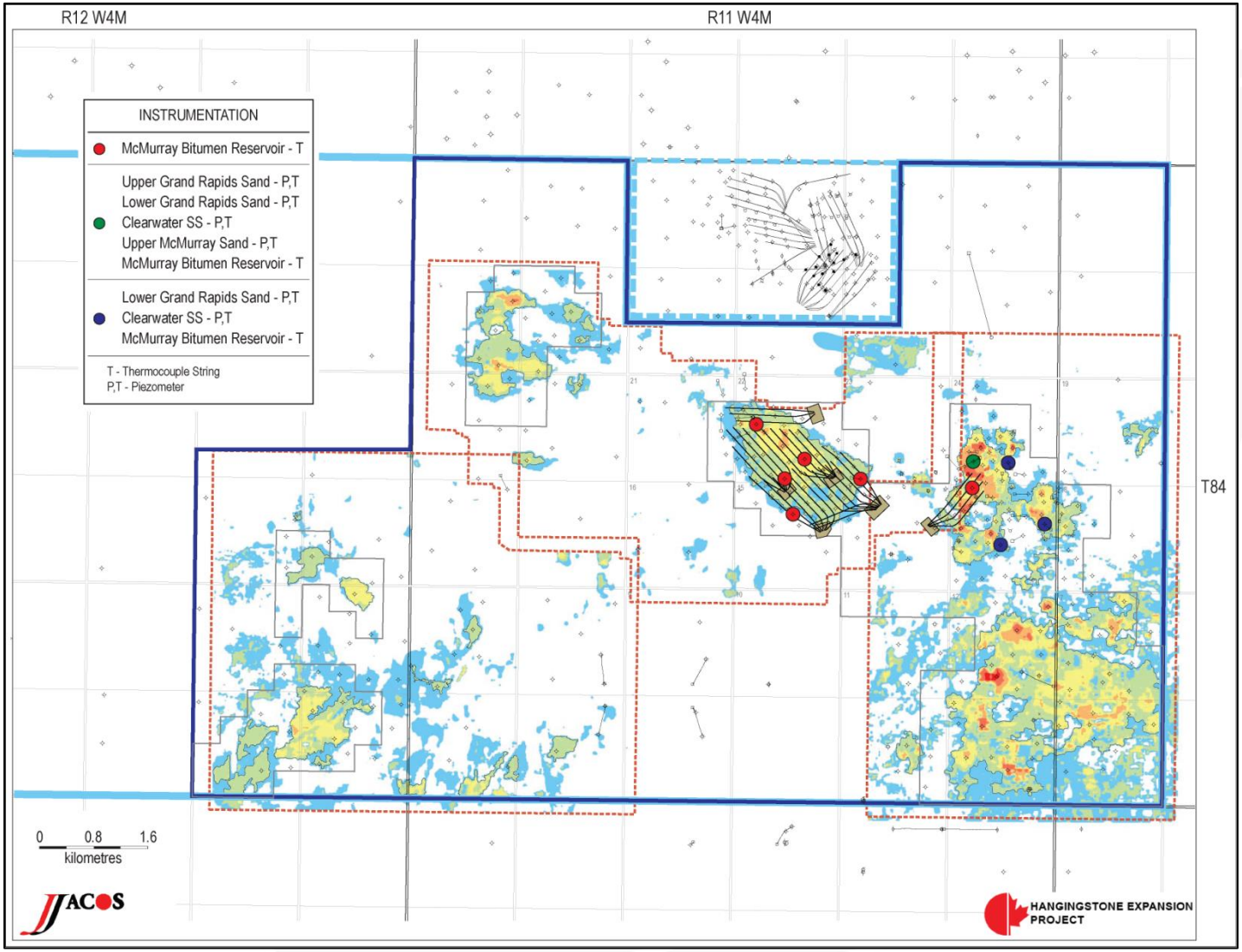
Hangingstone Expansion
Reservoir & Aquifer Monitoring



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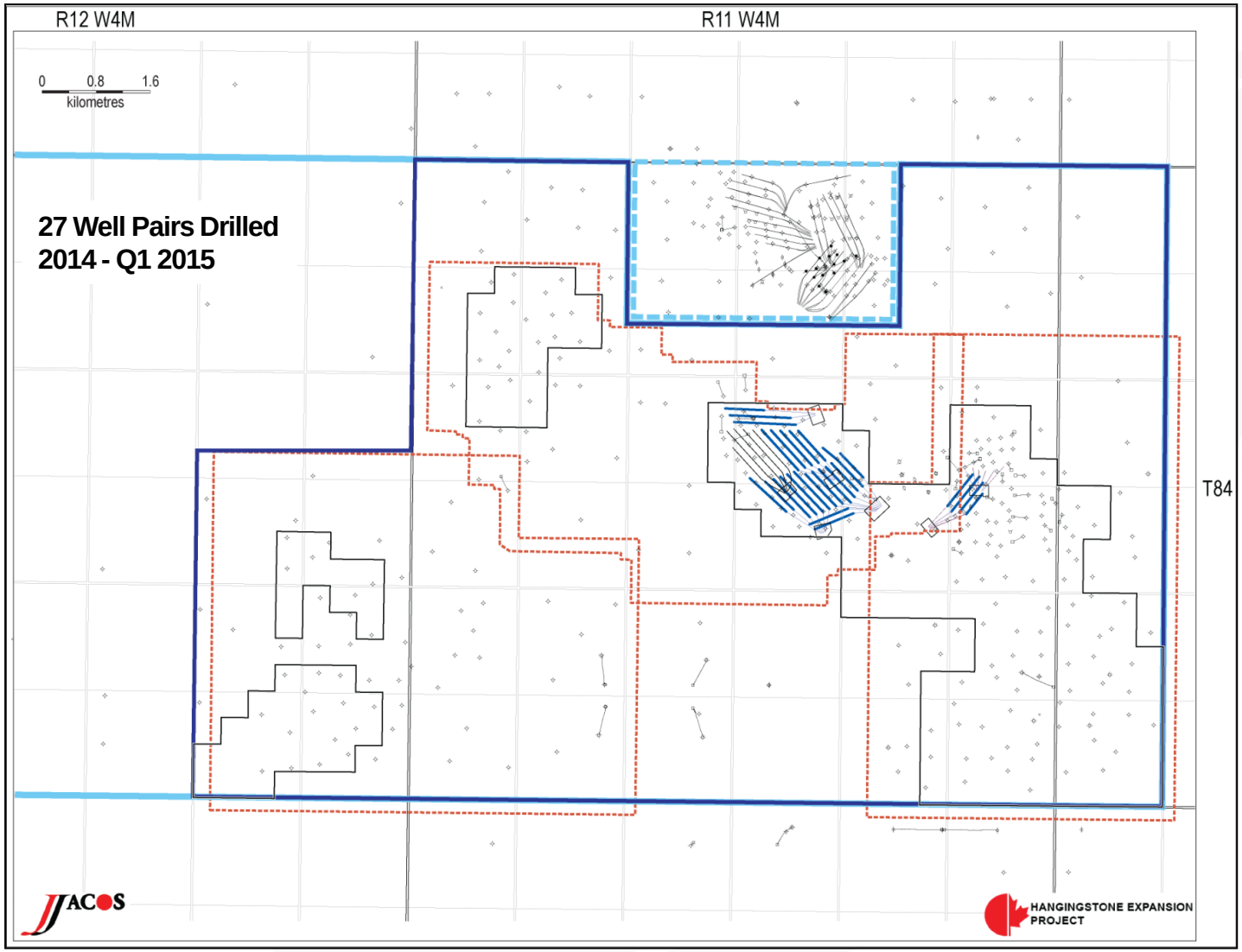
Hangingstone Expansion
2014 Drilling Activity



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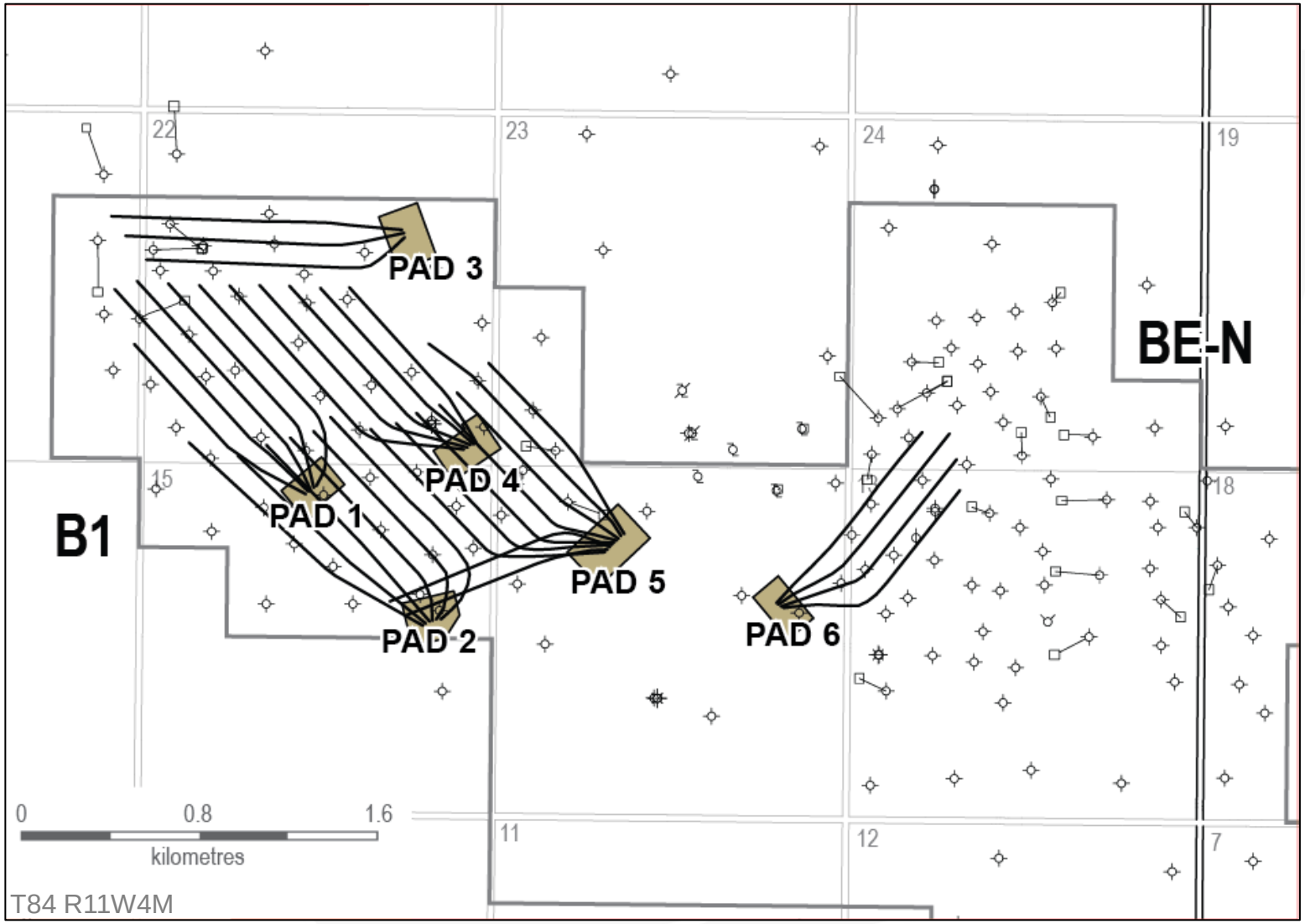
Hangingstone Expansion
Phase 1 Well Layout



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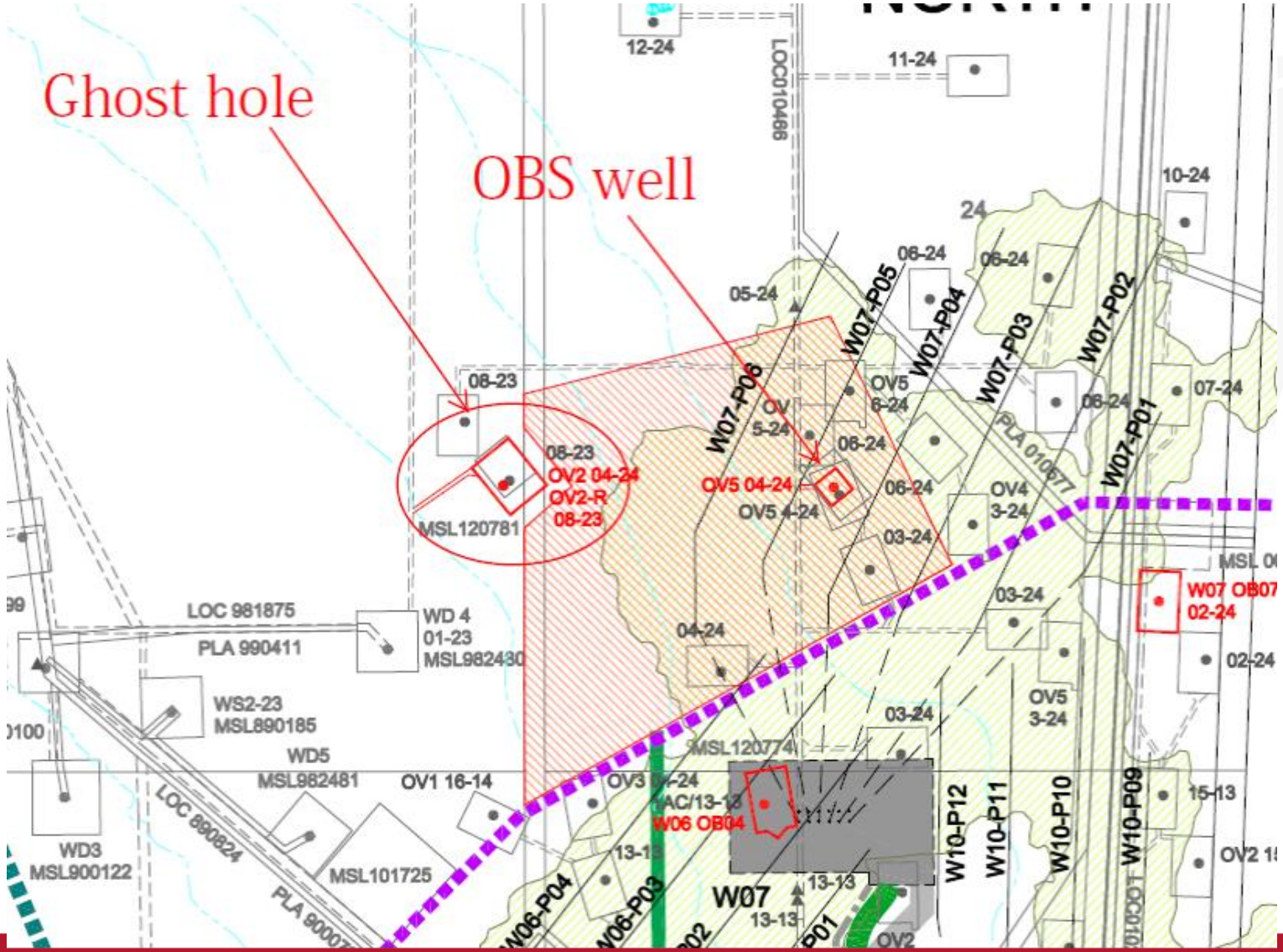
Hangingstone Expansion
Ghost Hole & Monitoring Well Locations



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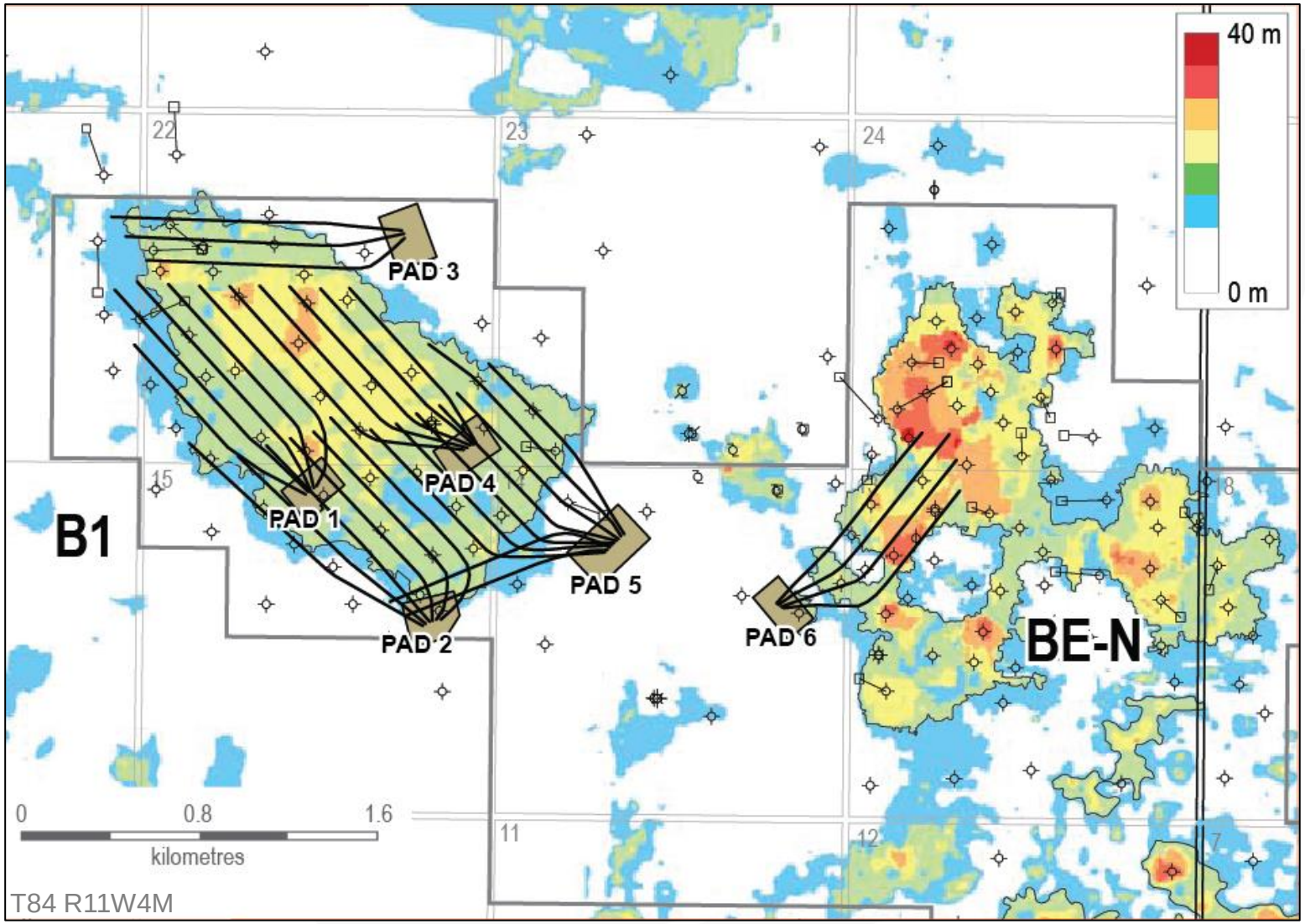
Hangingstone Expansion
Phase 1 Net Pay



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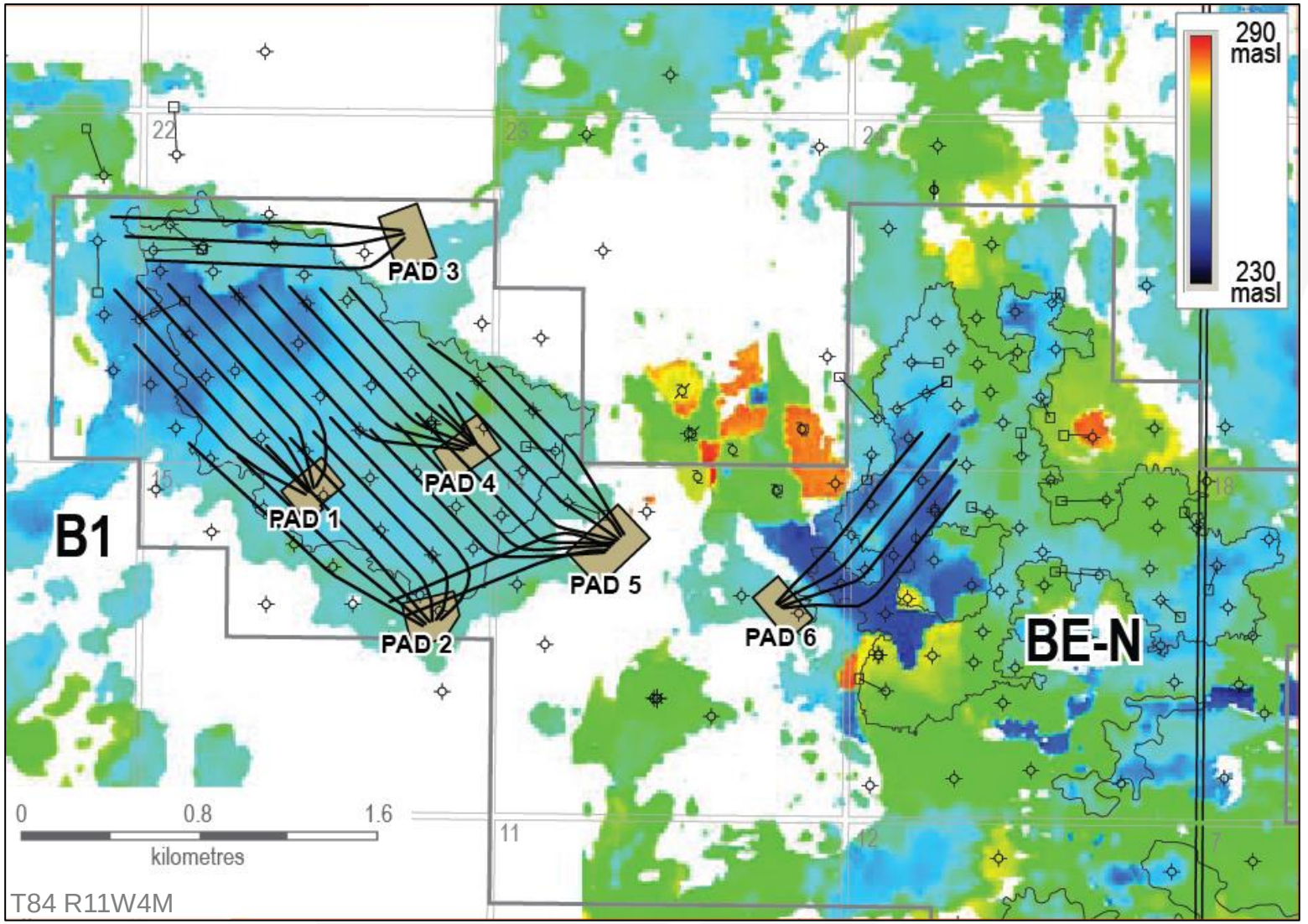
Hangingstone Expansion
Phase 1 Base Reservoir Structure



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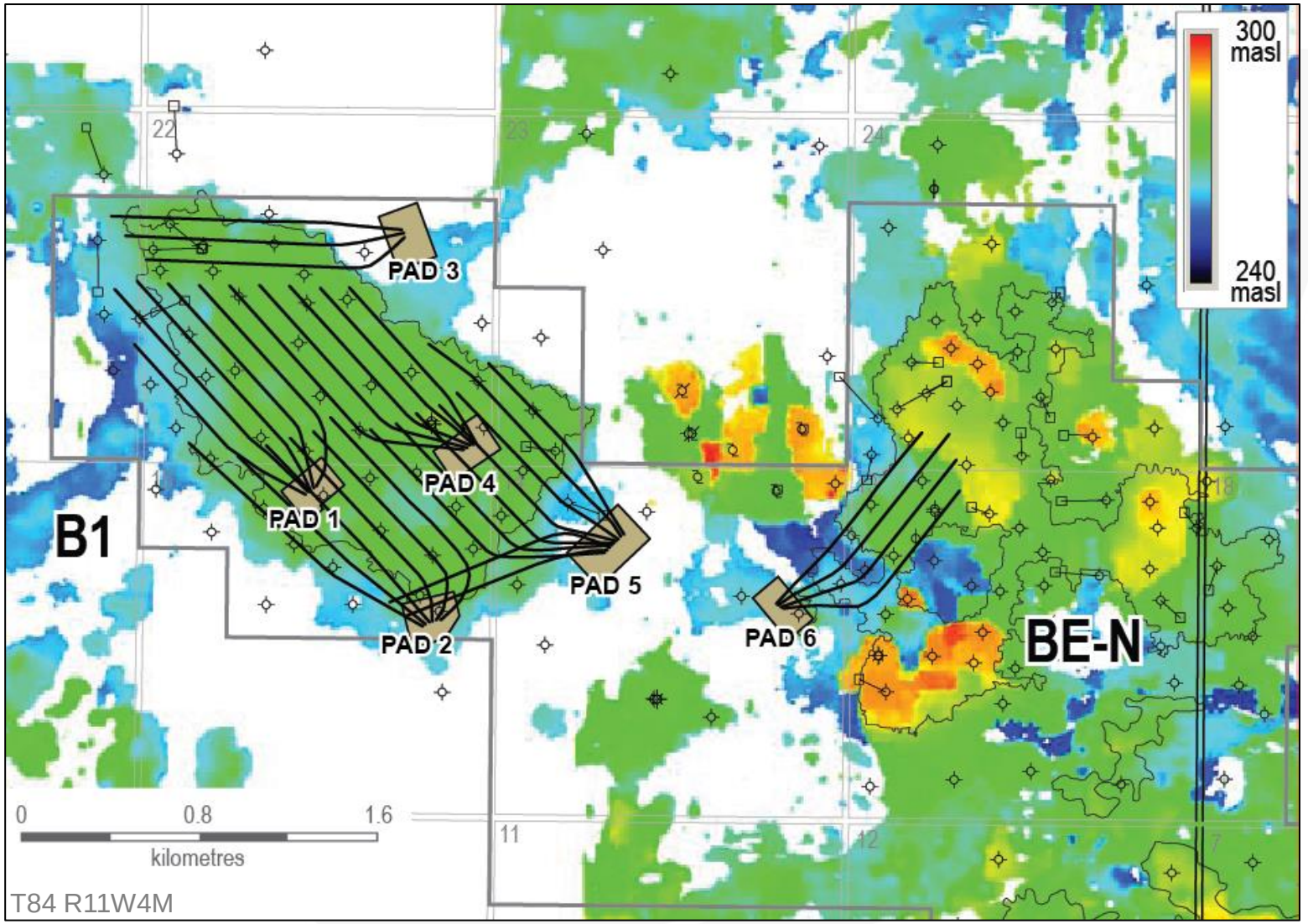
Hangingstone Expansion
Phase 1 Top Reservoir Structure



