PetroChina Canada

2019 Performance Presentation

MacKay River Commercial Project

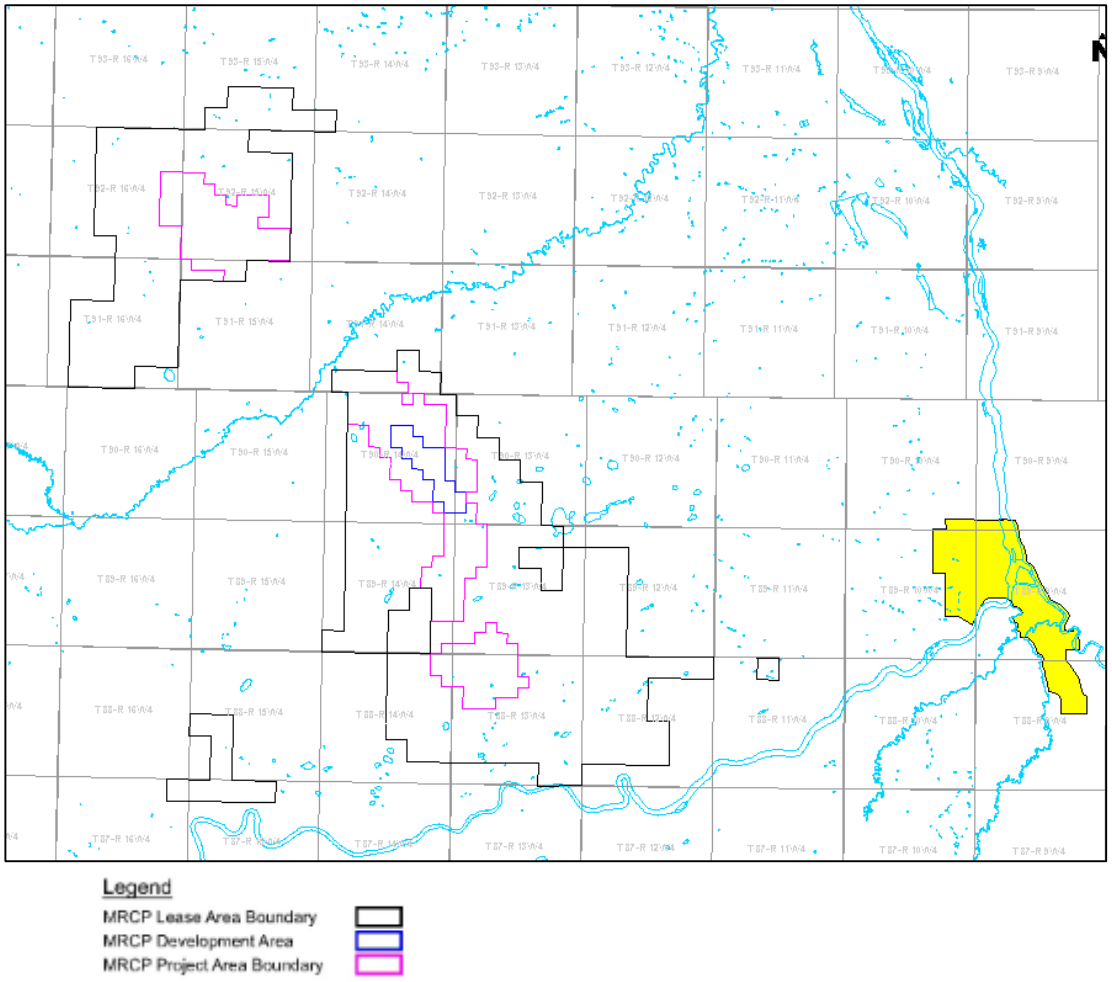
AER Scheme Approval No. 11715

January – December 2019

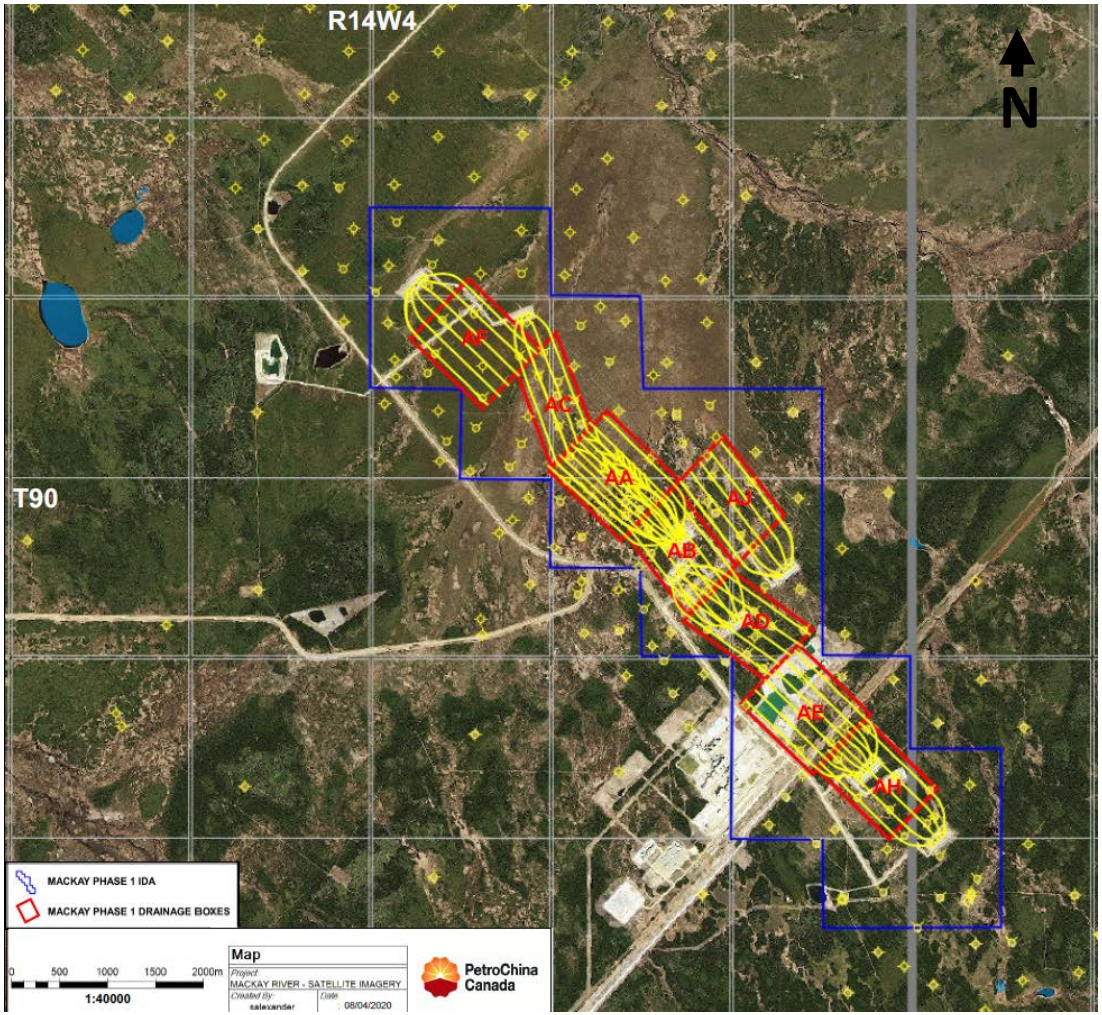
4.1 Introduction

Project Background

- PetroChina Canada (“PCC”) owns and operates the MacKay River Commercial Project (“MRCP”)
- The MRCP is a bitumen recovery project located within the Regional Municipality of Wood Buffalo (“RMWB”) in northeast Alberta; approximately 30 km northwest of Fort McMurray
- The MRCP utilizes steam-assisted gravity drainage (SAGD) technology
- The MRCP is planned for phased development to peak capacity of 150,000bbl/d bitumen



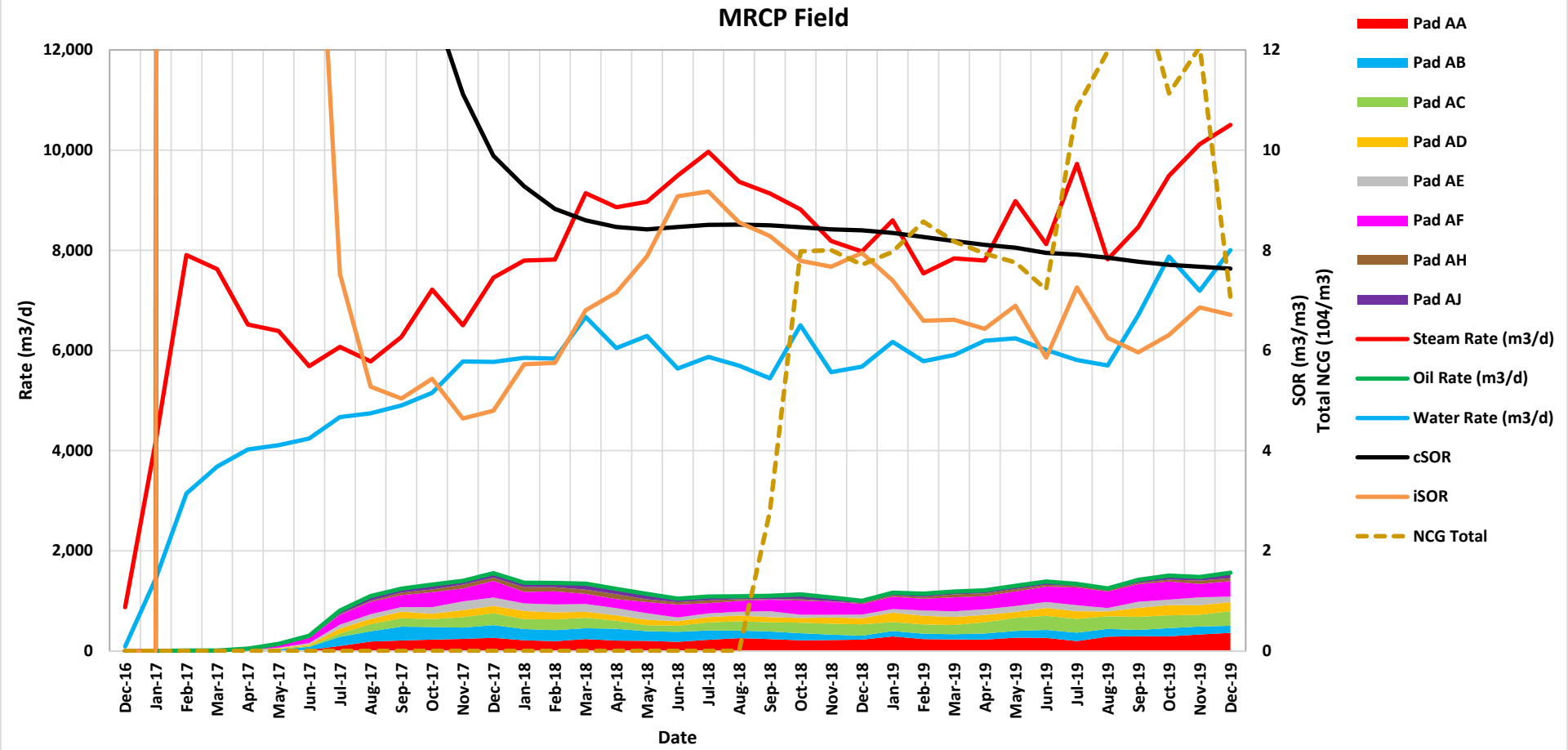
MRCP Phase 1 Overview



- Phase 1 has a bitumen capacity of 35,000 bpd
- The Phase 1 development area (DA) includes:
  - 8 SAGD surface well pads and associated subsurface drainage patterns
  - 42 SAGD Horizontal well pairs
    - 850m long horizontals
    - 125m well spacing
  - 4 Horizontal infill well pairs (PAD AA)
    - 850m long horizontals
    - Producer and/or injector uptracks
    - 62.5m well spacing
  - The Central Processing Facility ("CPF")
  - Water source wells and associated pipelines
  - Observation wells
  - Borrow areas
  - Access roads
  - Camps

