

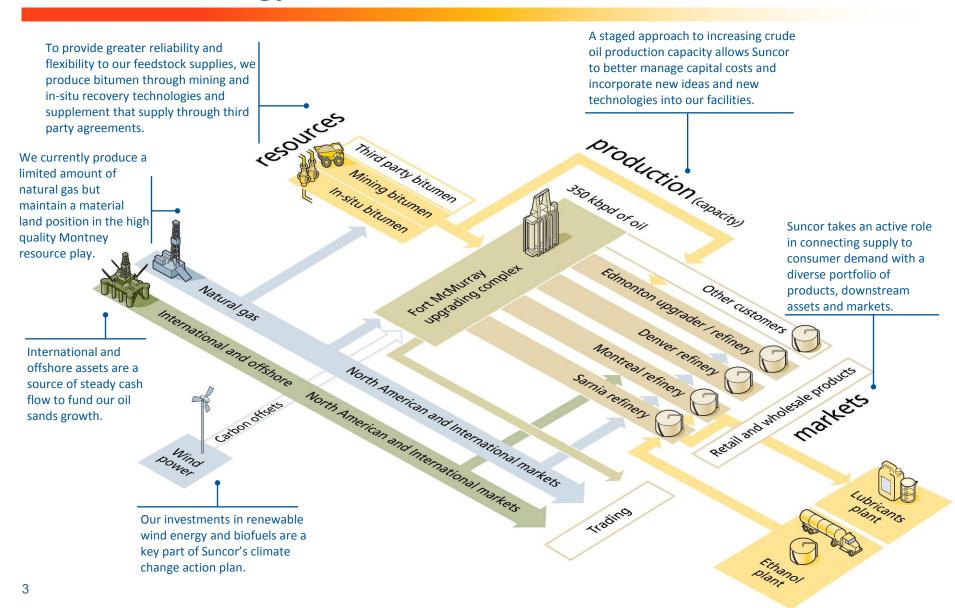
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- Appendix A: Piezometer Plots & Temperature vs Depth Plots

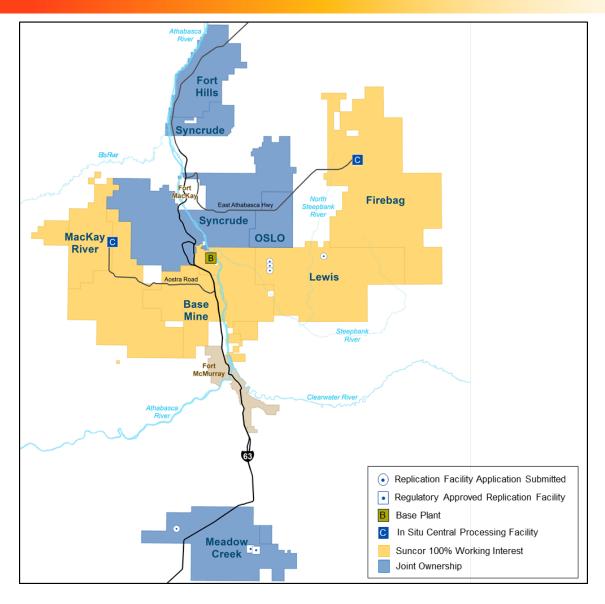




The Suncor Strategy



Suncor has High Quality Leases in Close Proximity





AER Directive 054 2019 Performance Presentation

Section 3.1.1 – Subsurface Issues Related to Resource Evaluation and Recovery



Table of Contents

- Background
- Geoscience/Seismic
- Caprock Integrity
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MacKay River Project Overview

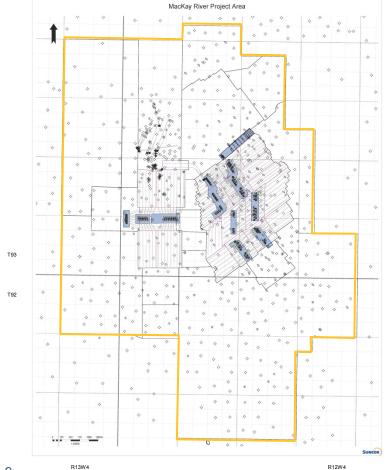
- Company's first operated steam-assisted gravity drainage (SAGD) facility located 60 km NW of Fort McMurray
- Current Approved Bitumen Production Rate 11,600 m³/d (73 kbpd)
- Adjacent to Suncor Dover (UTF / AOSTRA) Project
- Horizontal production wells are placed in the McMurray Formation at a depth of 98 to 145m from surface
- No extensive underlying water or gas over bitumen issues in current development areas
- Initial development had 25 well pairs with first steam in September 2002 and first production in November 2002 (Phase 1)
- 112 well pairs have been subsequently added

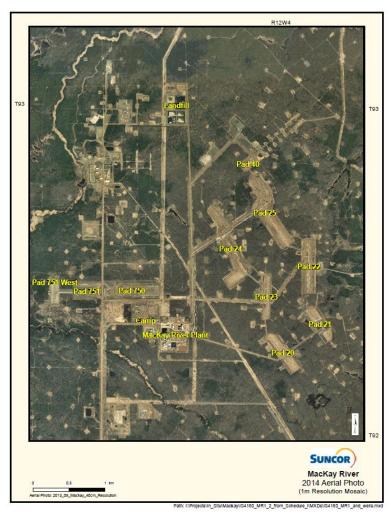
Producing Well Pairs	114
Non-Producing Well Pairs	21
Abandoned/Planned for Abandonment Well Pairs	2
Total Well Pairs	137



Project Area and Project Site

Current Project Area (PA) approximately
 24 ½ sections







Scheme Approval Amendments

- Amendment 8668A
 - Changed annual average volume to 33,000 bpd (5,250 m³/d)
- Amendment 8668B
 - · Increase to project area
- Amendment 8668C
 - Additional project area
 - Approval to inject non-condensable gas
- Amendment 8668D
 - · Additions to project area
 - Increase to annual average volume to 72,964 bpd (11,600 m³/d)
- Amendment 8668E
 - Approval to drill four well pairs
- Amendment 8668F
 - Approval to change approval holder from Petro-Canada to Suncor
- Amendment 8668G
 - Approval to undertake amendments & modifications to CPF systems
 - Approval tie-in 6 well pairs to well testing facilities
- Amendment 8668H
 - Approval to conduct non-condensable gas injection test on Pad 21 wells
- Amendment 8668I
 - Approval to conduct non-condensable gas injection at the Section 16 Test Project

- Amendment 8668J
 - Approval to transfer portions of the Dover project area into the MacKay River project area
- Amendment 8668K
 - Approval to tie-in 16 well pairs to well testing facilities
- Amendment 8668L
 - Approval to the remove the limiting factor of a mole percent restriction for the B Pattern non-condensable gas injection test on Pad 21
- Amendment 8668M
 - Approval to inject chemical into Pad 22 wells
- Amendment 8668N
 - Approval to abandon 3 wells and suspend 1 well on Pad 20
- Amendment 86680
 - Approval to change Phase 5F well trajectories
- Amendment 8668P
 - Approval to develop Pads 750/751/28 and add 2 sections to project area
- Amendment 8668Q
 - · Approval to conduct a pilot of water treatment technologies
- Amendment 8668R
 - Approval to abandon well G1I
- Amendment 8668S
 - Approval to conduct chemical injection test on Pad 21 (D-Pattern Injectors)



Scheme Approval Amendments

- Amendment 8668T
 - Pad 819 Approval
- Amendment 8668U
 - Maximum Operating Pressure Approval
- Amendment 8668V
 - NCG Expansion Project and Phase 5D/F Chemical Injection Approval
- Amendment 8668W
 - MR CPF Expansion Project and Directive 081 Waiver Approval
- Amendment 8668X
 - · Administrative reissue approval
- Amendment 8668Y
 - WHIP for Phases 5B2, 5D and 5F Patterns approval
- Amendment 8668Z:
 - Pad 828 change from 3 well pairs to 2 wells pairs and correction of well UWIs on Pad 21 Chemical Injection Test (D-Pattern Injectors) approval issued December 10, 2014.
- Amendment 8668AA:
 - Phase 1 NCG design amendment approval issued December 19, 2014.
- Amendment 8668BB:
 - Phase 2 and Phase 3 Chemical Co-Injection (E, F and G Patterns) approval issued January 1, 2015.

- Amendment 8668CC:
 - Approval for E1P Sidetrack well issued January 27, 2015.
- Amendment 8668DD:
 - Approval for NN6P Sidetrack well issued February 3, 2015.
- Amendment 8668EE:
 - Approval for VX[™] multiphase meter on Pad 824 issued February 19, 2015.
- Amendment 8668FF:
 - Approval for NCG Test at OO5I well on pad 24 issued March 17, 2015.
- Amendment 8668GG:
 - Approval to conduct CO2 Co-Injection at the OO9 well pair on Pad 24 issued April 13, 2015.
- Amendment 8668HH:
 - CO2 Co-Injection amendment to change to OO8 well pair on Pad 24 issued.
- Amendment 8668II:
 - Pad 824 Thermal Compatibility Assessment approval issued July 14, 2015.
- Amendment 8668JJ:
 - Approval for NCG Test at OO7I issued July 29, 2015.
- Amendment 8668KK:
 - Approval for an alternate MOP Strategy Trial.
- Amendment 8668LL:
 - · Approval for C2IPB Sidetrack Well.
- Amendment 8668MM:
 - Approval for Pad 750 Thermal Compatibility Assessment.



Scheme Approval Amendments

- Amendment 8668NN:
 - · Approval to increase MWHIP for all operating wells
- Amendment 866800:
 - · Approval to alter DA, DB, DC and DF Pattern MWHIPS
- Approval to adjust CO2 co-injection rate;
 - Approval to extend chemical co-injection test at the D pattern wells on Pad 21
- Amendment 8668PP:
 - Approval for abandonment of A3I
- Amendment 8668QQ:
 - Approval to change Clause 32
- Amendment 8668RR:
 - CO2 Extension
- Amendment 8668SS:
 - Phase 2 and 3 NCG Injection
- Amendment 8668TT:
 - Temporary Increase to BH MOP for Unloading
- Amendment 8668UU:
 - Subsurface Heating Pilot
- Amendment 8668VV:
 - MOP Increase QQ2 to QQ16
- Amendment 8668WW:
 - MWHIP Increase
- Amendment 8668XX:
 - MOP Increase QQ Wells

- Amendment 8668YY:
 - Field Wide NCG
- Amendment 8668ZZ:
 - 6 Month MOP Trial QQ Wells
- Amendment 8668AAA:
 - ER Pilot
- Amendment 8668BBB:
 - Thermal Assessment for Pad 751
- Amendment 8668CCC:
 - Addition of Sustaining Pad 826



Amendments Made in Reporting Year

- Amendment 8668VV:
 - MOP Increased QQ2 to QQ16
- Amendment 8668WW:
 - Increased MWHIP
- Amendment 8668YY:
 - Field Wide NCG
- Amendment 8668ZZ:
 - 6 Month MOP Trial QQ Wells
- Amendment 8668AAA:
 - ER Pilot
- Amendment 8668BBB:
 - Thermal Assessment for Pad 751
- Amendment 8668CCC:
 - Addition of Sustaining Pad 826





Oil Sands Facies and Gross Bitumen Pay

Facies:

Defined by visual mud index (VMI)

Cutoffs:

F1 (Sandstone) = 0-5% VMI F2 (Sandy IHS*) = 5-15% VMI F3 (IHS*) = 15-30% VMI F4 (Muddy IHS*) = 30-70% VMI F5 (Mudstone) = 70-100% VMI F10 (Breccia) = variable

* IHS = inclined, interbedded, sand and shale

Pay:

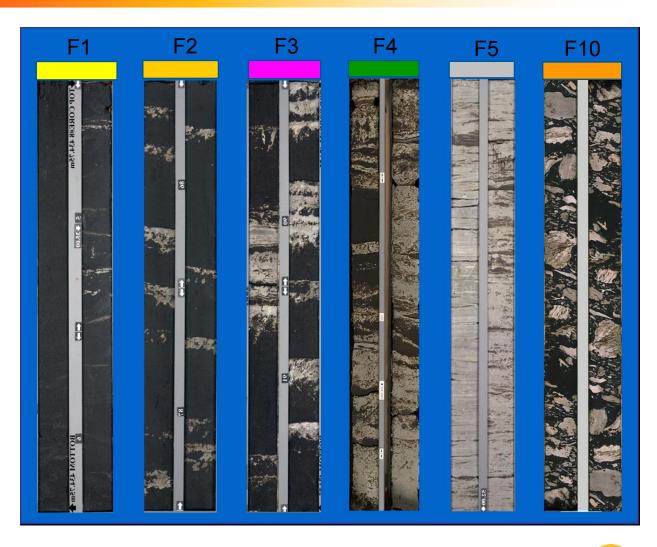
Includes Facies F1, F2, and F10 Can include F3-F5, if < 2m thick

Weight percent bitumen > 6%

Generally > 30% Porosity
- PA averages 31.1% in clean sands

Permeability ~ 1 to 5 Darcy's

> 10m for OBIP volumetric





Pattern OBIP Calculation

Gross Rock Volume (GRV) = total rock volume derived from Continuous Reservoir map

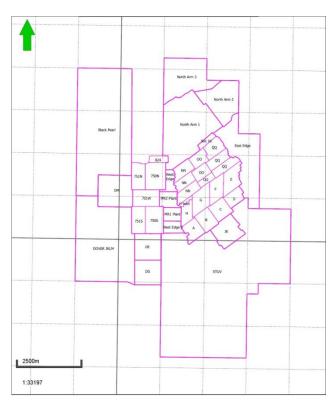
Original Bitumen in Place = product of the GRV multiplied by the average Porosity, and the average Oil Saturation over entire reservoir interval

New reservoir mapping includes non reservoir facies in calculation which are rectified via averaging of porosity and saturation values over the entire interval via petrophysics. Allows for consistency of calculation applied to all areas



Reservoir Properties and Base Case OBIP 2019

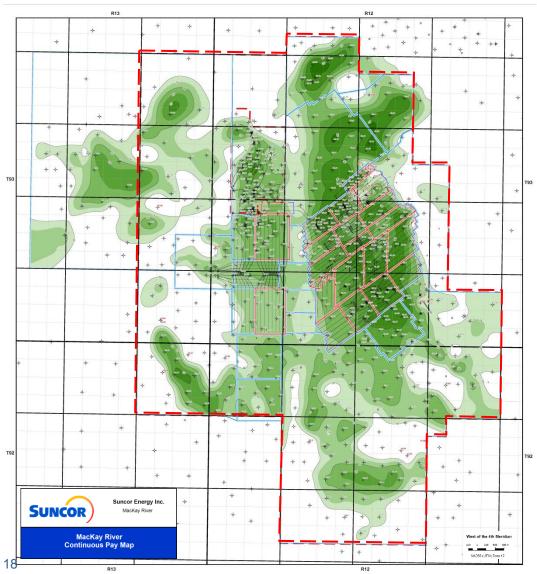
Average R	Volumes					
Pattern	So	Phi	h (m)	Area (m2)	OBIP(e³m³)	
Α	71%	33.5%	21.7	466 561	2,443	
В	82%	34.3%	27.0	476 917	3,616	
C	82%	34.0%	33.0	475 673	4,398	
D	82%	33.9%	27.1	362 305	2,742	
E	77%	33.1%	27.1	572 621	4,410	
F	83%	34.0%	29.6	475 138	3,961	
G	78%	33.7%	28.0	584 365	4,328	
Н	79%	33.7%	21.9	336 301	1,940	
NN (Phase 4/5)	79%	34.0%	26.0	1 061 057	7,347	
OO (Phase 4/5)	76%	33.8%	27.0	791 409	5,453	
QQ (Phase 4/5)	74%	33.8%	25.1	1 153 861	7,018	
Pad 824	81%	32.8%	19.0	182 277	916	
750N	79%	32.9%	22.8	795 880	4,716	
750S	73%	33.7%	18.2	711 080	3,203	
Subtotal				8 445 445	56,490	
Approval Area Total	72%	33%	20.2	43 759 598	220,390	