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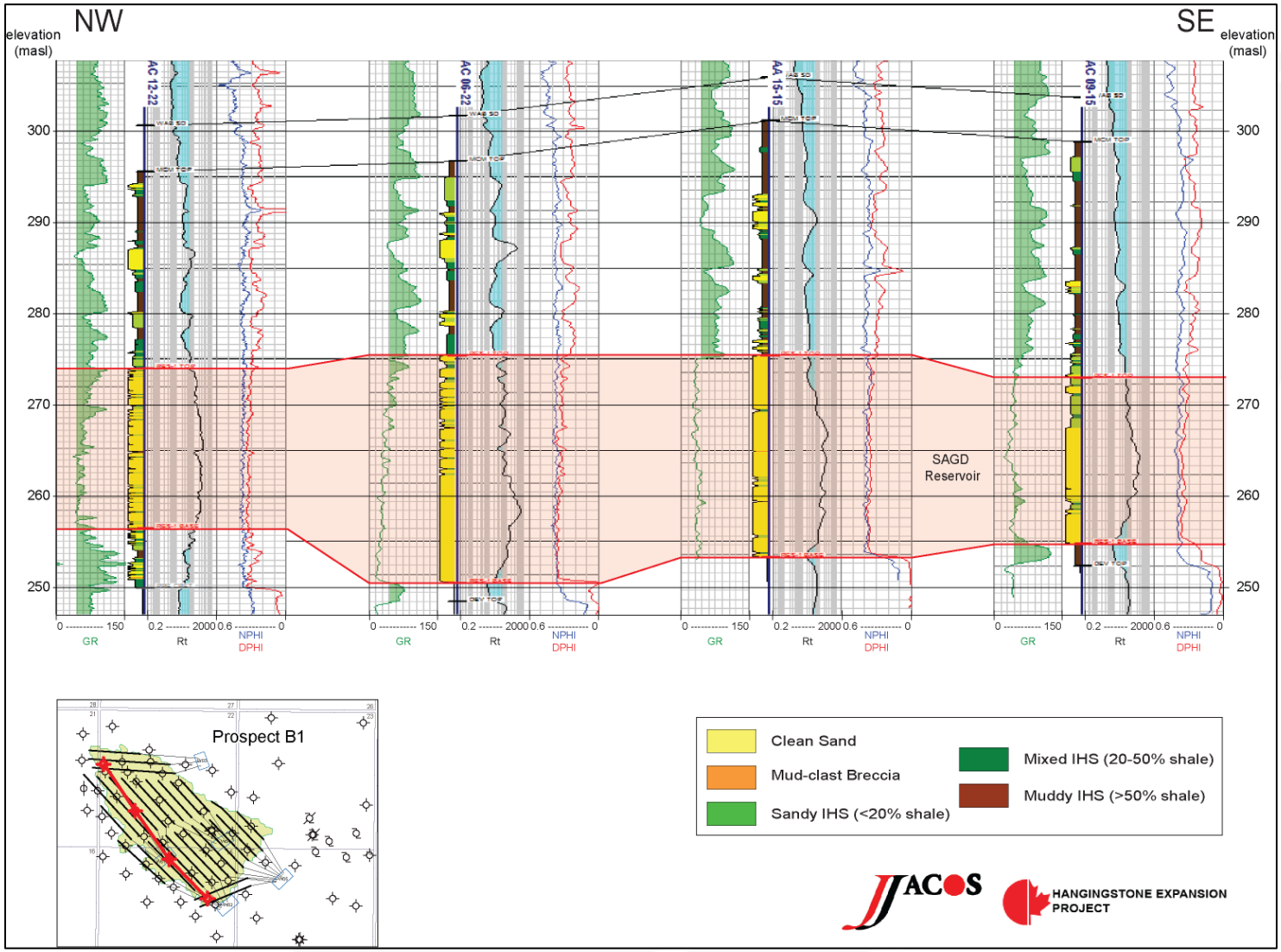
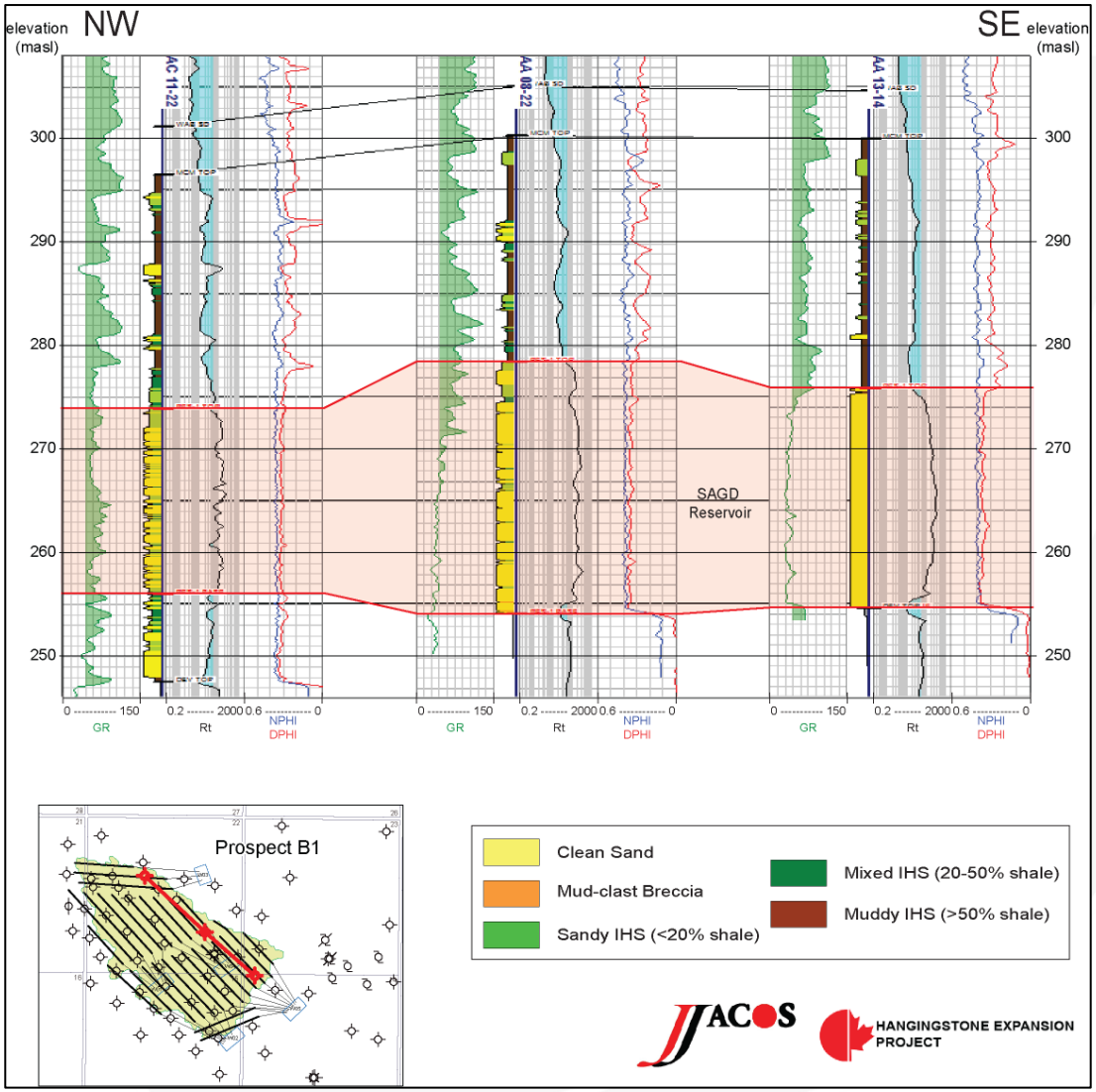
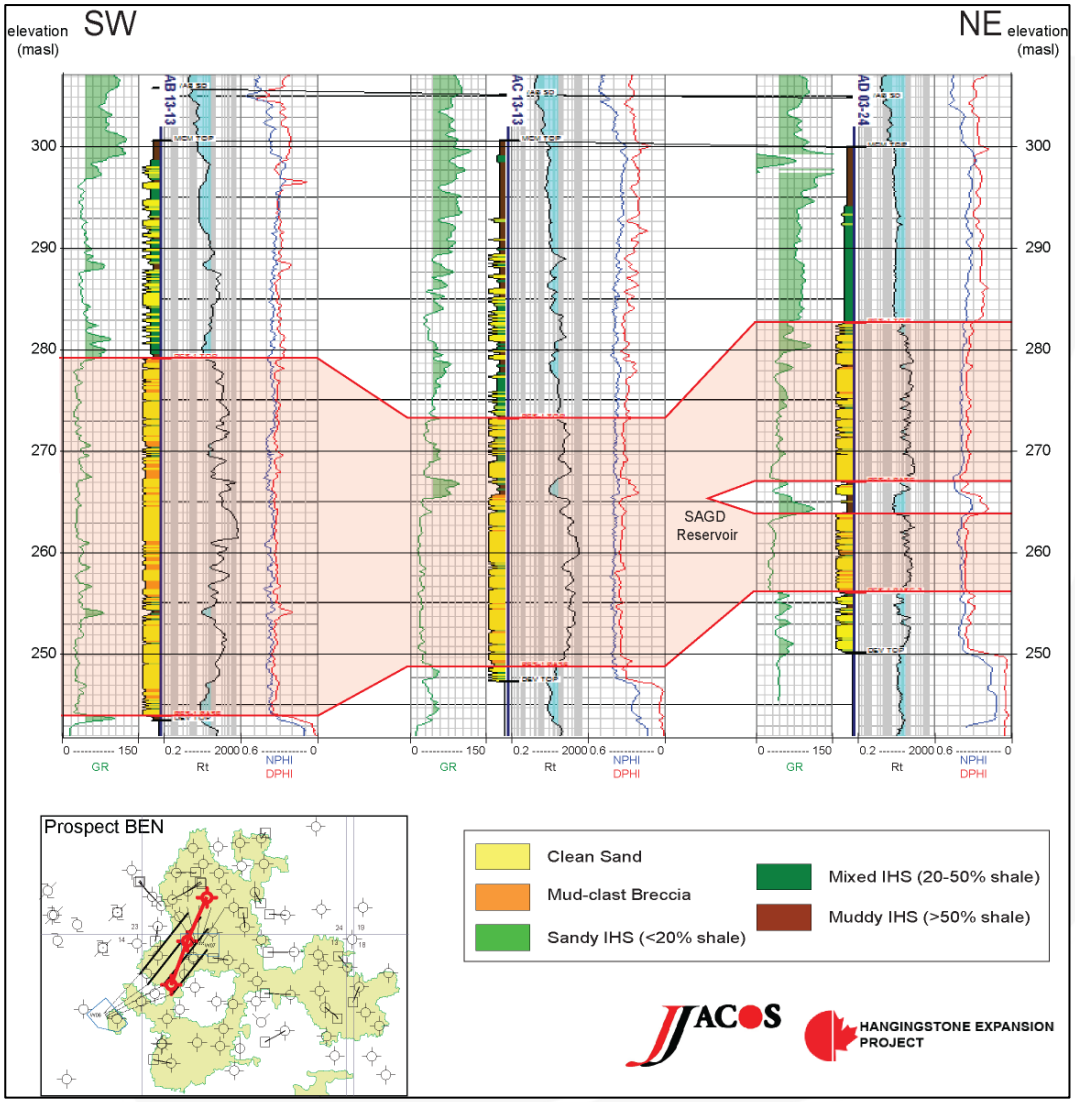
Hangingstone Expansion
Phase 1 Scheme Cross-Section (1)



Hangingstone Expansion
Phase 1 Scheme Cross-Section (2)



Hangingstone Expansion
Phase 1 Scheme Cross-Section (3)



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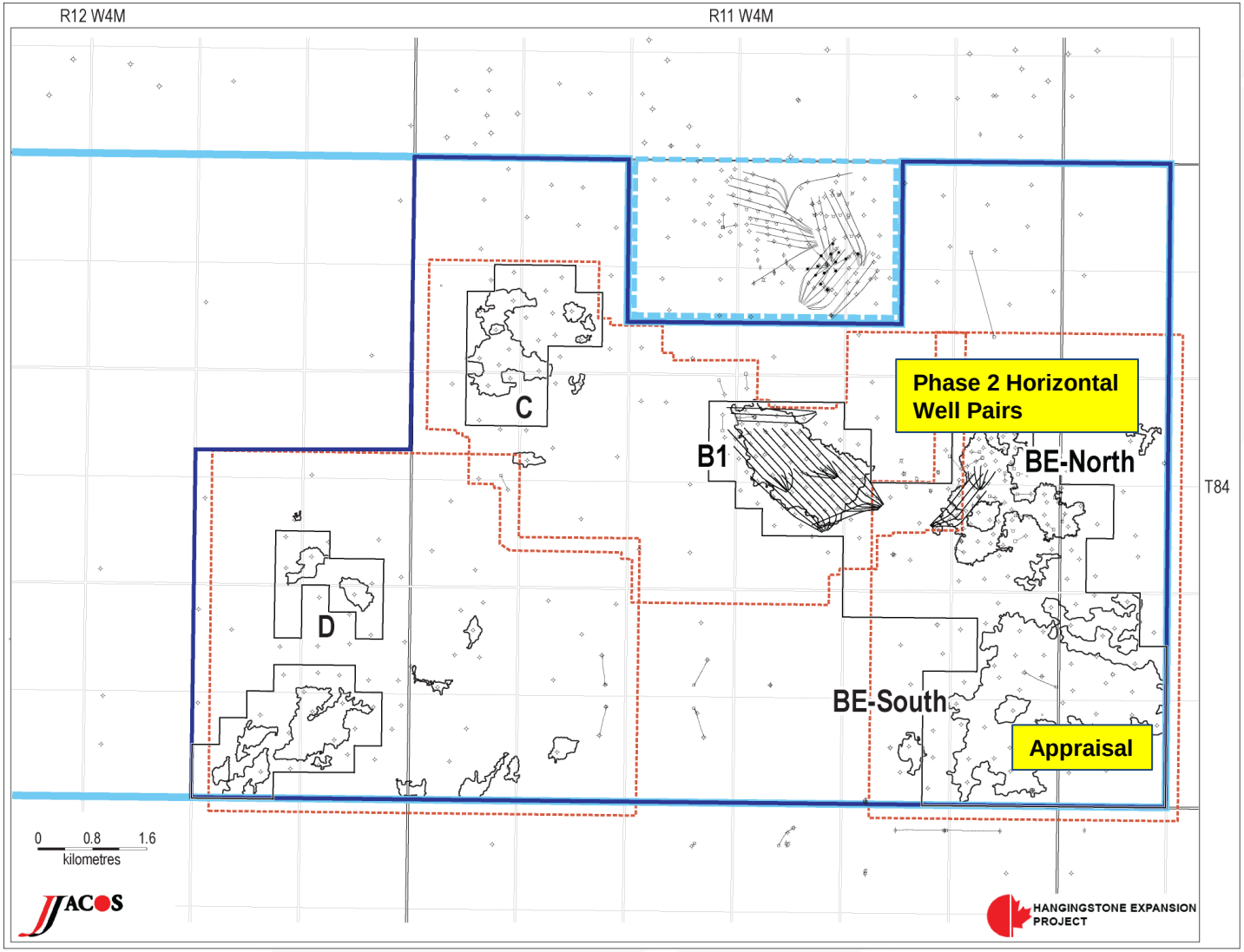
Hangingstone Expansion
Future Drilling Plans



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Cap Rock Integrity

•No change in conclusions - continue to observe no cap rock integrity issues through 2014

•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)

•Ongoing sand production in some wells, but manageable through:

- Stable operation
- Higher subcool

• Bottom pressure is regularly measured by purging the annulus with gas;

	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 - Demo

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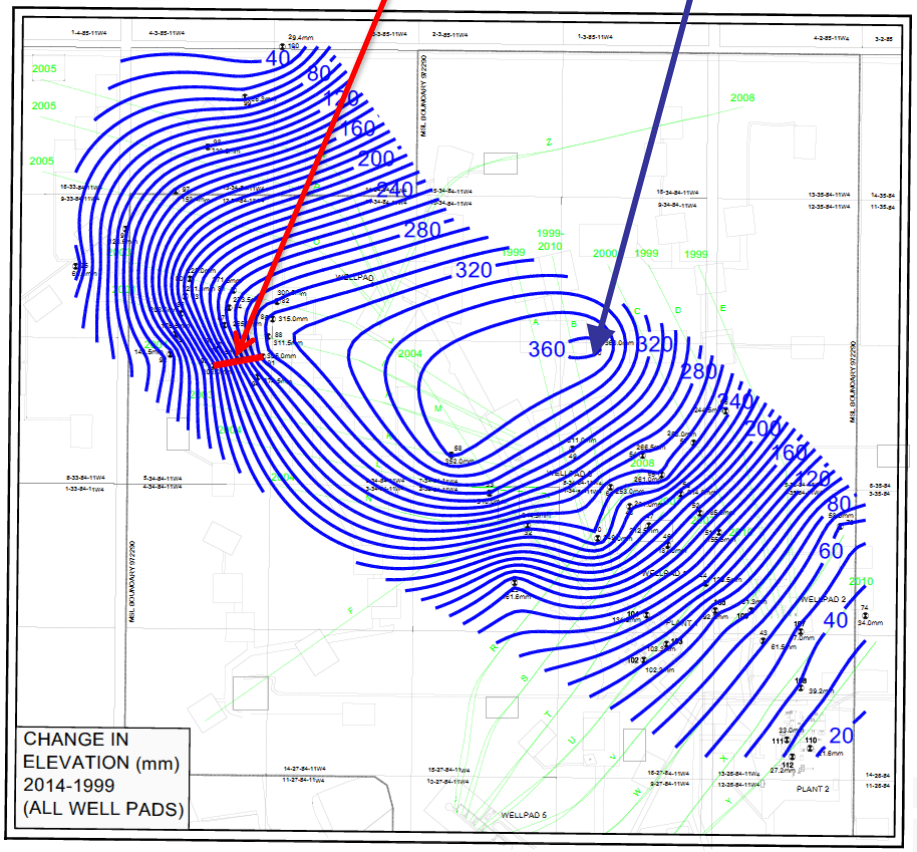
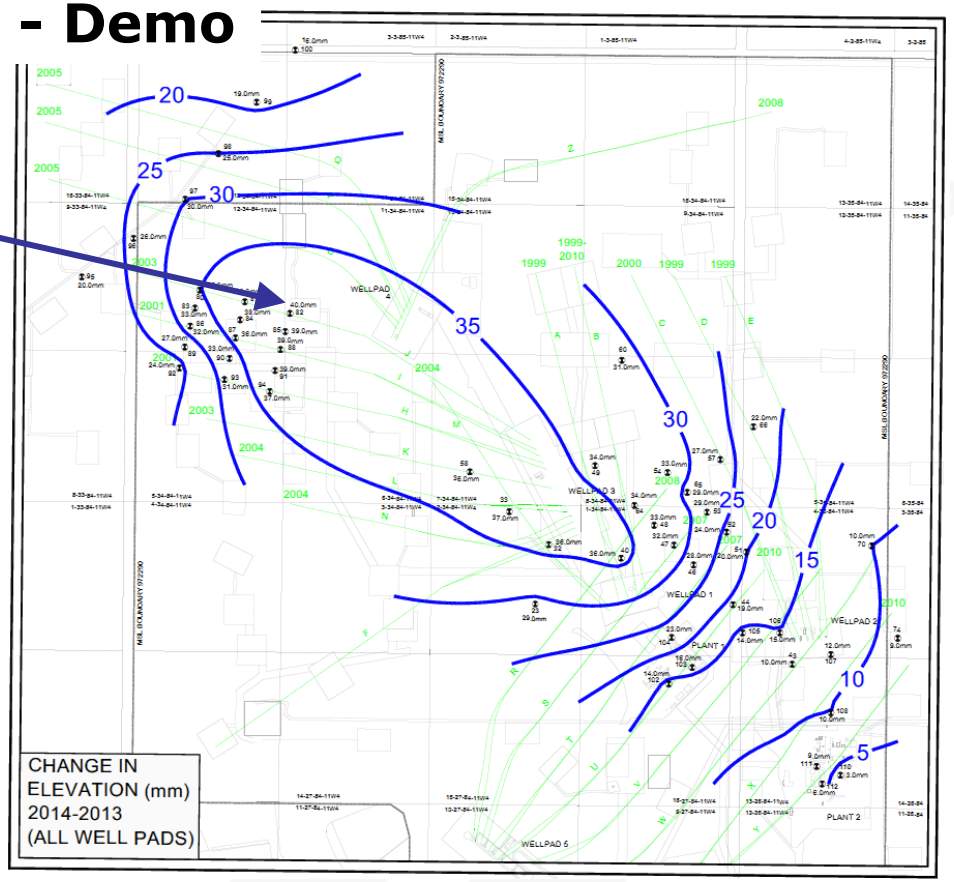
Network of 54 monuments

Maximum heave in 2013-2014: 40.0 mm

Cumulative Heave 1999-2014 363 mm

Max Slope: 0.072%





- Modeling predicted max heave of 400mm over 10 years with max slope of 0.12%
  - within structural design tolerances for surface facilities
- Measured heave thus far within predictions
- No concerns observed

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Well Design and Instrumentation

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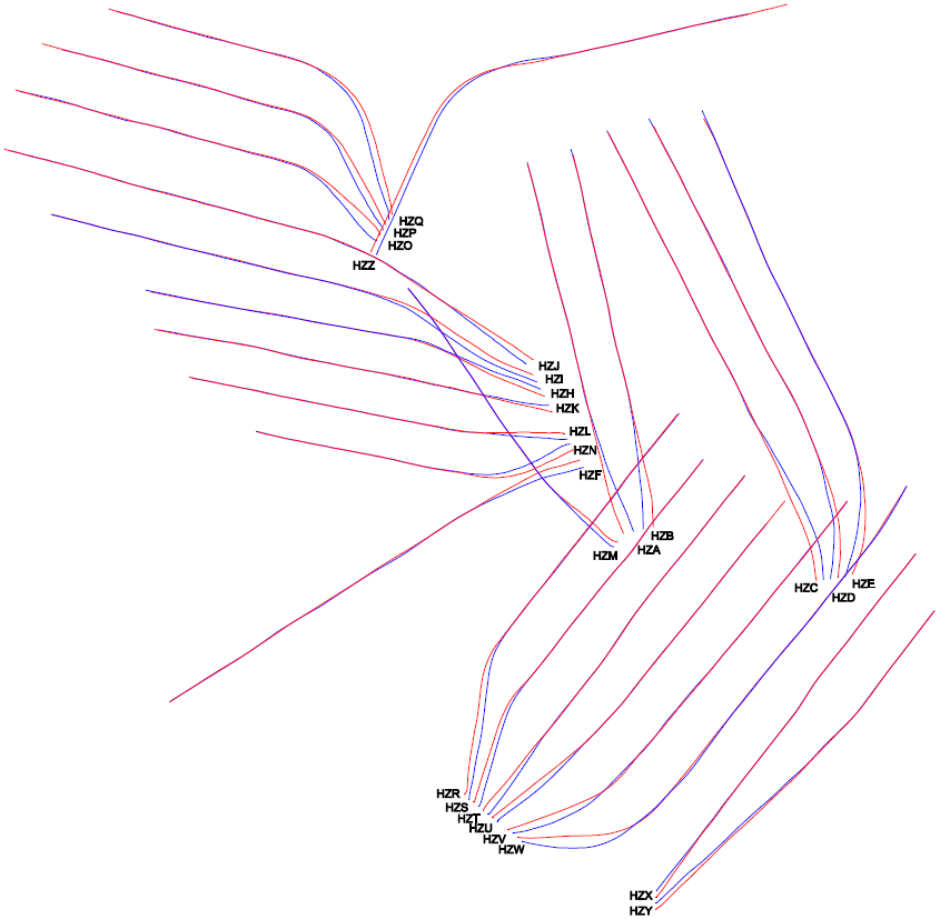
N/C from 2013 PR

SAGD Well Layout



- 24 active well pairs
  - "oldest" wells A/B, started up in July 1999
  - "youngest" wells V and W, started up in July 2012 and May 2013 respectively
- F-Well abandoned 2014

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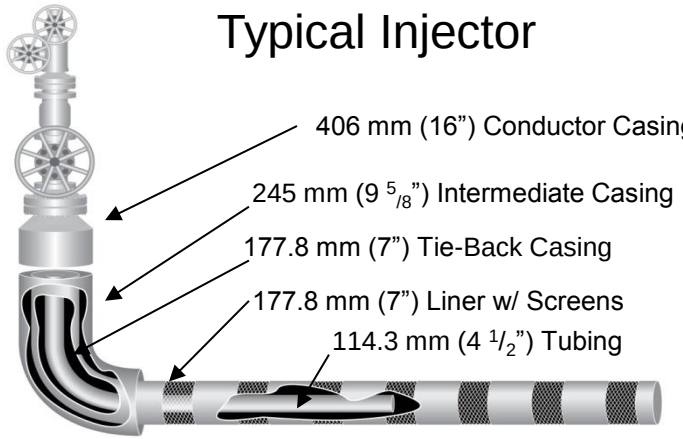
N/C from 2013 PR

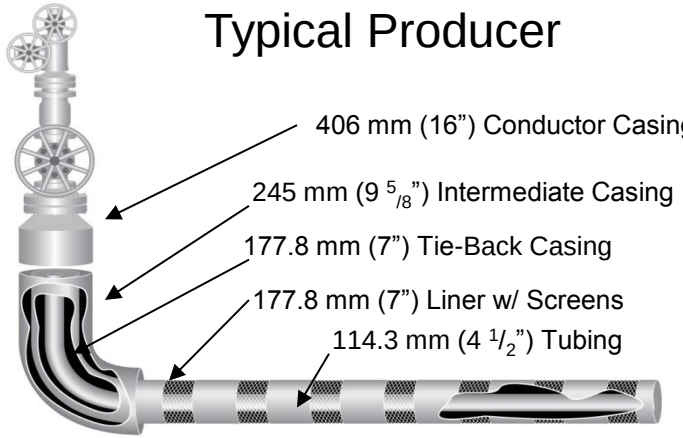
SAGD Well Completions

Approval Nos. 8788K (Demonstration)