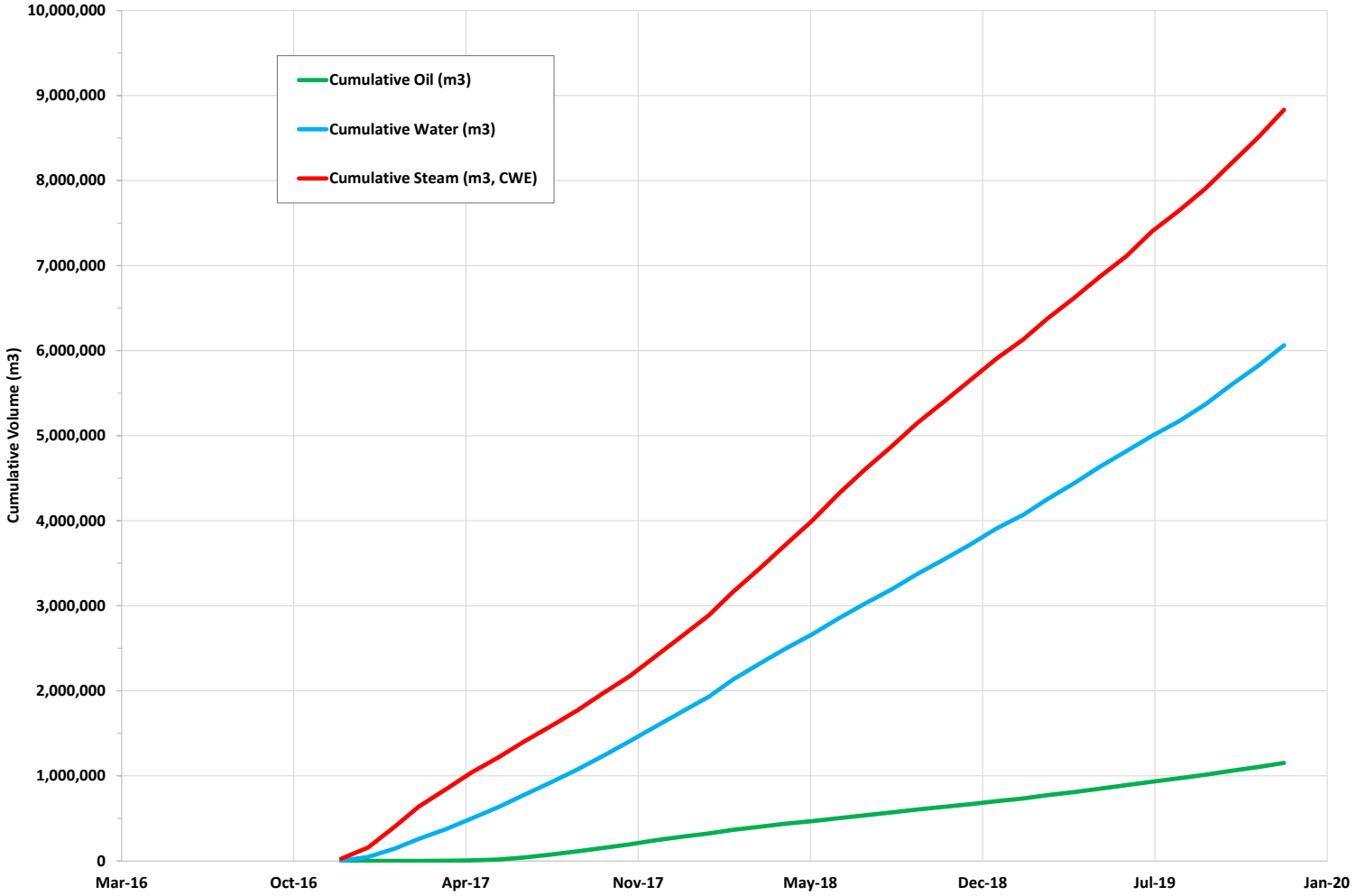
4.2 SUBSURFACE

MRCP – Field Performance



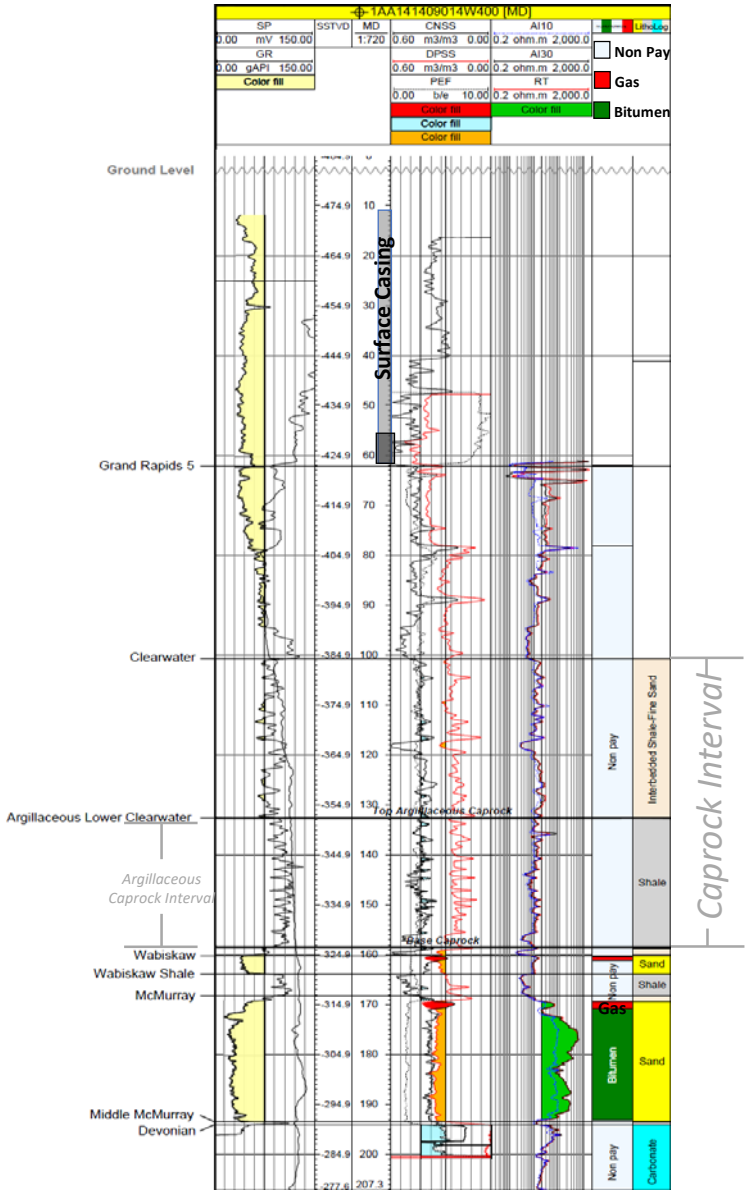
- During 2019 MRCP continued to ramp up production. 2019 monthly exit oil rate was 1,565 m3/d
- Steam and thus SOR were impacted by top gas zone effects and areas of thicker lower transition zone
- Geological baffles (zones of higher mud bed frequency) impacting chamber growth and performance in areas of the reservoir
- NCG injection started in Q3, 2018; reached maximum injection of 125,000 Sm3/d in Q3-Q4, 2019 and was suspended in Dec 2019, PCC to evaluate future re-activation if needed

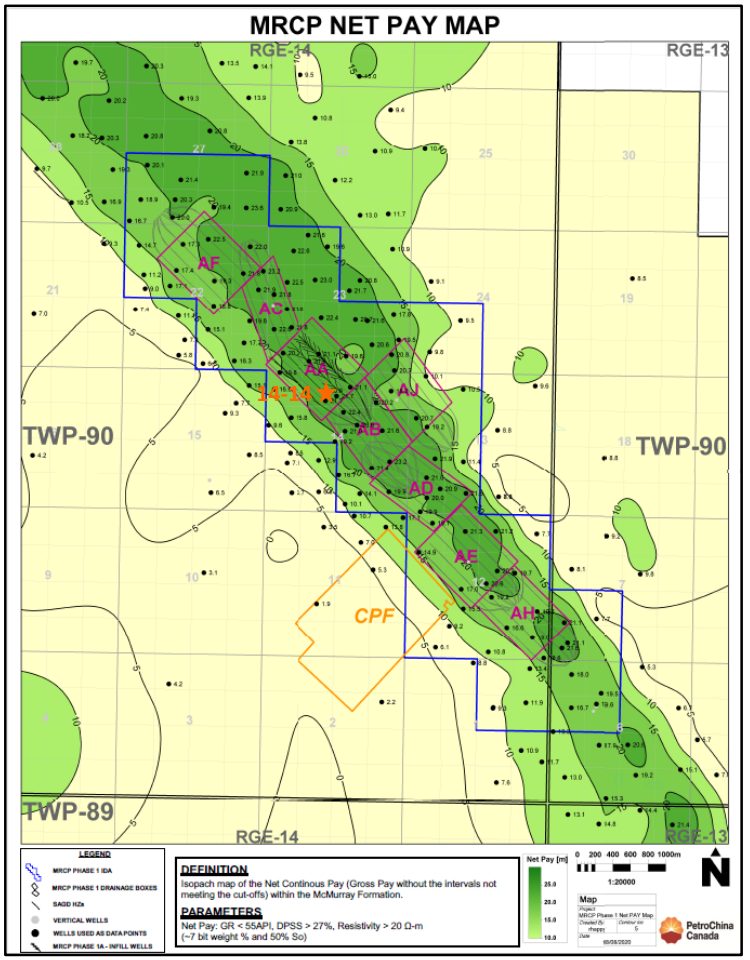
MRCP – Cumulative Fluid Volumes



- In a few areas, steam chamber interactions with top gas and losses to the lower transition zone has resulted in higher retention by the reservoir.
- Mitigation strategies in execution include gas cap pressurization (NCG injection and co-injection), and balancing operating pressures with multiple thief zones