Average Reservoir Depth = 109 m TVD, Pi = 400 kPa, Ti = 6-7 $^{\rm o}$ C , ${\rm K}_{\rm max}$ = 1.7-8.5 D, ${\rm K}_{\rm min}$ = 1.1-6.5 D



Bitumen Pay Isopach

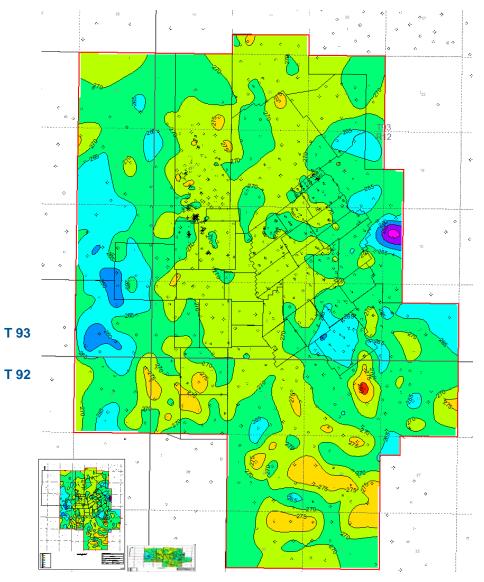


2019 MacKay Bitumen Pay Contour Interval = 5m





Base of Reservoir Structure Map



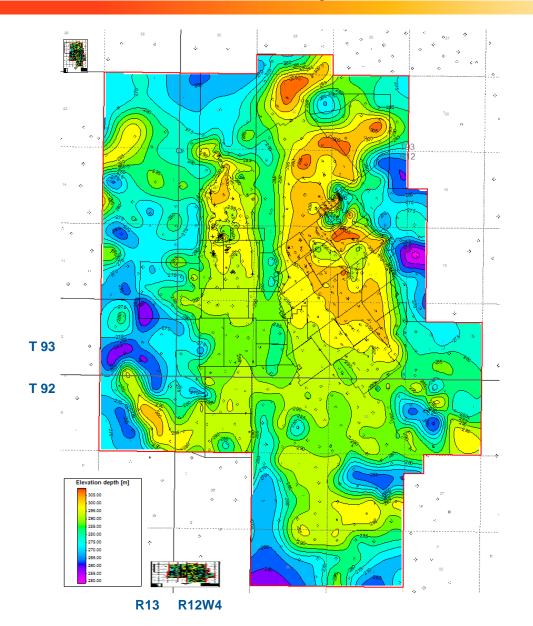
Legend Approved PA Boundary Contour Interval =5m

2019 MacKay Base of Reservoir Contour Interval = 5m



R13 R12W4

Top of Reservoir Structure Map

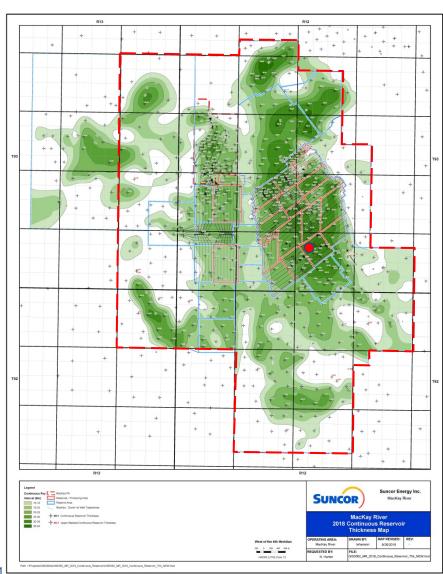


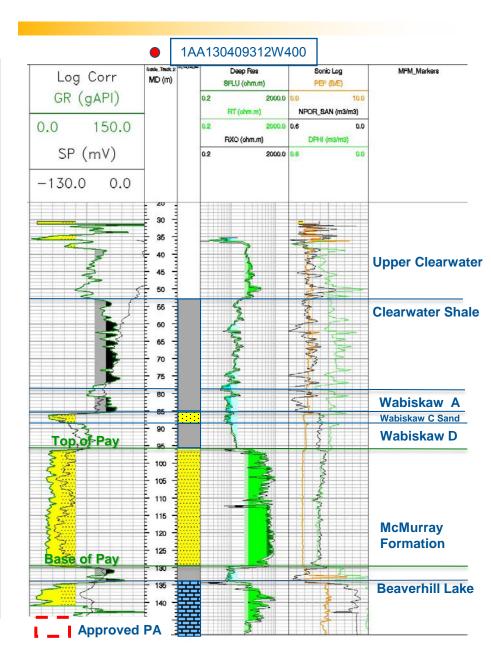
Legend Approved PA Boundary Contour Interval =5m

2019 MacKay Top of Reservoir
Contour Interval = 5m



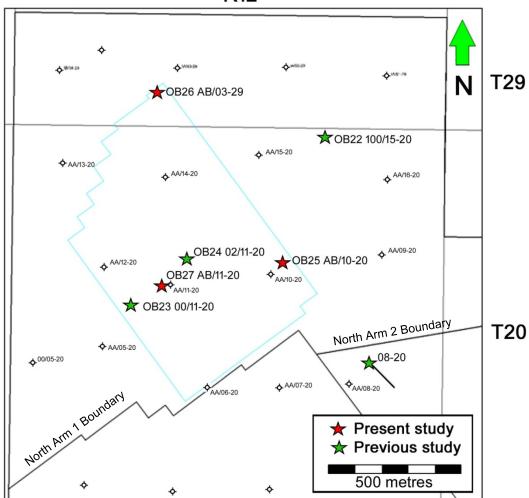
MacKay River Stratigraphy





2018-19 Activities

R12



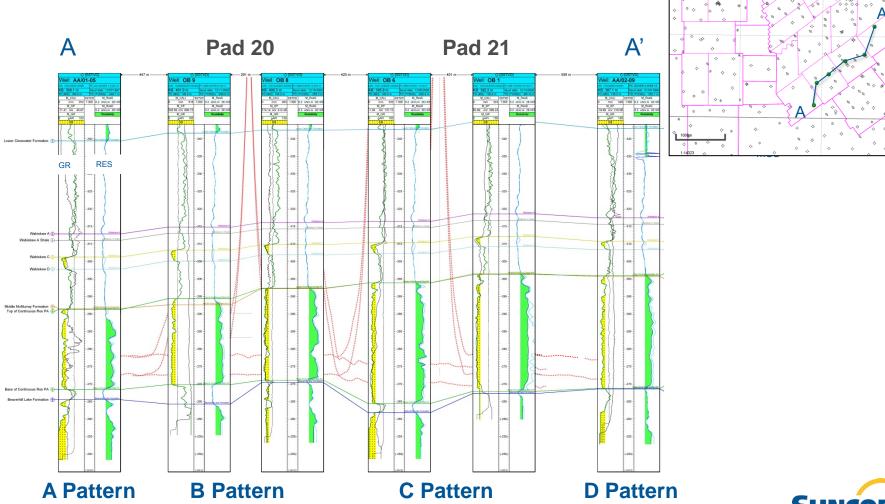
 Caprock fracture study completed in 2019 for North Arm 3 area

- New data was consistent with existing fracture data
- 3 wells in the 2019 study:
 - OB25
 - OB26
 - OB27
- Study incorporated:
 - Image log interpretation
 - Core logging of fractures and faults
 - Orientation interpretation and frequency of natural fractures and faults



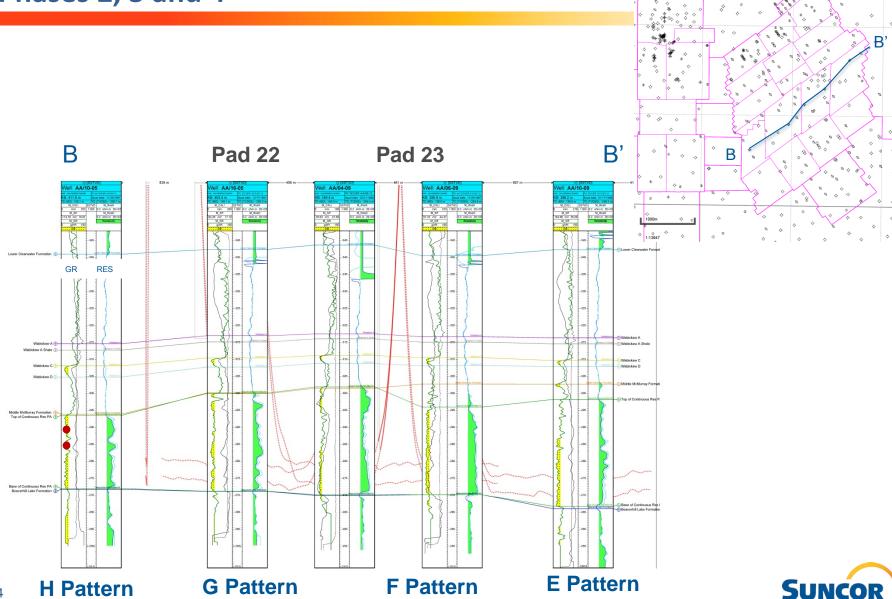
22

Phase 1



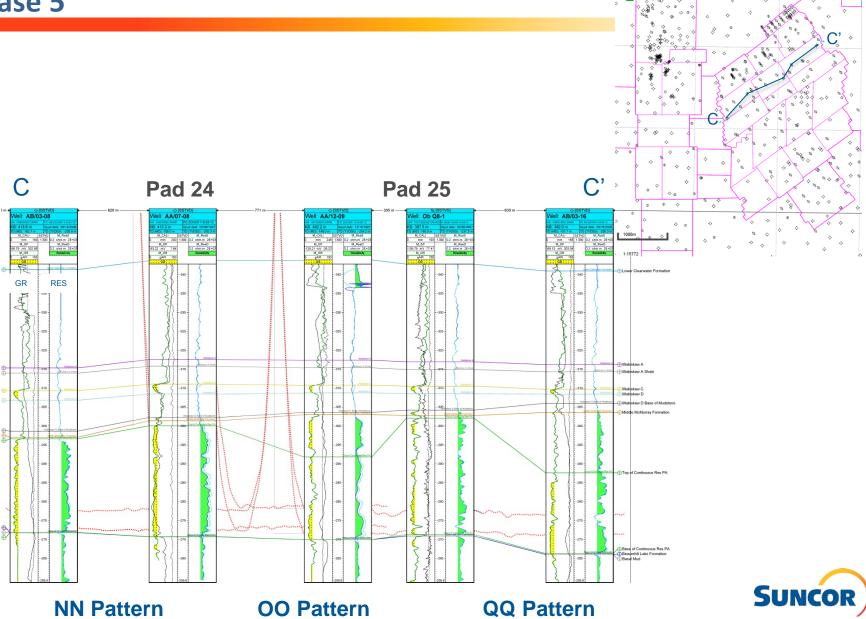


Phases 2, 3 and 4

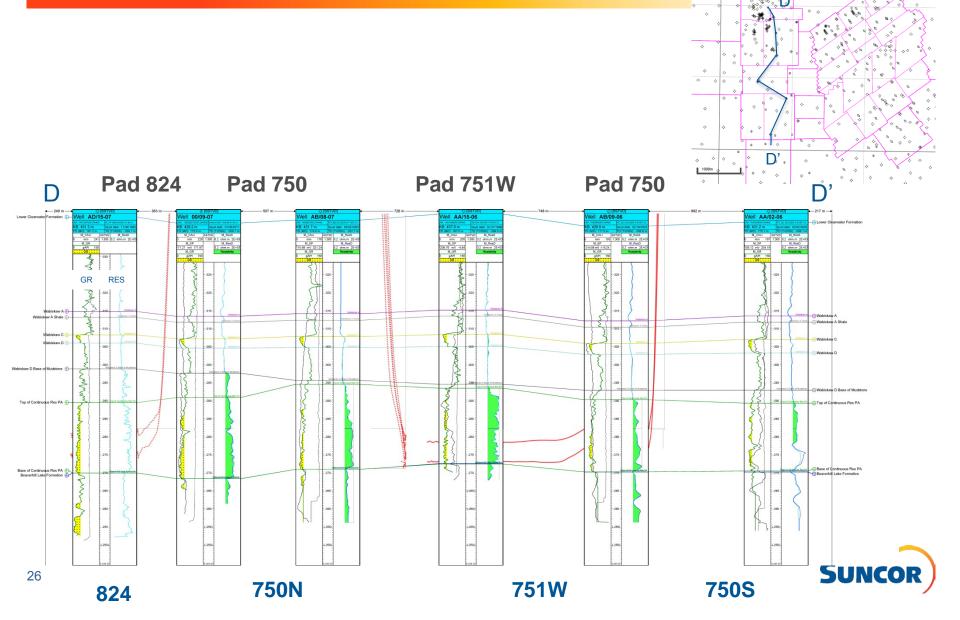




Phase 5



Pads 824 / 750 / 751



Steam Chamber Development: Surface Heave Monitoring



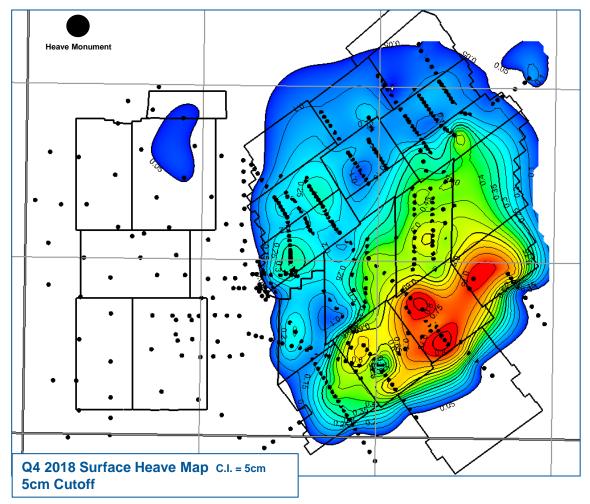
LEGEND

2013 HEAVE MONUMENT											
2012 HEAVE MONUMENT											C
2011 HEAVE MONUMENT											\subset
2009 HEAVE MONUMENT											C
2007 HEAVE MONUMENT											C
2002 HEAVE MONUMENT											C
DESTROYED MONUMENT											C
CONTROL											