Typical Injector



Typical Producer



Well Completions Table

Wellpair	Tie-Back	Liner Size		Screen Type			4-1/2" Tubing	
	Yes/No	7"	8-5/8"	Mesh-Rite	Wire Wrap	Seamed Slotted Liner	To Mid	To Toe
A	Yes	I/P	-	I/P	-	-	-	I/P
B	Yes	I/P	-	-	I/P	-	-	I/P
C	Yes	I/P	-	-	I/P	-	-	I/P
D	Yes	I/P	-	-	I/P	-	-	I/P
E	Yes	I/P	-	-	I/P	-	-	I/P
H	Yes	P	I	-	I/P	-	-	I/P
I	Yes	I/P	-	-	I/P	-	I	P
J	Yes	I/P	-	-	I/P	-	I	P
K	No	I/P	-	-	I/P	-	I	P
L	Yes	I/P	-	-	I/P	-	I	P
M	Yes	I/P	-	-	I/P	-	I	P
N	Yes	I/P	-	-	I/P	-	I	P
O	Yes	I/P	-	-	I/P	-	-	I/P
P	Yes	I/P	-	-	-	I/P	I	P
Q	Yes	I/P	-	-	I/P	-	I	P
R	Yes	I/P	-	-	I	P	I	P
S	Yes	P	I	-	-	I/P	-	I/P
T	Yes	P	I	-	-	I/P	-	I/P
U	Yes	P	I	-	-	I/P	-	I/P
V	Yes	P	I	Failed Liner - 4-1/2"WWS		I/P	-	I/P (2-7/8")
W	Yes	P	I	-	-	I/P	-	I/P
X	Yes	-	I/P	-	-	I/P	-	I
Y	Yes	-	I/P	Failed Liner - 5-1/2"WWS		I/P	-	I
Z	No	P	I	SCVF- 7" Cement to Surface		I/P	-	I

I = Injector Well
P = Producer Well

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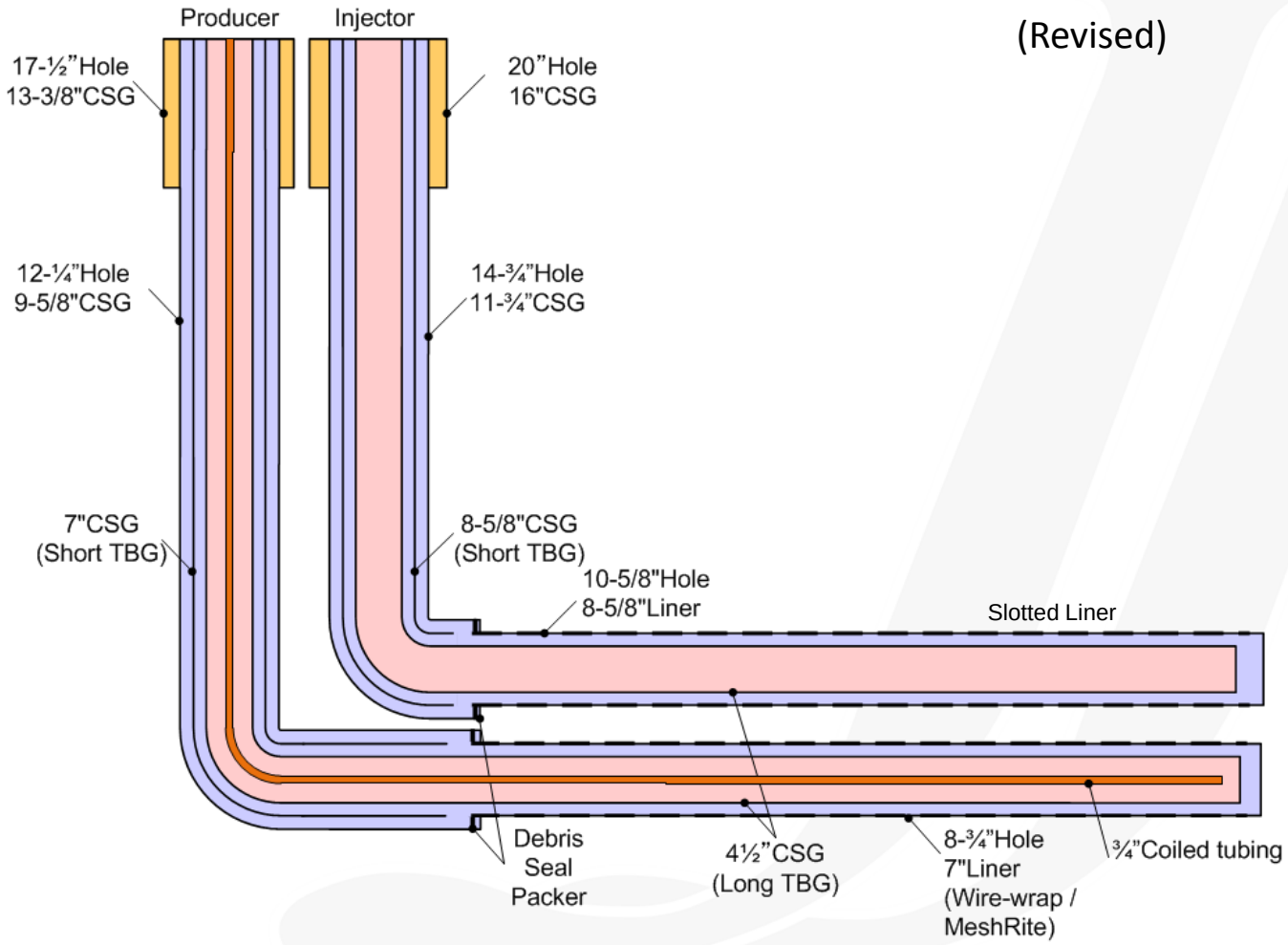
HE SAGD Well Completion Approval No. 11910

(Revised)



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N/C from 2013 PR

SAGD Well Completions

- 1999-2004 MeshRite/wire wrap – Limited technology available for "SAGD" applications
  - Isolated cases of sand production
- 2005-2010 Slotted Liner – Commercial emergence of technology, lower cost alternative
  - Good sand control
  - High pressure drops
- Hangingstone Expansion design – Straight cut slots on injectors / MeshRite and wire wrap on producers
  - Decision based on
    - Operating experience at DEMO operations
    - Thorough testing program and strength evaluations
    - Cost analysis

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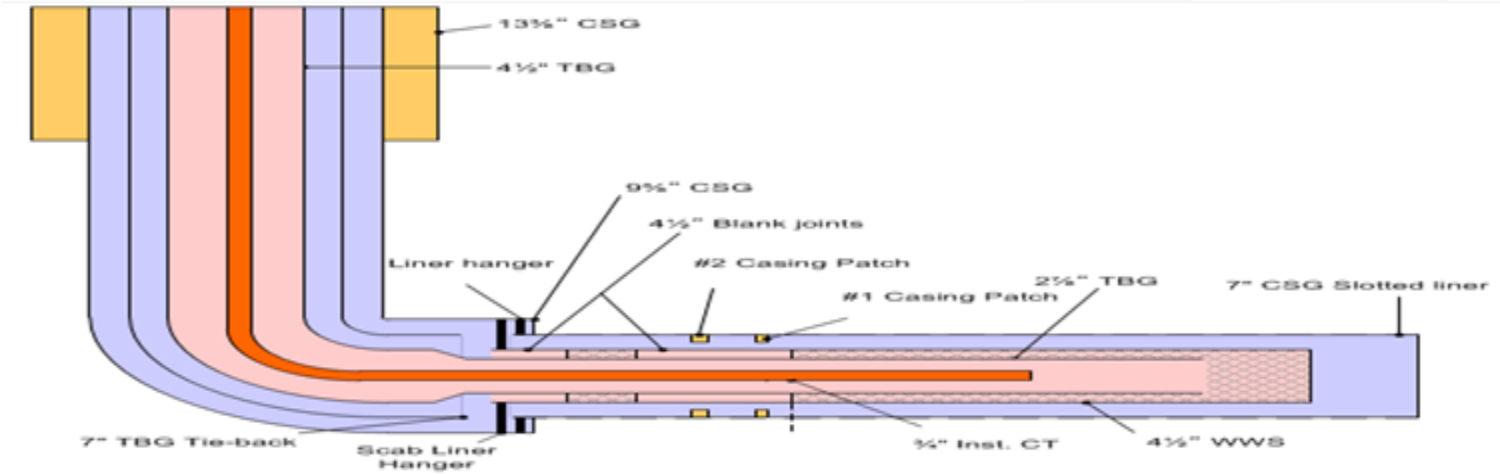
SAGD Well Completions – HZVP Liner Failure / Workover

- SAGD start-up in July 2012
- Liner failure (sand production / plugged well off) June 2013
- Well workover Aug – Oct 2013
- Installed one 7” casing patch, issues with casing patch setting tool
- Installed scab liner w/ 0.005” Wire-Wrapped-Screen
- Restarted SAGD in June 2014
  - Replaced instrumentation coil - mechanical failure
  - Fluid recovery of calcium chloride/nitrate heavy brine solution before commingling with produced fluid returns to CPF
  - Well running at conservative rates, BS&W sampling show intermittent traces of solids, and bitumen slowly increasing



SAGD Well Completions – Demo Workover Challenges

Contributing factors which resulted in “challenging” workovers

- JACOS DEMO operates at high injection pressures (≈4500kPa) resulting in downhole pressures higher than hydrostatic head
- Failed wells are in communication with adjacent wells making it difficult/impossible to de-pressure the reservoir
- Specialized brine (up to 1.6 density) is required to weight-up the column to preform workovers
  - Well control is difficult due to fluctuating downhole pressures; wells take kill fluids
  - Brine kill fluid returns have negative effect on plant water treatment systems; well produced fluid is trucked out until hardness/chlorides are at acceptable levels

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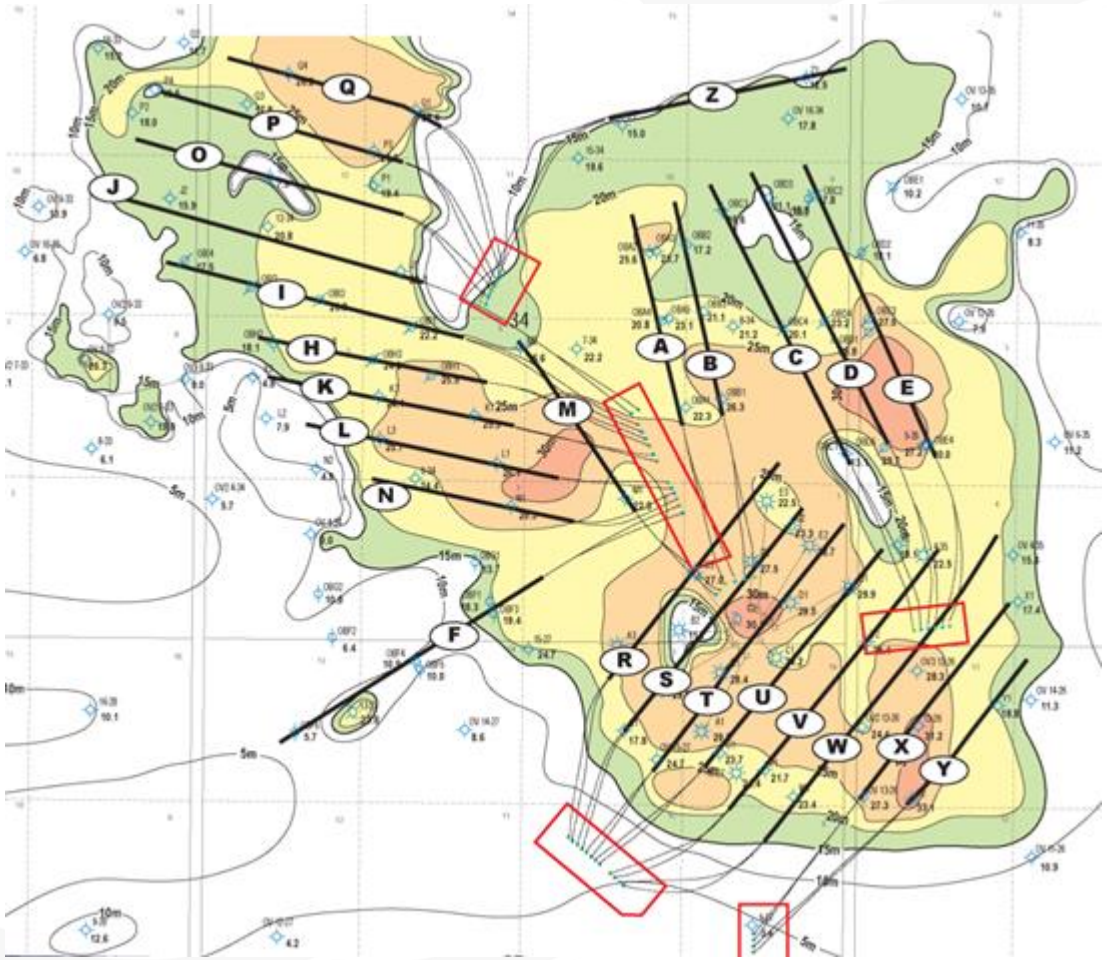
Artificial Lift - Approval Nos. 8788K (Demonstration)

HZXP/HZYP ESP trial was initiated to test downhole pumps.

The location of the wells was chosen due to the fact the wells are relatively isolated from the adjacent high pressure wells. The adjacent well (W) was the last well to be brought on stream.

Eventually when X/Y steam chamber coalesces with W-Well, X/Y will be converted to “natural lift” SAGD wells



Artificial Lift - Approval Nos. 8788K (Demonstration)

HZXP – Schlumberger Hotline 550 (218°C)

1st ESP pump installed Dec/10 –April/12 (Run Time 487D, Surface Connector Failure).

2nd ESP system installed May/12- June/13 (Run Time 381D, Surface Connector / Electrical Cable Failure).

-3rd ESP pump installed July/13

Operating Temperatures up to 210°C
Intake Pump Pressure – 2000-2800kPa
Production rate - 160-320 m^3/D
ISOR ≈ 2.5

HZYP – Schlumberger Hotline SA3 (250°C)

Pump installed Jan/13, online Feb/13

Operating Temperatures up to 175°C
Intake Pump Pressure – 2000-2800kPa
Production rate - 100-150m^3/D (Reduced rates due to high ΔP, temperature spikes)
ISOR ≈ 4.3

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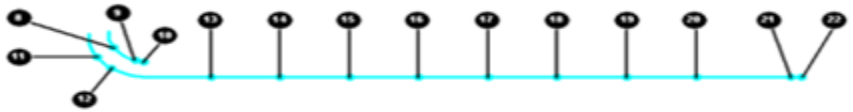
Demo Thermocouple Placement

Instrumenation in Wells

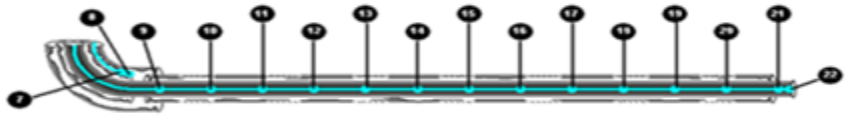
Wells A, B
Injector

Producer



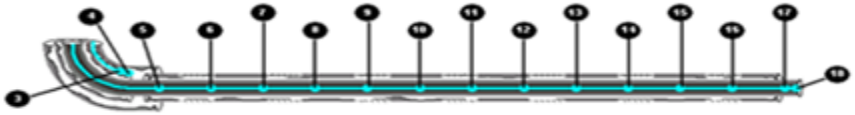
Wells C, H
Injector

Producer



Wells D, E, I
Injector

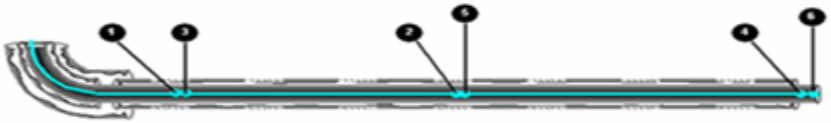
Producer



Wells J, K, L, M, N, O, P, Q, R, S, T
Injector

NO THERMOCOUPLES

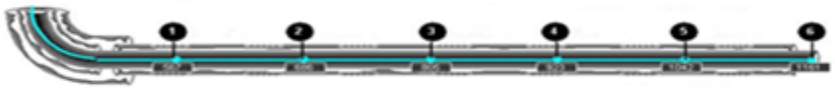
Producer



Well U, V, W, Y
Injector

NO THERMOCOUPLES

Producer



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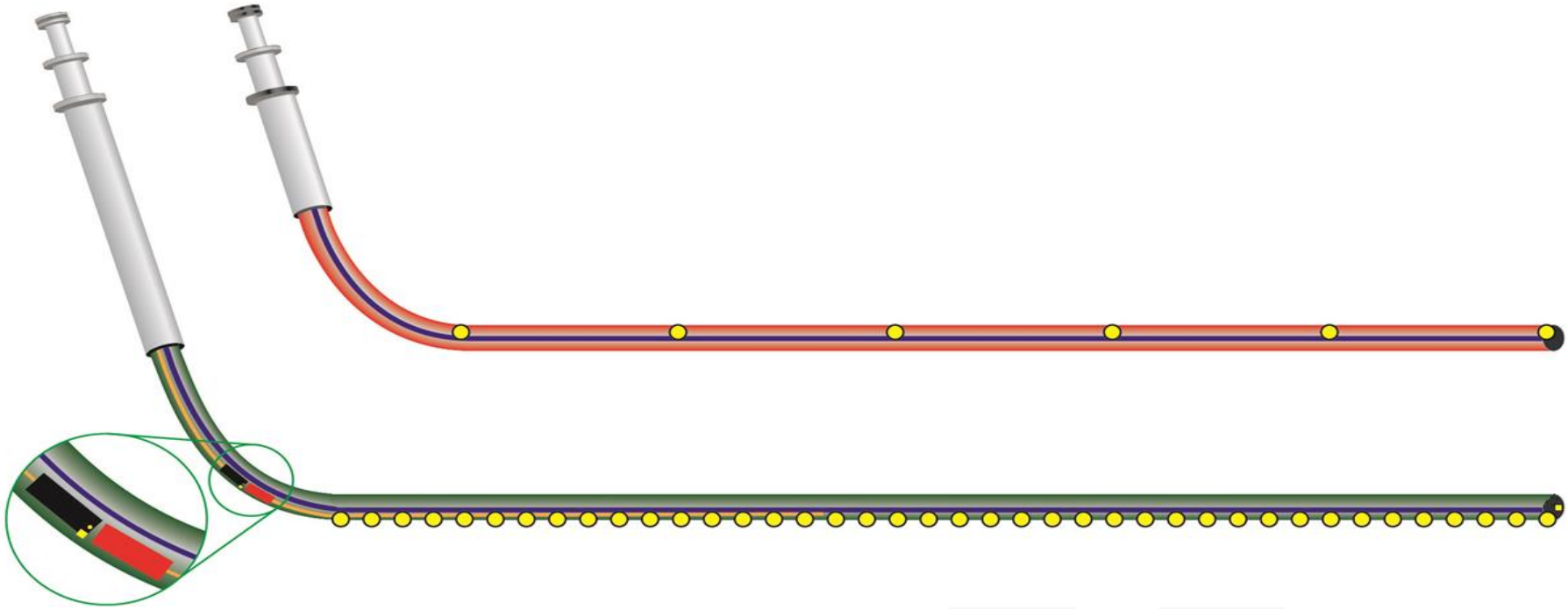
Instrumentation HZXP (ESP) - Approval Nos. 8788K (Demonstration)



HZXI – 6 Thermocouples
HZXP – 40 Point LX-Data Temperature, LX-Data Pressure
ESP – Single Point LX-Data Temperature, LX-Data Pressure

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Reservoir Performance

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Reservoir Performance Summary

- Currently producing 24 SAGD well pairs
- 2014 average bitumen rate ~ 5,734 bbl/day (912 m^3/day)
- Cumulative bitumen produced from project startup to 12/31/2014 ~ 32.7 million bbl (5.2 million m^3)
- Cumulative SOR to 12/31/2014 ~ 3.71
- OBIP for the developed area is 78 million bbl (12.6 million m^3)
- Recoverable bitumen is estimated at 48million bbl (7.6million m^3) (61% Ultimate Recovery)

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Steam Injection (Temperature, Pressure, Quality)

ANNUAL AVERAGE WELLHEAD PRESSURES AND TEMPERATURES		
2014		
WELLS	PRESSURES (kPa)	TEMPERATURES (^{o}C)
A-WELL	4563	259
B-WELL	4579	260
C-WELL	4548	259
D-WELL	4519	259
E-WELL	4549	259
H-WELL	4667	261
I-WELL	4729	261
J-WELL	4638	261
K-WELL	4640	262
L-WELL	4758	261
M-WELL	4675	260
N-WELL	4664	261
O-WELL	4508	259
P-WELL	4367	256
Q-WELL	4301	256
R-WELL	4721	262
S-WELL	4764	263
T-WELL	4825	263
U-WELL	4718	262
V-WELL	3862	247
W-WELL	4740	261
X-WELL	3381	243
Y-WELL	3655	246
Z-WELL	4788	259

100% Steam Quality* @:

HZA, HZB, HZC, HZD,HZE

Average Steam quality for the remaining wells ~ 97%

* Steam Traps @ Phase 1&2 Wellheads

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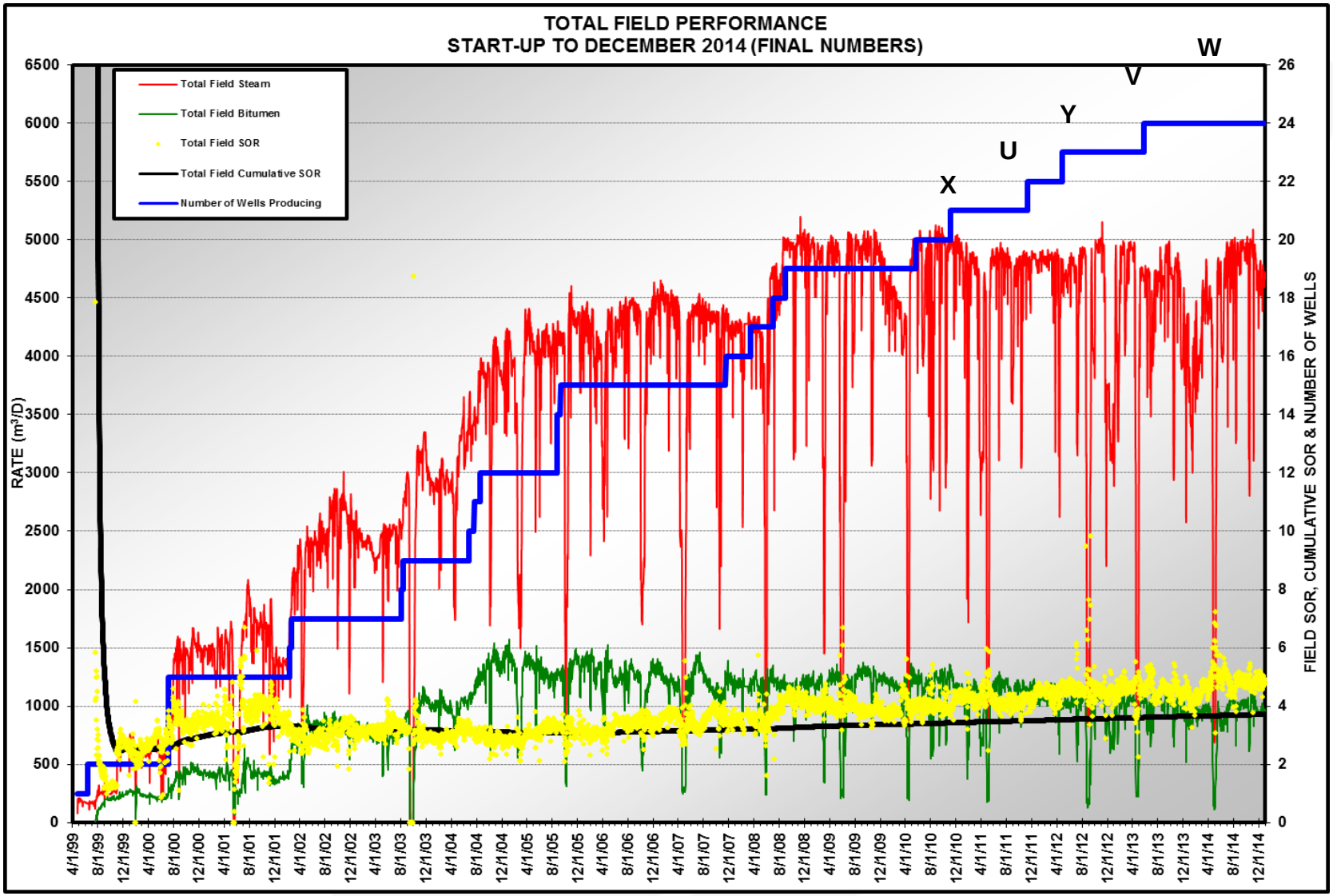