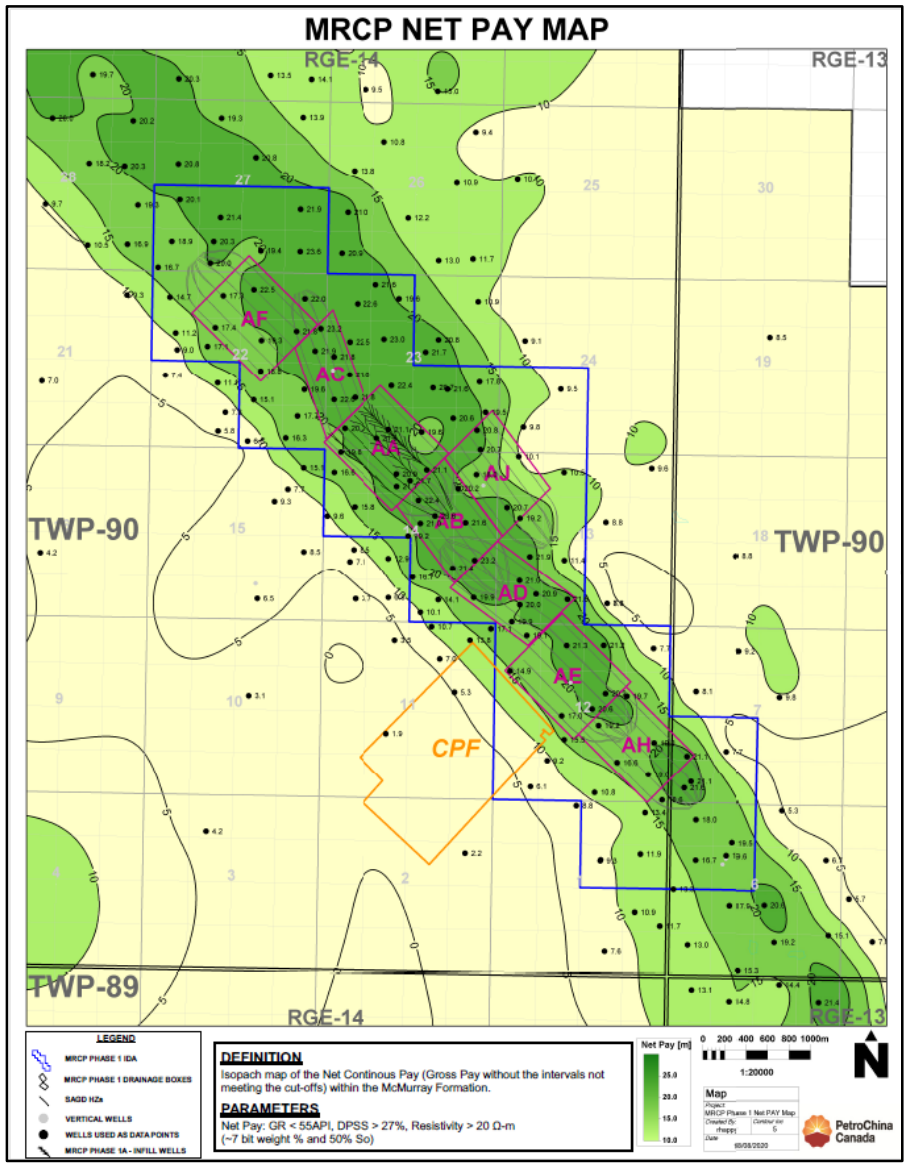
MacKay River Stratigraphy





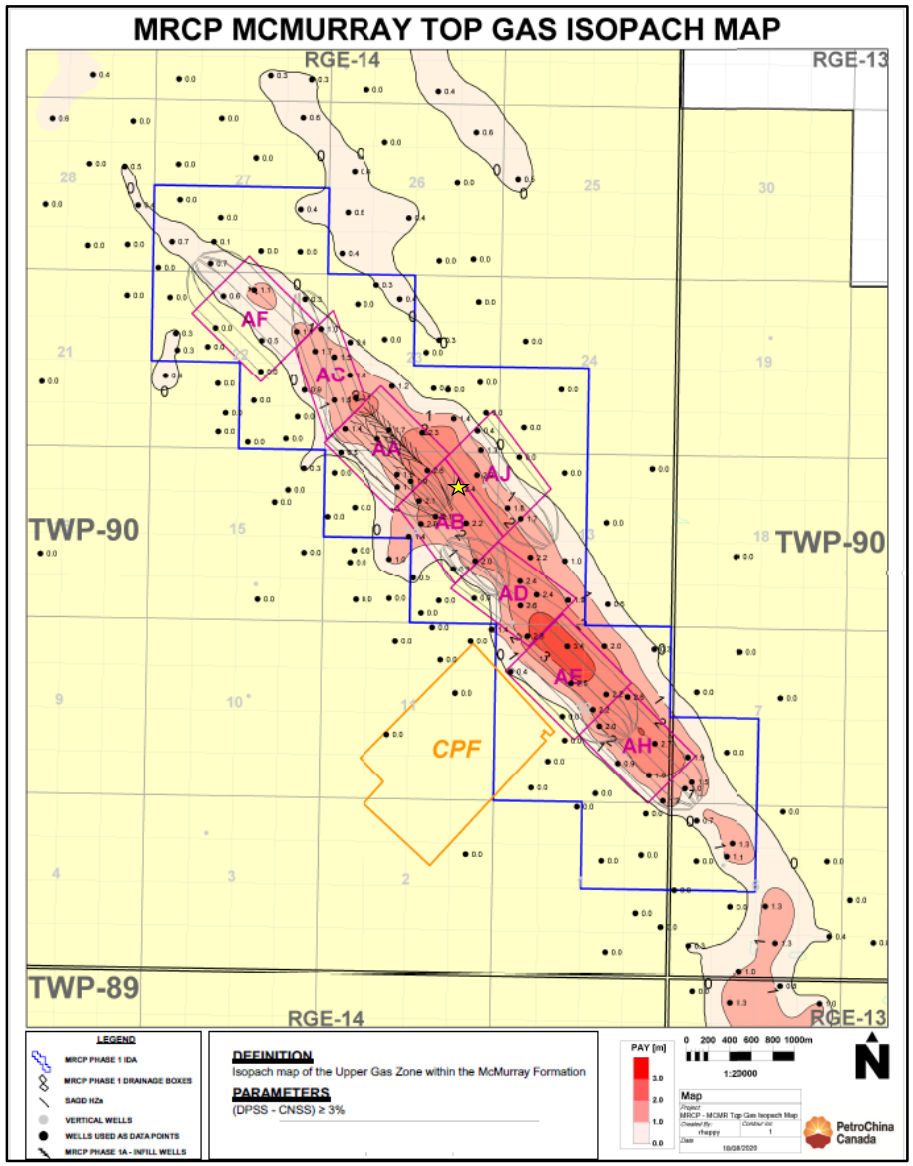
- Caprock is Argillaceous Lower Clearwater
- Wabiskaw sand above McMurray across DA
- Target reservoir is Upper McMurray

Bitumen Net Pay Map – Development Area

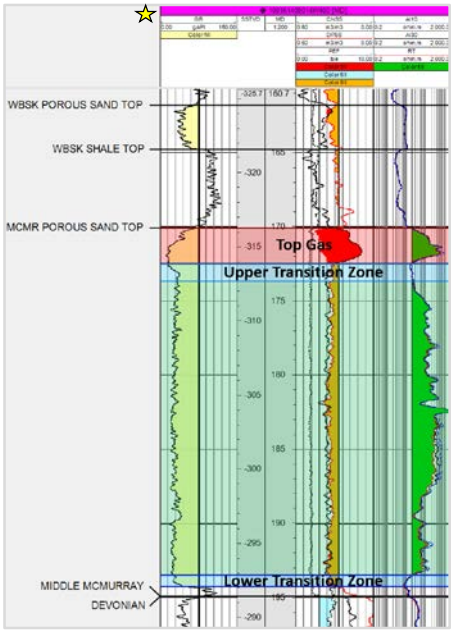


- Net pay cut-off at ≥10m
- Thickness ranges from 10-25m in the DA
- Upper McMurray reservoir shows strong NW-SE trend
- Central processing facility located Southwest of development area
- Majority of 8 drainage boxes are in >15m bitumen pay

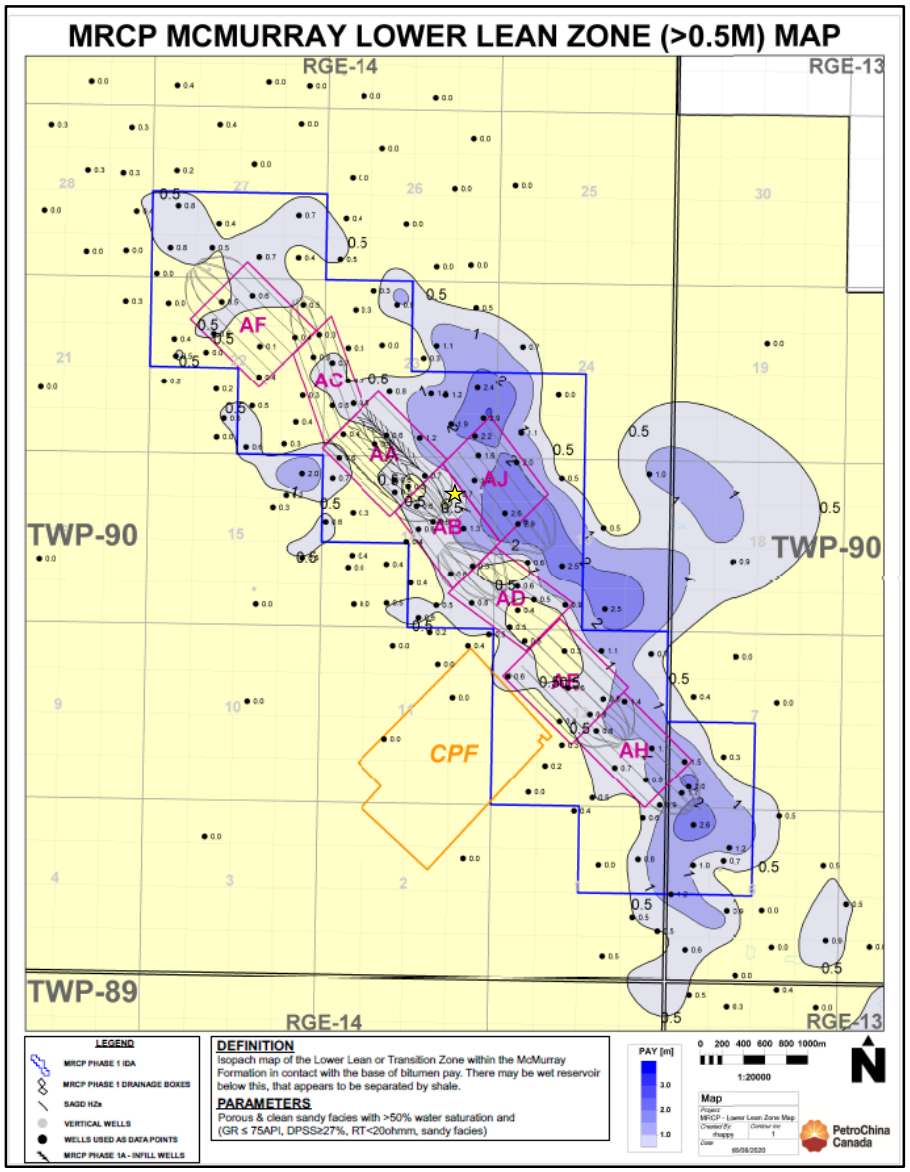
MCMR Top Gas Isopach Map



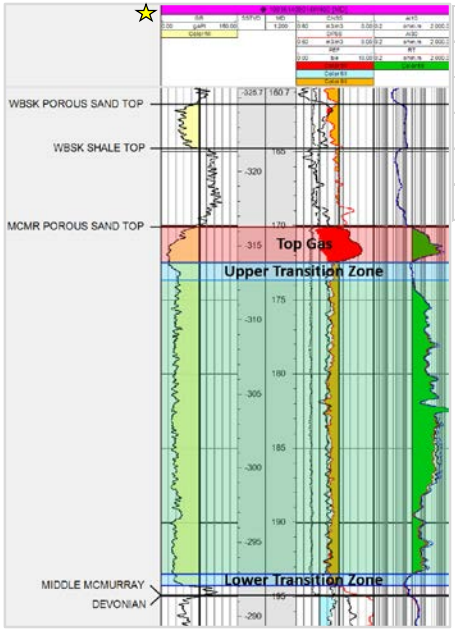
- Top gas zone present in the upper McMurray over the DA
- Ranges in thickness from approximately 0 to 3 meters



Lower Transition Zone Map

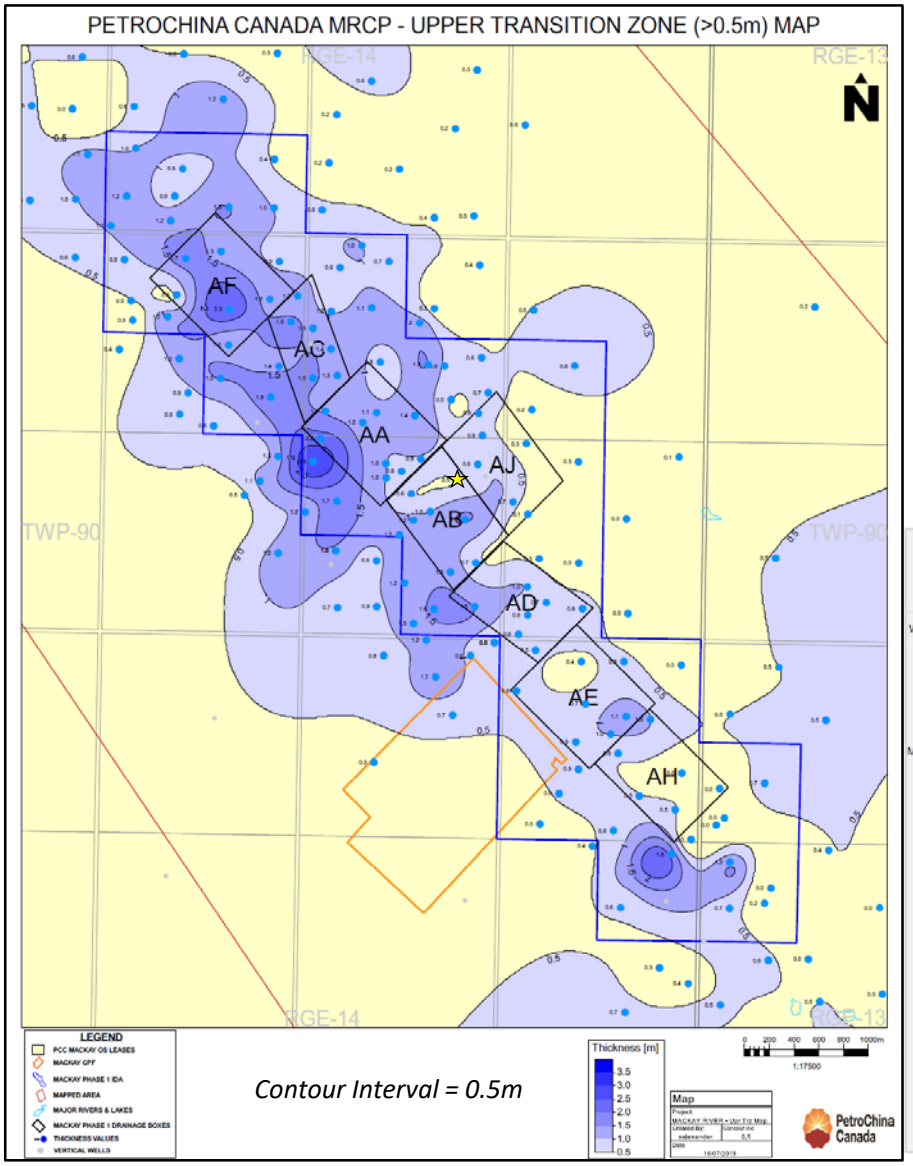


- Criteria:
  - Porous & clean sandy facies with >50% water saturation (GR ≤ 75API, DPSS≥27%, RT<20ohmm, sandy facies)
  - In communication with and below pay zone
- Characteristics:
  - Thin: <1.0m over most of the Phase 1 drainage boxes
  - Limited Lateral Extent

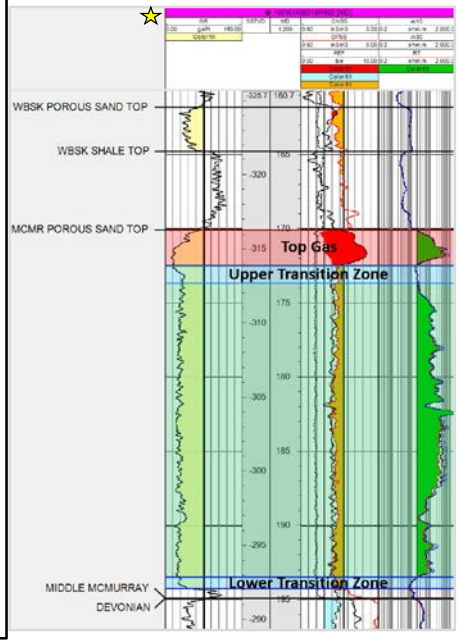


Lower Transition Zone Properties	
Parameter	**Average**
Total Water Saturation	70%
Total Porosity	33%
Horizontal Permeability (Core)	3300 mD
Vertical Permeability (Core)	2400 mD