- 420 active monuments exist over MacKay River for heave measurement and monitoring.
- No new monuments have been installed since August 2016.
- Survey History:
 - 1st: Fall 2002
 - 2nd: Dec 2006
 - 3rd: Fall/Winter 2007/08
 - 4th: Nov 2008
 - 5th: Jan/Feb 2010
 - 6th: Nov 2010
 - 7th: Dec 2011
 - 8th: Dec 2012
 - 9th: Oct 2013
 - 10th: Oct 2014
 - 11th: Oct 2015
 - 12th: Oct 2016
 - 13th: Oct 2017
 - 14th: Oct/Nov 2018



2D Surface Heave: Change from Baseline to October 2018



Uncertainty with manual heave monuments +/- 5mm

Survey strategy

 Heave surveys are performed at different frequencies to align with SAGD development

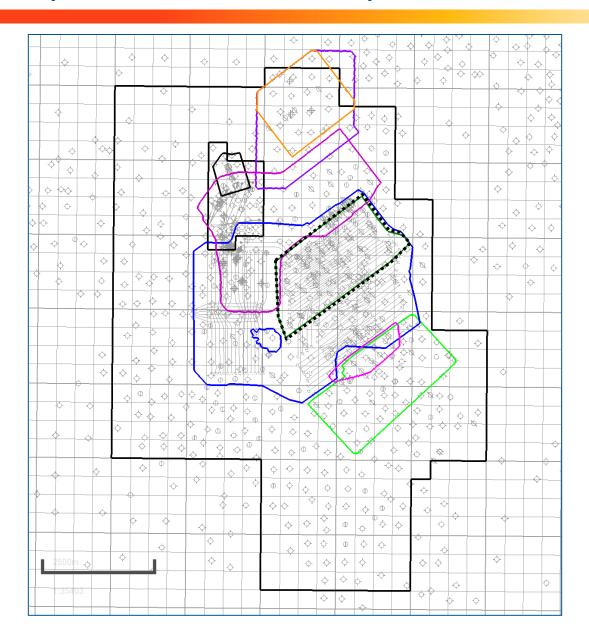
Heave monitoring application:

- Field performance monitoring coupled with seismic
- Surface heave maps made independent from 4D seismic

Other notes:

- The localized heave that is shown in the top right portion of the map is thought to be an anomalous reading from a single monument. This monument is outside the boundaries of the current producing area and the ground in this location is known to be very wet (situated next to beaver ponds and a pipeline corridor)
- This area continues to be closely monitored as a precaution

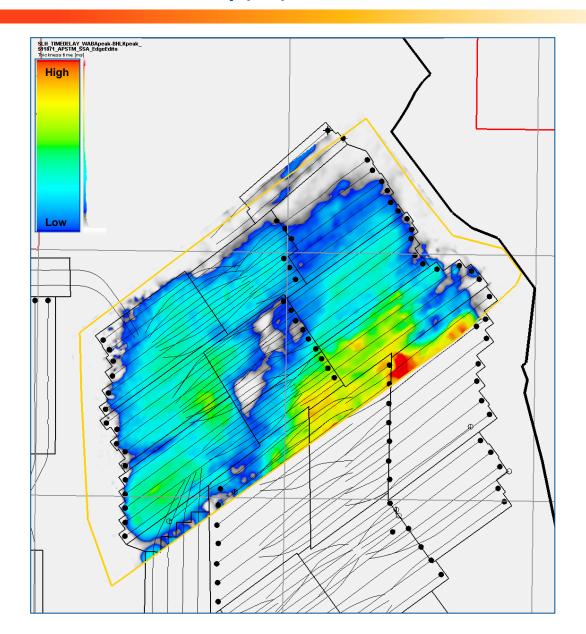








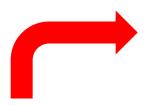
MacKay River – 2019 4D Time Delay (ms)







MacKay River Coupled Geomechanics/Reservoir Workflow



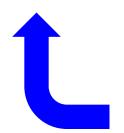
4 - Learnings

- Sensitize key variables within uncertainty range
- Quantify geomechanical risks
- Verify and update MOP
- Recommend/Design further measurements / lab tests



- SAGD well operations (Rate/Pressure)
- Ob well pressure (Piezometer)
- Ob well temperature (Thermocouple/Fiber)
- Surface heave (Monuments)
- Cores and borehole image log analysis
- Rock geo-mechanical properties (Lab tests)
- In situ stress (mini-frac tests)

Geomechanics analysis for safe optimal MacKay River operations



3 - Coupled Reservoir Geomechanics

- Update pressures and temperature
- Update stress state
- Recalibrate models using history match to field data
- Forecast/Design for safe development



2 - Data Interpretation

Reservoir Physics

- Well performance
- Pressure Leak-off
- Heat transfer

Geomechanics

- Stress state
- Rock behavior
 - Shear failure conditions
 - Tensile failure conditions
 - Permeability change
- Thermal expansion
- Reservoir level deformations



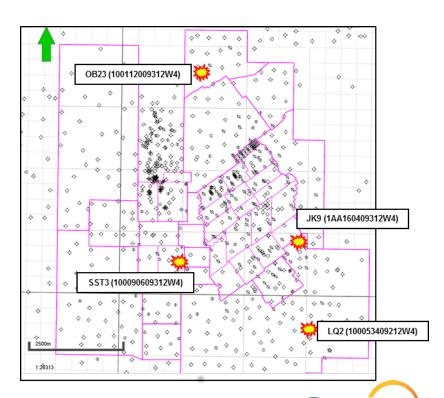


Geomechanics: Mini-frac Test

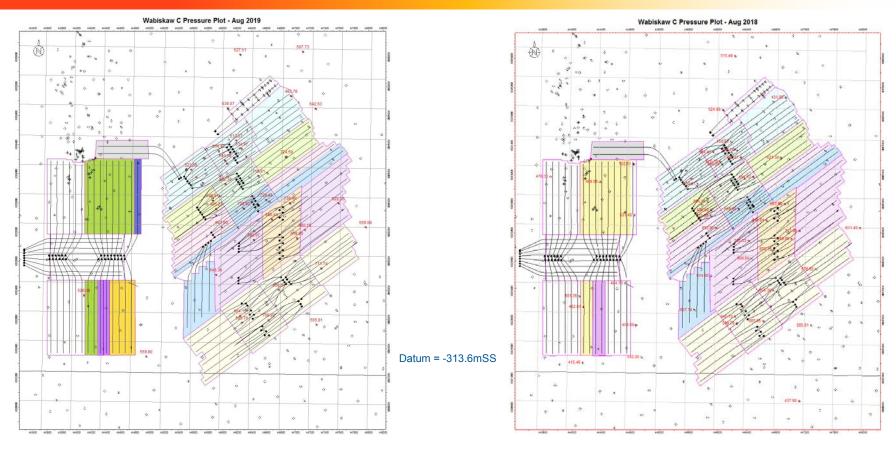
- No new mini-frac test in the reporting period
- Fracture gradient of the caprock within the operating area are at or above 21 kPag/m
- 2017 mini-frac data from OB23 well (in future development area) shows slightly lower fracture gradient, still consistent with the regional data set
- Subsequent geomechanical core test on OB23 by commercial lab indicate similar caprock strength to the existing MacKay River caprock SCAL data

Formation	OB23 (2017)	JK-9 (2014)	LQ2 (2011)	SST3 (2008)				
CW	20.4	22.3	21.3	24.1				
Wab A	19.5	21.1	21.2					
Wab D		22.1	22.6	24.3				
McM	19.0		21.1	19.9				

Unit of fracture gradients measured: kPag/m



Monitoring: Wabiskaw C Pressure & Temperature



- Average pressure increase of ~53 kPa in original producing area; pressure increase of ~27 kPa in Pad 750 area:
 - Pressures are below fracture pressures
- 16 wells with elevated temperatures (>30°C) directly above mature SAGD operations:
 - 4 wells between 90°C and 143°C; 12 wells between 30°C and 90°C
 - Elevated temperatures are within the expected range



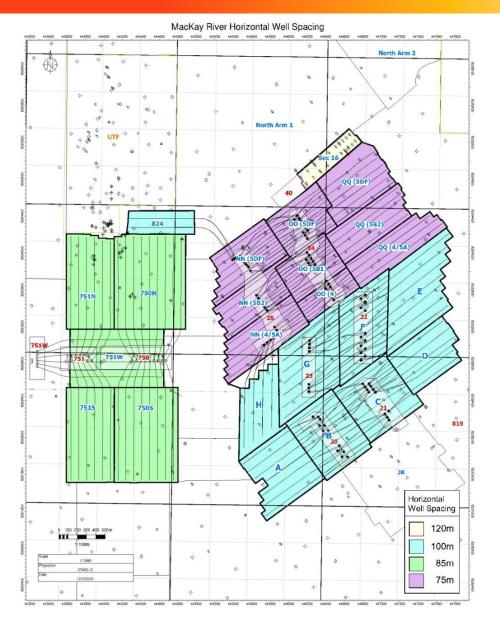
Geomechanics: Modeling

- Continued calibration of the model with an integrated dataset:
 - SAGD performance data
 - Pressure & temperature data acquired from the Wabiskaw C & McMurray
 - Surface heave data
- Continued verification that operation at the approved MOP's has no impact to MacKay River caprock integrity
- Completed a coupled geomechanical and reservoir simulation evaluation for future development in support of the Pad 826 AER D78 application





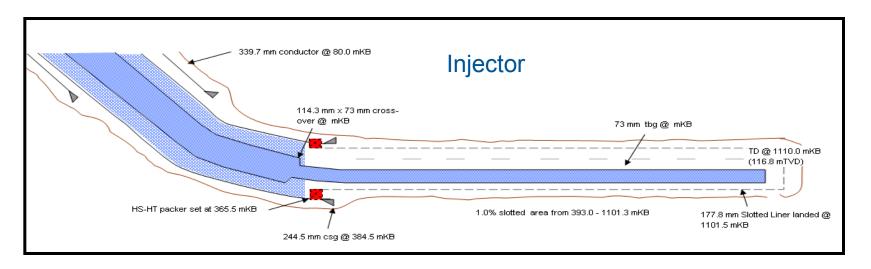
Mackay River Well Layout and Spacing Map

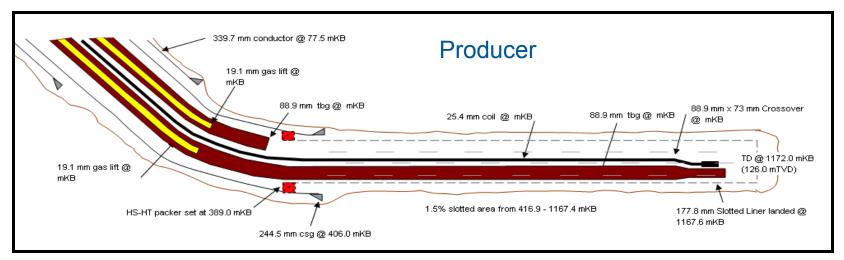


- 114 producing well pairs at MacKay River on 7 pads
- Optimal well spacing is evaluated for each new development



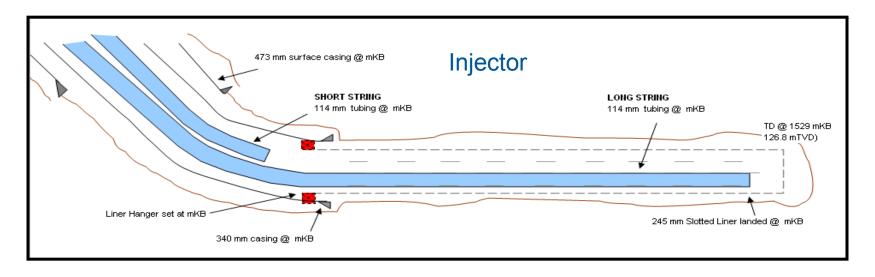
Typical Well Completions – Phase 1-4 Type