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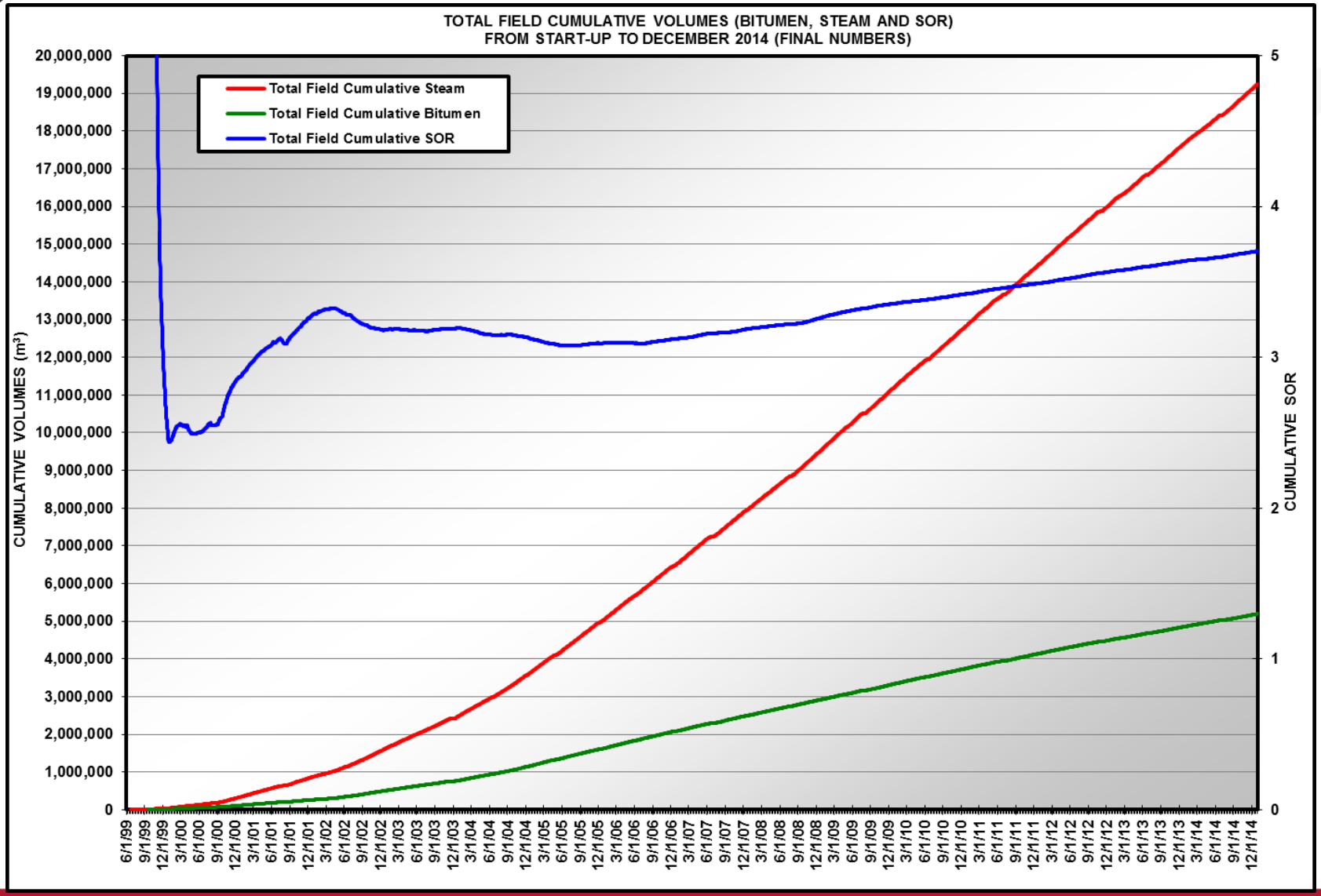
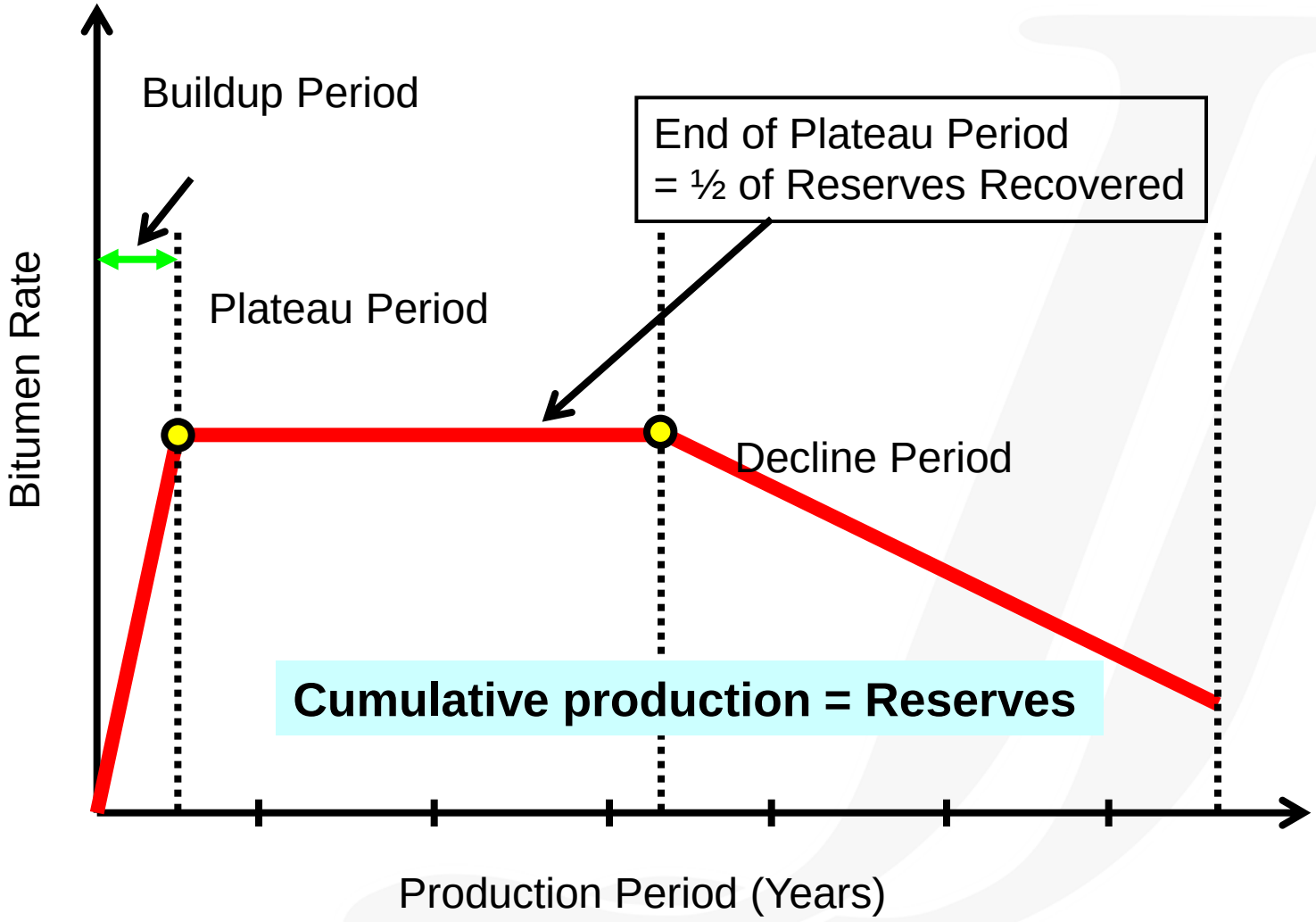


- Generic Production Curve Method for bitumen production
  - SAGD well life consists of build up period, plateau period and decline period.
  - Plateau rate is calculated as a function of effective net thickness.


Buildup Period
End of Plateau Period
= ½ of Reserves Recovered
Plateau Period
Bitumen Rate
Decline Period
Cumulative production = Reserves
Production Period (Years)

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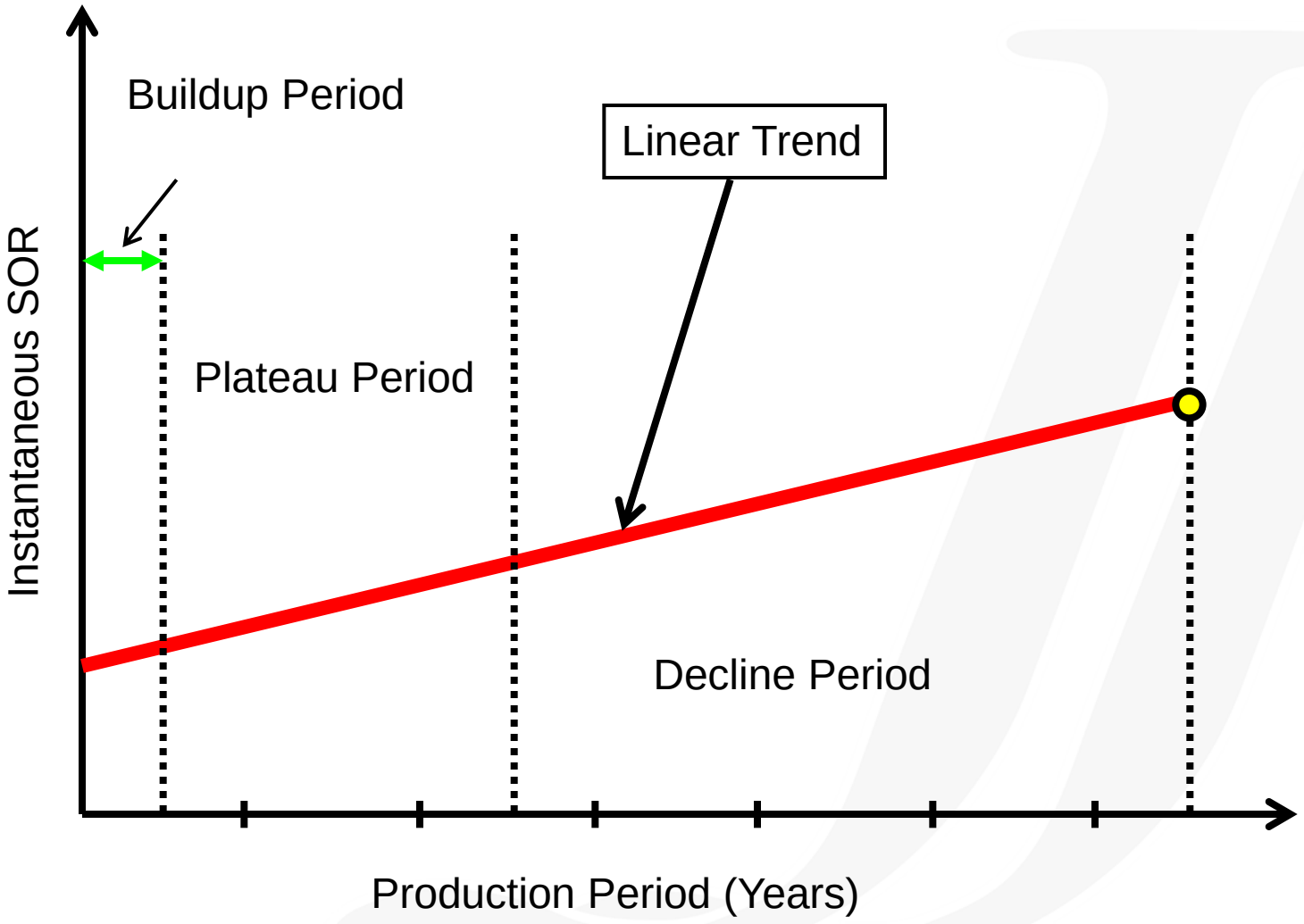
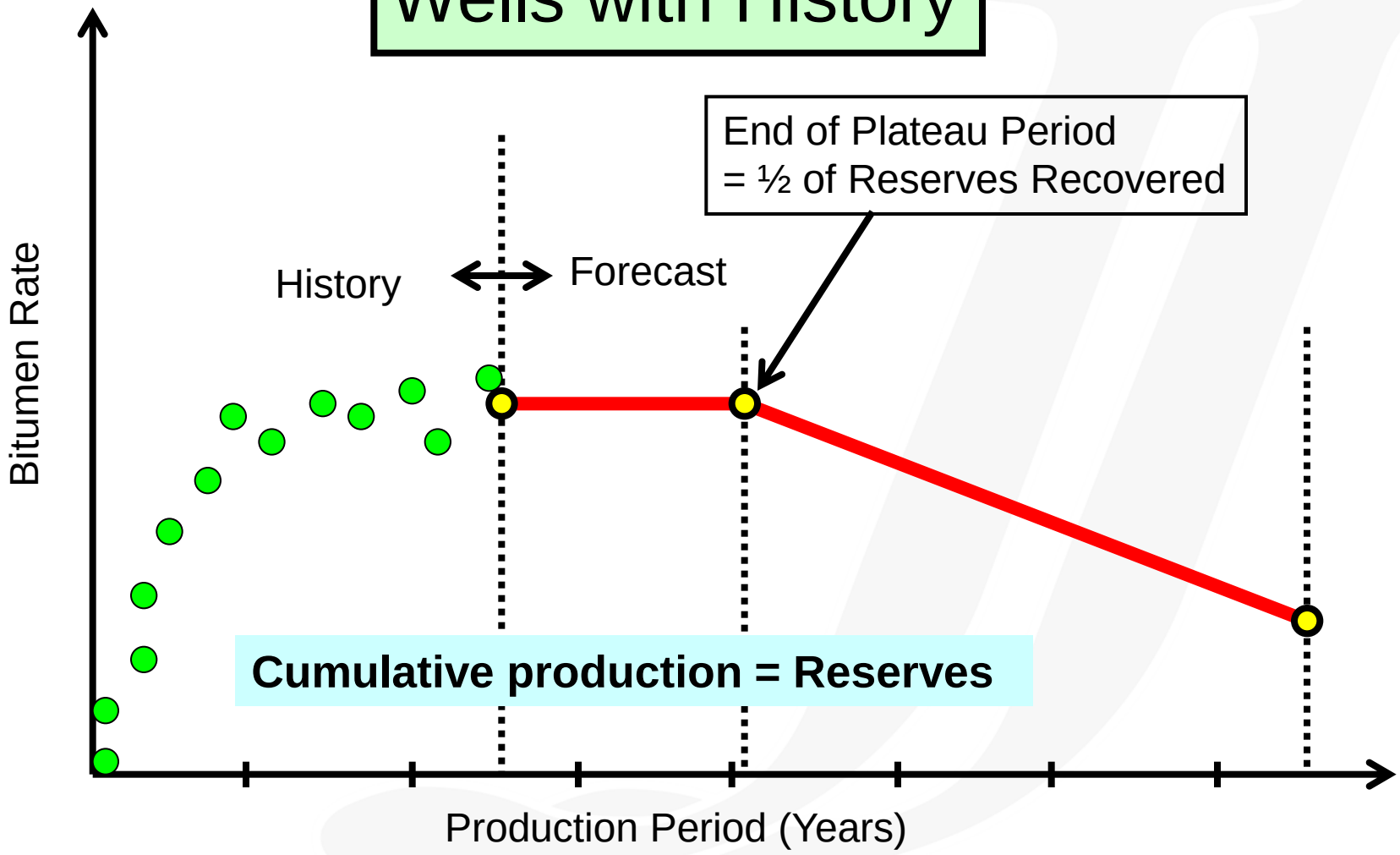
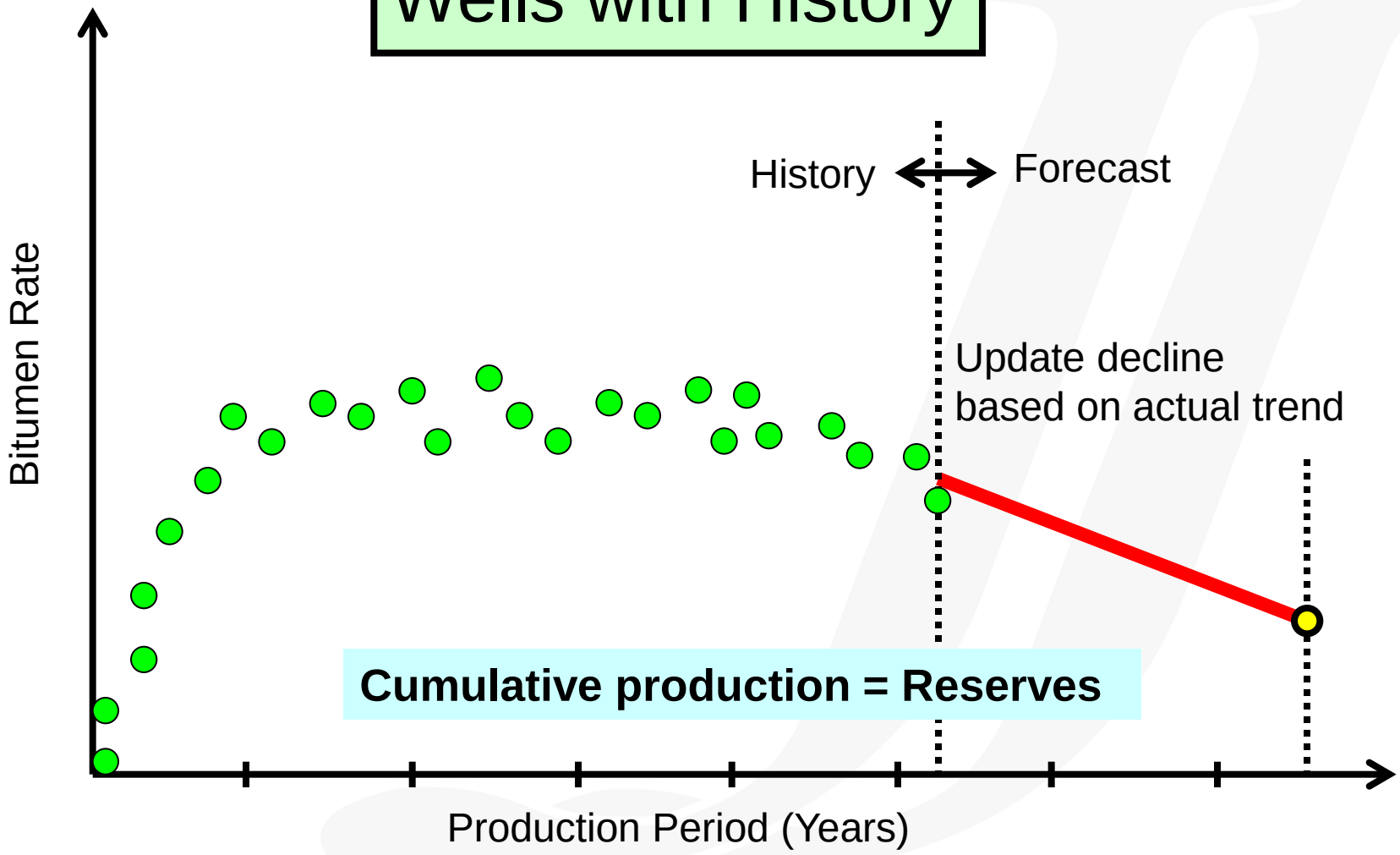
- A linear trend is adopted to describe the SOR performance.
- The initial SOR in the demo area has been evaluated as a function of effective net thickness. The initial SOR is classified into four categories of net thickness.
  - 10, 15, 20, 25m
- The increasing ratio with time is from simulation results.
  - 0.025/month
- The actual trend is close to this prediction.


Buildup Period
Linear Trend
Instantaneous SOR
Plateau Period
Decline Period
Production Period (Years)

Wells with History

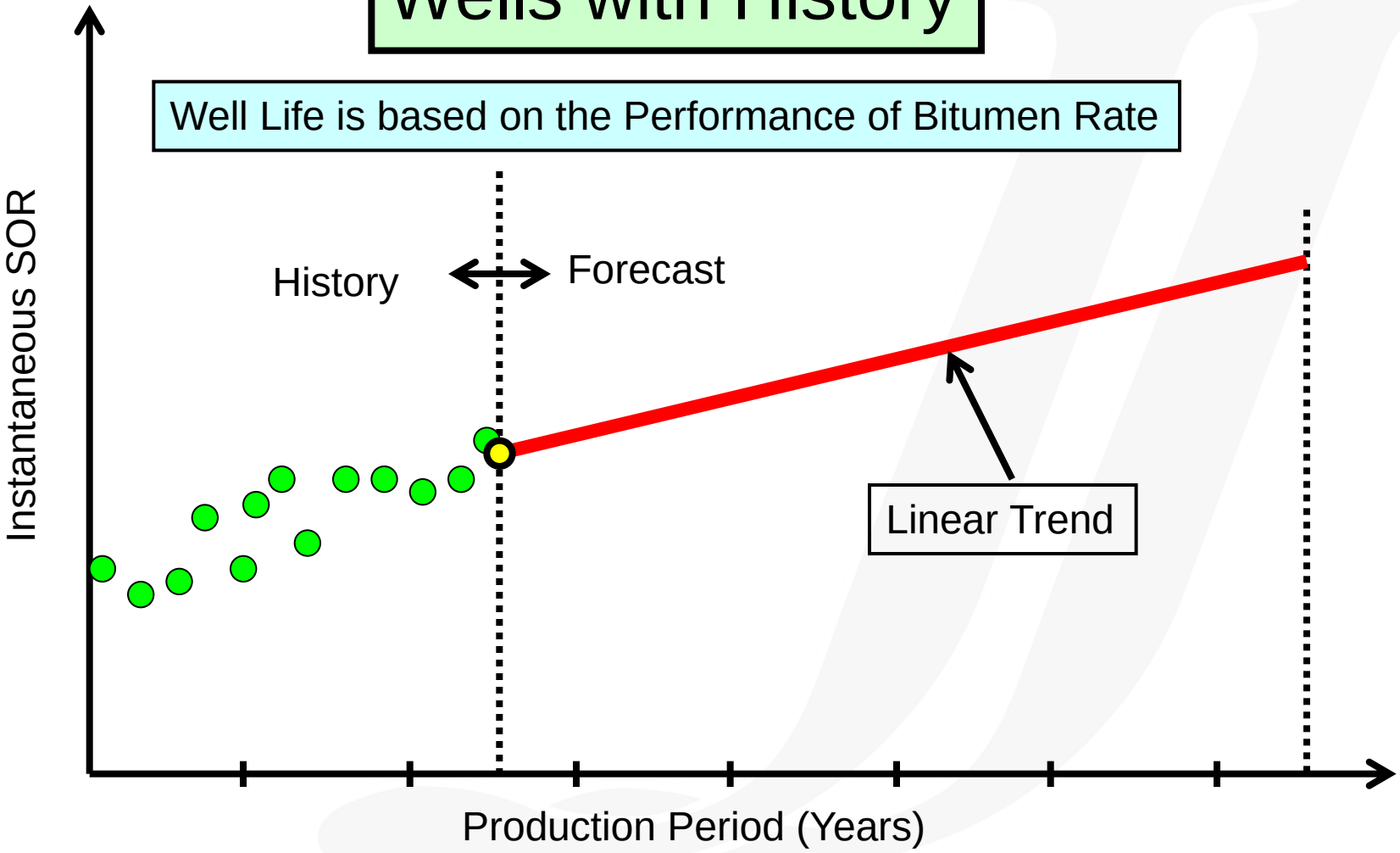


Wells with History



Wells with History

Well Life is based on the Performance of Bitumen Rate



- Decline method
  - Adopted to well groups (A to Q pairs) that have enough production history to estimate the decline
  - The steam chambers from the well pairs in this group have merged or will merge in the future (Steam chamber between J well and O well have a communication since 2011.)
  - A trend that reflects the stable operating period in both bitumen production and SOR is picked for the forecast with assumption that reservoir pressure will be relatively constant (fluctuation in pressure may exist due to marketing of bitumen and gas supply)

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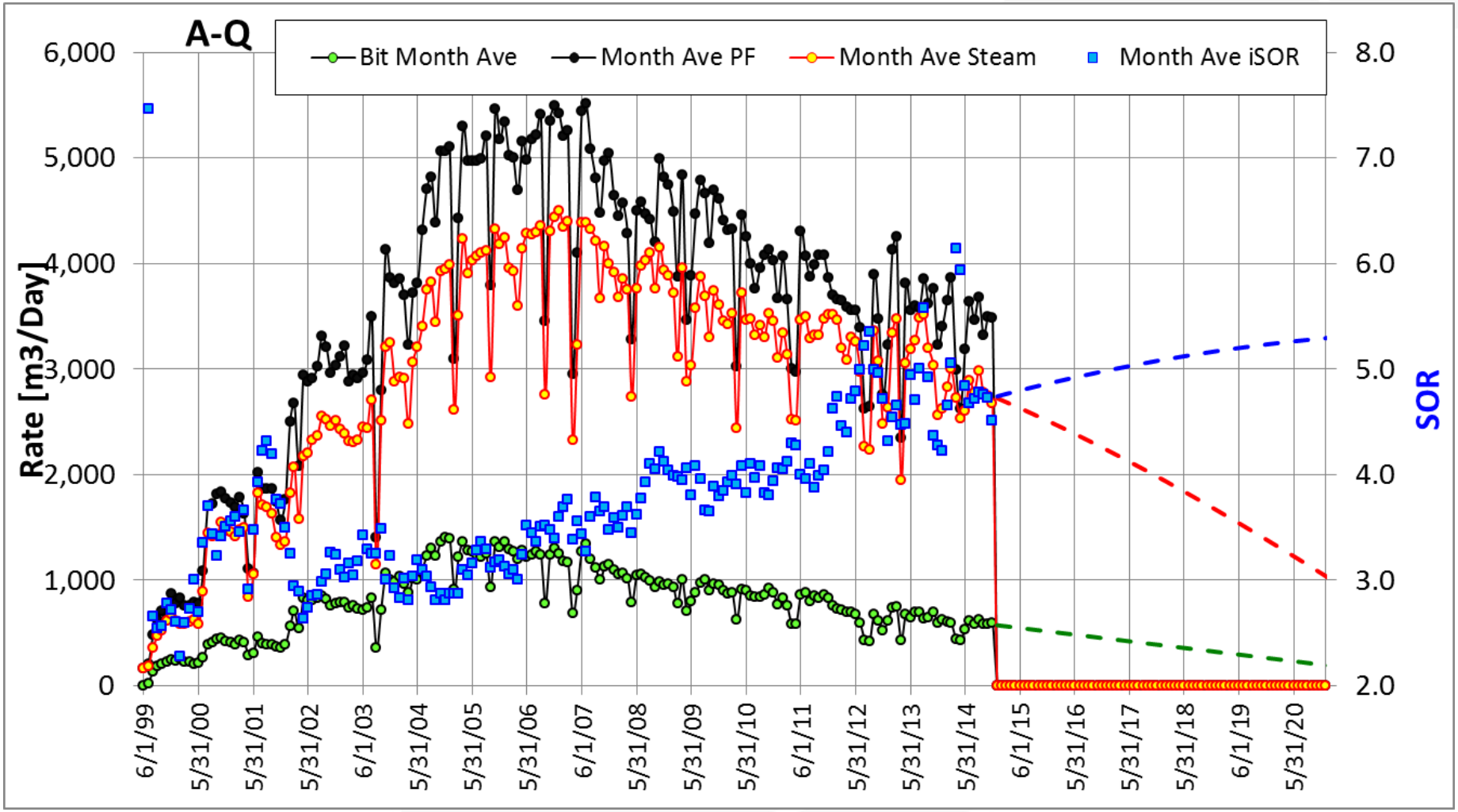
- Decline predicted from A – Q well pair production history