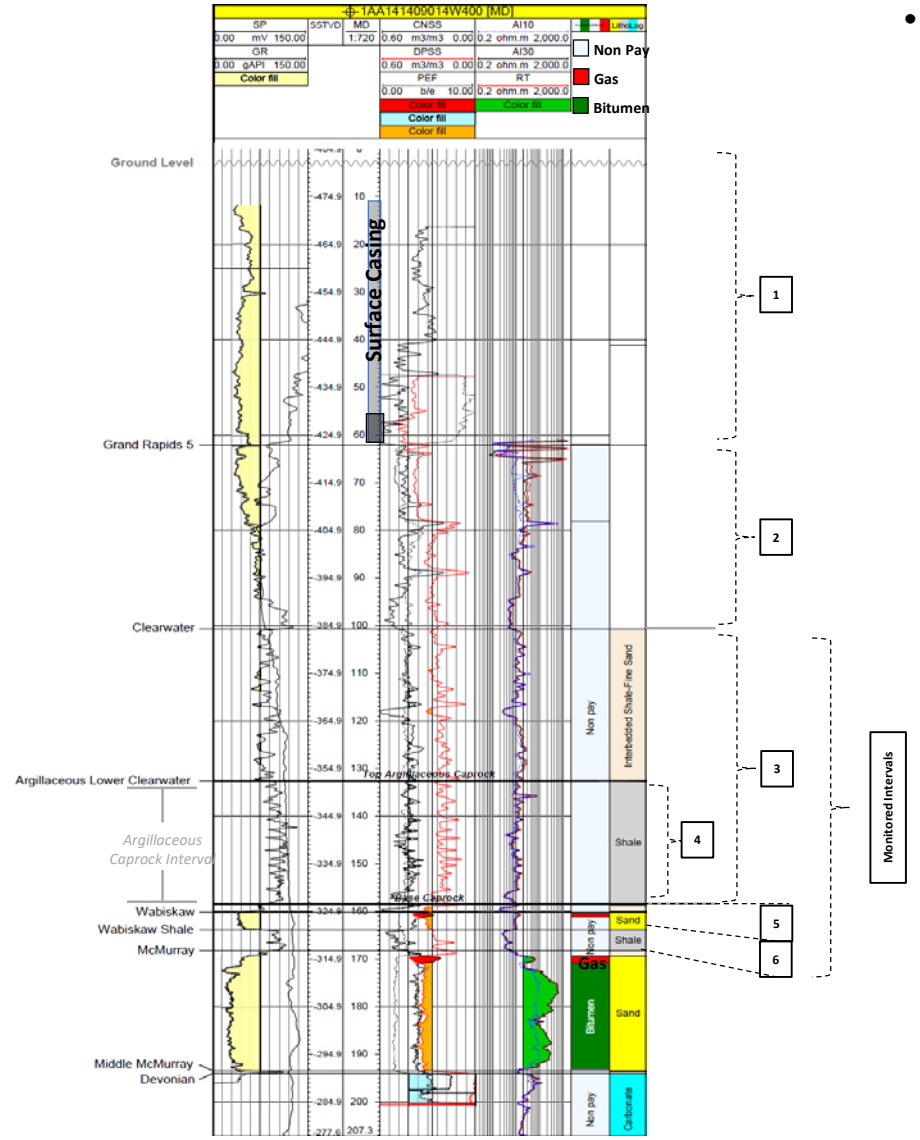
Upper Transition Zone Map



- Criteria:
  - Porous & clean sandy facies with >50% water saturation (GR ≤ 75API, DPSS≥27%, RT<20ohmm, sandy facies)
  - In communication with and above pay zone
- Characteristics:
  - Thin: <1.5m over most of the Phase 1 drainage boxes
  - Limited Lateral Extent



Caprock Monitoring: Overburden & Cap Rock Intervals

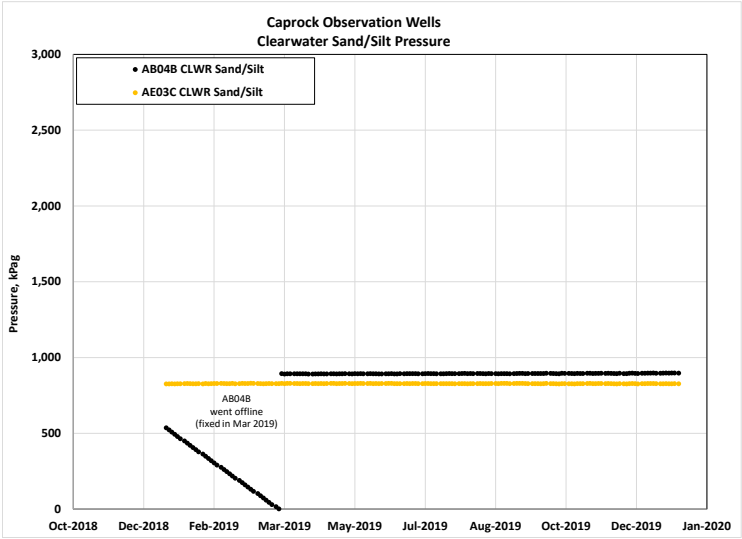


- Overburden intervals:
  1. Quaternary Sediments: from surface to the Grand Rapids
  2. Grand Rapids, overlies Clearwater
  3. Clearwater Formation, which is the gross caprock
  4. Argillaceous interval of Clearwater is the primary caprock for MRCP. It is present across the MRCP DA, it's a thick (>21 m), and laterally continuous, consistent, clay-rich caprock, free of influence of any vertical pore pressure transmission pathways.

     Some instrumentation is set outside the casing of observation wells to monitor the sandier Clearwater intervals above the Argillageous caprock.
  5. Wabiskaw sand is the first known horizontal pathway on top of the reservoir. It is the main target for reservoir containment assurance and/or caprock integrity monitoring, early warning for pressure buildup.
  6. Wabiskaw shale lies above the McMurray reservoir, and is the lower-most interval included within the overburden monitoring strategy.

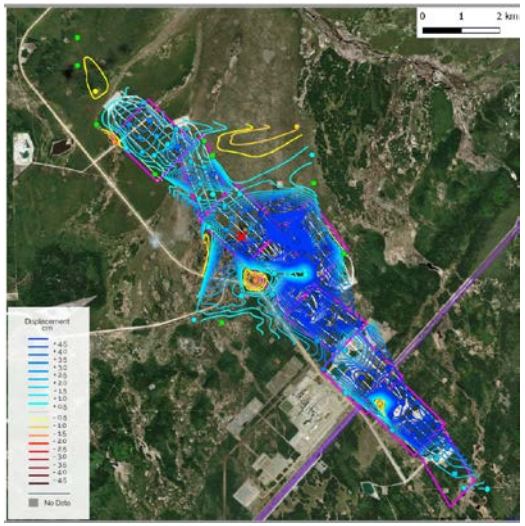
Caprock & Surface: Clearwater & Heave Monitoring

- **Overburden surveillance above MRCP caprock (Clearwater Argillageous)**
  - Clearwater sand/silt is above the MRCP caprock
  - Pressure: range 826 - 896 kPag (initial range: 826 - 896 kPag), Remains at virgin conditions, as expected
  - Temperature: range 4 - 5 C, (initial range: 4 - 5 C)
  - Pressure and temperature expected to remain steady as this interval is immediately above the caprock

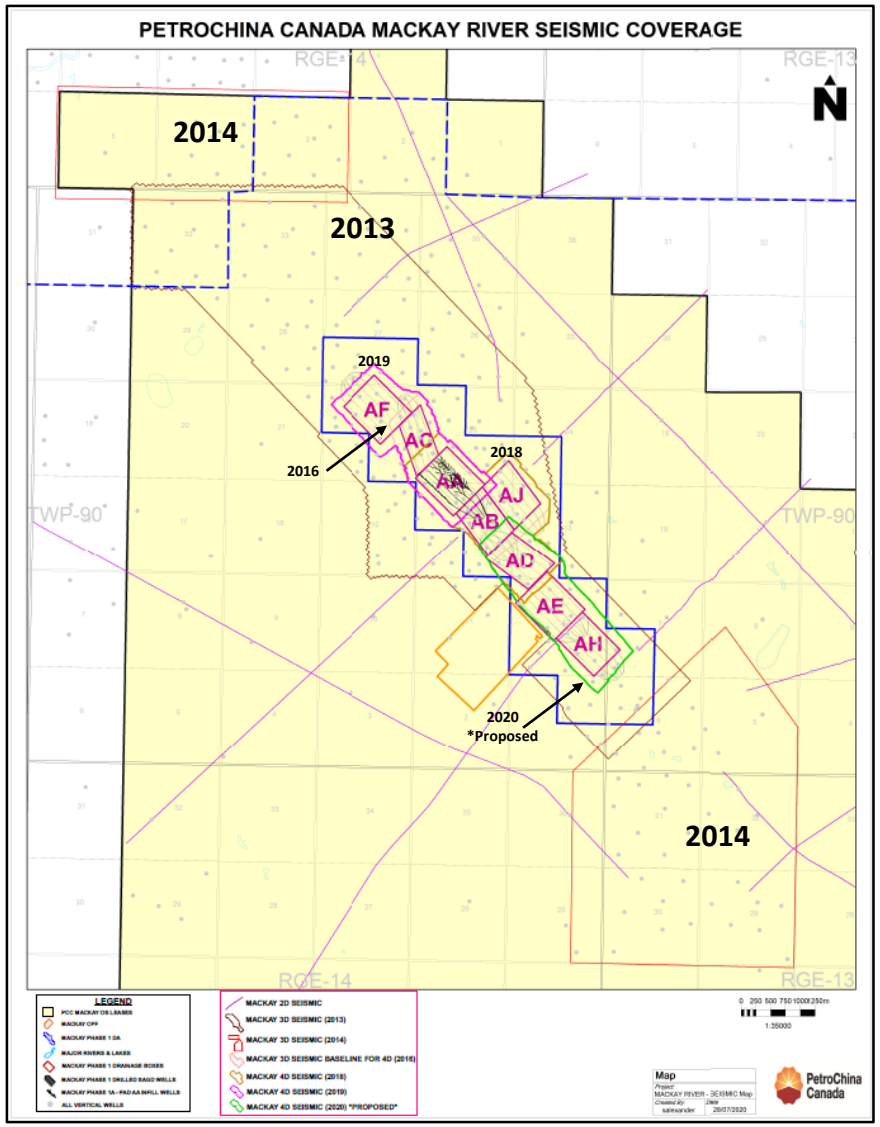


- **Surface Displacement Monitoring**
  - PCC implemented ground displacement monitoring using 104 corner reflectors over MRCP using Synthetic-aperture Radar Interferometry (InSAR) technology.
  - Heave is the dominant ground displacement effect registered in 2019
  - Moderate heave up to 12 cm (as expected) has been recorded in all MRCP pads
  - Cumulative displacement per pad, Sep 2014 – Mar 2019 is shown in the adjacent table
  - The total amount of displacement measured during the same period is shown in the map as isolines

Pad	Surface Displacement (cm)
AA	+ 6.0
AB	+ 7.0
AC	+ 3.5
AD	+ 8.2
AE	+ 3.9
AF	+ 3.5
AH	+ 7.0
AJ	+ 12.2



MRCP Seismic



Coverage Across MRCP includes:

- ~96 km of 2D
- ~58.4 km^2 of 3D
- ~3.9 km^2 of 3D baseline for 4D
- ~3.5 km^2 of 4D in 2018 - Interpreted
- ~3.0 km^2 of 4D in 2019 – Interpreted
- ~2.9 km^2 of 4D in 2020 – *Proposed

3D acquired in MRCP to help:

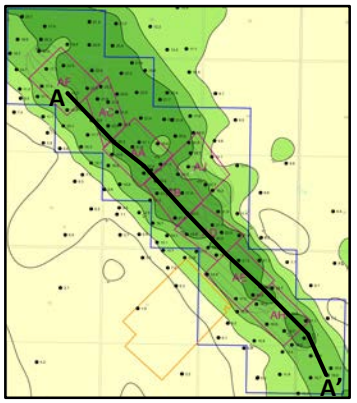
- Assess Caprock
- Plan/drill horizontal well trajectories
- Assess McMurray reservoir

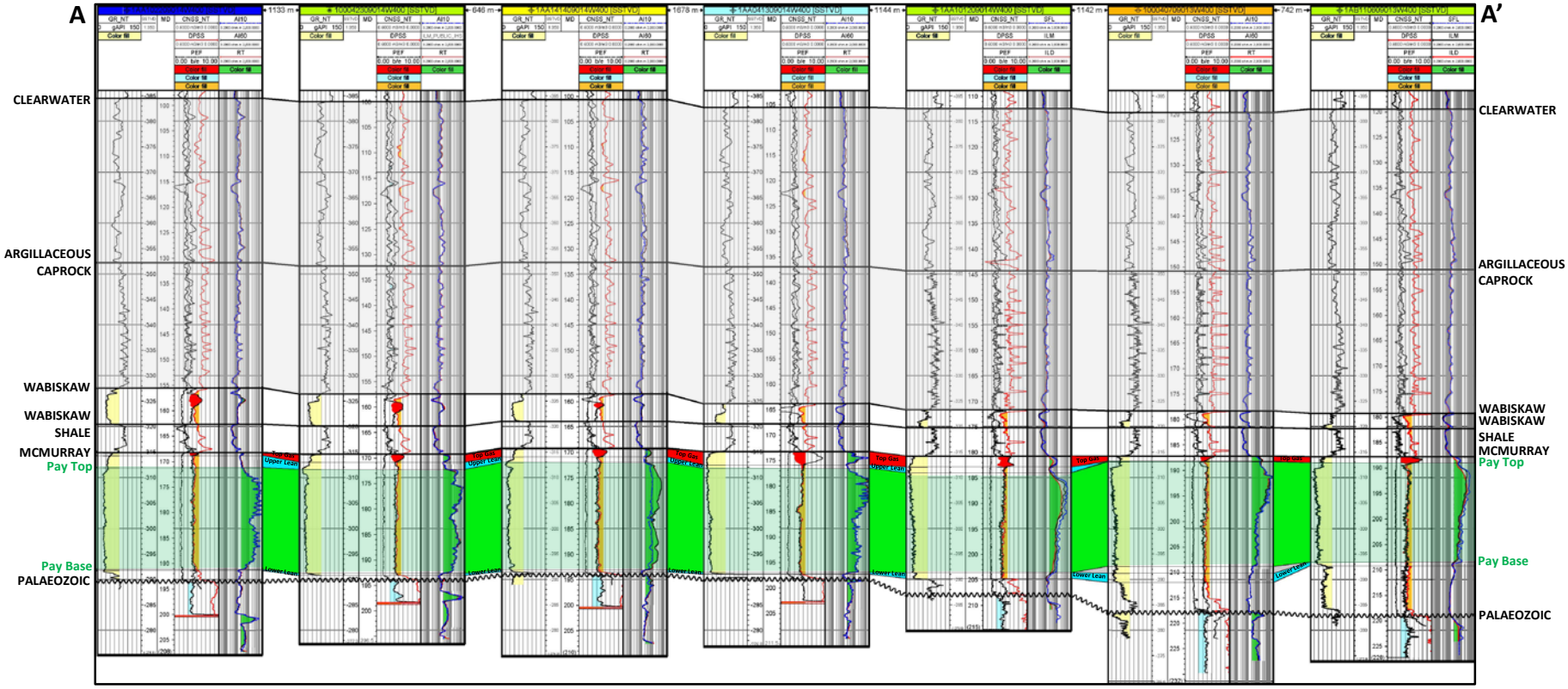
4D seismic survey acquired at MRCP in 2019