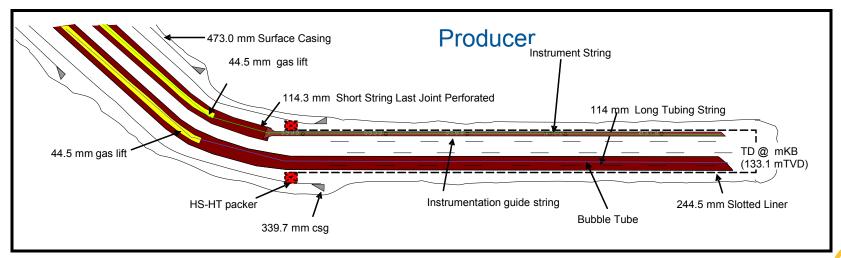






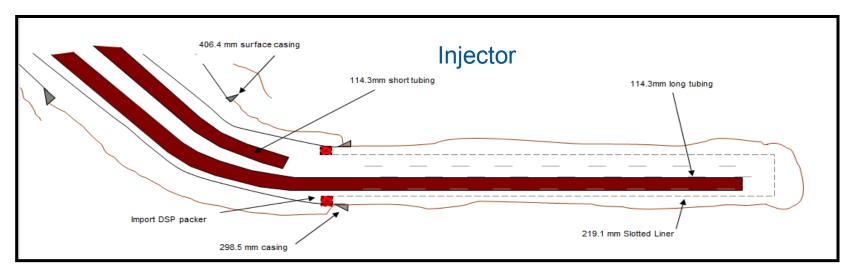
Typical Well Completions – Phase 5 Type

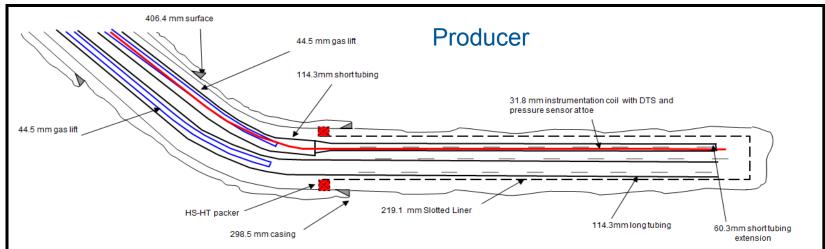




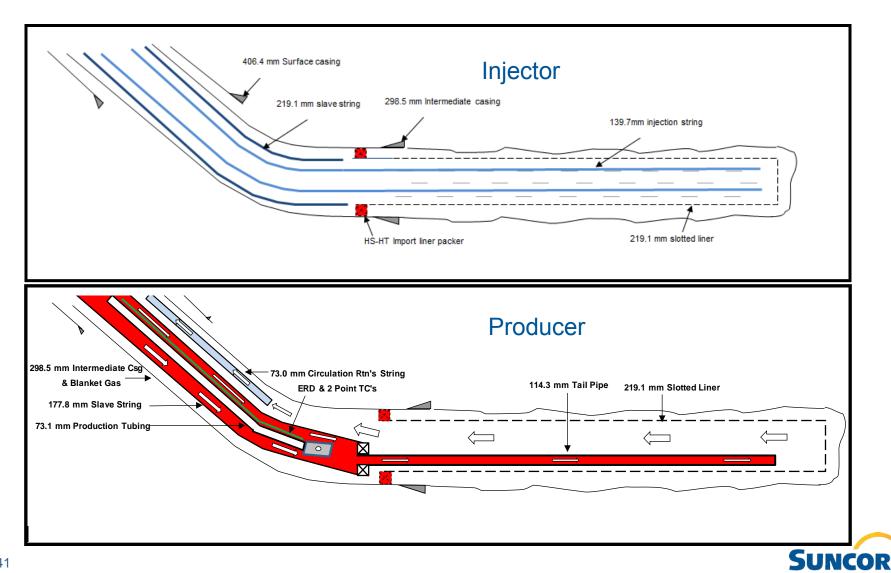
SUNCOR

Typical Well Completions – Pad 750 Type

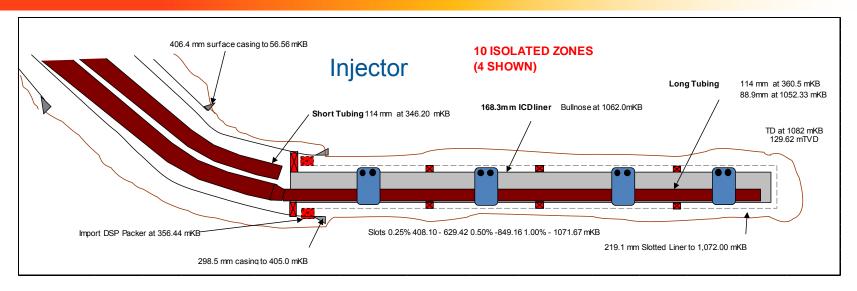


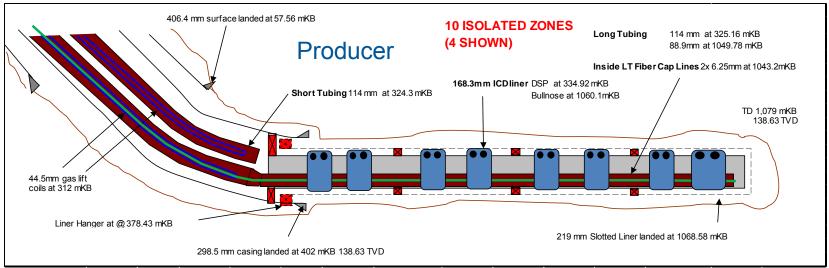


Typical Well Completions – Pad 824 (DSAGD)



Typical Well Completions – Flow Control Devices







Key Learnings: Wellbore Integrity Management

- Wellbore integrity management continues to be a high priority focused on wellbore containment over a wells' full life cycle
 - In Situ Well Integrity Standard comprehensive document developed to guide employees on well integrity considerations and practices through the life cycle of thermal wellbores (design, construction, operation and retirement)
 - Monitoring and surveillance for liner failures and intermediate casing failures;
 - Wellbore thermal shock mitigation for start-up after outages
 - Erosion/corrosion monitoring program
 - Monitoring and repair of surface casing vent flows (SCVFs)
 - Regular monitoring of pressure, rate and/or bubbles & H₂S concentration (annually for non-serious SCVFs, monthly – quarterly for serious SCVFs)
 - Gas venting rates continue to decline indicating remediation work may have been successful
 - Innovative repair techniques (i.e. SMART tool)
 - Extended gas and isotope analysis conducted to understand origin of gases from SCVF



Key Learnings: Wellbore Integrity Management

Summary of MacKay River Well Integrity Issues and Initiatives

Surface casing vent flows

- Three serious vent flows discovered; mitigations/monitoring in place
- Annual testing program of non-serious vent flows
- Evidence of vent flow cessation following periods of shut-in steam injection; heated overburden

Thermal Compatibility / Integrity

- Vintage well completions reviewed to ensure compatibility for thermal operations
- Thermal abandonments conducted on incompatible wells prior to first steam in new development regions
 - Monitoring chamber growth and adjusting annual abandonment program

External Surface Corrosion

- Production casing exposure to oxygenated water below grade
- Coating application; Thermal Arcing Spray on all new wells, old wells being reviewed
 - Three older wells have had TAS coating applied due to indication of mild wall loss

Intermediate Casing Integrity

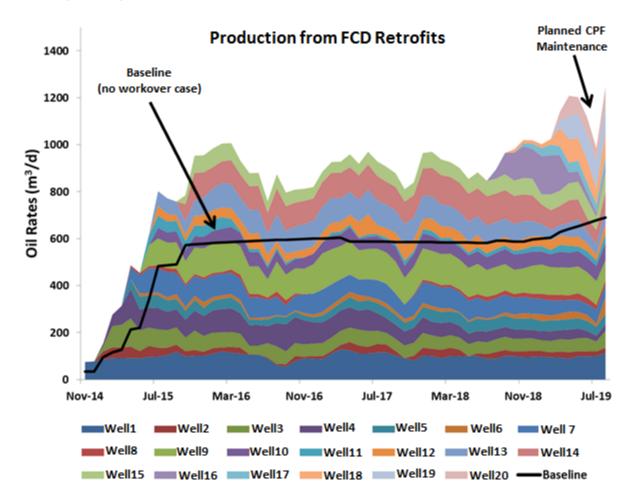
- Intermediate casing issues in localized area, related to heave and connections placed at or near lithology changes
- Future wells will use improved connections which provide a better radial seal and will avoid placing casing connections near lithological changes
- E2P intermediate casing leak detected in May 2019. Repair plan to be finalized in 2020



Flow Control Device Implementations

Wide use of flow control devices (FCDs)

- ~15% of production at Mackay River is from wells with FCDs
- Used to prevent hot spots
- First Suncor proprietary "M-tool" device installed in August 2018
- Installed FCDs on three Pad 750 producers in 2018 prior to commencing circulation
- Installed FCDs on Pad 751 in 2019 (well pairs to be started in 2020)

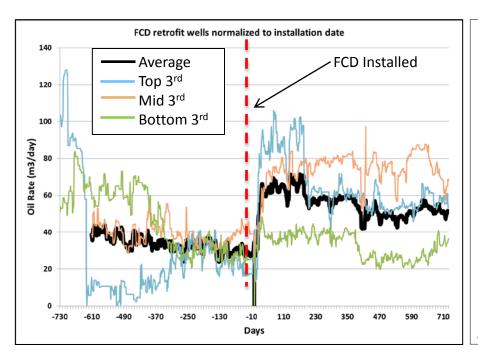


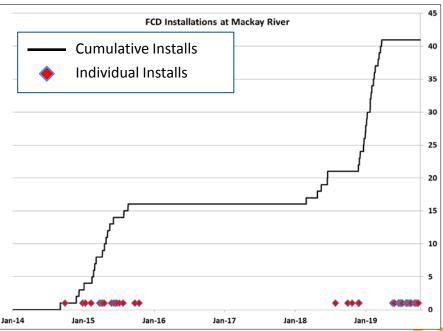


Flow Control Device Implementations

Mackay River continues to install FCDs

- Total of 42 FCDs installed
- All M-tool installations since 2017
- Sustaining production between pad start-ups
- Improved ramp-up stage
- Production improvements

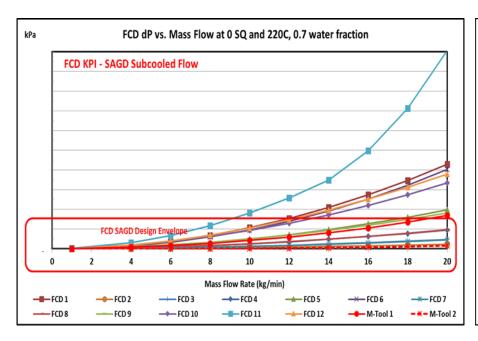


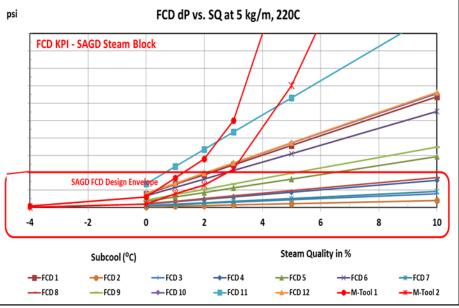




Flow Control Device (FCD) Technology Improvements

- M-tool deployment in 2018/2019 following lab testing in a flow loop
 - M-tool provides low resistance to liquid flow, high resistance to steam flow
 - Evaluating performance of recent pilots against anticipated results from lab
 - August 2018 first installation
- Four additional installations since August 2018

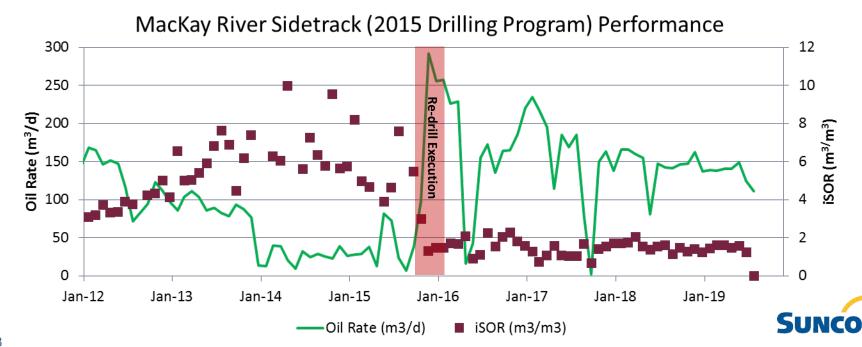






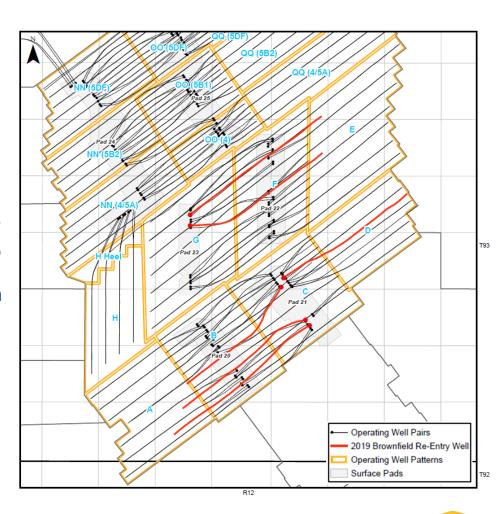
Key Learnings: Infill and Sidetracked wells

- Continued strong performance of infills vs. original/offset wells
 - Incremental oil rates
 - Lower water cuts
 - Lower SOR
- Based on the success of 2015 implementation, 6 new infill/sidetrack wells were drilled in 2019
 - Initial results are promising, with increased oil rates and lower SOR



2019 Brownfield Program Start-Up Update

- Six re-entry wells were drilled in 2019 from existing producers and their associated surface infrastructure:
 - B4PB infill between B4 and B5
 - B5PB infill between B5 and B6
 - B6PB infill between B6 and B7
 - D2PB infill between D2 and D3
 - F4PB sidetrack ~10m to the South of F4
 - F6PB sidetrack ~10m to the North of F6
- Drilling and completions work took place from May - July 2019
- Production commenced in July/August 2019. Wells are still ramping up and initial production volumes have been limited due to curtailment
- Performance updates to be included in the presentation for the next reporting period when more data is available







Artificial Lift

- Most existing SAGD production wells designed for gas lift:
 - Low cost completion
 - Recover gas
 - No downhole moving parts
- Lift capacity sufficient for production rates and reservoir pressures
 - No instances of fluid inventories building due to lift issues
 - Lower pressure patterns generally require higher gas lift rates
- Producing wells with downhole pumps
 - F1P, ESP since February 2009, current pump installed July 2017
 - Previous pump ran for ~2300 days
 - OO3P, ESP since October 2009, current pump installed March 2012
 - ~2300 days
 - 824P1, DSAGD completion, current pump installed October 2018
 - Original pump ran for ~970 days
 - 824P2, DSAGD completion, current pump installed August 2018
 - Original pump ran for ~870 days





Well Downhole Instrumentation

- Phase 1 (25 well pairs)
 - Temperature optic fibre in 1 producer is functional today (C2)
- Phase 2 (14 well pairs)
 - Temperature fibre optic installed in G6P
 - P/T gauge installed in G6I
- Phase 3 (7 well pairs)
 - No instrumentation
- Phase 4 (10 well pairs)
 - No instrumentation except temperature fibre optics in OO3 I & P
 - Temperature fibre optic installed in NN1P
- Phase 5A (6 well pairs)
 - Pressure bubble tube to the toe in every producer
 - QQ5P equipped with 6 point thermocouple bundle to the toe
 - NN5P equipped with 8 point thermocouple bundle to the toe

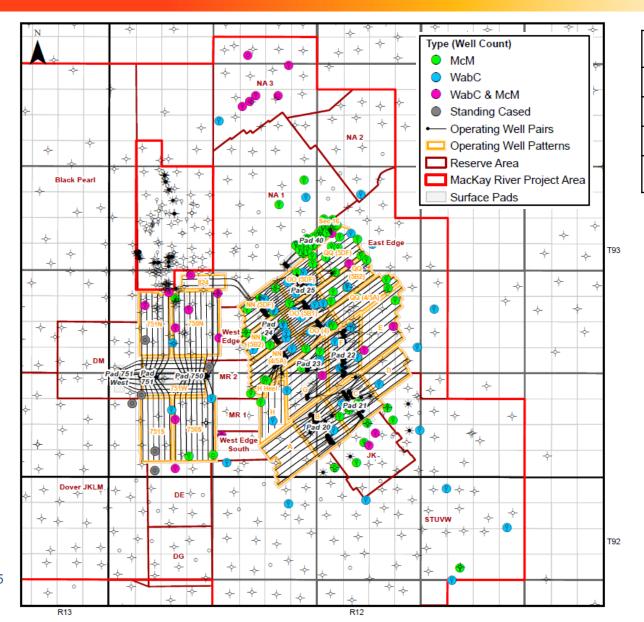


Well Downhole Instrumentation

- Phase 5B-1 (6 well pairs)
 - Pressure bubble tube to the toe in every producer except OO5
 - All producers equipped with 6 point thermocouple bundle to the toe except OO5 and OO9 which have temperature fibre optic
- Phase 5B-2 (10 well pairs)
 - Pressure bubble tube to the toe in every producer
 - All producers equipped with 6 point thermocouple bundle to the toe, except QQ9
- Phase 5D&F (18 well pairs)
 - Pressure bubble tube to the toe in every producer except OO well pairs which have pressure gauges
 - All producers equipped with fibre optic to the toe, except OO10
- Pad 824 (2 well pairs)
 - All producers equipped with ERD (P/T) and 2 point thermocouple on pump
- Pad 750 (16 well pairs)
 - Pressure ERD at the toe in every producer
 - All producers equipped with fibre optic to the toe



Observation Wells



Observation Wells				
85	McMurray			
53	Wabiskaw C			
22	Wab C & McM			
160	Total			