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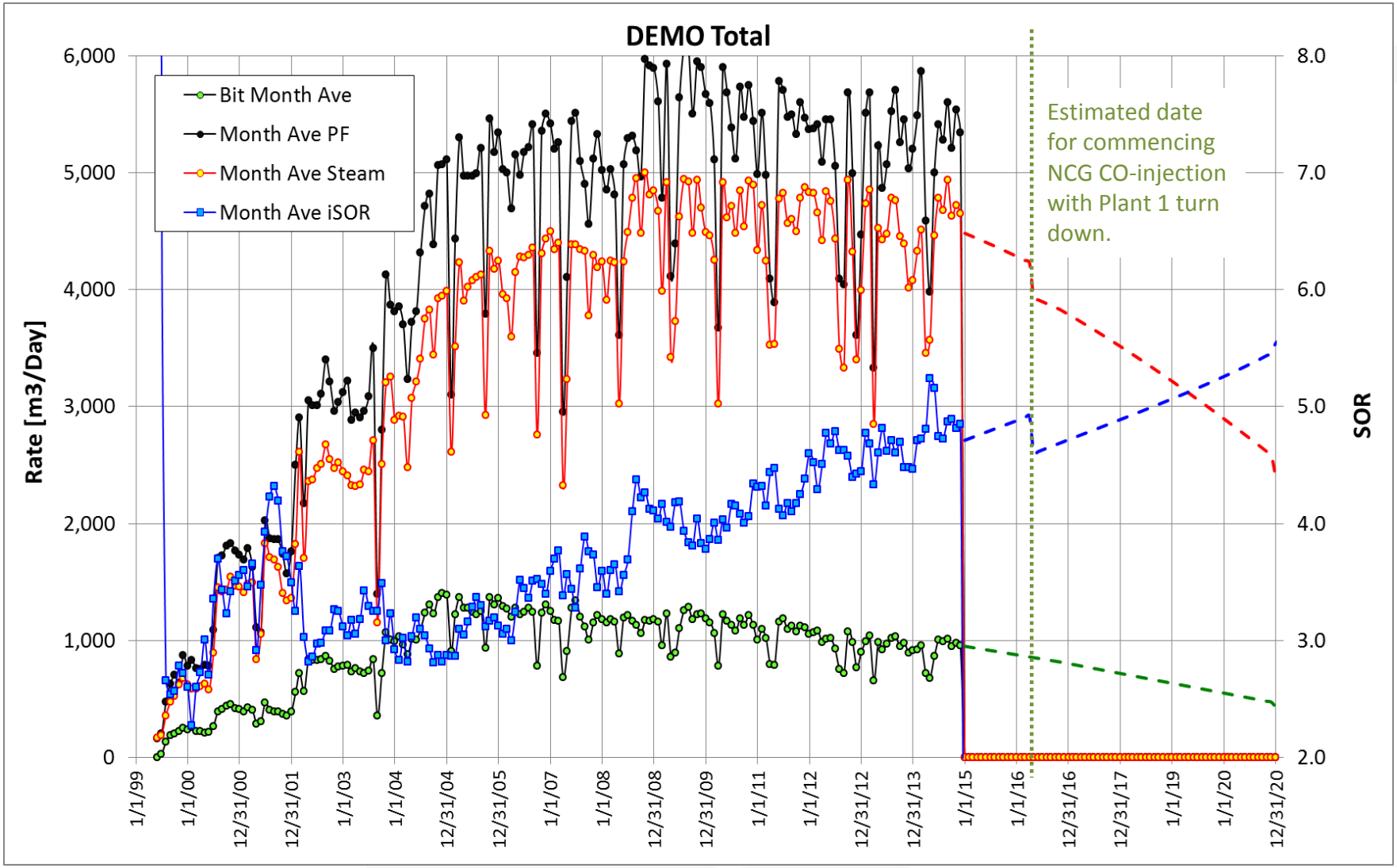

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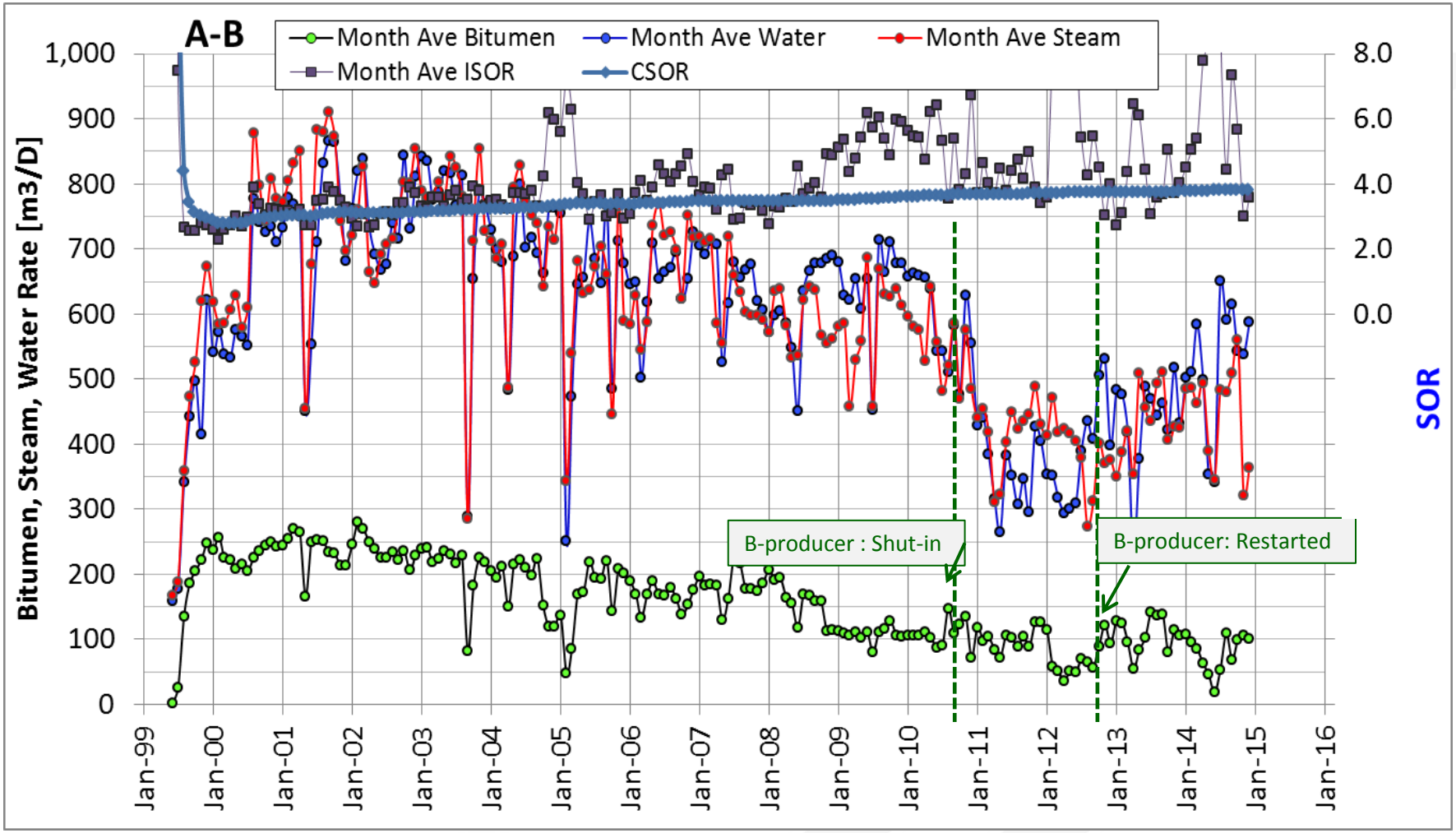
Start Year	Well Pair	Original Bitumen in Place (Mm3)	Cum Produced Bitumen (Mm3)	Current Recovery (%)	Ultimate Recovery (%)
1999	A,B,C D and E	3,113	1818	57	66
2002	H, I, J and K	2,158	1439		
2004	L, M and N	1,412	759		
2005	O, P and Q	1,203	505		
2007	S and T	1,186	296	25	58
2008	R and Z	913	218	24	44
2010	U and X	1,169	115	10	55
2012	Y and V	845	38	5	54
2013	W	585	16	3	55
	Total	12,584	5,205	41	61



Recovery factor at the end of 2014: 65.2%

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- These wells have approximately 14 years history and still maintain economic performance.
- These two wells produced ~ 5.6 MMbbl (0.89 million m^3) of bitumen and CSOR ~ 3.8
- The steam chambers for the A and B wells have been communicating since late 2001.
- The injection pressure of B is slightly higher than A, thereby sweeping bitumen from B to A. B well is a steam donor
- Drainage west of A pair is beyond 50m. Most of the bitumen in this area is expected to be recovered through the sweep between M and A wells. (M at higher pressure)
- NCG co-injection on A and B well pairs was conducted in parts of 2012 and 2013. No NCG in 2014

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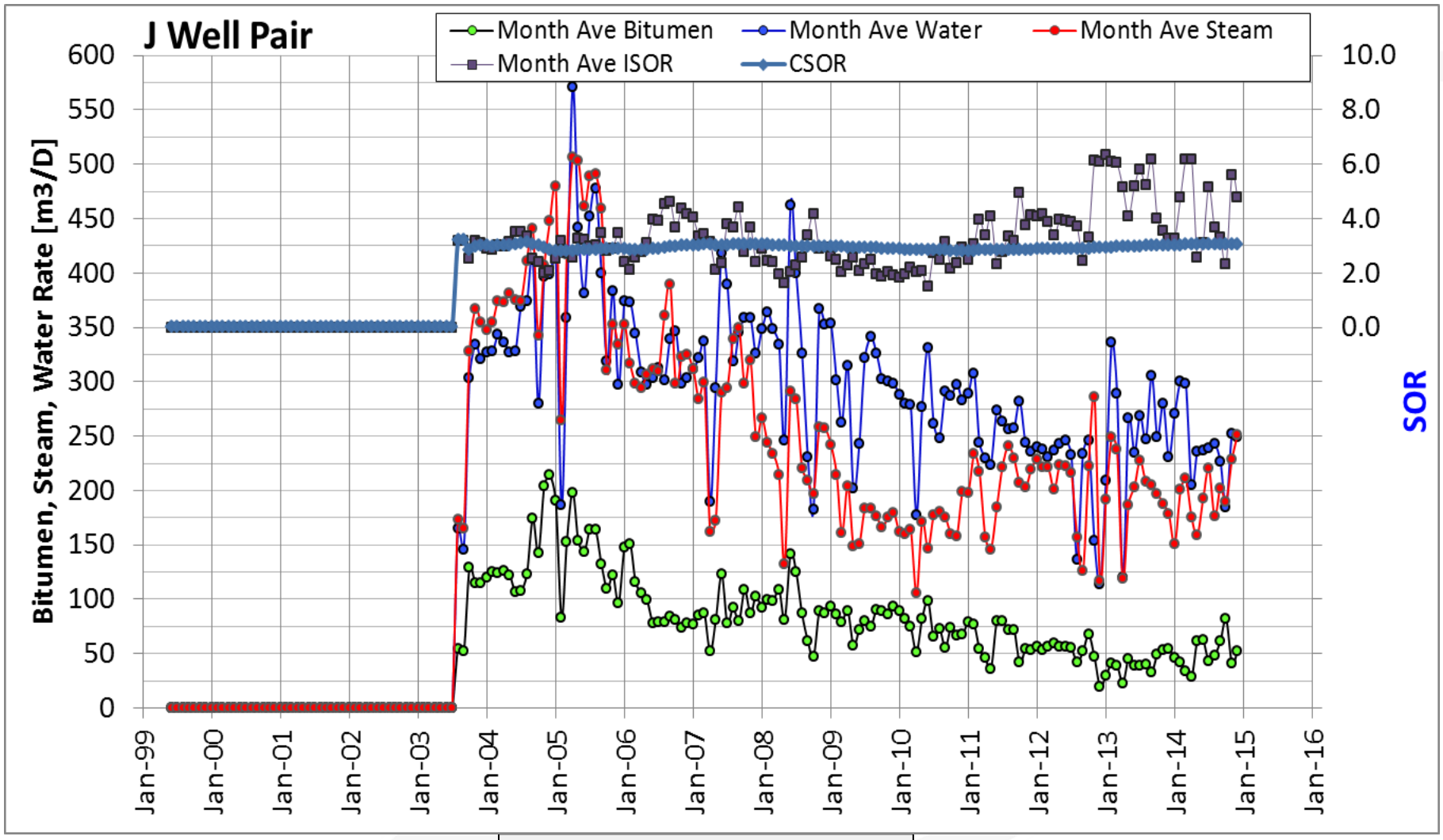

Recovery factor at the end of 2014: 49%

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- J pair has maintained good performance over the past year.
- The bitumen production profile appears to be following the typical build up, plateau, and decline periods.
- Well produced ~ 2.2 MMBBL and CSOR ~ 3.0
- The decline rate has moderated in the last 1-3 years.
- The J pair is in communication with the I pair to the south.
- The J pair started communication with the O pair in 2011 to the north and some steam is provided to the O well from J.

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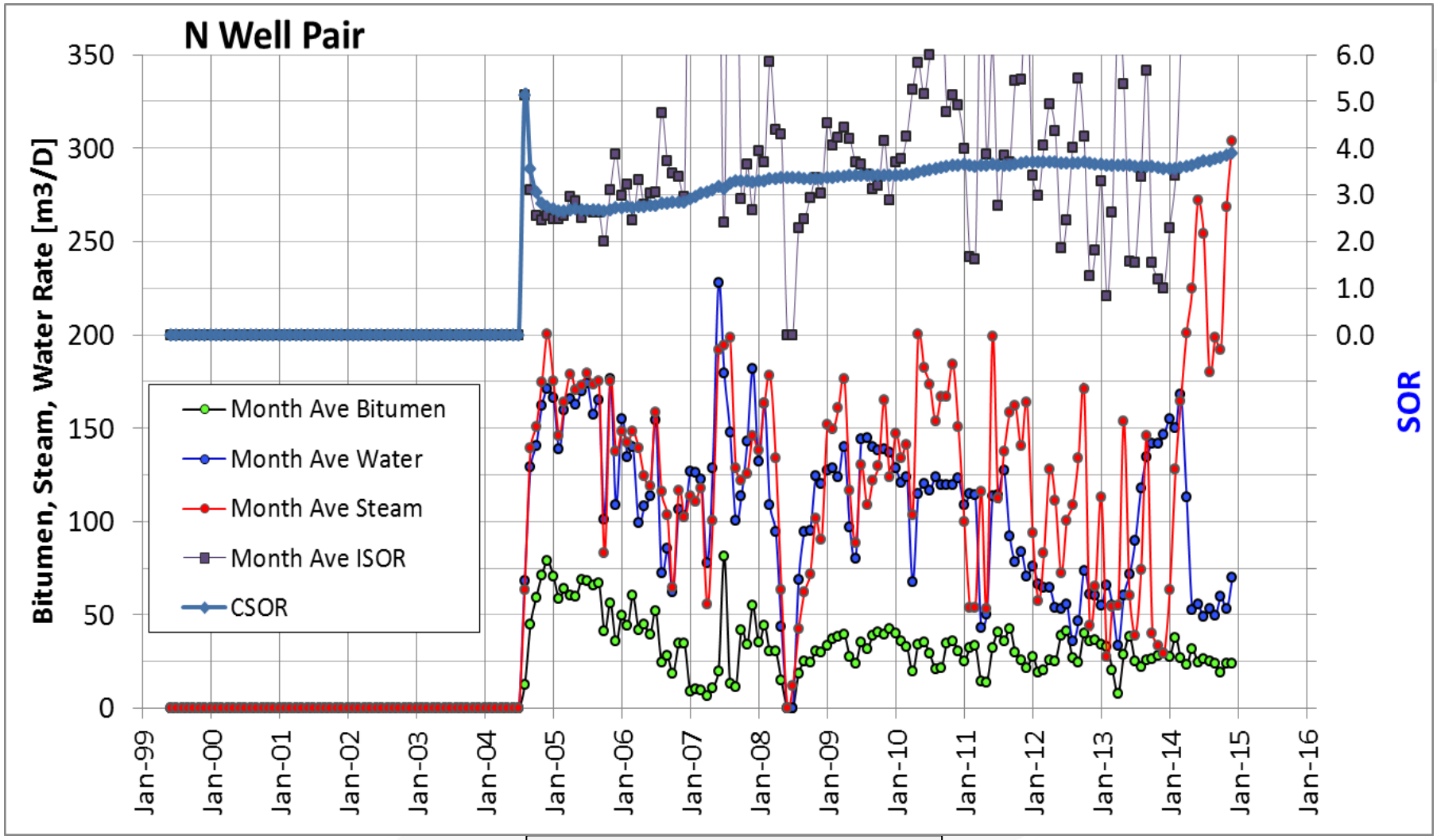

Recovery factor at the end of 2014: 37%

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- Actual bitumen production is lower than expected (150m^3/d).
- Well produced ~ 0.8 MMBBL and CSOR ~ 3.9
- Potential reasons for this low productivity are:
  - The reservoir along the HZ well contains clast facie and these slow down the steam chamber growth. Thermocouple data in the producer indicate that steam chamber growth at the toe is poor; likely due to the previously mentioned clast facie.
  - Steam coning induced sand production. This well has been controlled by production rate which prevents sand influx. This option enables the N well to produce steadily without sand issues.

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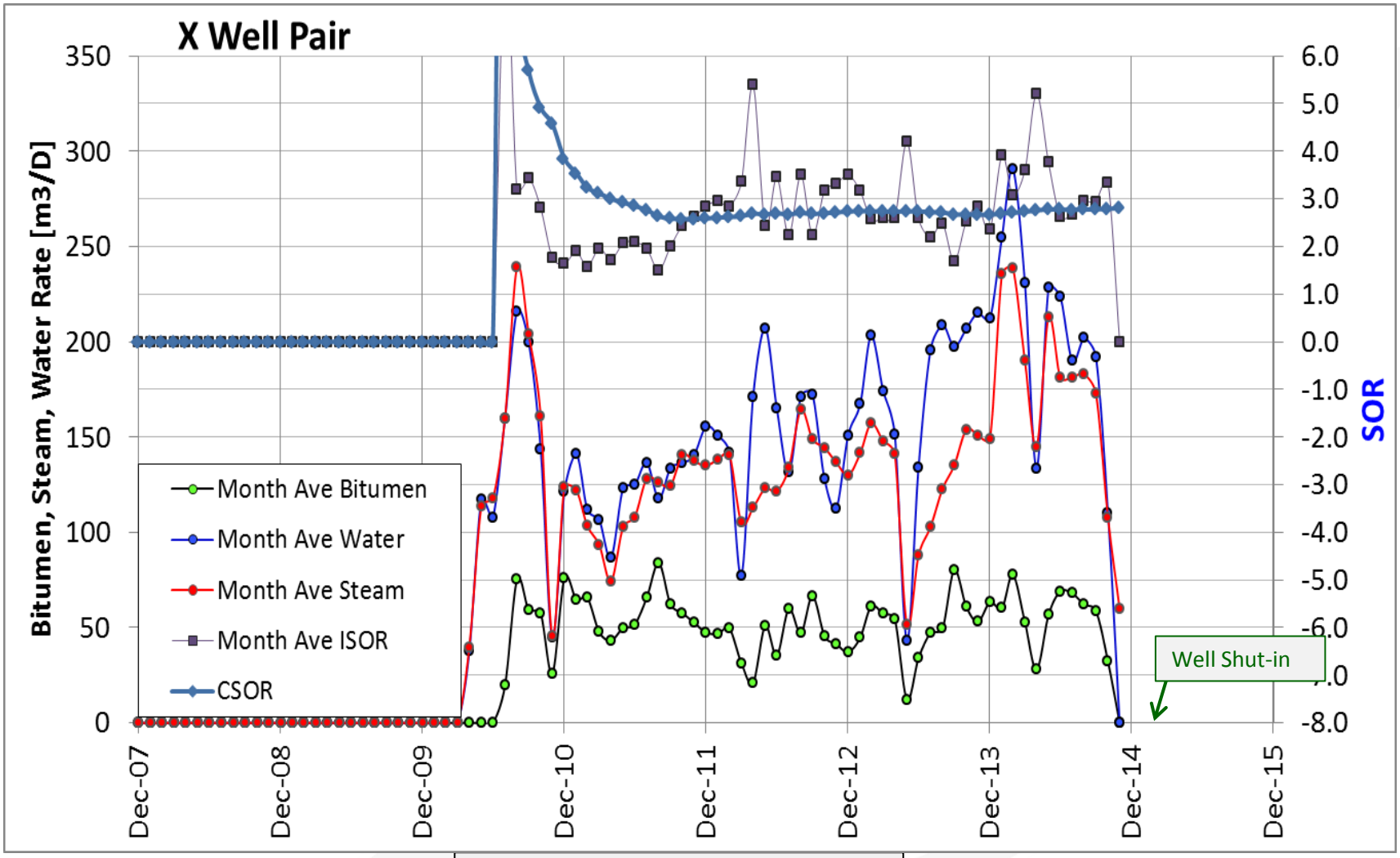

Recovery factor at the end of 2014: 14.2%

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'X' WELL

- First well with ESP test in the field.
- Well produced ~ 0.5 MMBBL & cSOR ~ 2.8
- X pair has maintained good performance since an ESP was installed to operate at low pressure (in December, 2010).
  - Maintained bitumen production
  - Reduced steam rate, which was free to be redeployed into other wells to maximize the total bitumen production from the facility.
  - Reduced SOR
- The second ESP failed in June 2013 (398 days in service) due to control line failure resulting in a short. The third ESP has been installed and running since July 2013. (Ref. : First ESP life : 487 days)
- X well was shut-in since November 2014 due to hot toe

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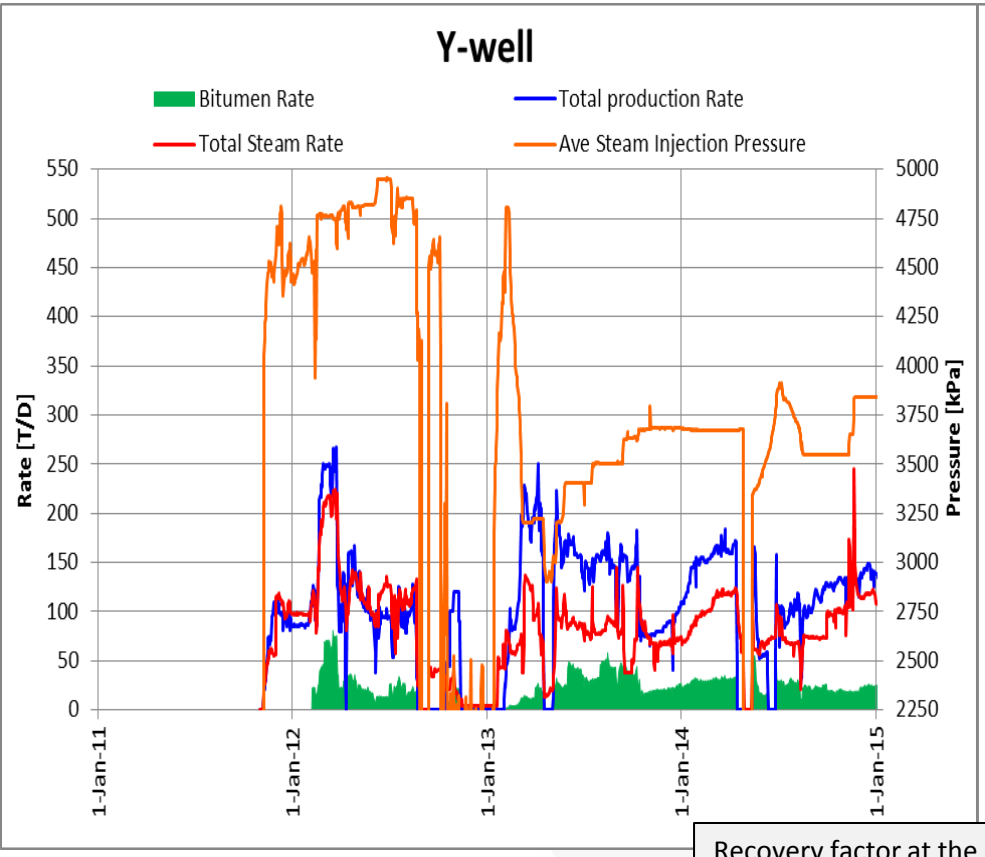
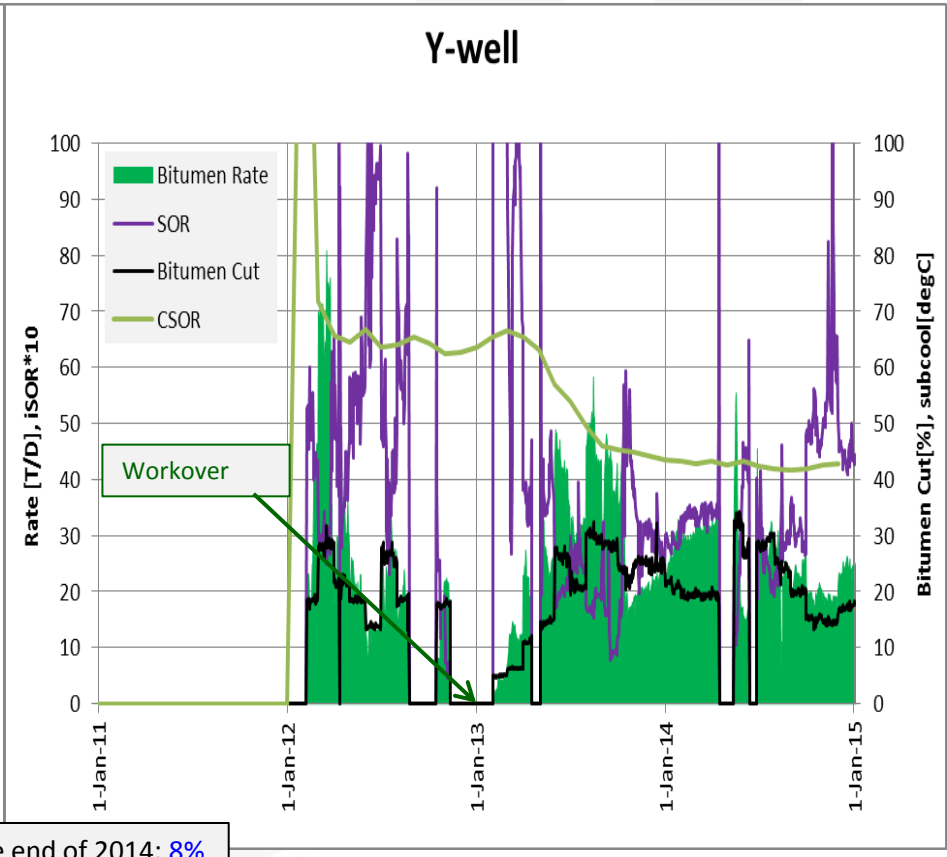
'Y' WELL

- **SAGD start-up in Feb 2012**
- **Sand production observed early in production life**
- **Liner failure (sand production / plugged well off) Nov 2012, well workover**
- **Rate control to minimize sand production**
- **Slowly ramping up production from the well considering past experiences with hot toe**





Recovery factor at the end of 2014: 8%

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NCG Co-injection

- Received AER approval to co-inject NCG in H-Q
  - No NCG co-injection happened in 2014
  - A-Q NCG Co-Injection
    - Date to start co-injection still to be determined
- Long Term Plan
  - Target NCG rate for Phases 1&2 is

Well Pair	A	B	C	D	E
Gas Rate (sm^3/d)	1,500	4,000	2,500	4,000	1,500

  - Target NCG rate for Phases 3 & 4 is ~26,000sm^3/d

Well Pair	H	I	J	K	L	M	P	Q
Gas Rate (sm^3/d)	5,600	4,650	2,400	2,730	4,000	2,270	2,200	2,200