- Will monitor steam chamber growth
- Updated 4D coverage 2019 acquisition

Structural Cross-Section across MRCP

- Good reservoir quality with continuity along Development Area
- Minor structural variation at base of pay
- Thick and laterally continuous caprock with consistent lithology





Geologic and Reservoir Properties – OBIP FOR OPERATING AREA

Drainage Box	# Well Pairs	Drainage Box Area (m^2)	Average S_o (frac)	Average Φ (frac)	Average K_h (D)	Average K_v (D)	Average Bitumen Pay Thickness (m)	Drainage Box OBIP (m3)	Estimated RF (%)*	Estimated Drainage Box RBIP (m3)
AA	6	698,200	0.83	0.34	2.7	1.1	21.3	4,197,138	54	2,273,450
AB	5	562,600	0.8	0.34	2.7	1.1	22.6	3,465,819	57	1,971,383
AC	4	418,700	0.85	0.34	2.6	1	21.9	2,655,008	63	1,669,316
AD	5	560,100	0.77	0.33	2.6	1	20.8	2,957,075	54	1,605,723
AE	6	674,700	0.76	0.33	2.2	0.9	20.8	3,513,514	53	1,860,095
AF	6	675,400	0.82	0.34	2.6	1	22	4,149,444	62	2,575,517
AH	5	594,300	0.77	0.34	2.6	1	20.4	3,179,650	48	1,526,232
AJ	5	562,300	0.75	0.34	2.5	0.9	20.5	2,941,176	57	1,669,316
Total	*42*	*4,746,300*	*0.79*	*0.34*	*2.6*	*1*	*21.3*	*27,058,824*	*56*	*15,151,033*

OBIP = Original Bitumen In-Place and measured in $10^6 m^3$ units and converted to 10^6 barrels using conversion factor of 6.2898

NRV = Net Rock Volume in $10^6 m^3$ derived from deterministic mapping of SAGDable net pay, or from geomodel calculations

SO = Average bitumen saturation from the SAGD exploitable reservoir interval generated from 1-SWT (in fractions)

PORT = Average porosity from the SAGD exploitable reservoir interval generated from PORT (in fractions)

$$OBIP = (NRV \times PORT \times SO)$$

Geologic and Reservoir Properties – OBIP

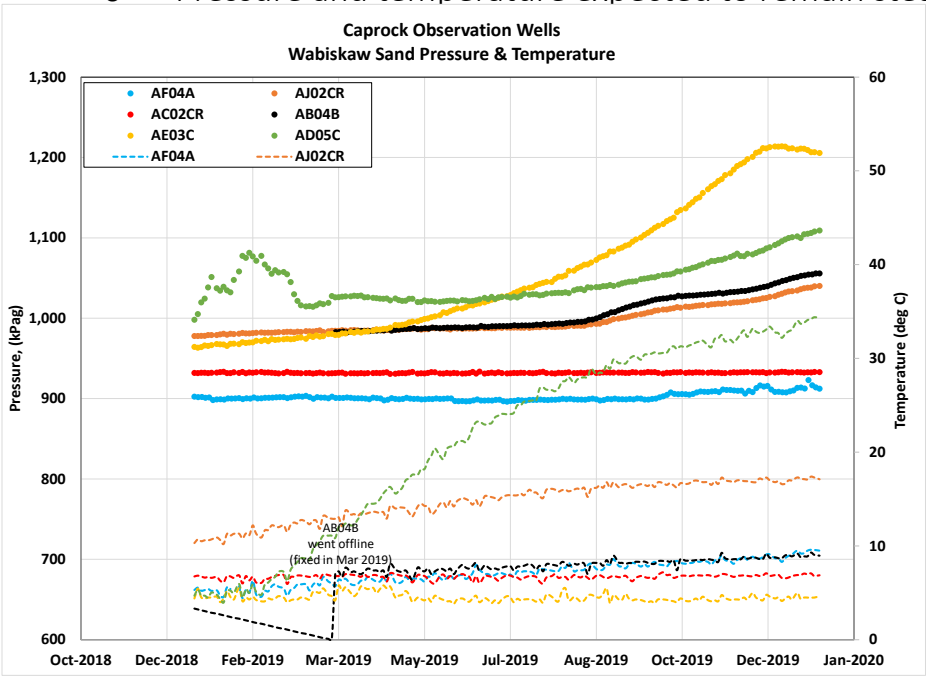
Parameters	Development Area	Project Area
Top of Reservoir Depth (mTVD)	176	175
Top of Reservoir Depth (TVD masl)	315	311
Base of Reservoir Depth (mTVD)	197	193
Base of Reservoir Depth (TVD masl)	294	293
Net Pay Thickness (m)	21.3	12.8
Porosity (frac)	0.34	0.33
Bitumen Saturation (frac)	0.79	0.75
OBIP (10^6 bbl)	170.2	2890.8
OBIP (10^6 m^3)	27.1	459.6
Initial Pressure (kPaa)	220 (top) – 400 (bottom)	220 (top) – 400 (bottom)*
Original Reservoir Temperature (°C)	6	6*

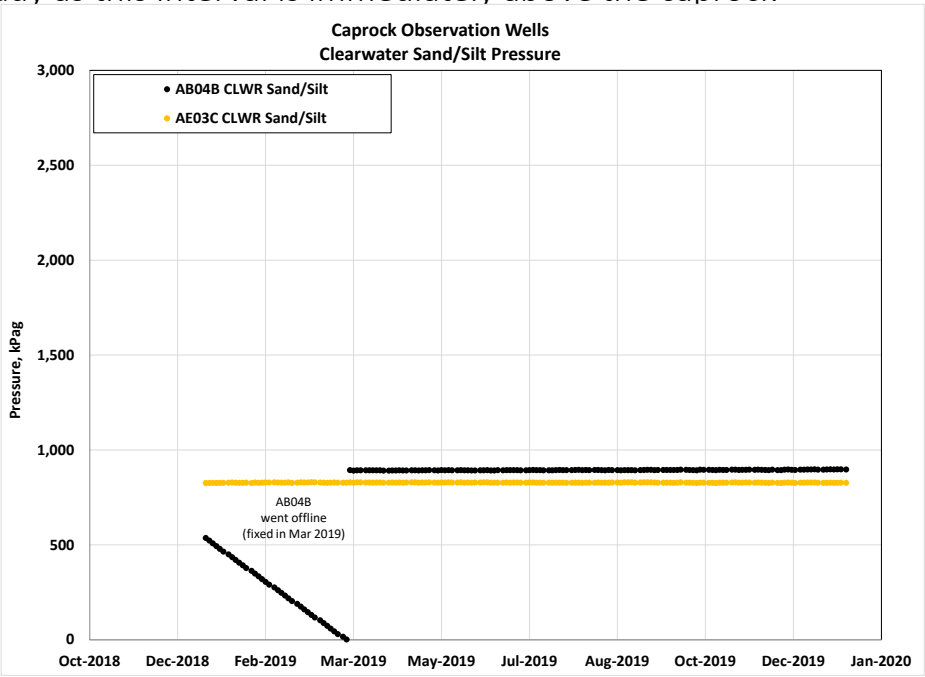
**Extrapolated from operating area*

Caprock Monitoring: P & T Wabiskaw and Clearwater Sands

Overburden surveillance below and above MRCP caprock (Clearwater Argillageous)

- Wabiskaw Sand First line of defense (above reservoir, below caprock):
  - Pressure: Average 964 kPag, range 900 – 1,214 kPag (initial range: 900 - 950 kPag)
  - Temperature: Average 10 ºC, range 6-35 ºC (initial range: 5-7 ºC)
  - All pressure and temperature trends were considered normal in 2019 and attributed to thermal operations in the MCMR reservoir
- Clearwater sand/silt is above of MRCP caprock
  - Pressure: range 826 -896 kPag (initial range: 826 - 896 kPag), Remains at virgin conditions as expected
  - Temperature: range 4 - 5 ºC, (initial range: 4 - 5 ºC)
  - Pressure and temperature expected to remain steady as this interval is immediately above the caprock





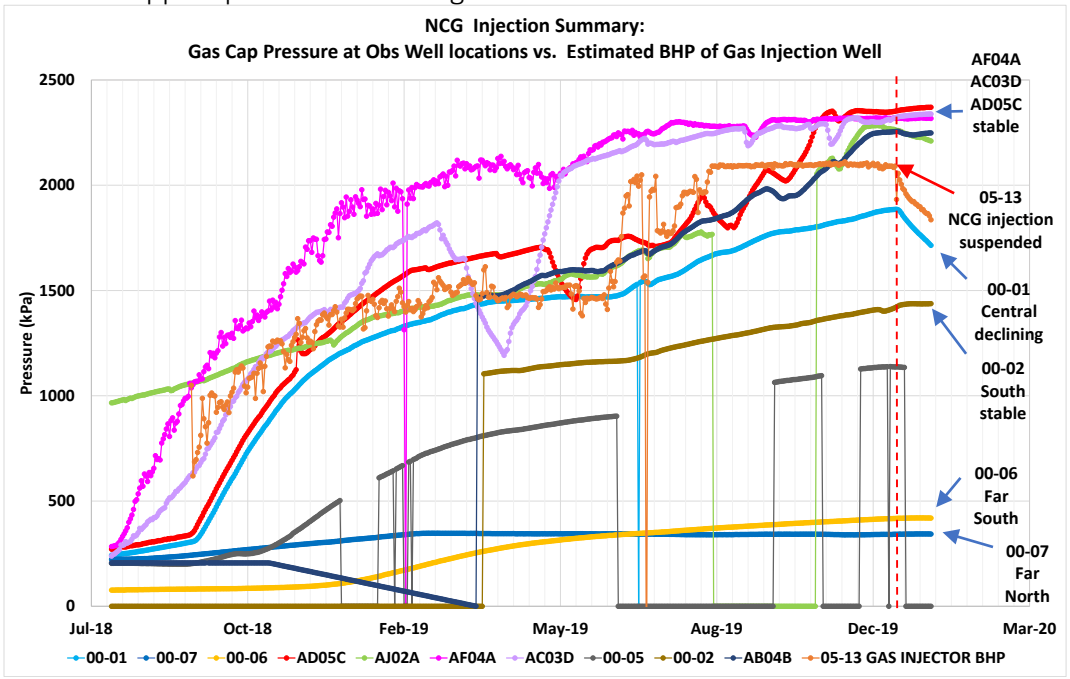
MRCP – Performance Indicators by Pad

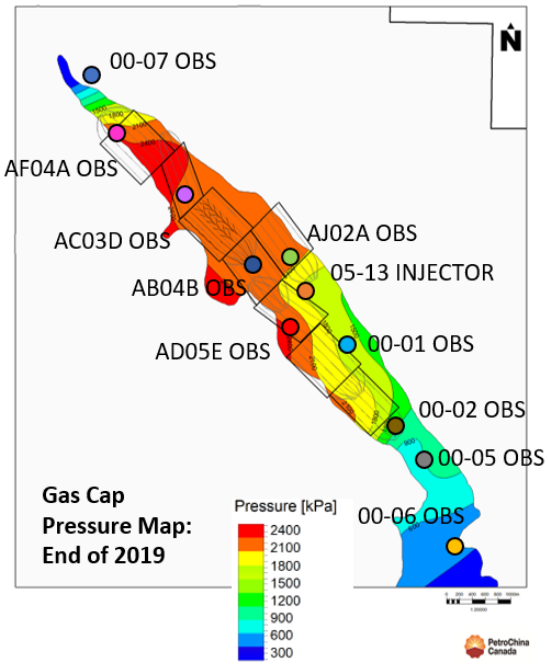
Pad	OBIP (m^3)	Cum. Oil to December 2019 (m^3)	Recovery to December 2019 (%)	CSOR	ISOR	Ultimate Recovery (%)
AA	4,197,138	218,172	5.20%	5.6	5.7	54%
AB	3,465,819	159,968	4.62%	7.6	8.3	57%
AC	2,655,008	186,221	7.01%	4.5	3.6	63%
AD	2,957,075	125,310	4.24%	8.5	7.1	54%
AE	3,513,514	102,835	2.93%	11.0	11.8	53%
AF	4,149,444	246,711	5.95%	5.1	4.4	62%
AH	3,179,650	42,903	1.35%	22.6	19.3	48%
AJ	2,941,176	70,948	2.41%	15.9	10.3	57%
Total	**27,058,824**	**1,153,067**	**4.26%**	**7.7**	**6.7**	**56%**