Observation Well Overview

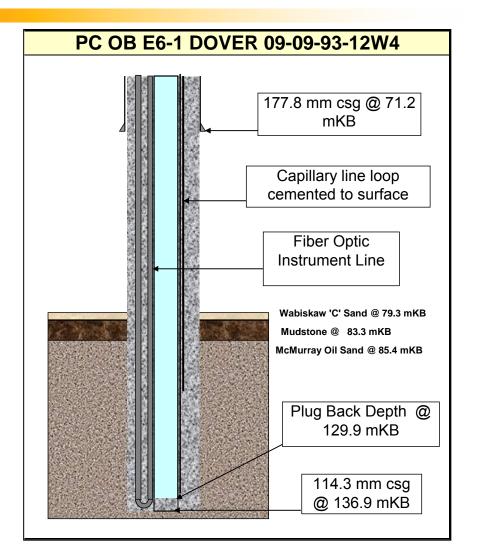
- Total of 160 instrumented observation wells at MacKay River
 - No new wells drilled in reporting period
- Observation wells at MacKay River serve three main purposes
 - Reservoir optimization (steam chamber monitoring)
 - 42 wells with fibre optic cable from surface to TD
 - 7 wells with fibre optic cable and McM pressure sensors
 - 56 wells with thermocouple bundles
 - 47 wells with thermocouples and McM pressure sensors
 - Wabiskaw C pressure monitoring
 - 67 wells with a single pressure / temperature sensor dedicated to Wab C
 - 18 wells with WabC pressure / temperature combined with McM temperature
 - 3. Subsurface Monitoring (outside of producing area)
 - 7 wells with thermocouple bundles and pressure sensors
 - 16 wells with a single pressure / temperature sensor (5 McM, 11 Wab C)
 - 4 wells with pressure / temperature in both McM and Wab C
- Current observation well design incorporates thermocouple measurement as this provides sufficient resolution for steam chamber monitoring and is preferred for remote well locations
- Reliability issues closely monitored and mitigated/repaired as required



Typical Observation Well Design

McMurray Observation Well (Type 1):

- Capillary line loop cemented outside casing
- Fibre optic cable pumped into capillary line loop to provide temperature profile along entire vertical well depth
- Allows for close monitoring of steam chamber development
- There are no reliability concerns with the Type 1 observation well temperature data

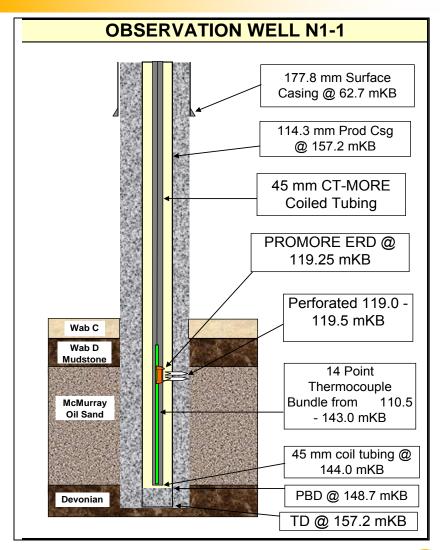




Typical Observation Well Design

McMurray Observation Well (Type 2):

- Coiled tubing instrument string containing 14 thermocouples and 1 P/T gauge run inside 114 mm intermediate casing
- Perforated near the top of the McMurray oil sands zone
- Pressure / temp gauge positioned at MPP
- 14 point thermocouple bundle collects temperature data across the McMurray
- 24 point thermocouple bundle go forward design

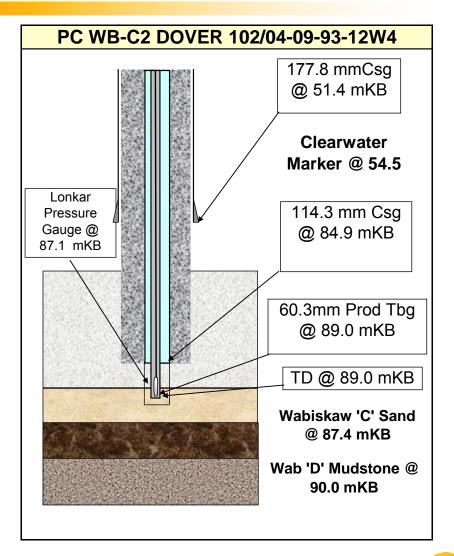




Typical Observation Well Design

Wabiskaw C Observation Well:

- Open hole into Wabiskaw C sand
- Wellbore does not penetrate Wabiskaw D mudstone or McMurray sand
- Pressure / temp gauge landed inside tubing



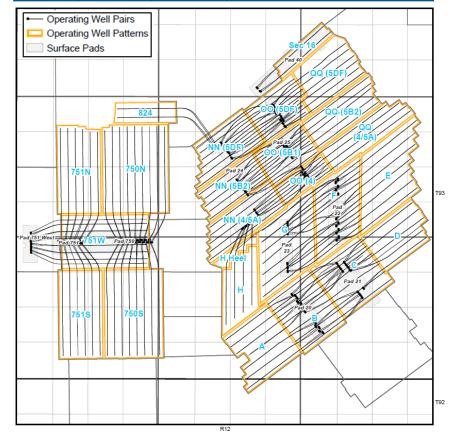




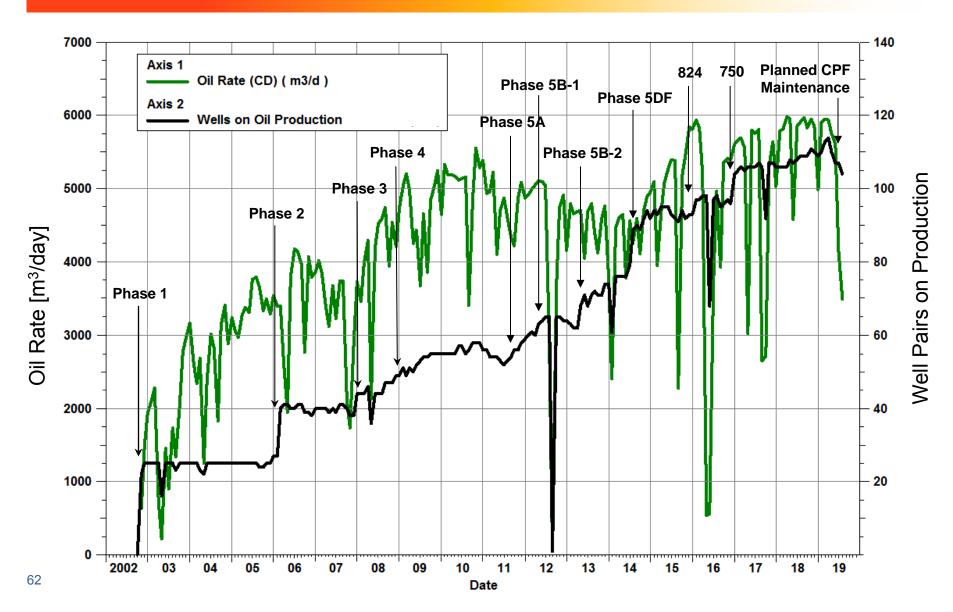
Summary of Operating Wells

Pad	Pattern	Phase	# Well Pairs	First Steam to Pad	
20	А		7		
	С	1	6	Comt 2002	
21	В		7	Sept 2002	
21	D		5		
22	Е	2	7	Jan 2006	
22	G	2	7	Jan 2006	
23	F	3	7	Sept 2007	
	00	4	3	Oct 2008 - Apr 2009	
		5B-1	6	Feb 2012	
24		5DF	6	May 2014	
	Н	4	4	Feb 2009 - Jun 2010	
	QQ	4	2	Nov 2008	
		5A	2	Jul 2011	
		5B-2	5	Jan - May 2013	
25		5DF	6	June 2014	
25	NN	4	1	Dec 2008	
		5A	4	Jun - Jul 2011	
		5B-2	5	Jan - Feb 2013	
		5DF	6	June 2014	

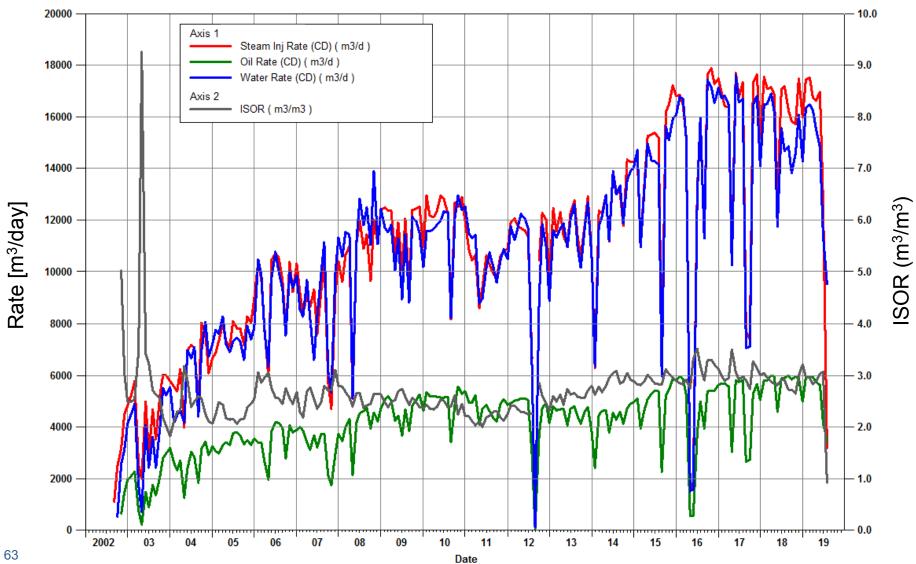
Pad	Pattern	# Well Pairs	First Steam to Pad	
24	24 824 2		Oct 2015	
750	750 750N 8		Sept 2016	
750	750 750S 8		Sept 2016 - Feb 2019	



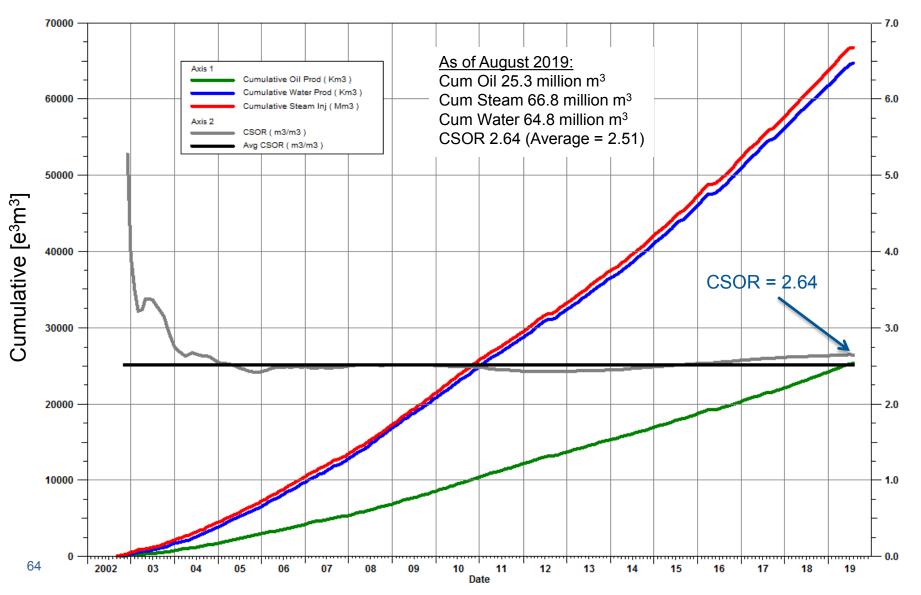
Producing Well Count



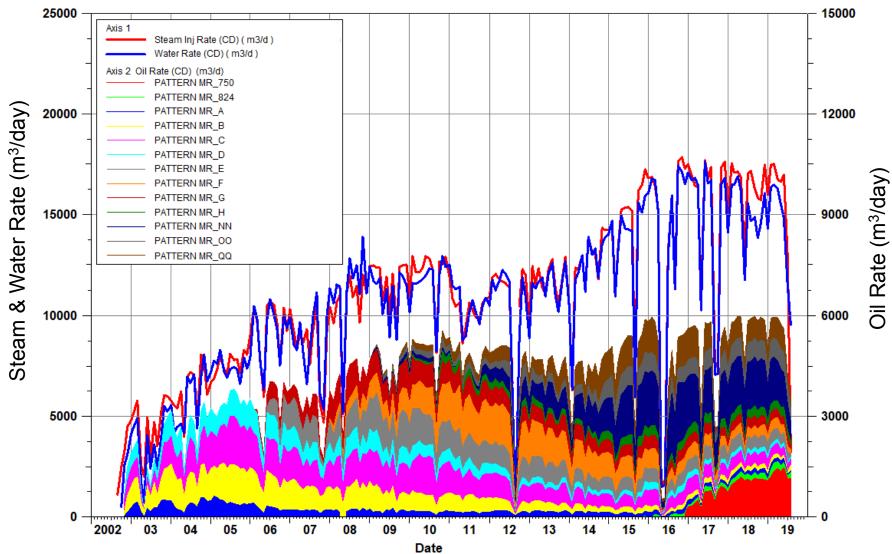
Fluid Rates



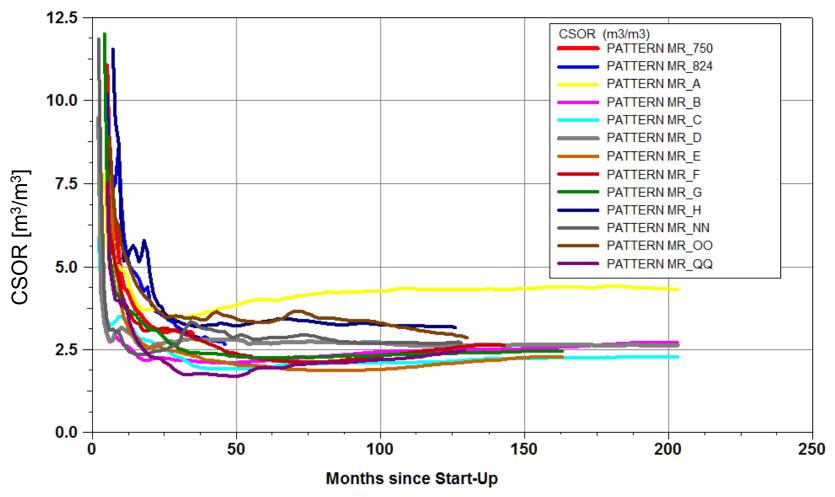
Cumulative Fluid Volumes



Average Oil Rate per Pattern



CSOR by Pattern (August 2019)



- C Pattern has the lowest CSOR
- NN wells have a mid range CSOR
- A Pattern has the highest CSOR



Performance Summary by Pattern

Pattern	OBIP [e³ m³]	Cum. Oil (Aug 2019) [e³ m³]	Recovery (Aug 2019) [%]	CSOR (Aug 2019) [m³/m³]	ISOR (*Jul 2019) [m³/m³]	Ultimate Recovery [%]
Pattern A	2,443	1,150	47%	4.31	4.0	55%
Pattern B	3,616	2,816	78%	2.70	4.3	81%
Pattern C	4,398	3,853	88%	2.27	3.0	88%
Pattern D	2,742	2,066	75%	2.61	3.2	82%
Pattern E	4,410	2,660	60%	2.27	1.9	77%
Pattern F	3,961	2,655	67%	2.63	3.0	79%
Pattern G	4,328	2,171	50%	2.44	1.8	60%
Pattern H	1,940	699	36%	3.16	3.6	67%
Pattern NN	7,347	2,917	40%	2.70	3.3	62%
Pattern OO	5,453	1,342	25%	2.85	1.8	42%
Pattern QQ	7,018	1,913	27%	2.46	5.7	48%
Pad 824	916	149	16%	2.65	4.1	51%
Pad 750	7,919	916	12%	2.99	3.1	51%
Total	56,491	25,305	45%	2.65	3.1	63%