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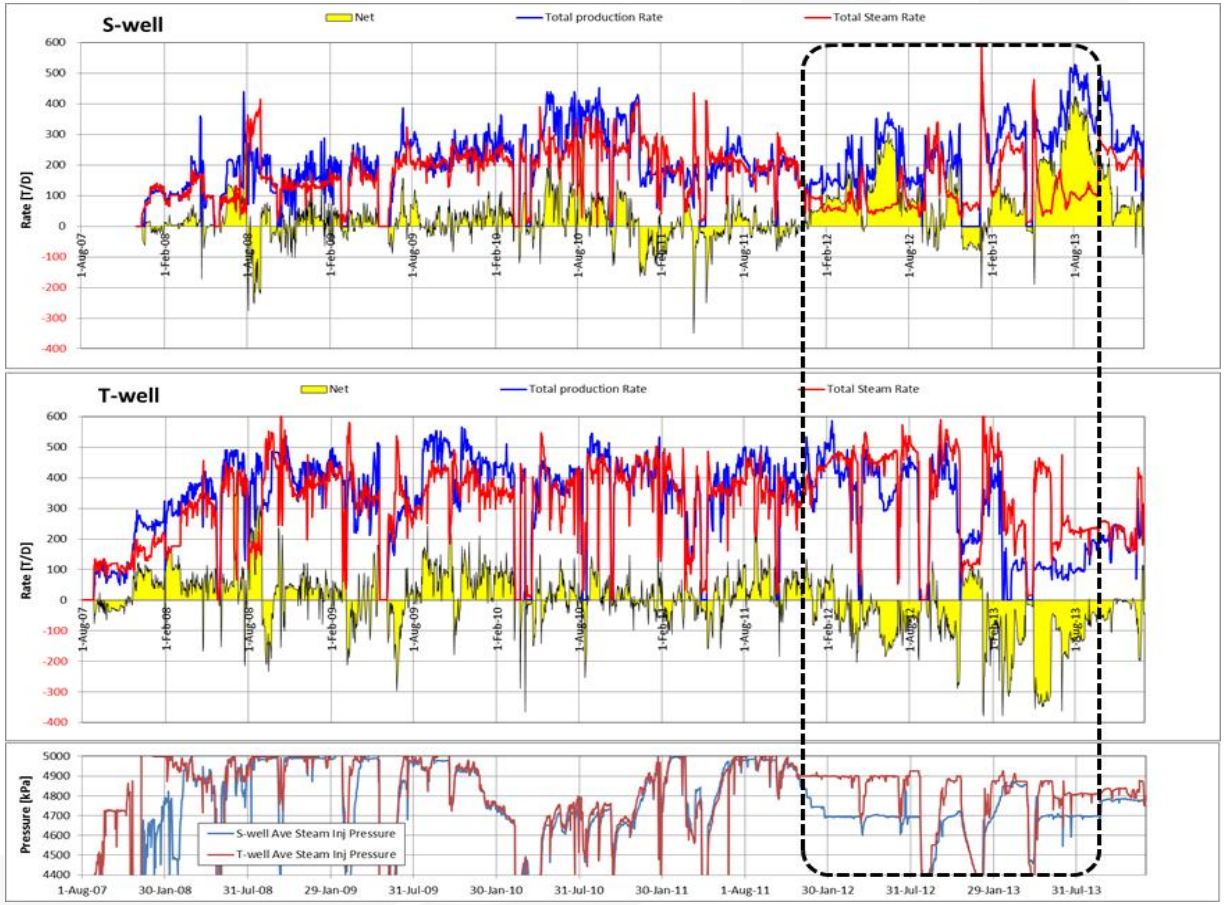
Fluid Communication

- A & B in December 2001
- D & E in April 2005
- H & I in May 2004
- H & K in January 2005
- J & O in March 2011
- S & T in January 2012
- P & O in April 2012



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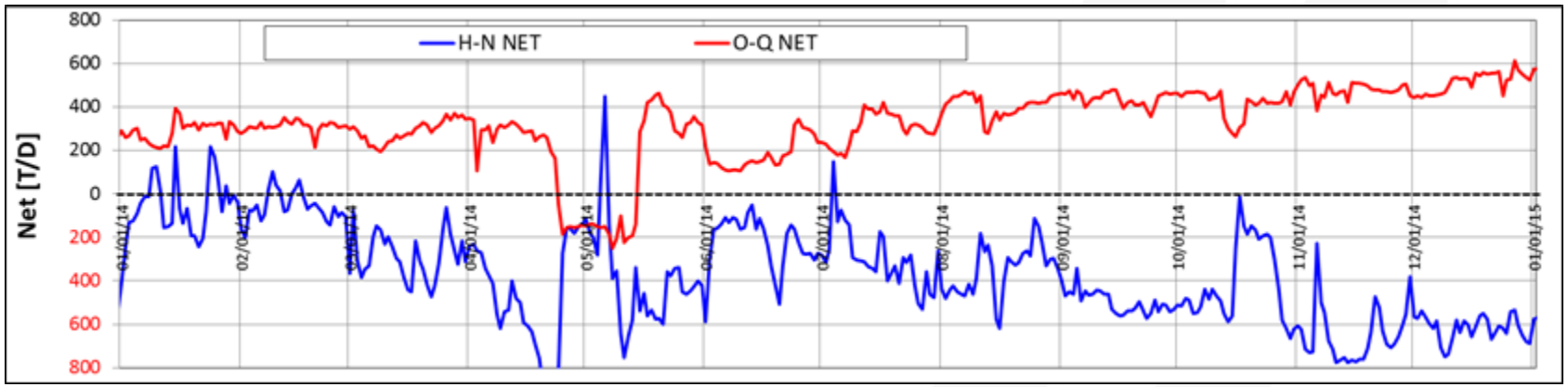
Fluid Communication

- Phases 3 & 4 are thermally mature
  - Production from phase 3 wells started in December 2001
  - Production from the last wells in phase 4 started in August 2005
  - Temperature observation wells show full steam chamber development in the clean sand
  - Fluid communication between the wells observed between the phases 3 & 4 and presented below.



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Future Development Options

- Lower pressure operation
- NCG Co-njection for the next group of thermally mature well pads
- Blowdown

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Surface Operations

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Facility Design

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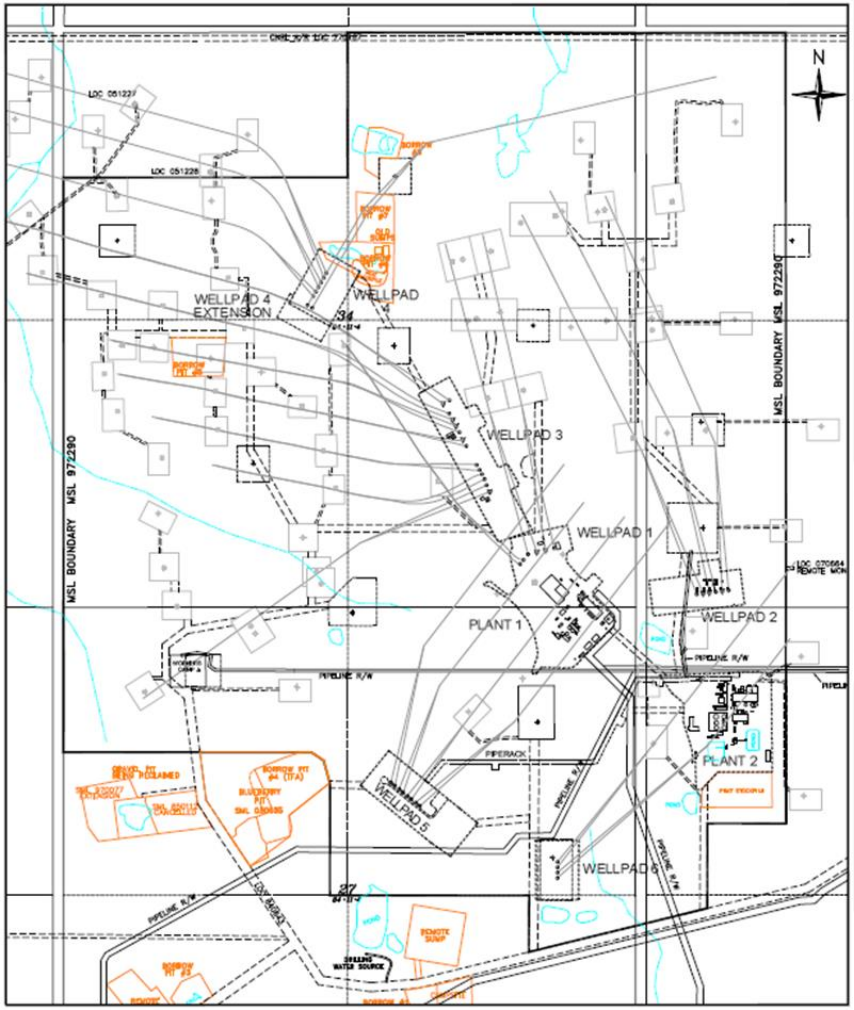
Site Plan



Vision. Integrity. Stability.

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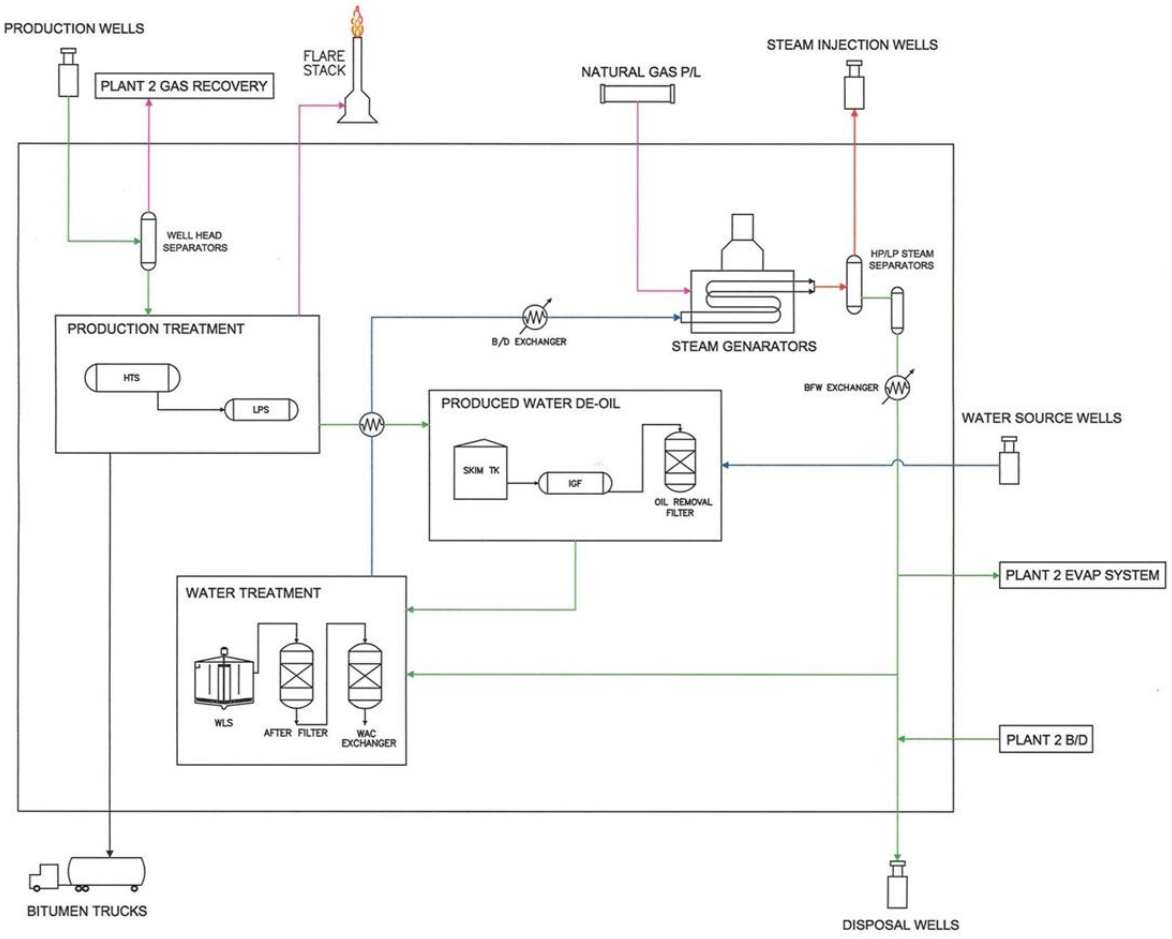
Plant Schematic – PLANT 1



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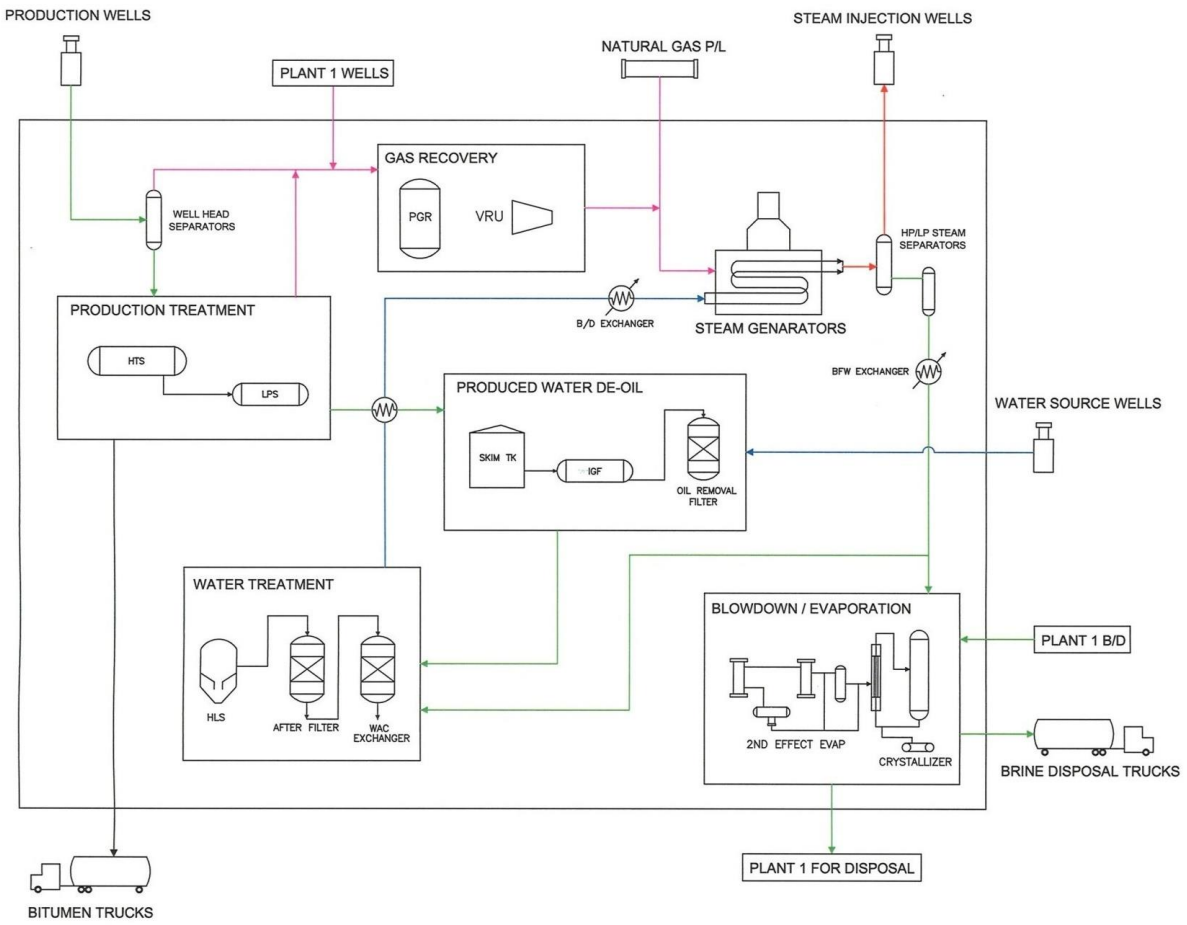
Plant Schematic – PLANT 2



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Facility Performance

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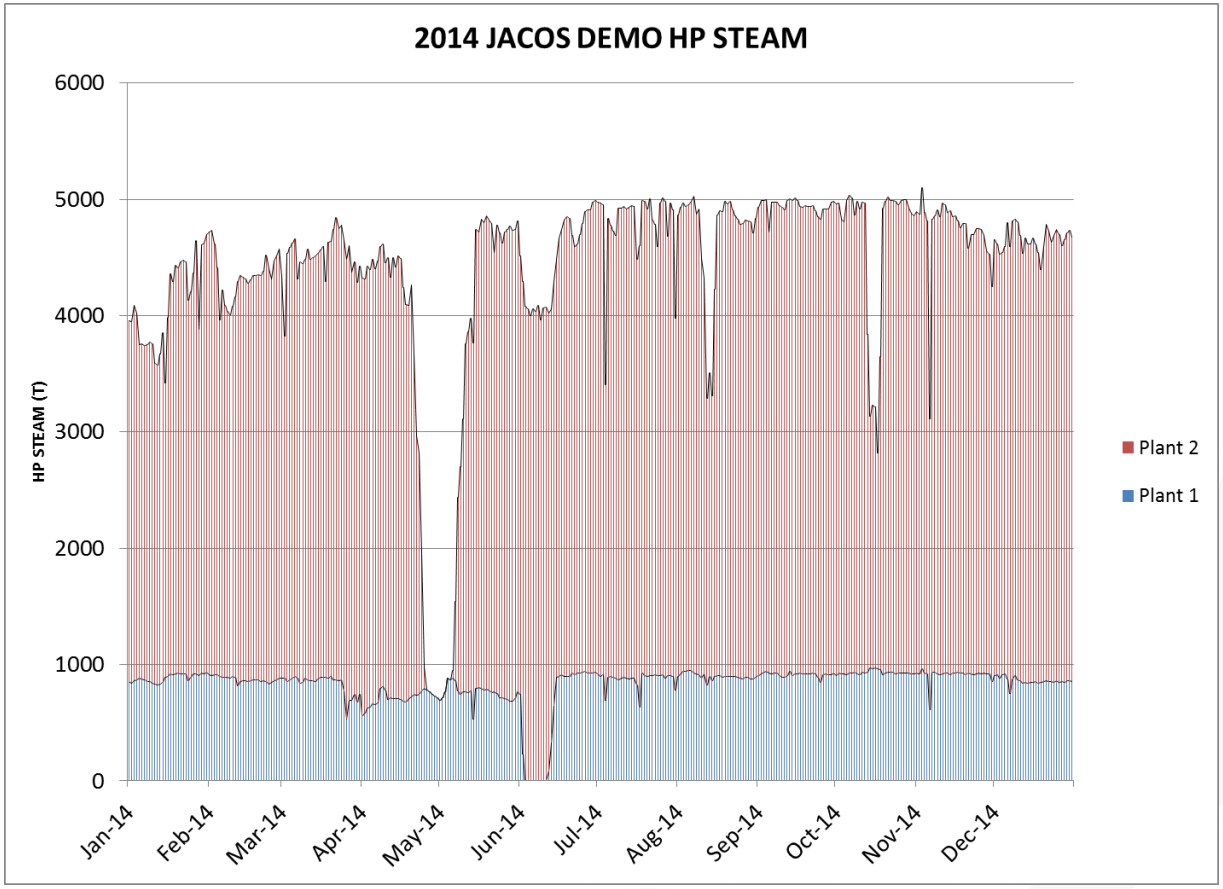
Facility Performance – 2014 Service Factor



2014 Service Factor – 93%

Operations interruptions are described in two categories

Planned Plant Turnarounds

- Major – April/May & June 2014
- Vessel inspections, PSV maintenance, process equipment cleaning, meter calibration/checks, boiler pigging, various repairs
- Minor – October 2014
- Boiler pigging, HTS cleaning, corrosion coupon installation

Contributed 6% of downtime

Transportation/Utility Restrictions

- Limitations in the following
  - Markets
  - Road access
  - Natural gas supply

Contributed 1% of downtime

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Steam Generation (Revised)

- Plant 1
  - B-201A/B – 50 MMBtu/h Boilers
- Plant 2
  - B510/520 – 180 MMBtu/h Boilers
  - B540 – 50 MMBtu/h Boiler

2014	Steam Volume (m^3)			Steam Quality	
	Plant 1	Plant 2	Total	Plant 1	Plant 2
January	27,450	99,244	126,694	74%	74%
February	24,463	97,007	121,470	74%	75%
March	25,820	114,177	139,997	74%	75%
April	21,355	82,653	104,007	73%	74%
May	23,487	87,293	110,780	73%	74%
June	16,698	117,365	134,063	74%	75%
July	27,180	121,357	148,537	75%	75%
August	27,917	117,420	145,337	74%	75%
September	27,454	120,815	148,269	75%	75%
October	28,903	114,788	143,691	75%	74%
November	27,379	114,550	141,929	74%	75%
December	26,696	117,669	144,366	74%	75%
Total	304,803	1,304,337	1,609,140	74%	75%
Daily Average	833	3,564	4,397		
Design Capacity	1,206	6,009	7,215	80%	80%

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Power & Energy Intensity

Power (kWh&MW) & Intensity [Natural Gas (m^3 & GJ)/Bitumen (m^3)]

2014	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)
Jan	2,694,904	3.6	8,654	28,320	306	39.39	12.0
Feb	2,431,689	3.6	8,224	25,755	319	39.14	12.5
Mar	2,593,331	3.5	9,604	29,600	324	40.04	13.0
Apr	2,152,011	3.0	7,156	21,591	331	39.72	13.2
May	2,196,687	3.0	7,935	21,082	376	39.05	14.7
Jun	2,061,747	2.9	9,157	25,957	353	38.89	13.7
Jul	2,249,298	3.0	9,956	31,238	319	38.90	12.4
Aug	2,254,009	3.0	9,635	30,695	314	39.04	12.3
Sep	2,253,553	3.1	9,905	30,378	326	40.16	13.1
Oct	2,405,888	3.2	9,667	29,338	330	40.00	13.2
Nov	2,438,218	3.4	9,382	29,423	319	40.04	12.8
Dec	2,512,952	3.4	9,586	29,380	326	40.18	13.1
TOTAL	**28,244,287**	**3.2**	**108,860**	**332,757**	**327**		**12.3**

* - Total natural gas to plant

** - Using monthly nat gas heating values

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Natural/Produced Gas Summary - 2014

(e^3m^3)	Purchased Gas	Produced Gas	Flared Gas	Produced Gas Recovery
January	8,654	279	31	88.9%
February	8,224	246	26	89.4%
March	9,604	286	28	90.4%
April	7,156	223	35	84.2%
May	7,935	205	30	85.3%
June	9,157	283	23	91.9%
July	9,956	317	27	91.6%
August	9,635	314	30	90.4%
September	9,905	324	25	92.4%
October	9,667	298	25	91.6%
November	9,382	296	24	91.9%
December	9,586	346	26	92.5%
TOTAL	108,860	3,417	330	90.4%

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Measurement & Reporting

N/C from 2013 PR

Production / Injection

- 15 out 24 SAGD well pairs have individual metered wellhead separators; produced fluid rates are continuously measured and recorded
- Two Group/Test separators
  - P / Q / Z Wells
  - R / S / T / U / V / W Wells
- Bitumen cut determined as follows
  - Phase 5 Wells (R→W) – Online Cut Meter (Phase Dynamics)
  - All other wells – Manual bitumen cut measurement (twice a month)
- Steam injection rates are continuously measured at each and every wellhead and prorated to high-pressure steam meters

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Proration Factor Method

- Total daily bitumen production is determined with metered truck-out volumes and inventory levels in sales tanks. The trucked volume is prorated to the custody transfer meter from the receivers trucking terminals.
- ∑Individual wellhead bitumen is measured/calculated and prorated to the plant production.
- Produced water from each well is calculated with the following formula
  - PW = Produced Fluid – Bitumen
  - Produced water from all the wells is then prorated to the total metered de-oiled produced water (This volume includes all condensed produced steam which is not measured off the liquid leg of the well head separators)

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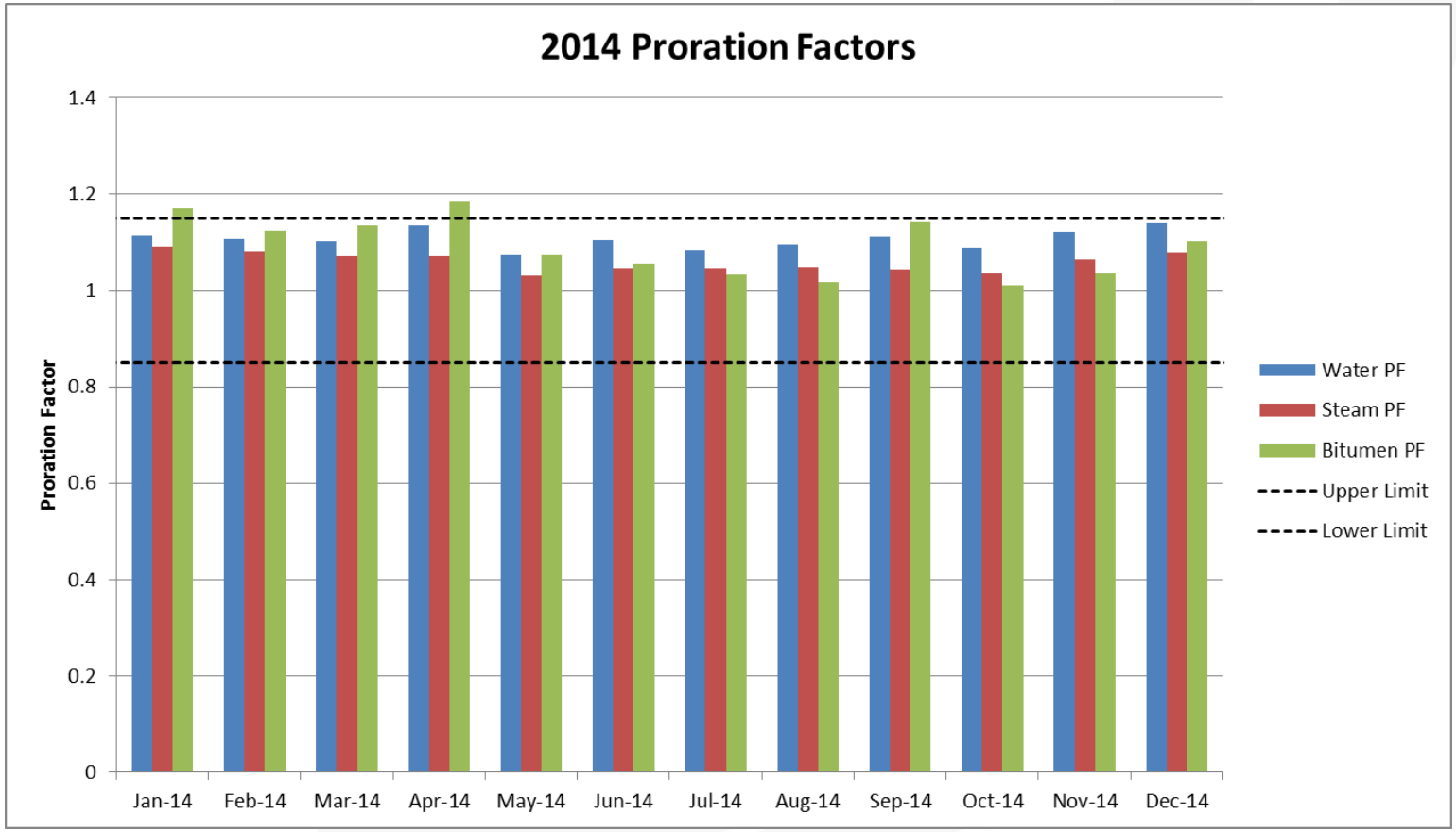
Proration Factors (Revised)