- Higher SORs experienced on AE, AH, AJ and AD pads primarily due to gas cap contact and slightly larger lower transition zone leak off.
- Mitigations:
  - Operating pressure is balanced accordingly with the thief zones pressure
  - Gas cap pressurization with natural gas started in Sep 2018 in vertical well 05-13 (central DA), suspended in Dec 2019.
  - Gas co-injection started in well pairs of pads AH, AE, AD in Jan 2019 and it is expected to continue support gas cap pressurization in the Southern DA during 2020

Gas Cap Pressurization

- The purpose of gas cap pressurization at MRCP is to increase the pressure in the gas cap to operate at a more favourable pressure balance between steam chambers and top thieve zones to minimize steam losses
  - Initial gas cap pressure of 200 kPag, presented a challenge to SAGD operation pressure balance
  - Evidence of steam chamber communication to the gas cap since early 2018
  - The pressurization process started in Sep 2018. Natural gas was injected in the vertical well 103/05-13-090-14W4-00. By Q3, 2019 injection reached maximum of 125,000 Sm3/d. In Dec 2019, injection was suspended in 05-13 as gas cap pressure was close to target value and for economic reasons.
  - PCC continues to monitor the pressure of the gas cap over MRCP. Evaluation of the reservoir performance and economics will determine re-activation of natural gas injection at any time in the future.
  - Gas co-injection started in Jan 2019, mainly in South DA to support gas cap pressurization in areas distanced from injector 05-13, typical co-injection rates ranges from 2,400 to 4, 200 Sm3/d (approved 5,000 Sm3/d). Co-injection is intended to continue to support pressure balancing.



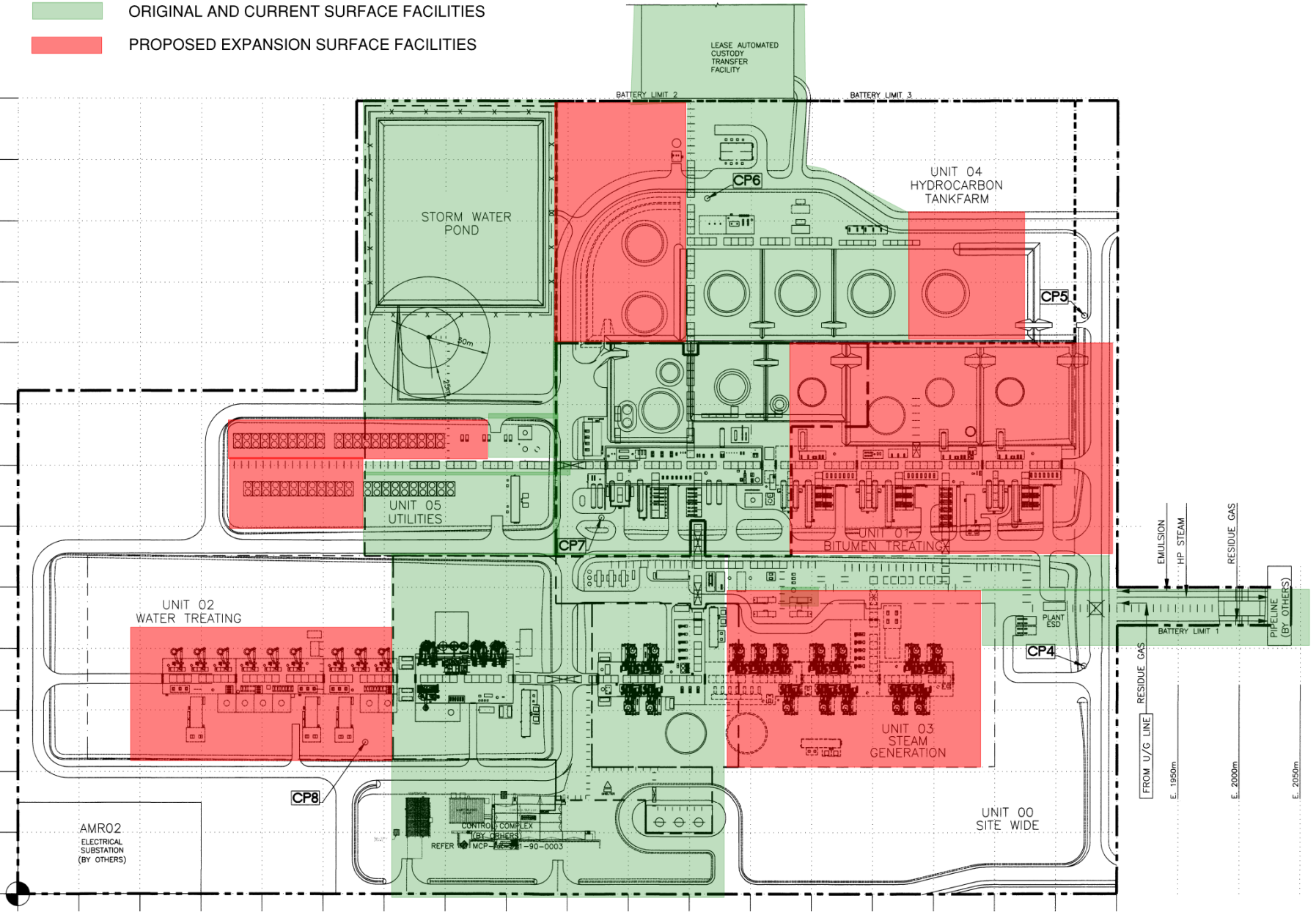


4.3 SURFACE

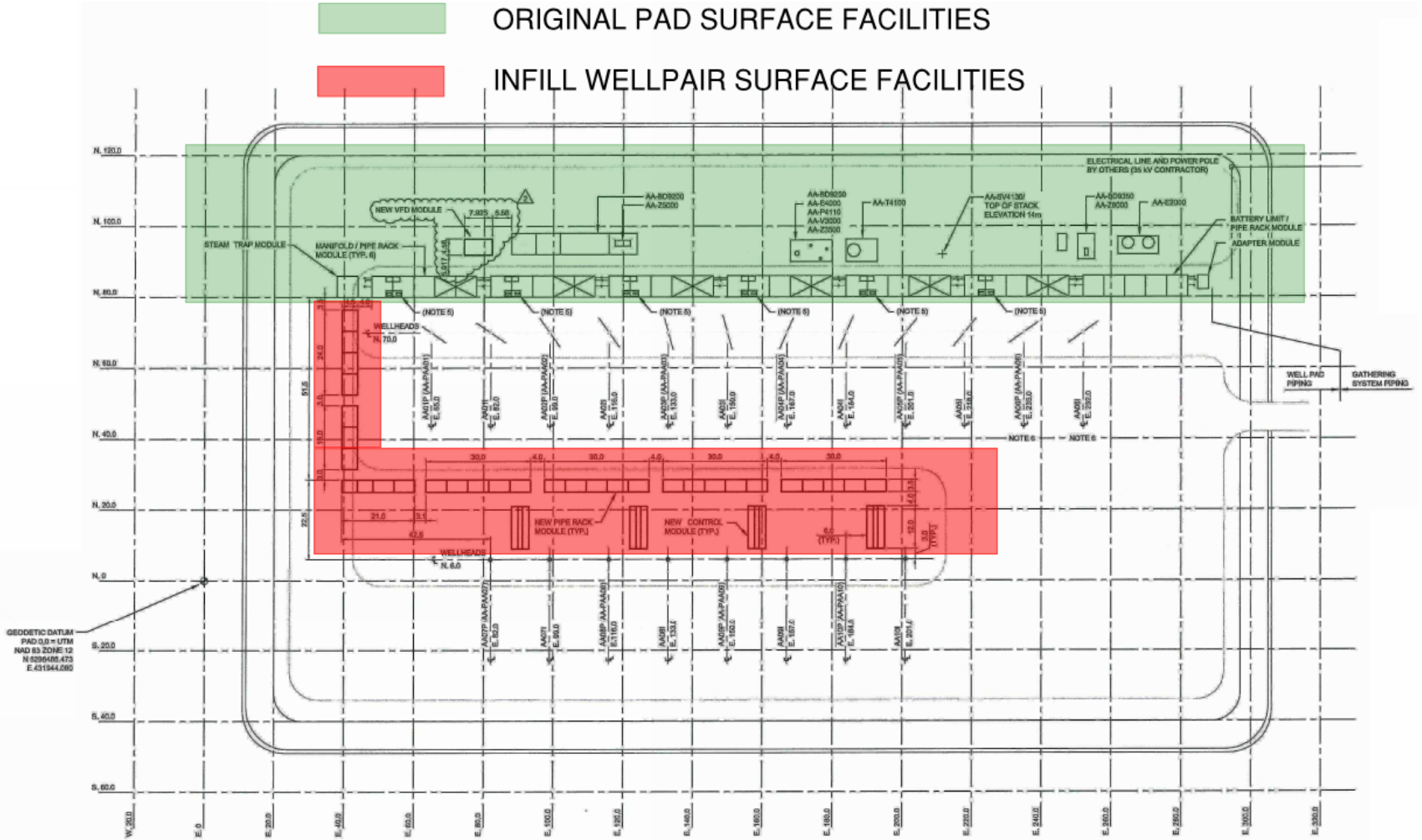
Central Plant Facility Development

ORIGINAL AND CURRENT SURFACE FACILITIES

PROPOSED EXPANSION SURFACE FACILITIES



Pad Surface Facility Development



EQUIPMENT LIST

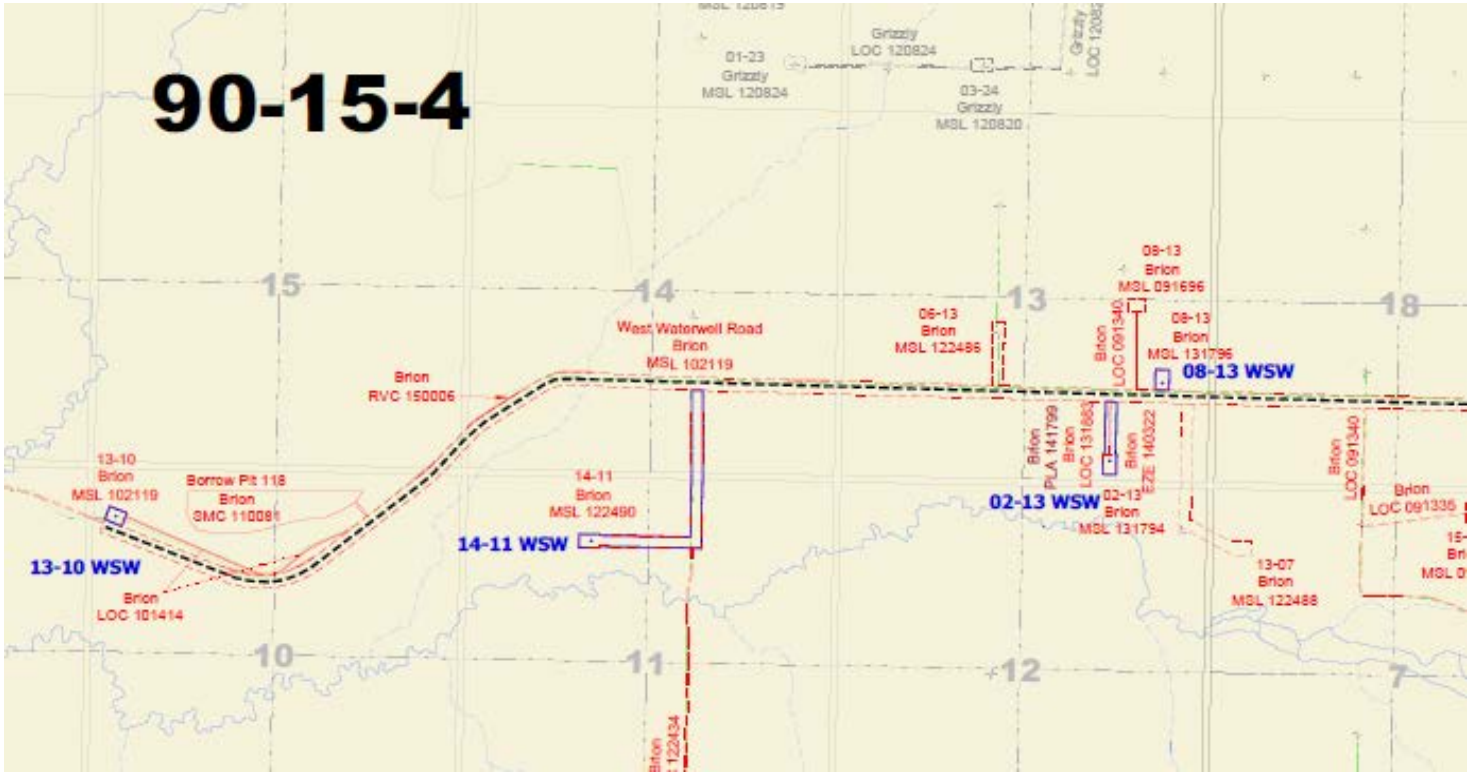
AA01I	INJECTION WELL	AA05P	PRODUCTION WELL	AA-PAA03	DOWNHOLE PUMP	AA07I	INJECTION WELL (NEW)	AA-PAA07	DOWNHOLE PUMP (NEW)
AA02I	INJECTION WELL	AA06P	PRODUCTION WELL	AA-PAA04	DOWNHOLE PUMP	AA08I	INJECTION WELL (NEW)	AA-PAA08	DOWNHOLE PUMP (NEW)
AA03I	INJECTION WELL	AA-BD9200	MCC / AIR COMPRESSOR BUILDING	AA-PAA05	DOWNHOLE PUMP	AA09I	INJECTION WELL (NEW)	AA-PAA09	DOWNHOLE PUMP (NEW)
AA04I	INJECTION WELL	AA-BD9250	TEST SEPARATOR BUILDING	AA-PAA06	DOWNHOLE PUMP	AA10I	INJECTION WELL (NEW)	AA-PAA10	DOWNHOLE PUMP (NEW)
AA05I	INJECTION WELL	AA-BD9350	START-UP PRODUCTION / ANNULUS GAS PUMP BUILDING	AA-T4100	POP TANK				
AA06I	INJECTION WELL	AA-E2000	START-UP PRODUCTION AERIAL COOLER	AA-V3000	TEST SEPARATOR	AA07P	PRODUCTION WELL (NEW)		
AA01P	PRODUCTION WELL	AA-E4000	PAD RESIDUE GAS HEATER	AA-Z3500	SAMPLE PACKAGE	AA08P	PRODUCTION WELL (NEW)		
AA02P	PRODUCTION WELL	AA-P4110	POP TANK PUMP	AA-Z5000	PAD INSTRUMENT AIR PACKAGE	AA09P	PRODUCTION WELL (NEW)		
AA03P	PRODUCTION WELL	AA-PAA01	DOWNHOLE PUMP	AA-Z6000	START UP / ANNULUS GAS PUMP PACKAGE	AA10P	PRODUCTION WELL (NEW)		
AA04P	PRODUCTION WELL	AA-PAA02	DOWNHOLE PUMP	AA-BV4130	VENT STACK				