^{*}July data was used in place of August data due to erroneous ISOR values resulting from planned CPF Maintenance

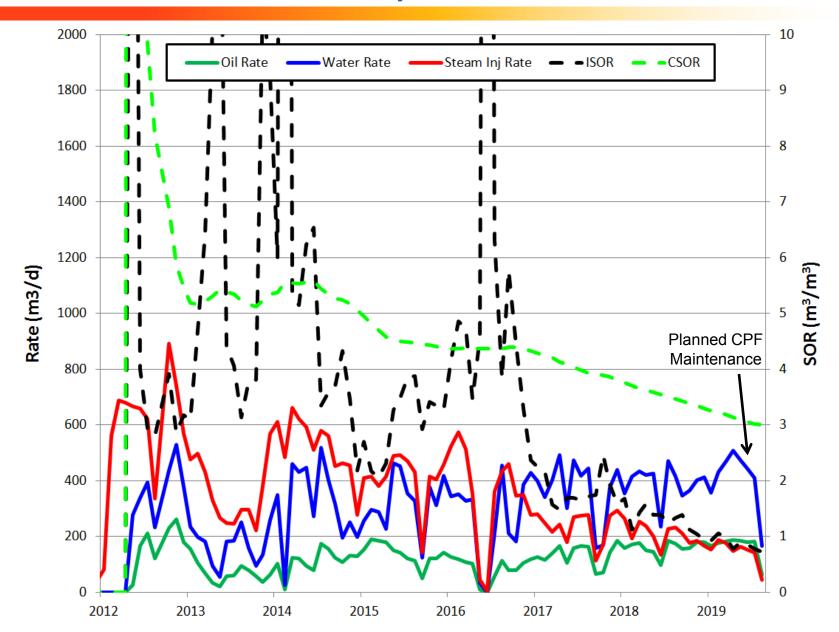


Phase 5B – Examples Based on Recovery

Well Pairs	ISOR [m³/m³]	CSOR [m³/m³]	Cum Oil [10 ³ m ³]	Peak Oil Rate [m³/d/well pair]	Current (June 2019) Oil Rate [m³/d/well pair]	Comments
OO4-9 (Phase 5B-1) Low Recovery	1.0	3.0	331	31 - 104	0 - 19	 Challenging geology 5/6 wells are currently in circulation mode due to operational issues 6 wells pairs in selected area of pattern 14% recovery to date (ultimate RF: 33%)
QQ6-10 (Phase 5B-2) Medium Recovery	3.8	3.4	720	88 - 113	42 - 108	 Challenging geology Shallow, lowest MOP in MacKay, improvement has been observed since commencement of MOP trial (Amendment 8668VV) 5 well pairs in selected area of pattern 21% recovery to date (ultimate RF: 44%)
NN6-10 (Phase 5B-2) High Recovery	3.4	3.2	825	114 - 184	37 - 97	 High quality geology 5 well pairs in selected area of pattern 40% recovery to date (ultimate RF: 63%)

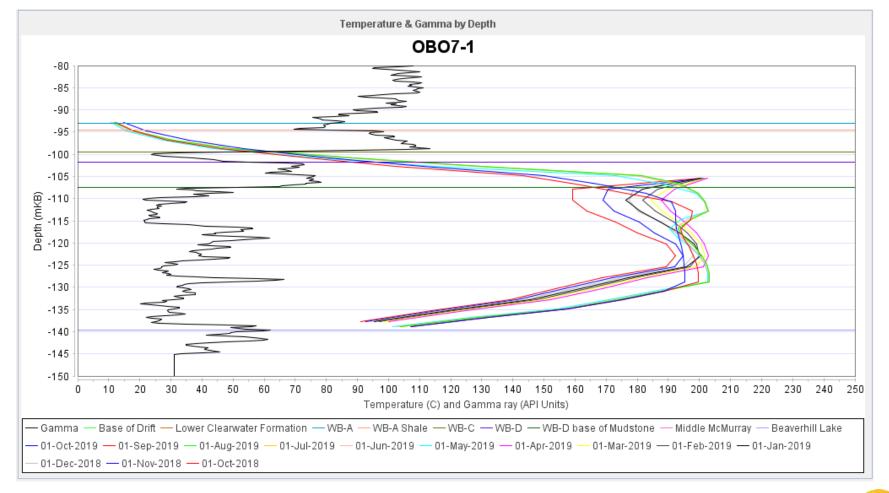


OO4-9 Well Pairs – Low Recovery



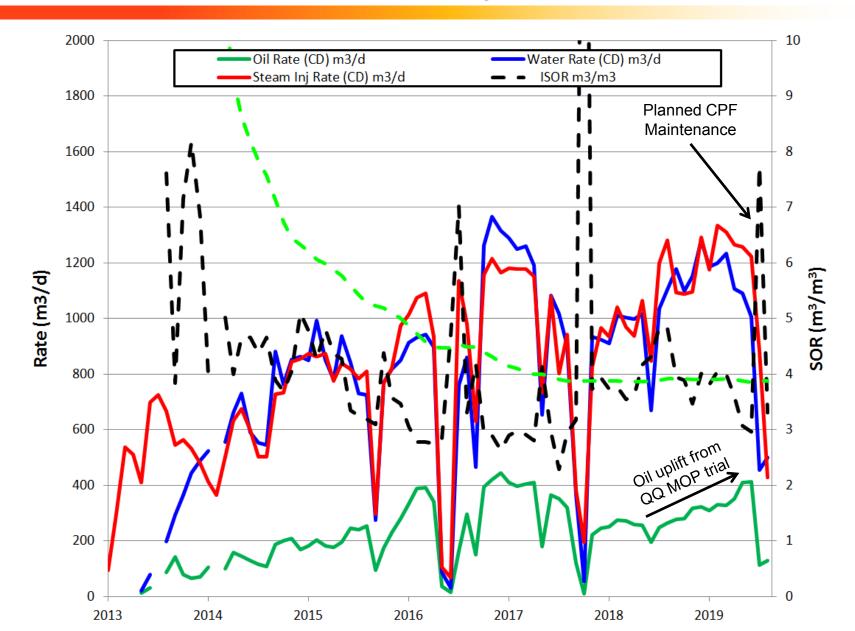
OO4-9 Well Pairs – Observation Well Temperature

OBO7-1: Heel of OO7 Well Pair (Low Recovery)



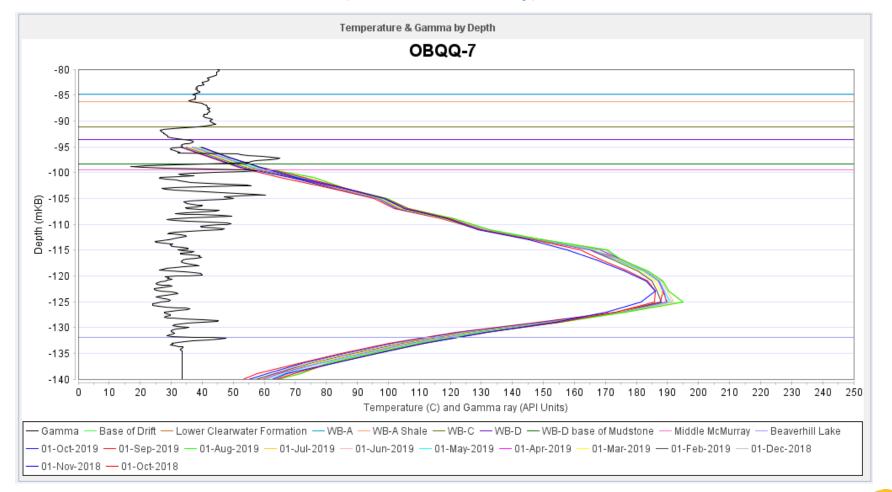


QQ6-10 Well Pairs – Medium Recovery



QQ6-10 Well Pairs – Observation Well Temperature

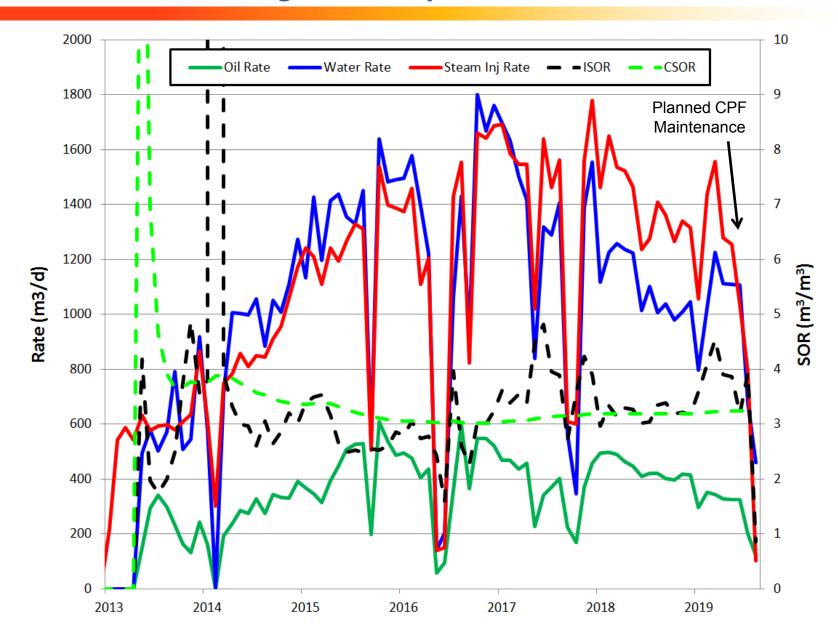
OBQQ-7: Heel of QQ7 Well Pair (Medium Recovery)





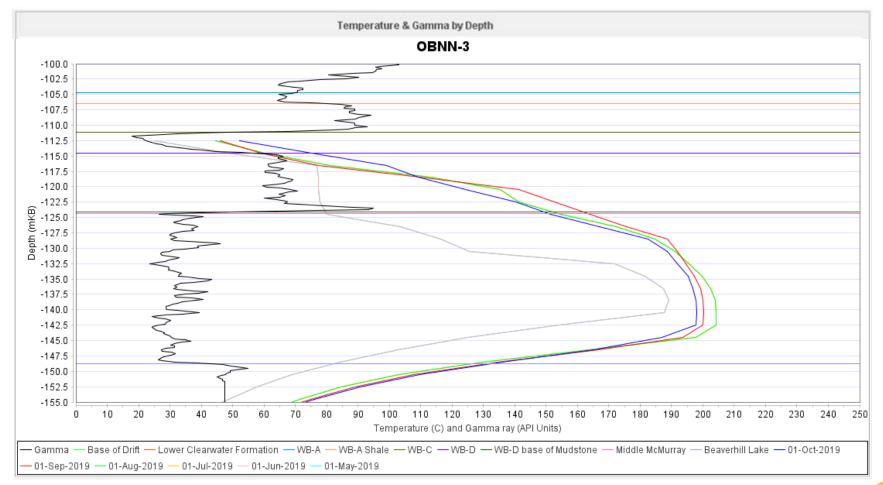
NN6-10 Well Pairs – High Recovery

73



NN6-10 Well Pairs – Observation Well Temperature

OBNN-3: Mid-section of NN8 Well Pair (High Recovery)





Pad Abandonment Outlook

- The strategy for future well and pad (including surface equipment) abandonments is under development
- Do not anticipate abandonment of operating Pads during the next 5 years
 - Pads 20 and 21 (A/C and B/D patterns) are the most mature and are expected to be under pressure maintenance
 - Individual wells may be suspended or abandoned as required
- Pad 40 expected to be abandoned within the next 5 years
 - Three of four wells on pad abandoned (NP, NI and SP)
 - Considerations for surface equipment are under review



Steam Injection Conditions

	Wells	Maximum Operating Pressure		
Pattern		Surface	Bottomhole	
		(kPag)	(kPag)	
Α	A1-7	2120	1690	
В	B1-7	2020	1600	
С	C1-6	1745	1390	
D	D1-5	1555	1240	
E (S)	E1-4	1640	1310	
E (N)	E5-7	1600	1270	
F	F1-7	1680	1340	
G	G1-7	1935	1530	
Н	H1-4	2225	1780	
NN	NN1-5	2100	1680	
NN	NN6-10	2185	1750	
NN	NN11-16	2125	1700	
00	001-3	1870	1490	
00	004-9	1910	1520	
00	OO10-15	1880	1500	
QQ	QQ2-5	1535	1370	
QQ	QQ6-10	1500	1350	
QQ	QQ11-16	1500	1350	
824	824WP1-2	2320	2060	
750 (N)	WP1-8	N/A	2110	
750 (S)	WP10-17	N/A	2140	

- Approved MOPs based on the methodology detailed in Application 1724610
- Approved Bottomhole MOP at 80% of the fracture closure pressure
- MOPs are set by shallowest point in each pattern to allow for intra-pattern communication
- Steam injection pressure limits are enforced via pressure transmitters
- Steam injection pressure is reduced as required to maintain estimated bottomhole pressure below MOP for neighboring patterns in communication
- Approved trial to increase MOP on QQ2-5 to 1370 kPag (previously 1210 kPag) and QQ6-16 to 1350 kPag (previously 1200 kPag) until Nov. 30, 2019



Stewardship to Maximum Bottom-hole Operating Pressure

Pattern	Wells	Maximum Operating Pressure	Average pressure Sep 2018 – Aug 2019
		Bottomhole	Bottomhole
		(kPag)	(kPag)
Α	A1-7	1690	1233
В	B1-7	1600	1200
С	C1-6	1390	1200
D	D1-5	1240	1196
E (S)	E1-4	1310	1204
E (N)	E5-7	1270	1194
F	F1-7	1340	1198
G	G1-7	1530	1269
Н	H1-4	1780	1469
NN	NN1-5	1680	1554
NN	NN6-10	1750	1609
NN	NN11-16	1700	1555
00	001-3	1490	1234
00	004-9	1520	1474
00	OO10-15	1500	1395
QQ	QQ2-5	1370	1189
QQ	QQ6-10	1350	1245
QQ	QQ11-16	1350	1232
824	824WP1-2	2060	1963
750 N	WP1-8	2110	2022
750 S	WP10-17	2140	1982*

- All of the Mackay wells in SAGD are currently operating at pressures below the approved maximum bottomhole operating pressure
- Alarm systems are in place to ensure the approved maximum bottomhole operating pressures are not exceeded
- Steam injection pressure is reduced as required to maintain estimated bottomhole pressure below maximum bottomhole operating pressure

Impact

- Lower production rates in low MOP areas
- Slower ramp-up post planned outage's
- Impacts new well conversions in low MOP areas
- Small impact to mature well performance