- The average 2014 proration factor for bitumen was **1.091**, steam was **1.059**, and water was **1.107**



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Measurement and Reporting – Water Balance

The chart below summarizes the water balance for 2014

(m^3)	IN			OUT							(ABS) Δ(%)
	Produced Water	Raw Water	Total	Steam to Wells	Disposal to Wells	Disposal to Truck out	Utility Water Out	Evaporation	HE Water	Total	
January	120,964	17,692	138,656	126,414	2,648	195	27	5,664	2,763	137,711	0.7%
February	115,170	17,261	132,431	121,216	2,212	235	28	5,516	2,199	131,406	0.8%
March	132,216	17,740	149,956	139,715	2,300	0	22	6,000	2,017	150,054	0.1%
April	99,313	13,318	112,631	103,739	2,656	155	37	4,440	1,790	112,817	0.2%
May	102,291	20,762	123,053	110,508	3,215	360	38	4,967	3,447	122,535	0.4%
June	123,906	20,002	143,908	133,797	2,022	76	38	5,300	1,629	142,862	0.7%
July	136,513	24,405	160,918	148,261	2,458	37	33	6,620	3,254	160,662	0.2%
August	132,815	24,431	157,245	145,060	2,233	111	85	6,720	3,703	157,912	0.4%
September	137,683	22,154	159,837	148,002	2,595	148	33	6,270	2,490	159,537	0.2%
October	132,214	21,495	153,709	143,414	2,868	149	13	6,300	2,477	155,221	1.0%
November	136,719	18,627	155,346	141,663	2,598	39	24	5,650	2,709	152,682	1.7%
December	135,917	21,904	157,820	144,091	2,651	0	25	5,950	1,848	154,565	2.1%
Total	1,505,723	239,789	1,745,512	1,605,879	30,455	1,504	403	69,397	30,326	1,737,964	0.4%

- Evaporation from multiple sources is calculated (details in MARP). Sources include tanks, the hot lime softener, and the crystallizer
- Hangingstone Expansion (HE) water is used for construction and drilling at the expansion project

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Optimization of test duration

- Optimization of test duration
  - Achieve the minimum test period and frequency for each well
  - Maximize time & frequency for wells with weak returning pressure and/or unstable operation

- Minimum test period: 2 days per month
- Minimum test frequency: Target 1 per month
- Minimum BS&W tests: 2 cuts per month

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2014 MARP Submission

New to JACOS 2014 MARP

- Water/Steam Primary and Secondary Measurement
  - Additional meter details added
  - Calculation/flow diagram details

- Addition of new gas co-injection wells
  - Originally Phase 1&2 approved for co-injection (5 wells)
    - Application No. 1635331
  - 2014 additional Phase 3&4 co-injection was approved (8 wells)
    - Application No. 1764015
    - Note, co-injection for Phase 3&4 has not yet commenced

- Revision/clarification of raw water reporting method for Hangingstone Expansion (construction & drilling)
  - All source water from wells DQ-02-2 and DQ06-7 is REC at demo
  - Expansion construction/drilling usage will be DISP from demo

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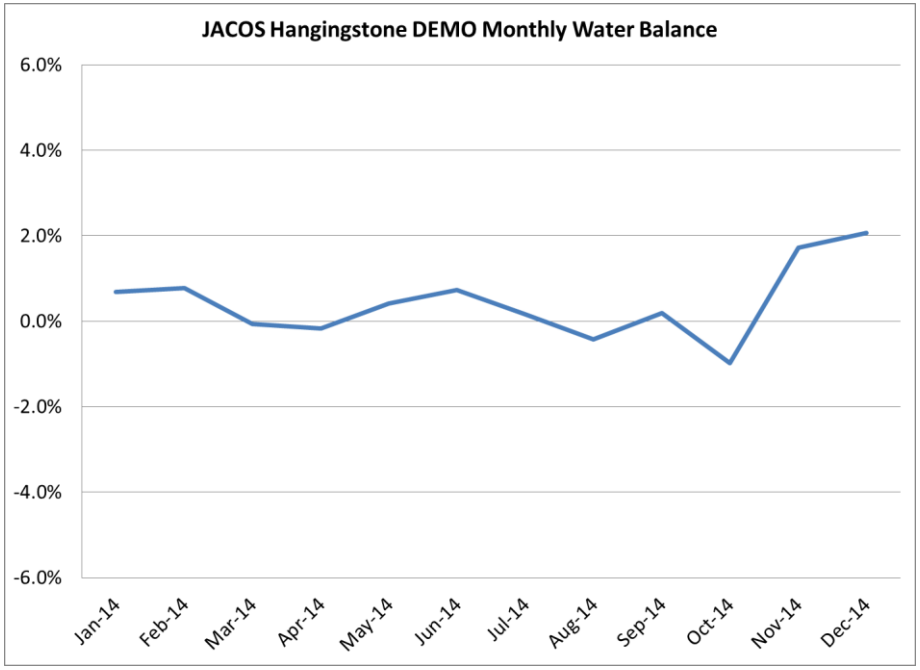
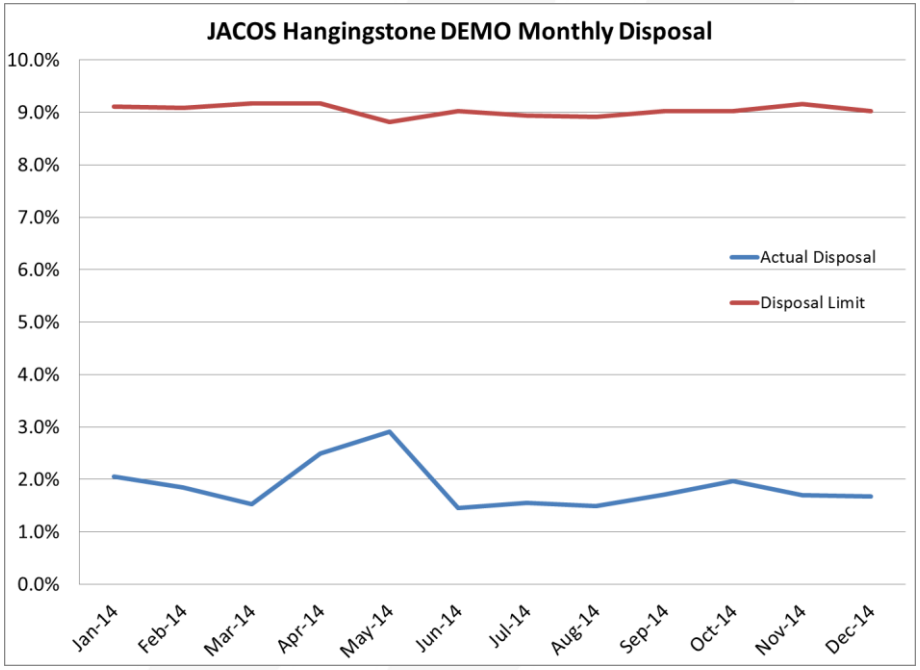
Directive 081 – Water Disposal Limits and Reporting Requirements for Thermal In Situ Oil Sands Schemes





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Water

Raw, Produced, Injection, Disposal

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Water Sources & Uses

Wells - DQ02-2 & DQ06-7
SE 11-084-11W4M

Water Source – fresh groundwater; both wells withdraw from the Muriel Lake formation (Leismer Channel). There is no brackish water and no surface water use.

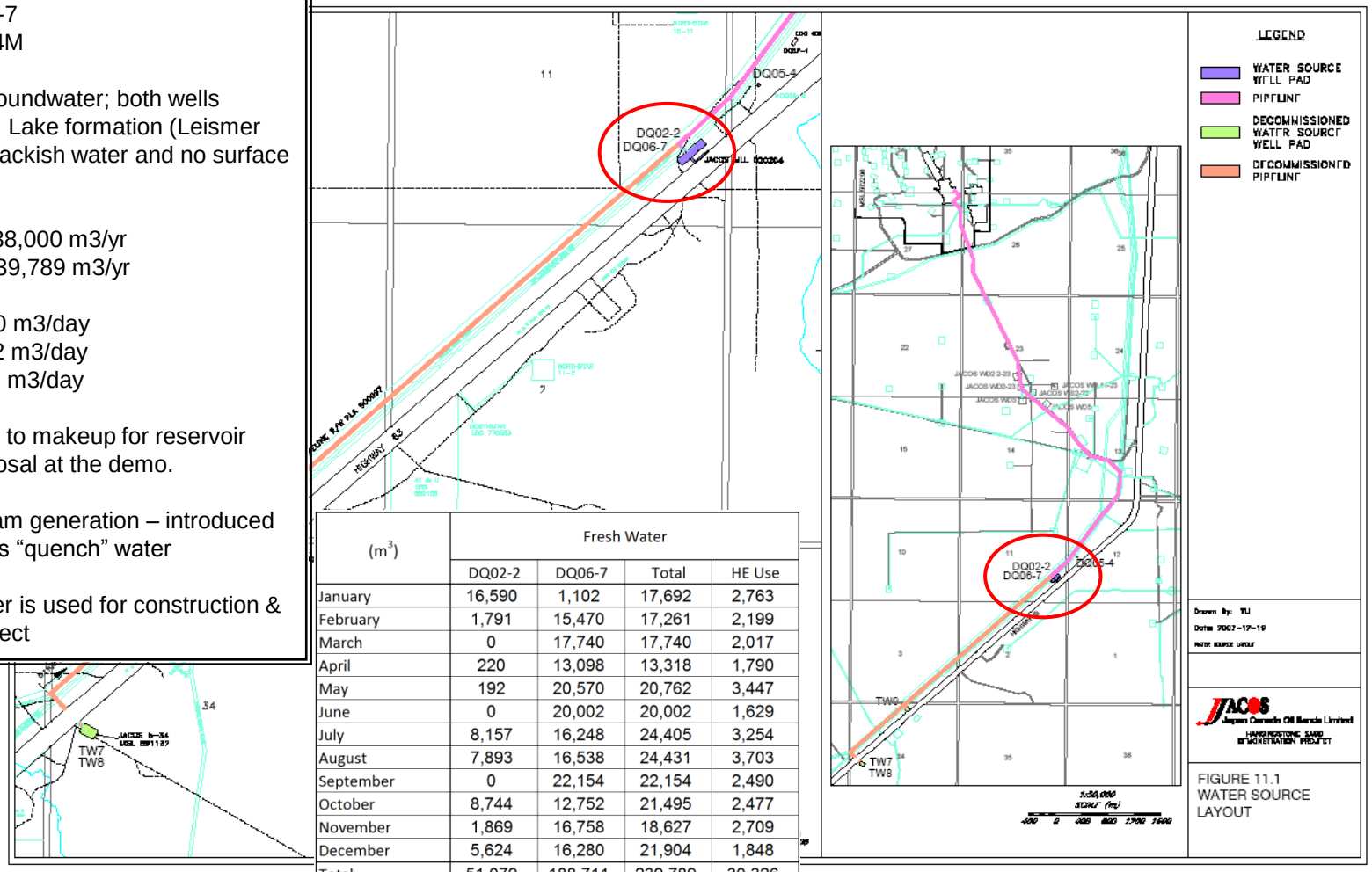
Licensed withdrawal - 438,000 m3/yr
2014 withdrawal - 239,789 m3/yr

Max pumping rate - 1200 m3/day
2014 max day - 1022 m3/day
2014 average - 657 m3/day

Source water is required to makeup for reservoir loss, evaporation & disposal at the demo.

All makeup used for steam generation – introduced at wellheads and plant as “quench” water

Additionally, source water is used for construction & drilling of expansion project



(m^3)	Fresh Water			
	DQ02-2	DQ06-7	Total	HE Use
January	16,590	1,102	17,692	2,763
February	1,791	15,470	17,261	2,199
March	0	17,740	17,740	2,017
April	220	13,098	13,318	1,790
May	192	20,570	20,762	3,447
June	0	20,002	20,002	1,629
July	8,157	16,248	24,405	3,254
August	7,893	16,538	24,431	3,703
September	0	22,154	22,154	2,490
October	8,744	12,752	21,495	2,477
November	1,869	16,758	18,627	2,709
December	5,624	16,280	21,904	1,848
Total	51,079	188,711	239,789	30,326

FIGURE 11.1
WATER SOURCE LAYOUT

Vision. Integrity. Stability.

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Disposal Limit & Actual

$$Disposal\ Limit\ (\%) = \frac{(Produced\ Water\ * Produced\ Factor) + (Fresh\ water\ * Fresh\ Factor)}{Produced\ Water + Fresh\ Water} * 100\%$$

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

	Produced Water (m^3)	Fresh Water (m^3)	Disposal Limit, %	Disposal (m^3)	Brine Trucked (m^3)	Disposal Actual, %
Jan-14	120964	17692	9.11%	2648	195	2.05%
Feb-14	115170	17261	9.09%	2212	235	1.85%
Mar-14	132216	17740	9.17%	2300	0	1.53%
Apr-14	99313	13318	9.17%	2656	155	2.50%
May-14	102291	20762	8.82%	3215	360	2.91%
Jun-14	123906	20002	9.03%	2022	76	1.46%
Jul-14	136513	24405	8.94%	2458	37	1.55%
Aug-14	132815	24431	8.91%	2233	111	1.49%
Sep-14	137683	22154	9.03%	2595	148	1.72%
Oct-14	132214	21495	9.02%	2868	149	1.96%
Nov-14	136719	18627	9.16%	2598	39	1.70%
Dec-14	135917	21904	9.03%	2651	0	1.68%
Average	125477	19982	9.04%	2538	125	1.87%
Total	1505723	239789	9.04%	30455	1504	1.83%

**Produced water factor:* 0.1 ; *Fresh water factor:* 0.03

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Produced Water

- Produced Water Recycle = (Steam Injection – Fresh Water) / Produced Water
- Reservoir Loss = 1 – (Produced Water / Steam Injection)

(m^3)	Fresh Water to Demo	Produced Water Volume	Steam Injection Volume	Produced Water Recycle	Reservoir Loss
January	14,929	120,964	126,414	92%	4.3%
February	15,062	115,170	121,216	92%	5.0%
March	15,723	132,216	139,715	94%	5.4%
April	11,528	99,313	103,739	93%	4.3%
May	17,315	102,291	110,508	91%	7.4%
June	18,373	123,906	133,797	93%	7.4%
July	21,151	136,513	148,261	93%	7.9%
August	20,728	132,815	145,060	94%	8.4%
September	19,664	137,683	148,002	93%	7.0%
October	19,018	132,214	143,414	94%	7.8%
November	15,918	136,719	141,663	92%	3.5%
December	20,056	135,917	144,091	91%	5.7%
Total	**209,464**	**1,505,723**	**1,605,879**	**93%**	**6.2%**

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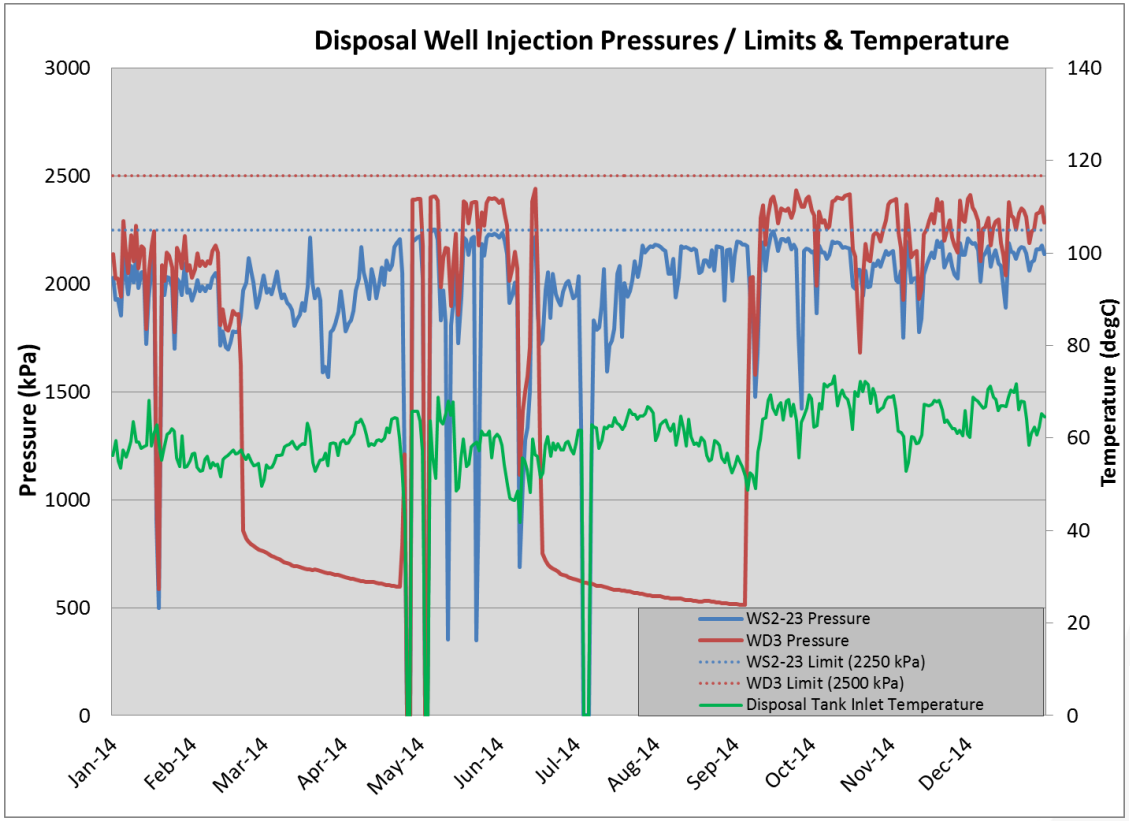
2014 Waste Water Disposal



JACOS CLASS 1b WELLS

WS2-23 F1/02-23-084-11W4/0
- McMurray formation

WD-3 00/15-14-084-11W4/0
- McMurray formation

WD-4 00/01-23-084-11W4/0
(*abandoned 2009*)
- McMurray formation

WD-5 00/16-14-084-11W4/0
(abandoned 2009)
- McMurray formation

OFFSITE BRINE DISPOSAL

Absolute 10-17-053-23W4

Worthington Business Park ,Edmonton

Rate Summary	2014 Avg Rate (m^3/D)
WD-3	8
WS2-23	76
Total disposal to JACOS wells	84
Brine to offsite disposal well	4
TOTAL DISPOSAL	88

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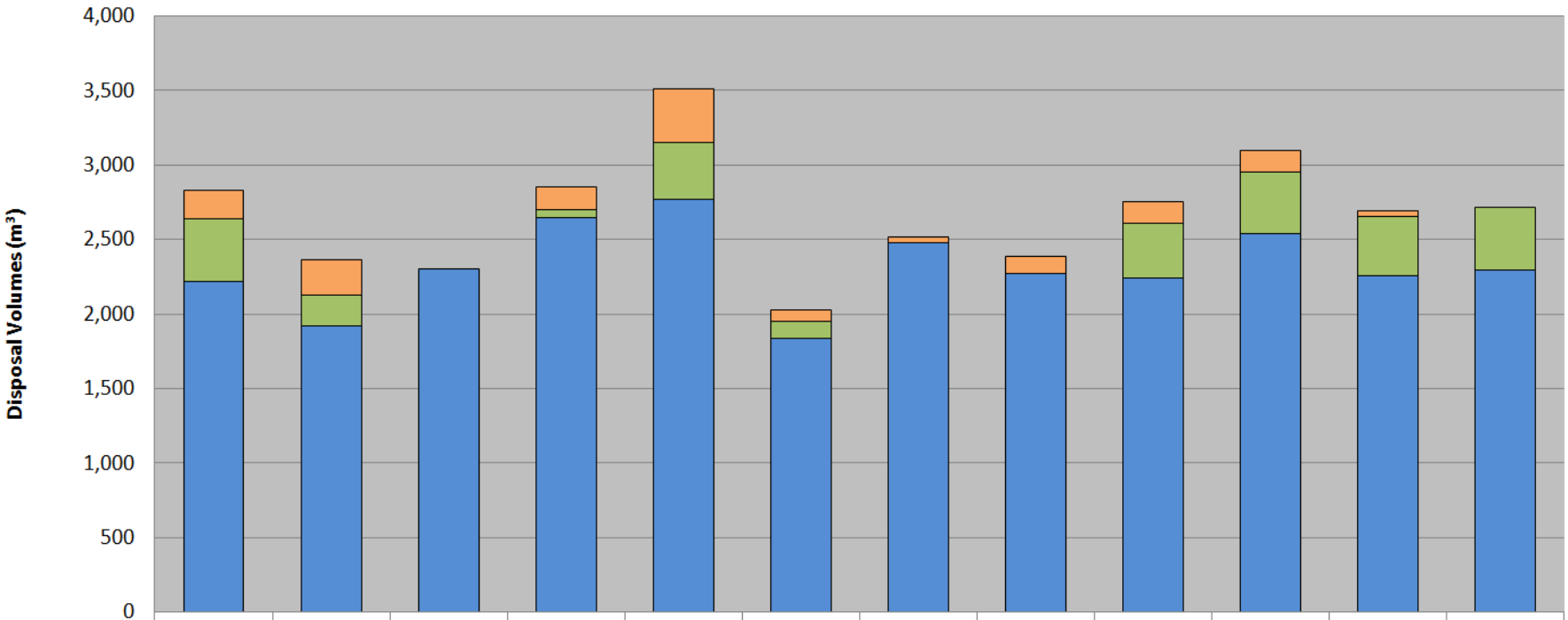
2014 Waste Water Disposal Volumes



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Trucked Out	195	235	0	155	360	76	37	111	148	149	39	0
WD-3	420	206	0	47	384	118	0	0	368	412	392	422
WS2-23	2,218	1,924	2,306	2,649	2,769	1,835	2,480	2,274	2,241	2,539	2,260	2,293

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Solid Waste Disposal

Types of Solid Waste

- Lime Sludge
- Sand
- Spent filter media

SOLID WASTE DISPOSAL

16.6 tonne/day

Class II Oilfield Landfills:
Tervita Janvier SE-03-081-06W4M

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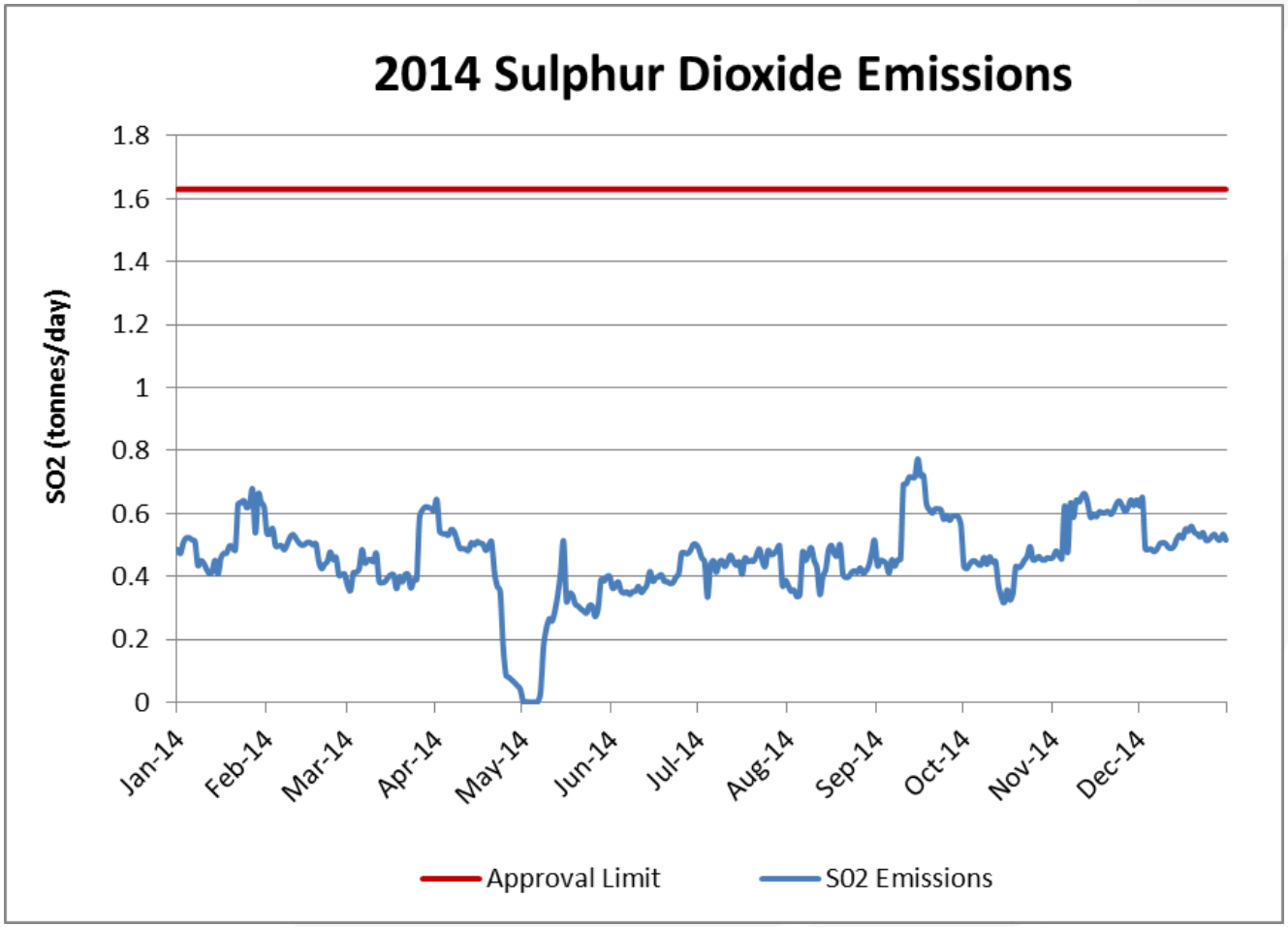
Sulphur Dioxide Emissions



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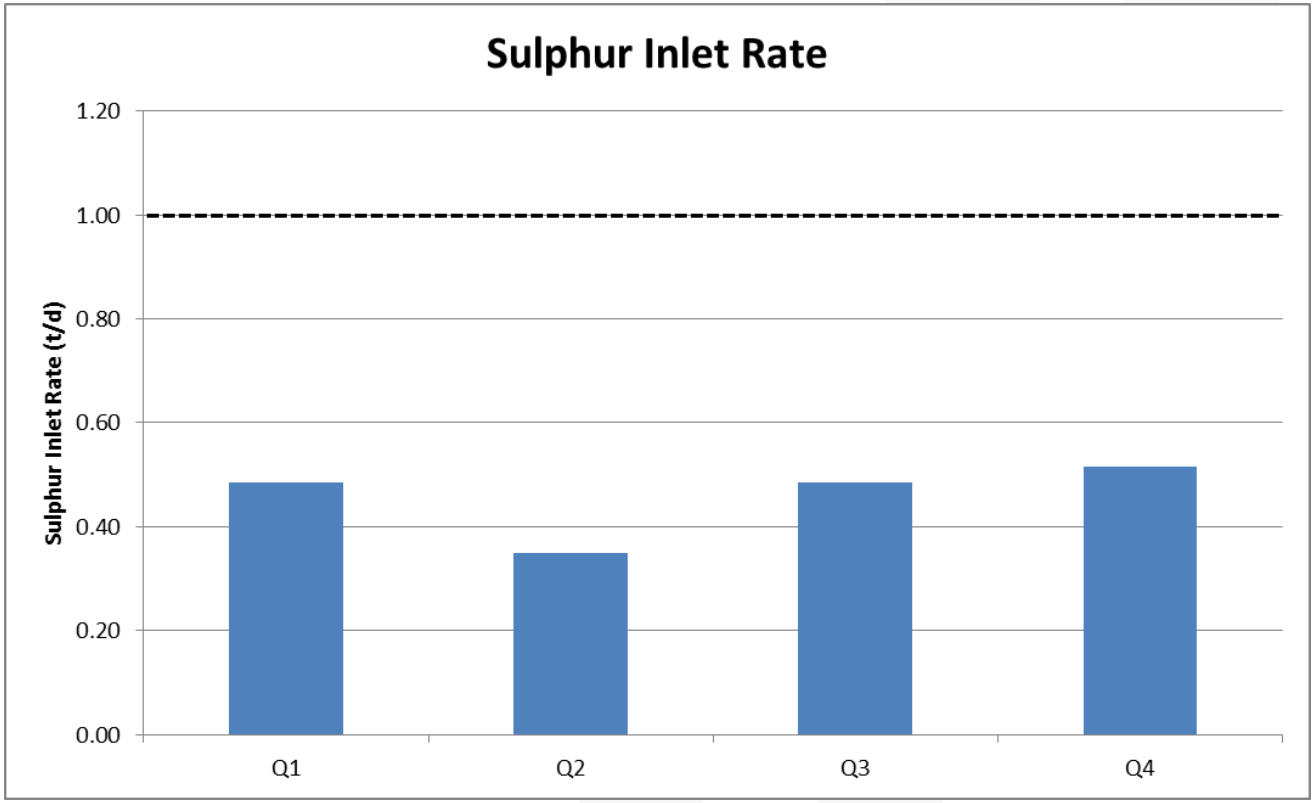
Sulphur Inlet Rate

- Sulphur inlet rates are under the 1 t/day criteria from ID 2001-3 for sulphur recovery
- Gas samples (flare inlets & recovered gas) are collected and analyzed monthly.
- Recovered gas sampling increased to weekly during NCG co-injection



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Environmental

Demo Scheme No. 8788

- **Active Ambient air monitoring program:**
  - Data collected from July 1st to December 31, 2014 (6 months in 2014) as per approval; in compliance with all AAAQO.
- **Routine Annual monitoring programs:**
  - Six passive ambient air monitoring stations collected SO_2 and H_2S data during 2014 – no exceedances noted.
  - Groundwater - spring/fall sampling results were largely comparable to previous yeas. Increasing trends in parameters were still noted at ENV98-1A. A soil excavation program planned for 2015 to address the exceedance.
  - Fugitive emission survey (LDAR) results in compliance with CCME guidelines. Select minor repairs to be made during spring of 2015.
  - Water Use - report in draft; updates to AESRD Water Use Reporting registry ongoing.
  - Soil Management – From the previous Soil Monitoring Program, mitigation measures to be developed as part of the Management Program by Q1 of 2015.
  - Stack survey results were in alignment with previous years and in compliance with approved limits.
  - All other annual compliance initiatives competed were comparable with findings from previous years.