Built and Planned Water Infrastructure

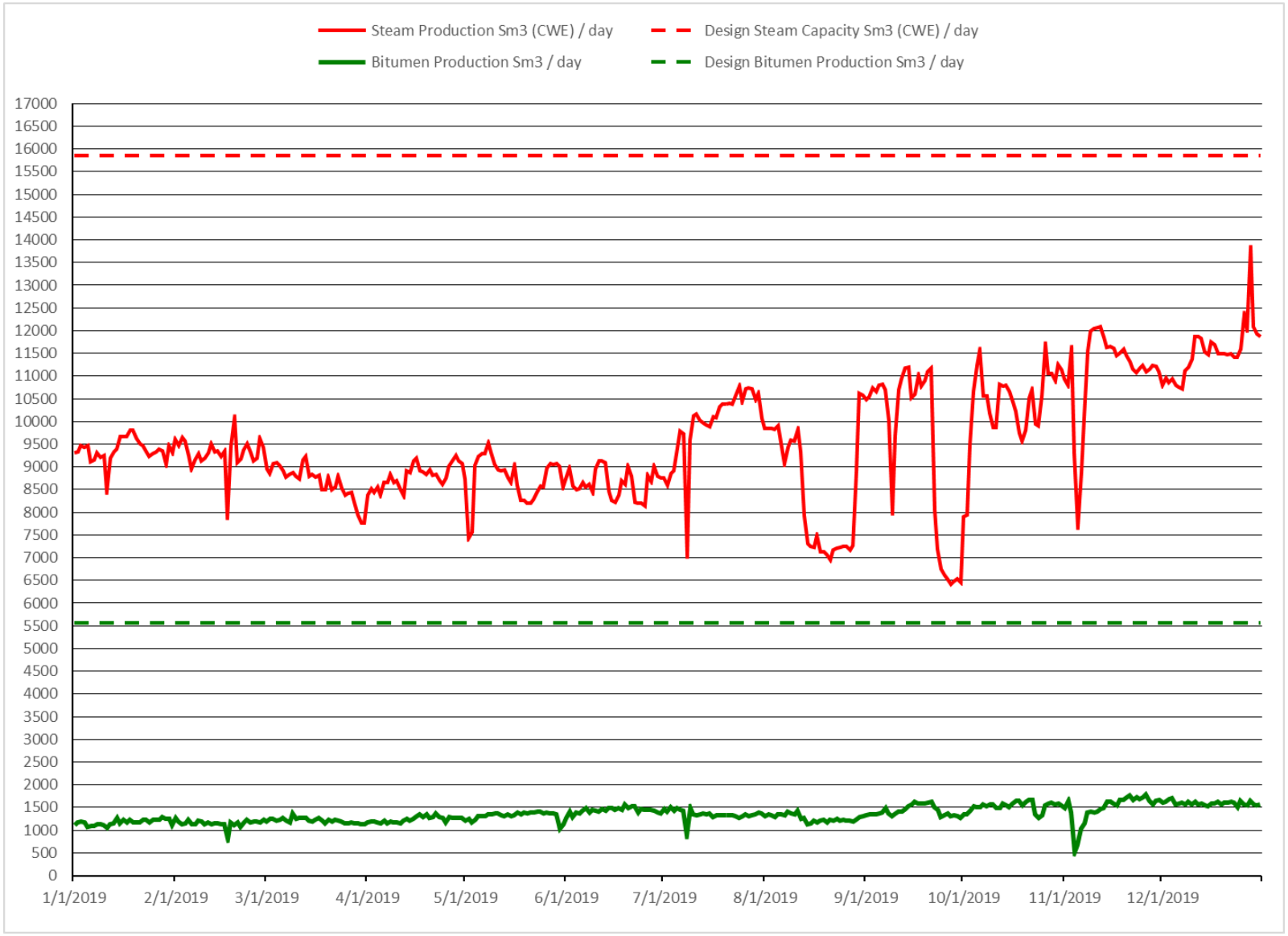
Water Act Licence No. 00266369-01-03:

- Approved Annual Withdrawal Volume = 2,116,964 m^3/year from the Empress Channel Aquifer
  - 13-10-90-15W4, max rate 2,930 m^3/d
  - 14-11-90-15W4M, max rate 3,000 m^3/d
  - 02-13-90-15W4M, max rate 2,900 m^3/d
  - 08-13-90-15W4M, max rate 3,100 m^3/d

No planned future water source wells.



Operational Comparison to Design Throughputs



4.4 Historical and Upcoming Activity

Injector Re-drills and Producer Sidetracks

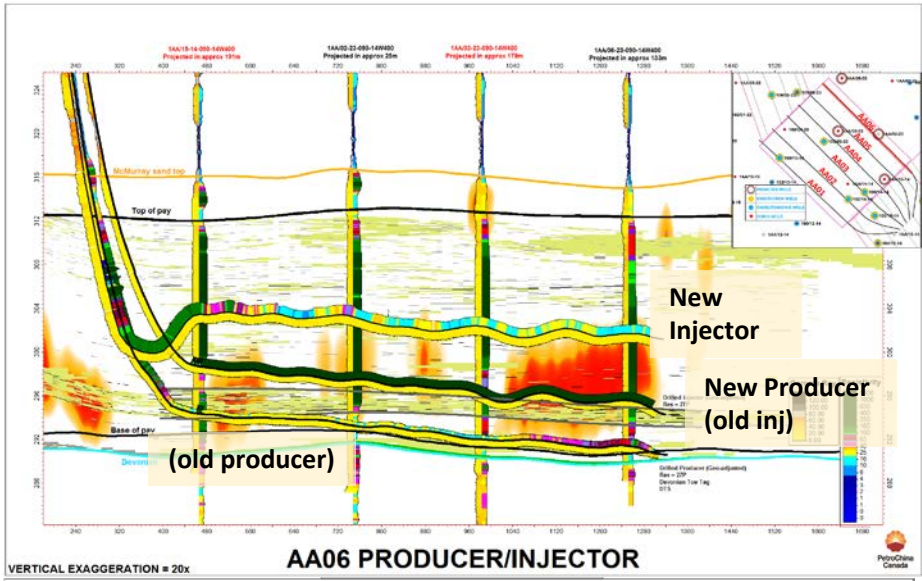
Two special completion projects were finished in early Q2 2019

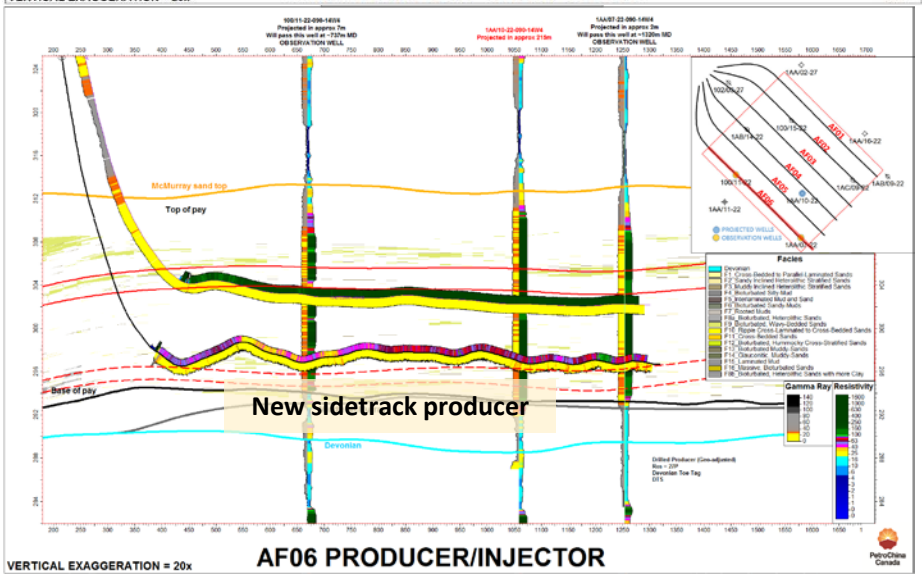
AA06/AB05 Injector re-drill:

- New injector drilled 5m on top of existing one. Existing injector was converted to producer
- In both cases, initial well pair placement affected by mud bed zone between injector and producer
- New configuration targeted cleaner reservoir and better communication
- Although, this type of action is associated with a reduction of the exploited reservoir volume; the new placement compensates with improved productivity.
- Both wells improved significantly
- Example shown: AA06

AC03 and AF06 Sidetracks:

- After experiencing producer liner failure, these wells were proposed to be sidetracked
- New producer is at same elevation of the previous one (4-5 meters offset)
- Reserves not affected
- Both wells improved significantly
- Example shown: AF06





2019 Regulatory and Operational Changes

Amendments to Scheme Approval No. 11715			
Amendment No.	**Application No.**	**Description**	**Approval Date**
11715O	1918286	Polymer Treatment	22-Mar-2019
11715P	1920498	Wellbore Conditioning (Infill Well)	10-May-2019
11715Q	1921790	Increase Gas Cap Pressurization Volume	21-Jun-2019

There were no phase expansions, change in injection strategy, or infrastructure changes throughout 2019 that materially affected scheme performance or energy material balances

Key Learnings To-Date

- SAGD
  - Continuing to ramp-up production through optimization efforts and mitigating the effects of:
    - Top gas and thicker lower transition zones
    - Operational pressure strategies tied to “thief” zones
    - Effects of baffles and barriers
    - Fines migration
  - The use of Progressive Cavity Pumps post-circulation proved to be a low cost conversion solution, however consideration must be given to:
    - Produced fluid composition (vapor, fines)
    - Pump efficiency degradation
  - Electrical Submersible Pump conversions post-circulation met or exceeded run-life expectations.
  - The use of fiber optic temperature coils has proven to be a valuable tool to diagnose downhole issues and survey the conformance along the horizontal section.
  - In wells that are equipped with Inflow Control Devices the use of continuous fiber optic temperature surveys may have limited value during normal operations.