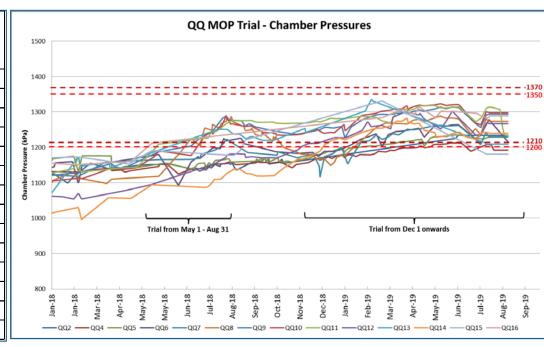


^{*750}P11 & 750P13 LRT data available beginning in August 2019

Pad QQ Temporary Bottom-hole Pressure Trial

- Approved to increase bottom-hole (BH) MOP from
 - 1,210 to 1,370 kPag on QQ2 to QQ5 and
 - 1,200 to 1,350 kPag on QQ6 to QQ16
 - until November 30, 2019; as per Approval No. 8668VV associated with Application No. 1905502
- With flexibility of MOP Trial, all well pairs improved operability

	Chamber	Chamber	Chamber
Well	Pressure (kPa)	Pressure (kPa)	Pressure (kPa)
	Pre-trial	August 31, 2018	June 30, 2019
QQ2	1145	1158	1234
QQ4	1130	1157	1211
QQ5	1140	1158	1235
QQ6	1155	1218	1257
QQ7	1160	1223	1256
QQ8	1110	1273	1271
QQ9	1145	1277	1306
QQ10	1140	1267	1313
QQ11	1145	1275	1309
QQ12	1070	1181	1276
QQ13	1160	1238	1238
QQ14	1055	1138	1239
QQ15	1150	1177	1217
QQ16	1160	1212	1300

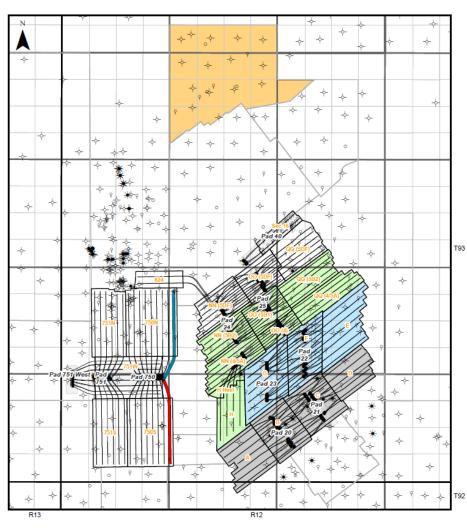


Stewardship to Maximum Bottomhole Operating Pressure

- For SAGD wells Low Rate Tests (LRT) are performed by reducing the steam injection rates and used to calculate estimated chamber pressure to ensure that the Maximum Bottomhole Injection Pressure (MBHIP) is not exceeded
- For SAGD wells with downhole instrumentation, such as a pressure gauge in the toe of the producer, real time pressure data is gathered via the fiber and email alerts are setup in order to alert operations of an Maximum Bottomhole Operating Pressure (MBHOP) exceedance



New Technology Projects – Near Term



NCG Co-Injection Expansion

- A/B/C/D first injection Oct 2016
- E/F/G first injection Nov 2018
- H/OO1-9/QQ2-10/NN1-10 first injection Q2 2020

Closed Loop Hot Oil Circulation Pilot (750S10)

- Pilot Operations May 2018 Jan 2019
- Pilot demonstrated that the closed loop circulation process is a conduction dominated process
- Poor conformance; can be improved through downhole completion design modifications (i.e. larger tubulars), higher circulation rate in the closed loop, reverse circulation and higher hot oil temperature

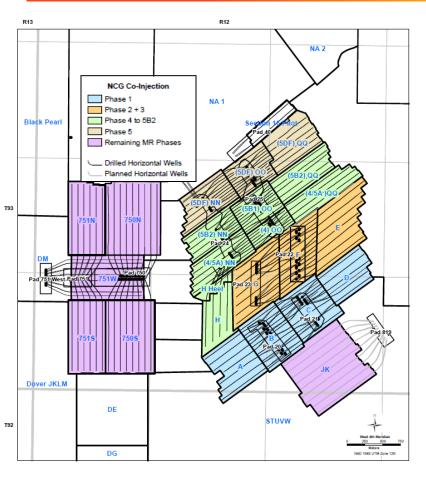
Electric Resistive Heater Pilot (750S9)

Pilot operations – Jan 2020

In Situ Demonstration Facility (ISDF)

- Demonstration facility currently at scoping stage
- Integrated Application approved in 2018

SAGD NCG Co-Injection Strategy



Pilot

- NCG co-injection into B pattern Oct 2011
- Injection was based on steam availability

Phase 1

NCG co-injection to A, B, C and D patterns – Oct 2016

Phase 2 + 3

NCG co-injection to E, F and G patterns – Nov 2018

Received Regulatory Approval For:

Phase 4 to 5B2



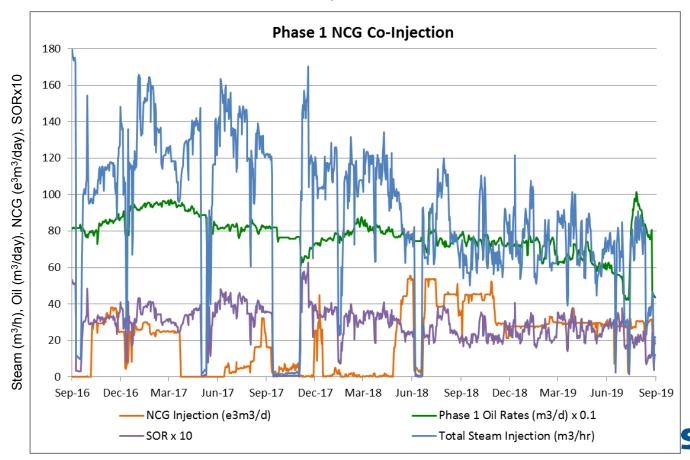
Phase 5

 NCG co-injection to Pad 824, NN11 to NN16, OO10 to OO15 and QQ11 to QQ16 – Q2 2021



Key Learnings – Phase 1 NCG Co-Injection

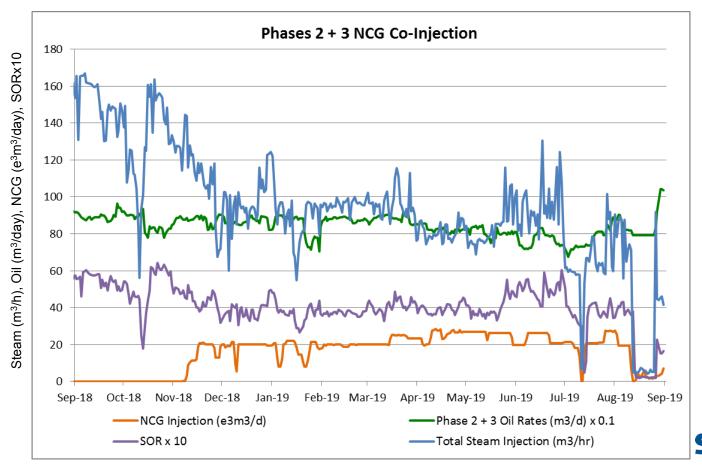
- Steam decreased rates while co-injecting less NCG than anticipated to sustain target chamber pressures
- No significant impacts to oil rates have been observed and partial pressure cooling effects have not been observed on observation wells within the patterns





Key Learnings – Phases 2 + 3 NCG Co-Injection

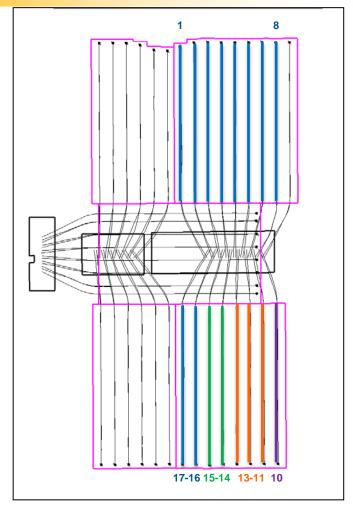
- Steam cuts at quarterly intervals contributing towards optimized steam distribution across the field
- No significant impacts to oil rates have been observed and partial pressure cooling effects have not been observed on observation wells within the patterns





Pad 750 Well Pair Start-Up Update

- 1 well pair (WP13) commenced circulation steam injection in October 2018 and converted to SAGD in March 2019
- 2 well pairs (WP11-12) commenced circulation steam injection in December 2018 and converted to SAGD in March 2019
- WPs 11-13 were completed with FCDs
- 1 well pair (WP10) commenced circulation steam injection in February 2019 and converted to SAGD in August 2019
- During the circulation phase, well pairs were operated below approved bottom-hole MOP



First steam September 2016

First steam July 2017

First steam October/December 2018

First steam February 2019





Future Development: Pad 751

- Pad 751 is a future area of development within the MacKay River PA
 - To provide sustaining production for the existing MR1 central processing facility (CPF)
- Approval received August 7, 2012
 - 18 well pairs and 2 single producers in total
- Drilling completed June 2014
- Pad 751 completions completed in October 2019
 - Targeting first steam in 2020





Future Development: Pad 819

- Pad 819 is a future area of development within the MacKay River PA
- Provides sustaining production for the existing MR1 central processing facility (CPF)
- Directive 078 amendment approval received in January 2014
 - 9 well pairs located south of existing infrastructure
- All non-thermal compatible wells have been abandoned
- Drilling planned to be completed in 2020
- Targeting first steam in 2021





Future Development: Pad 826

- Pad 826 is a future area of development within the MacKay River PA
- Provides sustaining production for the existing MR1 central processing facility (CPF)
- Directive 078 amendment approval received in September 2019
 - 6 well pairs located north of existing infrastructure
- Drilling planned to be completed in 2021
- Targeting first steam in 2022







AER Directive 054 2019 Performance Presentation

Section 3.1.2 – Surface Operations, Compliance, and Issues not related to Resource Evaluation and Recovery



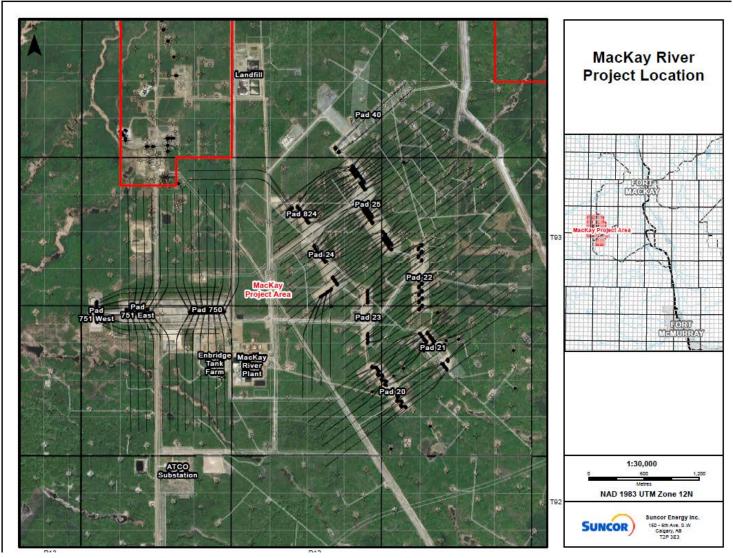
Table of Contents

- Introduction
- Facilities
- Central Processing Facilities (CPF) Performance
- Measurement and Reporting
- Water Production, Injection and Use
- Sulphur Production
- Environmental Performance
- Future Plans



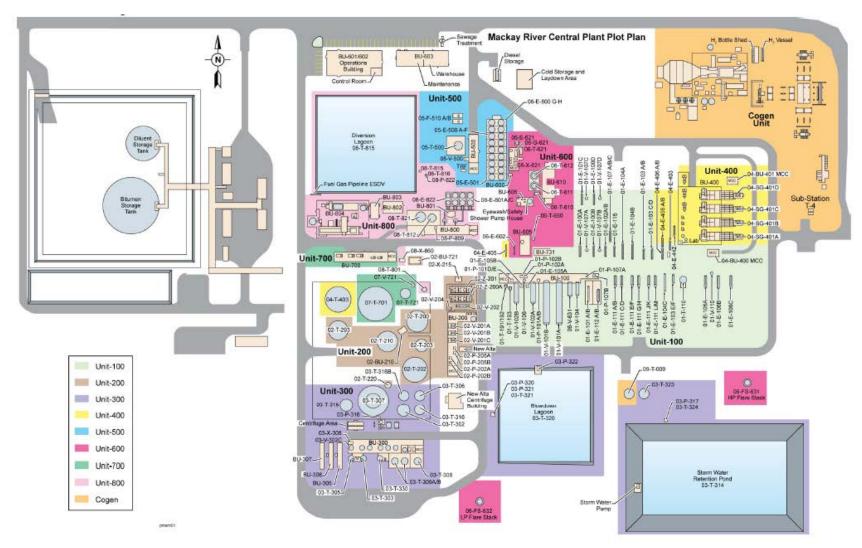


MacKay River Project Site



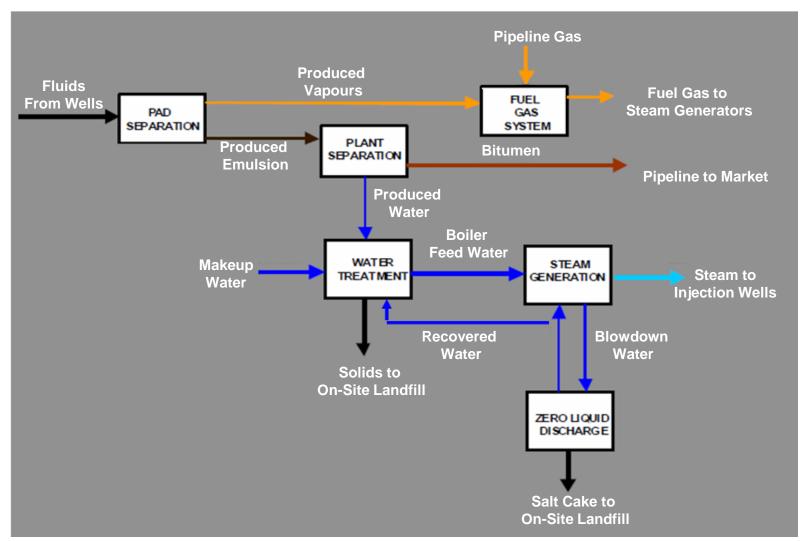


CPF Plot Plan





Simplified CPF Process Block Diagram



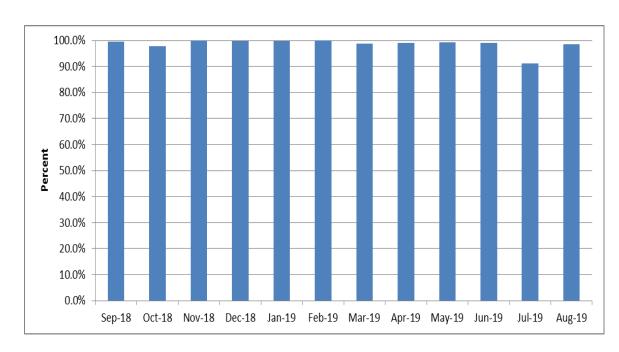




CPF Performance (September 2018 to August 2019)