Facility Repairs and Upgrades:

- **Surface Run-off Modifications & Repairs:**
  - Surface re-contouring work was carried out at Plant 2 to improve run-off water drainage to the licensed pond.
  - JACOS issued a self-disclosure letter to the AER regarding corrective actions required at Plant 2 sumps and trenches.
  - Detailed design for repairs developed for deficient sumps, tanks and trenches.
  - Repairs included re-grading the Plant 2 run-off pond.

- **Secondary Containment Repair:**
  - Secondary containment repair and replacement work to conclude in 2015.

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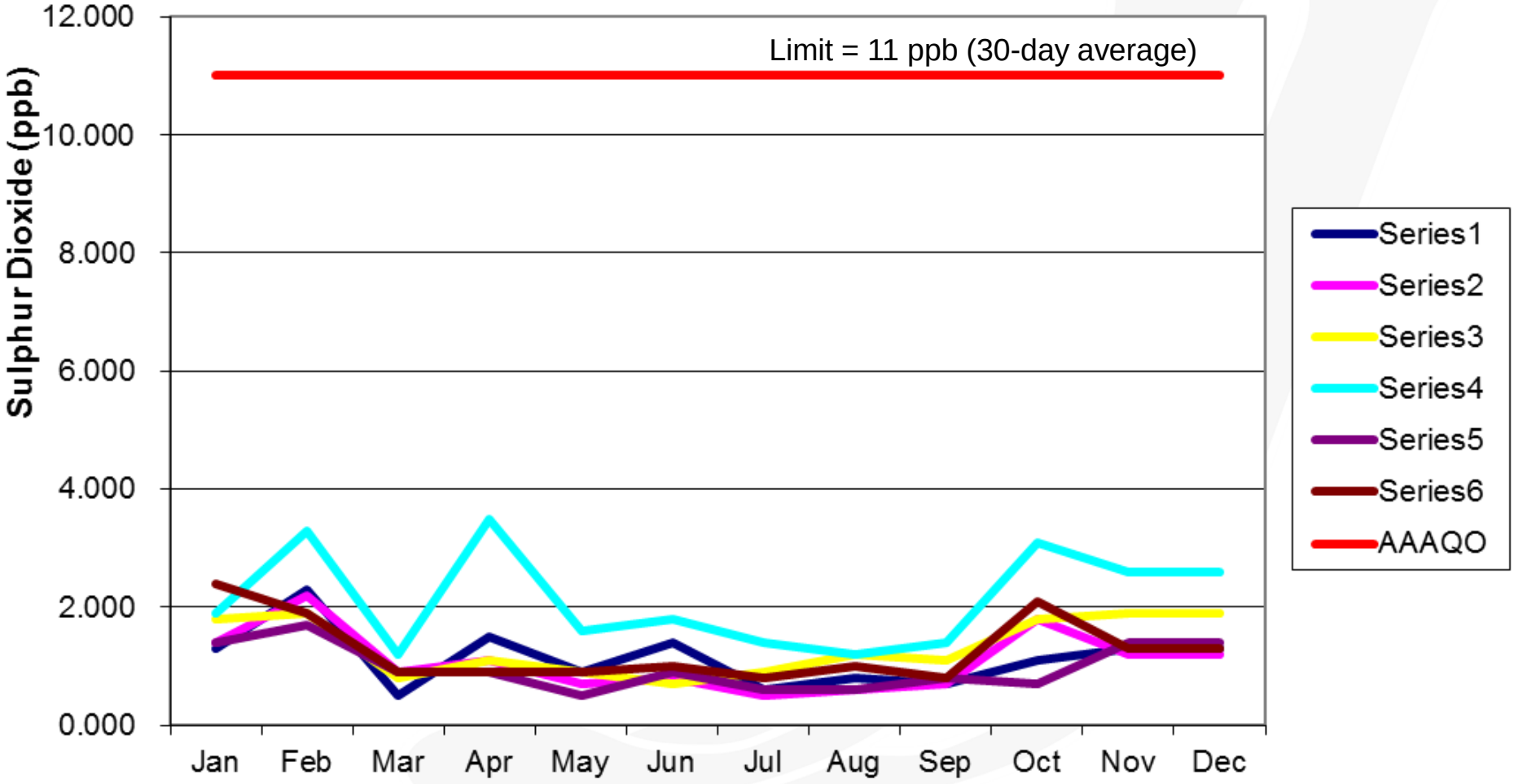
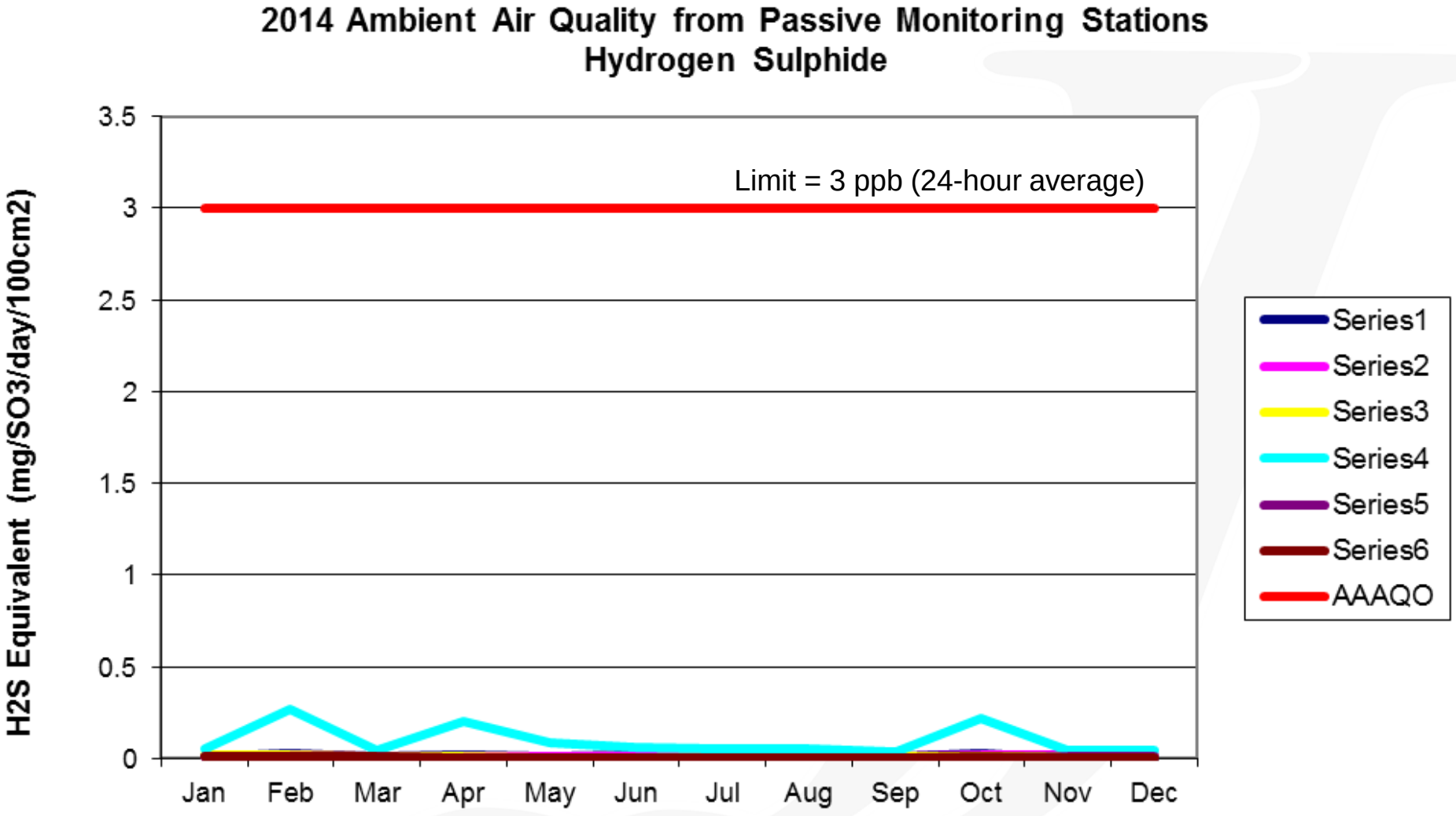
Demo Scheme No. 8788

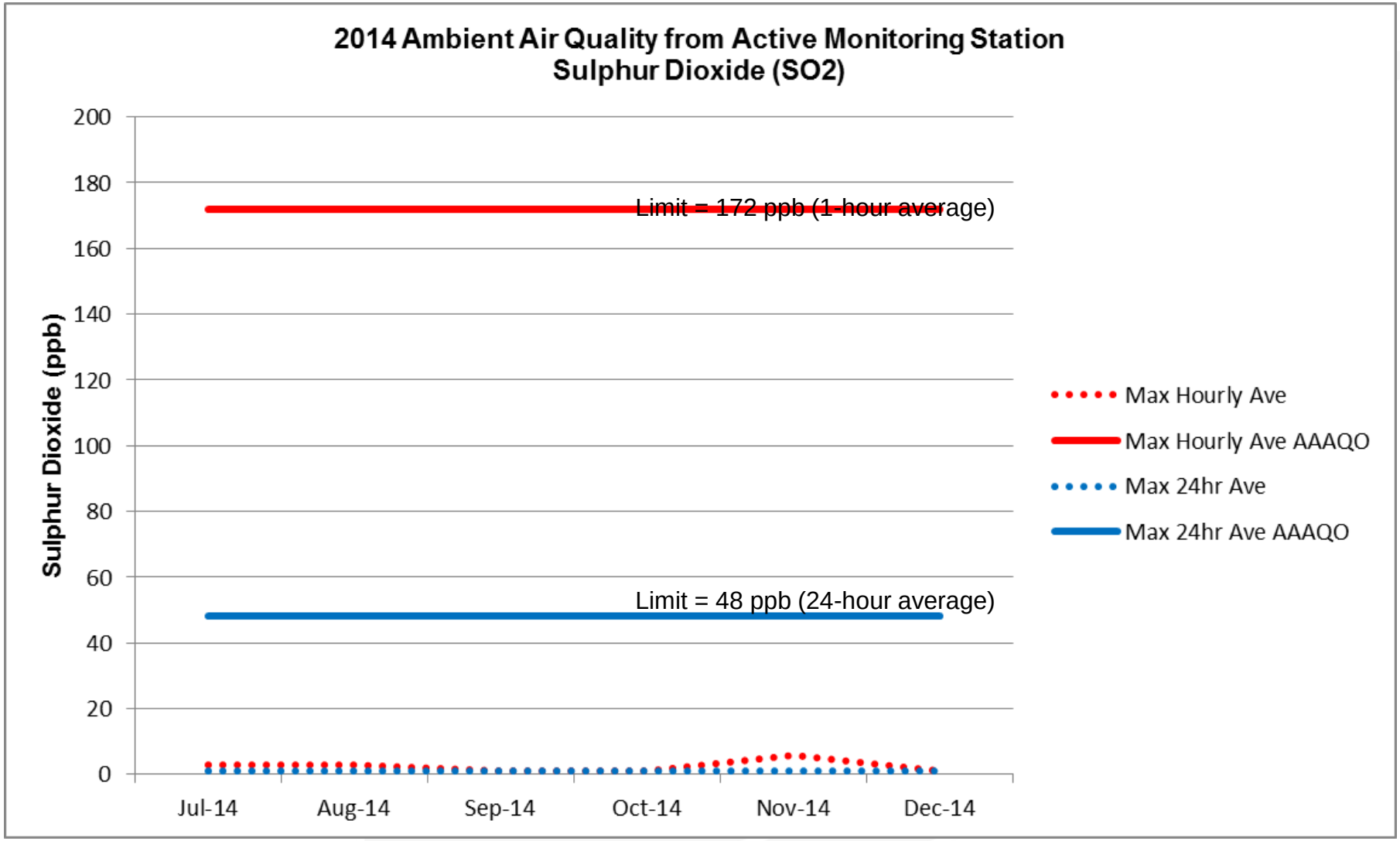
2014 Ambient Air Quality from Passive Monitoring Stations
Total Sulphur Dioxide



Demo Scheme No. 8788



Demo Scheme No. 8788



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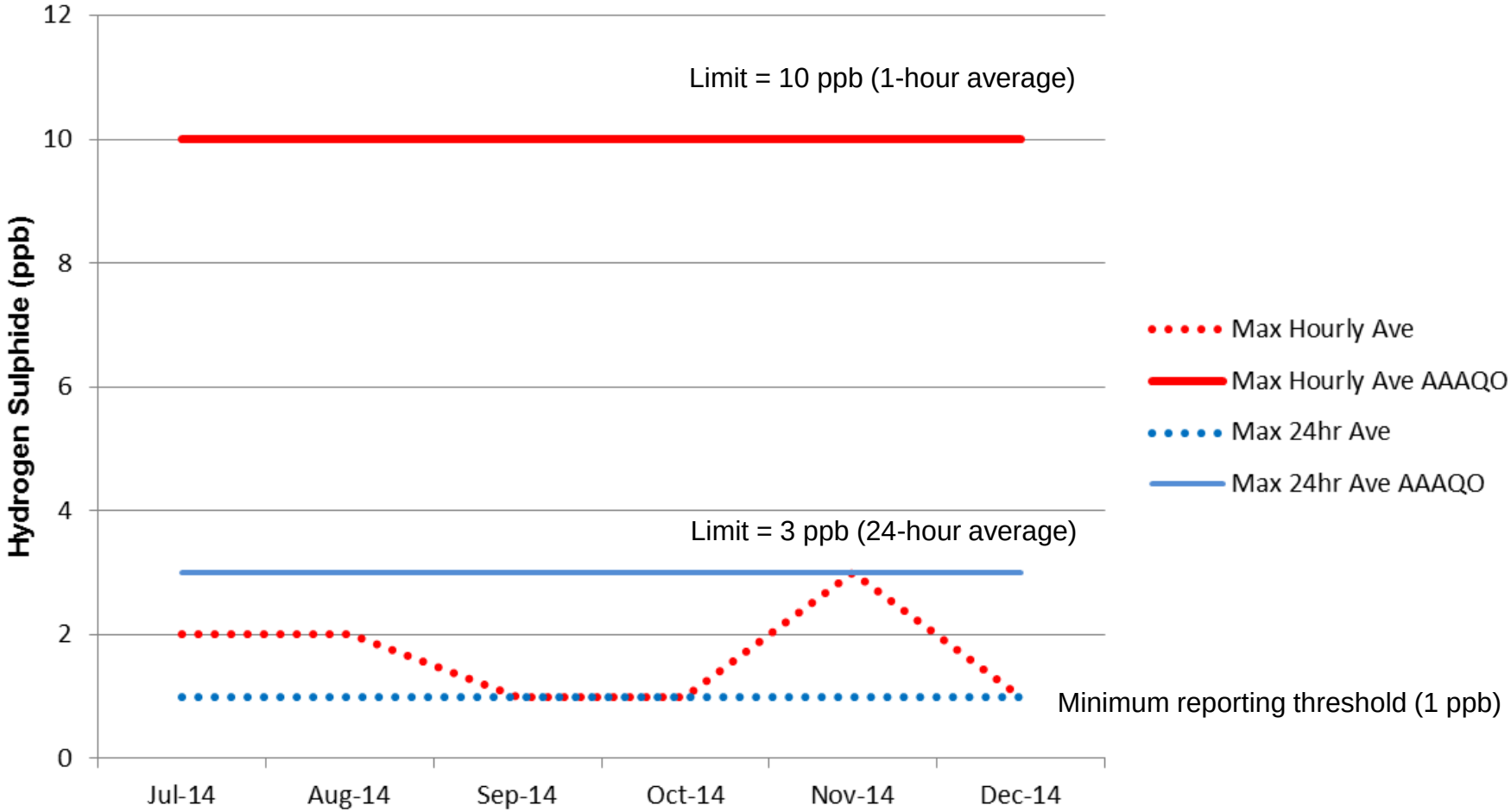
Demo Scheme No. 8788



- **Environmental monitoring programs:**
  - Groundwater monitoring –drilling of groundwater monitoring wells commenced Dec/14
  - Wildlife mitigation & monitoring program – data collection & review underway
  - Woodland caribou monitoring & mitigation plan – program execution underway
  - Wetland monitoring program proposal – approved; program implementation underway
  - Soil monitoring program proposal – due Jan 31/15; draft currently under review
  - Wetland reclamation trial program proposal – filed on Dec 31/14
  - Reclamation monitoring program proposal – filed on Dec 31/14

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- Regional Initiative Involvement:

ABMI	CAPP	CEMA
RAMP	iFROG – COSIA JIP (wetland monitoring research group)	JOSM/AEMERA

- Remediation and Reclamation Progress:
  - In 2014, 95 reclaimed OSE sites were assessed, and 35 were planted/transplanted
  - Black spruce were planted at the former 16-14 remote sump
  - A Detailed Site Assessment and Reclamation Application was filed for 5&6-34
  - The 2009 and 2010 OSE programs received reclamation certificates (34.77 ha)
  - Phase 2 ESAs: 100/16-14, 13-13, and 3&4-27
  - Detailed Site Assessments: 14-21, 15-34, 12-27. Results indicated further work required to meet surface and vegetation requirements, no reclamation applications were submitted.

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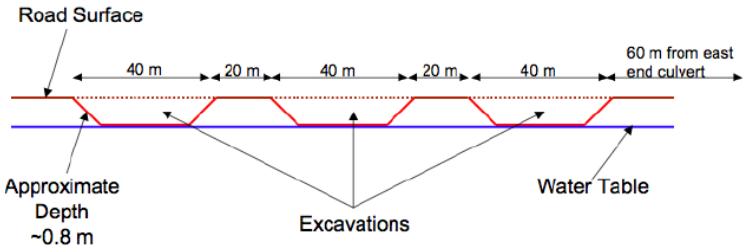
"Removing the Wellsite Footprint" (iFROG Program) – Partial Road Removal Project

- **Work completed:**
  - The partial removal of the road fill material in winter 2011.
  - Three excavations along the road as re-vegetation treatment plots.
  - Moss, tree, & shrub species planted in 2011 and 2012 and 2013.
  - Re-vegetation and hydrologic communication assessed in 2014.

- **Work planned:**
  - Final reporting and project closure set for 2014. Continuation of work through COSIA JIP.

Design Overview



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Compliance Statement & Approvals

Demo Scheme No. 8788 – Compliance Statement

- **JACOS is in compliance with conditions of their approval and regulatory requirements, subject to the following:**
  - **Secondary Containment Self-Disclosure – May 26/14**
    - Sump, trench, and tank secondary containment systems repair in progress
    - Engineering study in progress to recommend repairs for certain systems (HLS sump)
    - Mitigation and Monitoring plan developed for non-compliant sumps and tanks at Plant 1.
  - **Ongoing reclamation of various historical sites - prioritized by environmental risk**

Demo Scheme No. 8788 – Compliance Statement

(Added)

– HZII Wellhead Leak & Repair Status – (FIS No. 291042)

- On October 19, 2014 a small volume of steam was observed leaking from the bolted flange of the HZII Injector Well casing.
- Release could not immediately be controlled so it was reported to the AER (FIS No. 291042)
- Steam injection to the well was immediately shut in to control the leak.
- No adverse impact to the environment as most of the release was steam; about 25 litres of condensed steam dripped into the well's cellar and contained.
- Daily monitoring is ongoing; all subsurface tubulars are currently gas blanketed and well leak is controlled
- Repair was planned for November 2014 but delayed due to discontinuation of wellhead replacement components
- Re-engineering and manufacturing of components was required.
- Components have now been sourced and repair is scheduled during plant turnaround in May 2015.

Demo Scheme No. 8788 – Compliance Statement

- **Greenhouse Gas Emissions:**
  - –SGER Compliance Report for 2013 – submitted in Mar/14
  - –NPRI & Federal GHG report for 2013 – submitted in May/14.
  - –Material error in fuel gas emission factor calculation, resulting in overestimate of emissions, found through course of 2013 report verification. Error present in all past reports including baseline.
    - •Baseline Application restated and approved by ESRD
    - •2010 – 2013 compliance reports re-stated and currently waiting for approval.
    - •Total direct GHG emissions for 2014 – 225,347 T CO_2e.
    - •Approved baseline emission intensity was revised to 0.4662 tonne CO_2-e/m3

Regulatory/ Approval Limits

Parameter	Requirement	Actual
Solution Gas Recovery	> 90%	90.4%
SO_2 Emissions	< 1.63 T/d	0.46 T/d
D81 Disposal Limit	<9.04%	1.83%
Plant 2 B-520 NO_x	< 7.60 kg/hr	3.15 kg/hr

Demo Scheme No. 8788 – Approvals

- **Amendments to Scheme Approval 8788 in 2014:**
  - Amendment 'J' - NCG co-injection on Well Pairs H – Q received on Mar 21/14
  - Amendment 'K' – rescind minimum recycle rate of 90% and, in place, comply with Directive 081 received on May 28/14
  - Category 1 D78 approval for MVR installation received on Mar 6/14
  - Formal abandonment of 'F' well pair in Aug/14
- **MARP: 2014 update submitted on Feb 28/14**
- **EPAP: Filed 2014 Declaration on Nov 28/14**

Expansion Scheme No. 11910 – Compliance Statement

- **JACOS is in compliance with conditions of their approval and regulatory requirements, subject to the following:**
- Self-Disclosure, Mar 10/14: Trespass of 100/07-22-084-11W4/00 (W04-P04) into Devonian where JACOS does not have mineral rights – drilling halted immediately and well plugged back; no adverse impact as Devonian is non-hydrocarbon bearing at this location; corrective actions were taken to prevent reoccurrence
- Self-Disclosure, Jun 26/14: WA Approval No. 00322883 (DQ12-18 well drilled for Expansion Project) – **Note: no water being withdrawn from this well -** failure to report water levels in 2 obs wells; level transmitters installed and data collection commenced; one transmitter has failed; wellheads will be modified to standard water well design and transmitter reinstalled; WUR account for this approval being set up.
- Self-Disclosure, Oct 17/14: Runoff water release caused erosion & sedimentation issues – pumping stopped immediately; silt fence installed to prevent silt from leaving site; ditch upgrades will be made before spring runoff; monitor spring runoff closely to ensure compliance.

Expansion Scheme No. 11910 – Approvals

- Amendment 'B' to Scheme Approval 11910:
  - Approval to install Highway 63 box culvert crossing
- Scheme Approval Variance:
  - Clause 7 of Approval No. 11910B to allow the SAGD wells on Pad 5 to be drilled before the 00/01-22-084-11W4/2 well is completed or abandoned
- D78 Category 1 Information Updates:
  - Well Pair 1 and 3 on Well Pad 06 updates
  - Well Pad 05 trajectory updates
  - Well Pair 3 on Well Pad 06 ICP modification
- EPEA Approval Amendment 153105-00-02:
  - Noise and air quality monitoring update
- Process pond design clarification letter:
  - 2nd SIR response submitted Dec 15/14; waiting for response

Compliance & Approvals – Future Plans

Demo:

- Closure of Secondary Containment Self-Disclosure Items
- Timing of Plant 1 decommissioning under evaluation

Expansion:

- Seeking response on process pond design SIR 2 submission