SSP – Field Test

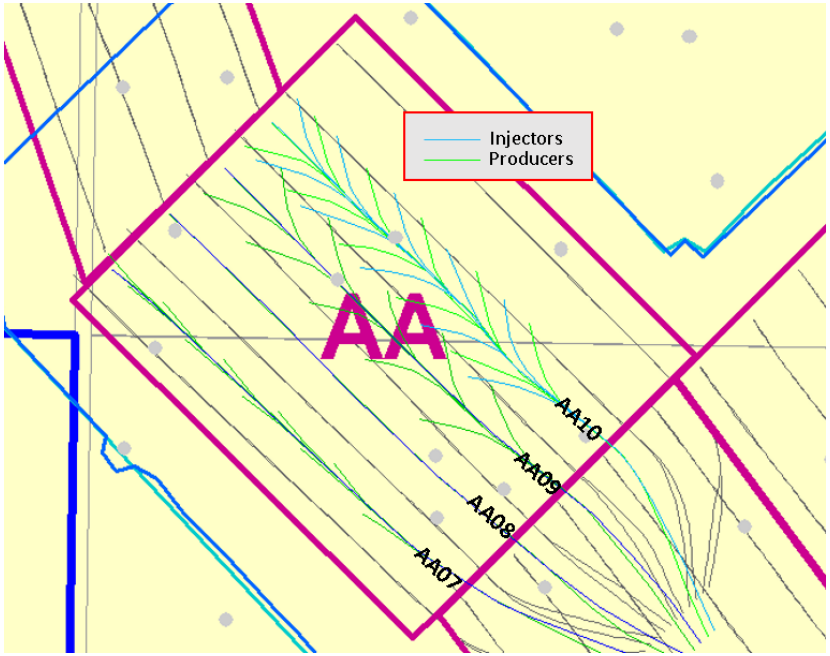
- Steam Stimulation Process (SSP):
  - injection of a limited amount of steam at high pressure to create a dilation of the reservoir rock surrounding the selected SAGD well pair. During the SSP steam is injected in a SAGD well pair in order to cause the rock matrix around the wellbore to dilate and increase porosity and permeability, improving fluid mobility through mud laminations or low permeability streaks.
- The SSP was safely executed in well pair AF05
- All observation wells pressure gauges and adjacent SAGD well pairs steady
- No interference observed, no alarms triggered
- Results:
  - Some improvement observed after SSP
  - PCC is currently evaluating post-test performance
  - Results of evaluation will determine future applicability of the technique
  - PCC has not observed durable positive effects of SSP, considering the risks and economics (deferred production, extra steam) this type of teste has been deemed not successful
  - There are no plans to conduct additional testing of this type.

Well Pad AA Infill Wells

- 4 new well pairs drilled and completed at Well Pad AA in 2019
- Steam circulation began late Nov 2019
- SAGD conversion planned Q1 2020
- Among the objectives were: accelerate oil recovery by reducing well spacing and testing technologies that could be applied to future MRCP developments:

Multilaterals proposed to test communication with adjacent steam chambers and enhance communication through heterogeneous reservoir zones and geological baffles (zones of higher mud bed frequency)

- AA07:
  - Casing Inflow Control Device in producer,
  - Uptrack laterals
  - Vacuum Insulated Tubing
- AA08:
  - Casing Inflow Control Device in producer
  - Base Pair (conventional well pair, enhanced design with learning from first 42 well pairs)
- AA09:
  - Casing Inflow Control Device in producer,
  - Producer multilaterals to adjacent steam chamber
- AA10:
  - Casing Inflow Control Device in producer,
  - Producer and injector multilaterals to adjacent steam chamber



2019 Voluntary Self-Disclosures

Notification Date	Details	Reason	Resolution
8-Jan-19	During the AF05 SSP trial, it became apparent that a steam valve was passing approximately 1.0 m3/hr during the planned shut-in period resulting in a exceedance of the trial injection duration.	It has been determined that the steam control valve had an actuator that was out of spec and may not have had the ability to fully close. The actuator was replaced at the end of January, 2019.	SSP Injection Duration Above 3400 kPa - VSD accepted by the AER on Jan 30. Follow up action required: Root cause investigation was provided to AER on April 16, 2019.
22-Jan-19	Diesel leak from generator - Investigation identified that the bung plug of the containment building was not engaged which allowed diesel to escape the containment	Operator Error- Accidental	FIS 20190242 Final Report submitted to AER on June 25, 2019.
10-May-19	In November 2018, well tests for the production well AD04 did not meet the AER testing requirements of 1hr/40hr production.	Degradation of pump efficiency required that the well be flowed to the LP annulus header.	PCC has outlined a line-out procedure allowing tests to be collected via the LP annulus.
10-Dec-19	CEMS was commissioned with incorrect path length entered in CEMS flow analyzer resulting in incorrect emission measurement.		Report was made to regulators on December 17, 2019. No follow up is expected.

2019 Compliance Summary

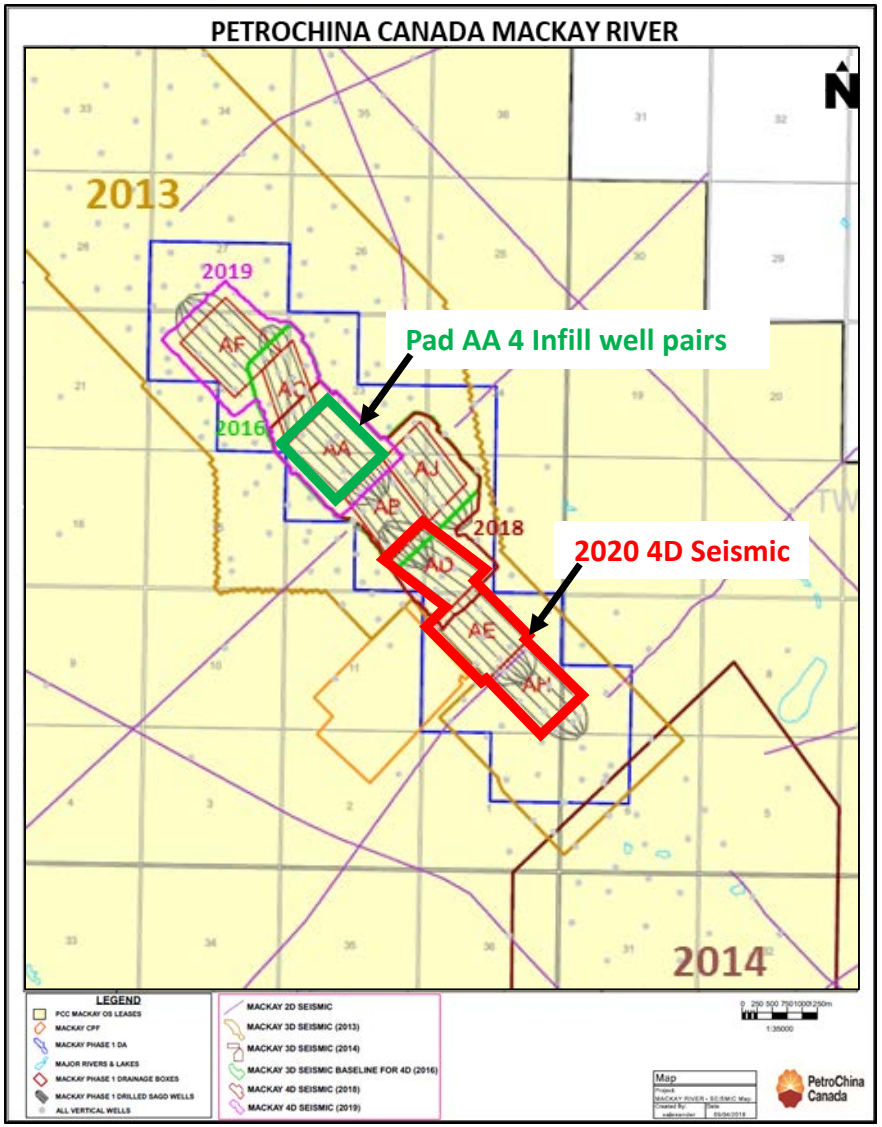
Notification Date	Details	Reason	Resolution
27-Feb-19	Release Report: PCC MRCP Well PAD AJ injector well AJ05I was taken off line Oct 3 2018 as a part of a production optimization strategy for the AJ05 well pair. At ~14:25 on Feb 27 2019 Well AJ05I experienced a steam leak at the bonnet flange on the short string wing valve	Bonnet flange on the short string wing valve that was identified to have been forced apart apparently as a result of an internal ice heave	Root cause analysis, and remedial action plan submitted
1-Apr-19	Alleged Contravention Report: A number of pre-release and discharge analyticals were found to be missing as required by EPEA 254465 for run-off water discharging. When performing the first 2019 run-off discharges, there were a number of discharge analytical also missed by the new contractor on-site.	Training required	Training has been reviewed with the new managing contractor. Appropriate back-up has been identified and trained for when the environmental coordinator is off-shift. Requirements have been reviewed with site management as well.
26-Jun-19	Failure to report a leak on a pipeline immediately	The leak was identified June 11 but not reported to leadership or HSSE until June 20. The release was also not reported to AER until June 20.	AER requirements were met with no further action required
3-Sep-19	Failure to Notify: PetroChina reported a pipeline release 12 hours after discovery	Training required	HSSE team communicated follow up actions (namely communications regarding spill response and notification) in response to the incident to AER and the resolution was found to be satisfactory.
9-Dec-19	Notice of Noncompliance with Directive 050: PCC did not submit the required post-disposal information within 24 months of rig release for seven wells.	The contractor for this work did not submit the required data to AER.	Contractor completed upload of the required data and AER verified that the data was satisfactory.

Future Initiatives - 2020

- Winter Appraisal Program:
  - No delineation wells
  - ~3 km^2 of 4D seismic covering drainage boxes AD, AE & AH

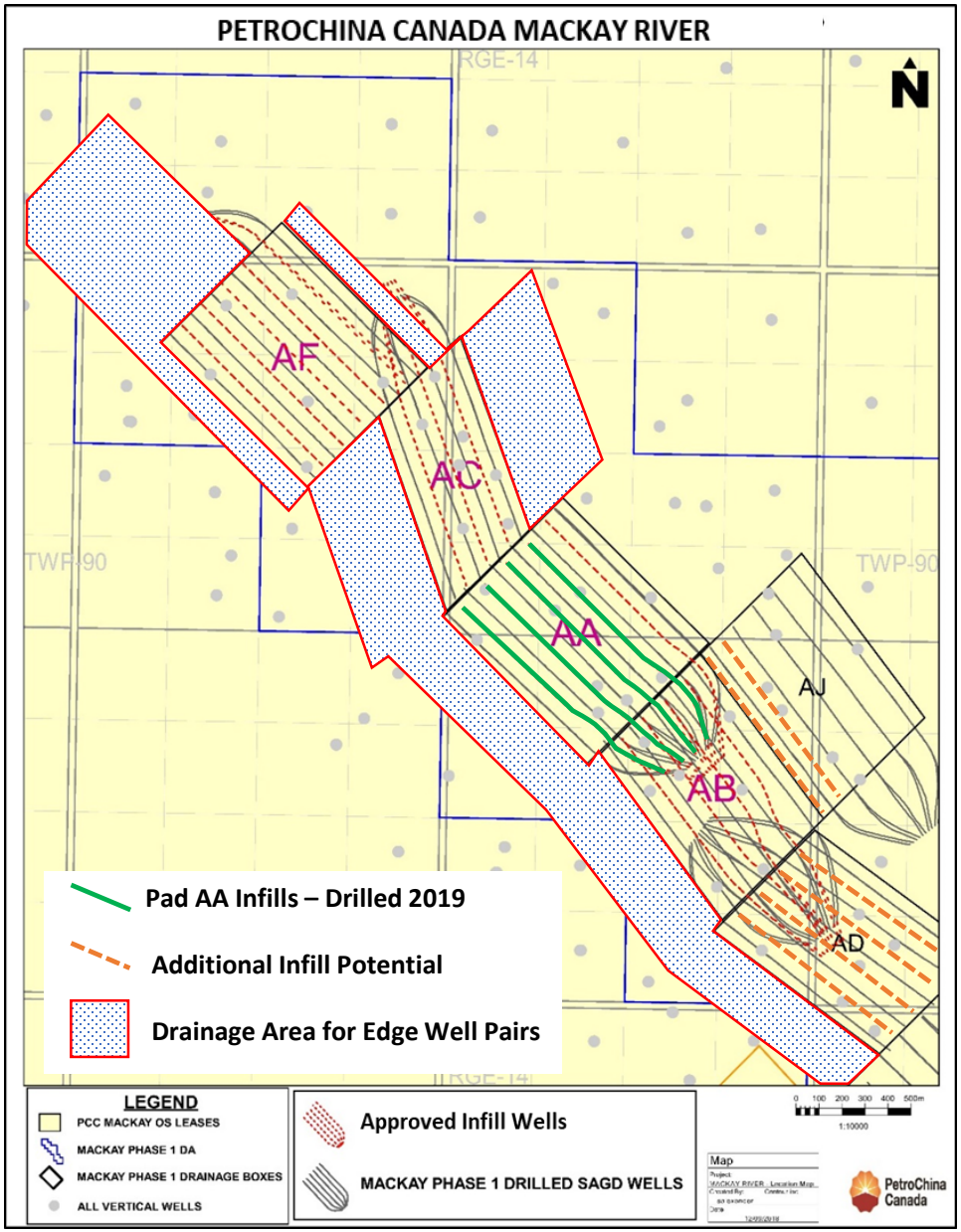
- Potential Commercial Amendment Application:
  - Pressure maintenance in bottom transition zone is being investigated

- MacKay Infill Well Pairs:
  - 4 new infill well pairs on Pad AA
    - Drilled in 2019
    - Steam circulation started in late Nov 2019
    - SAGD conversion planned Q1 2020



Future Initiatives

- PCC long range planning is ongoing and subject to change
  - No new delineation wells are planned
    - Sufficient delineation exist in near term, ~5 years
  - 4D seismic will be acquired throughout MRCP
    - As needed basis to monitor and manage reservoir
    - Opportunistically cycle through the drainage areas
    - ~2 to 3 drainage boxes annually
- Potential Amendment Applications:
  - Application for additional future sustaining well pairs
- Future Sustaining Development Potential
  - Development of the approved 13 infills well pairs
  - PCC is currently reviewing opportunity for:
    - Additional infills
    - Edge well pairs
  - Development extends from current drainage boxes
    - Use existing footprint and pad facilities wherever possible
    - Incorporate learning from Pad AA Infill well pairs



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