The reliability of the facility has been steady:

Average 98.6% (September 2018 to August 2019)

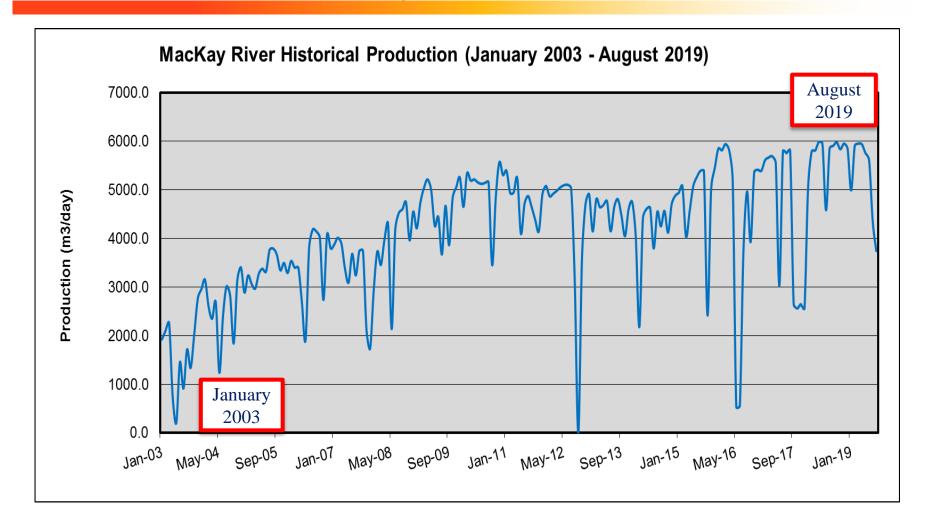


Major challenges:

July 2019- Unplanned plant outage

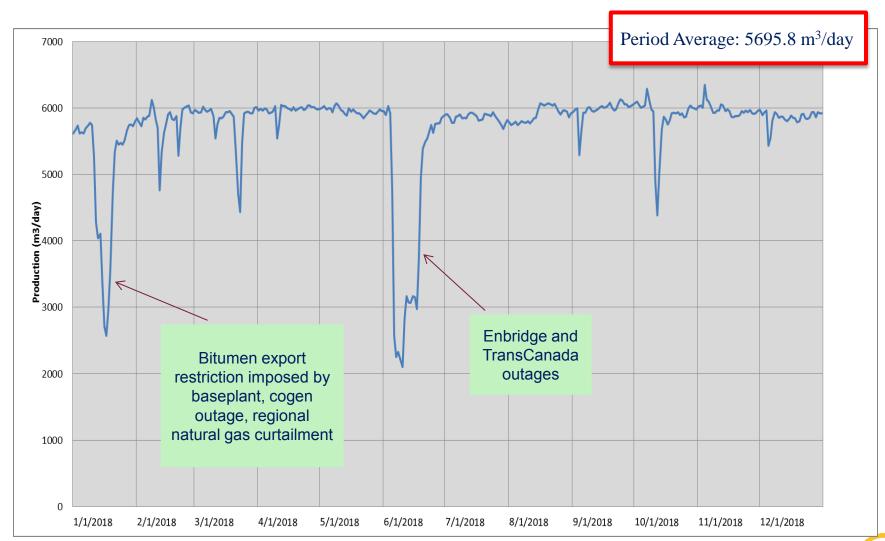


Historical Production (January 2003 – 2019 YTD)



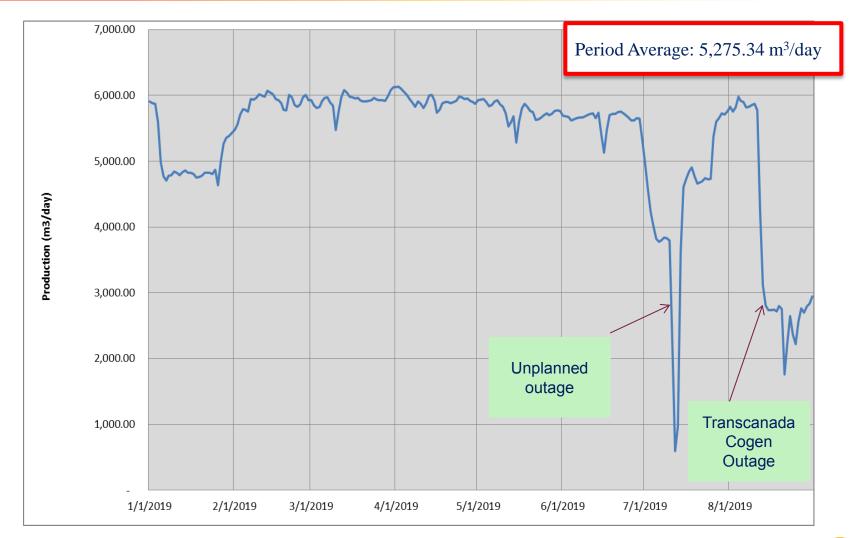


Production (2018)





Production (January 2019 to August 2019)





Water Treatment Technology

Warm Lime Softening (WLS) and Weak Acid Cation (WAC) softening for produced water;

Zero Liquid Discharge (ZLD) System on blowdown slip stream:

- Evaporators: one steam and one mechanical driven;
- Crystallizer: Steam driven;
- Dryer: gas fired;
- Filter press (2): back up for dryer.



Boiler Feed Water Quality

Parameter	Avg. Value (Sept 2018 – Aug 2019)	Max Value During Period	BFW Specifications
Temperature, ºC	159.5	169.43	140 - 170
Hardness (Dissolved), mg/L	0.2	1.25	<1.0
Total Dissolved Solids, mg/L	6187.2	7757.5	<8000
Silica, as SiO2, mg/L	19.08	32.77	<50.0



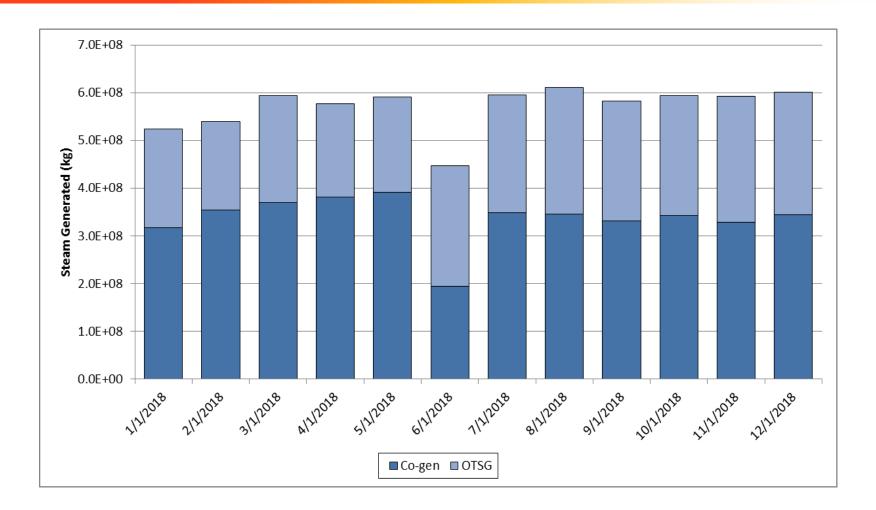
Water Treatment Successes and Challenges

WLS performance has been steady:

- Reliability is 99.9%:
 - Consecutive days within spec since September 1st 2018: 314 days Parameters: temperature, hardness, total dissolved solids, pH, silica, oil, free oxygen, total dissolved iron.



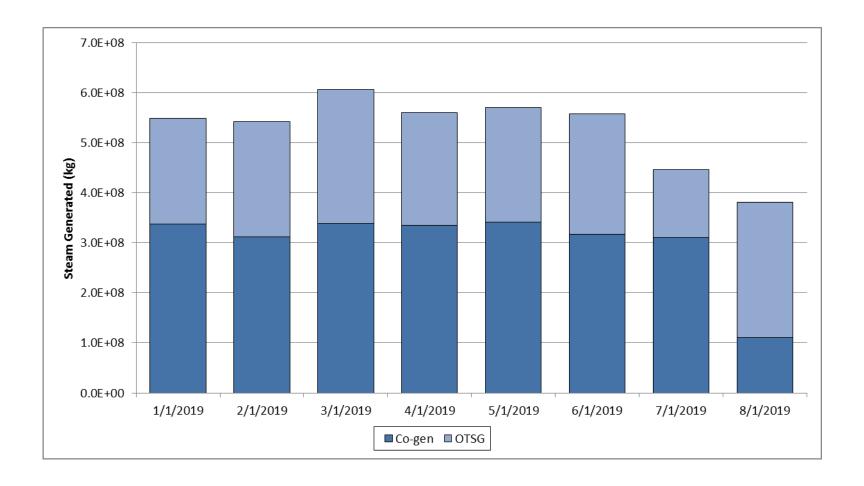
Steam Generation (2018)



Steam Quality from Co-gen is maintained approximately 77% and OTSG is approximately 80%



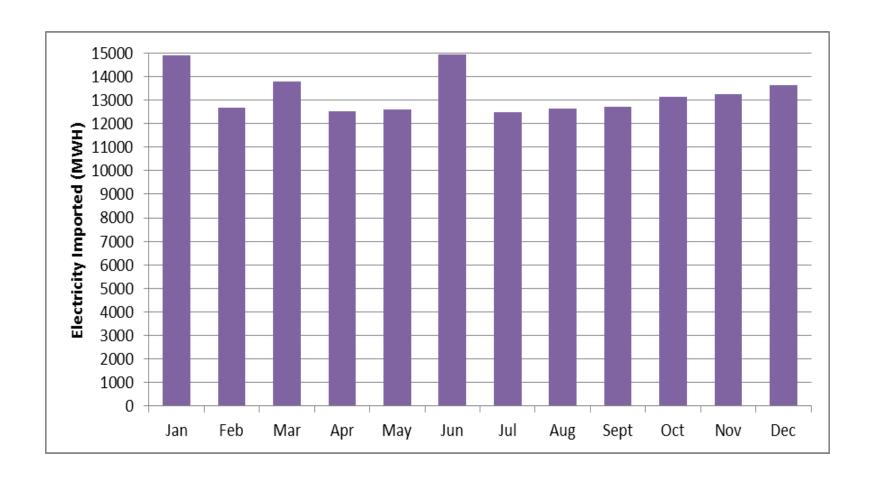
Steam Generation (2019 YTD)



Steam Quality from Co-gen is maintained approximately 77% and OTSG is approximately 80%



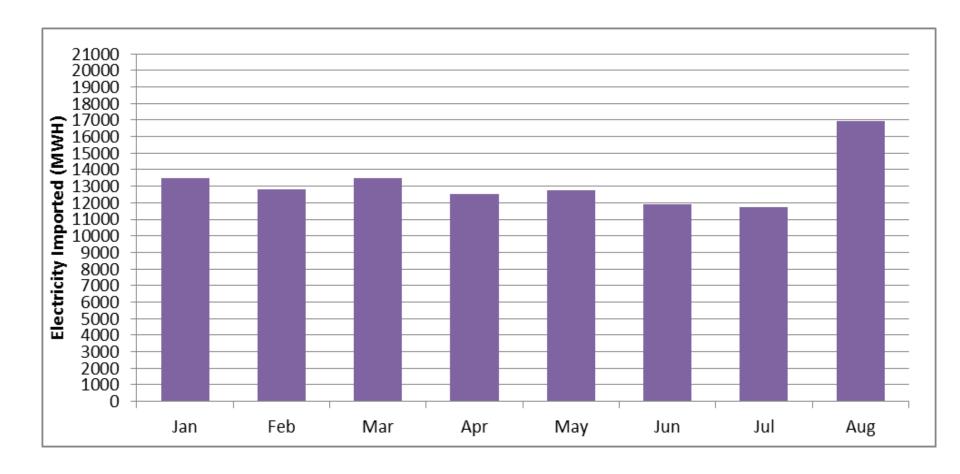
Power Imported (2018)



*Note: All power imported into Mackay River is consumed



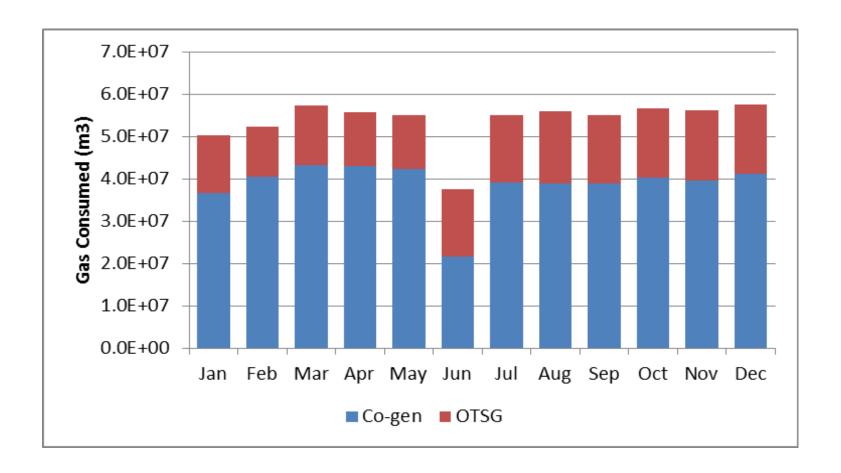
Power Imported (2019 YTD)



*Note: All power imported into Mackay River is consumed

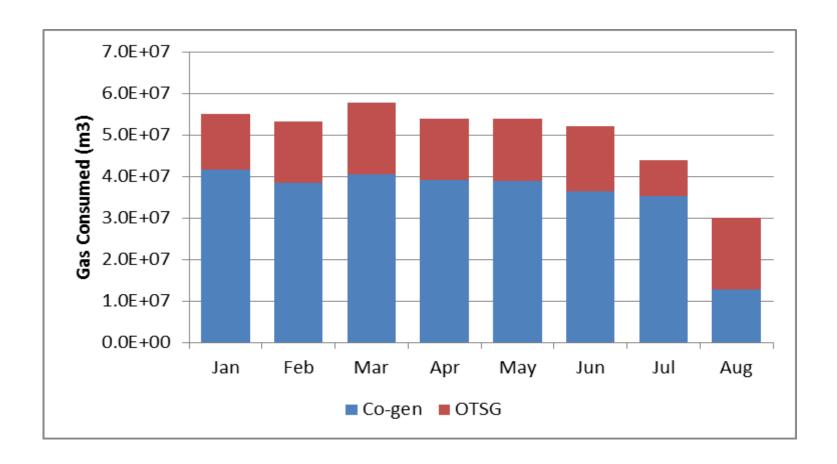


Gas Consumption (2018)





Gas Consumption (2019 YTD)





Energy Intensity

Energy Intensity Formula

- Energy Intensity (GJ/m³) = Total energy consumed by site / Sales bitumen volume;
- Total energy consumed by site (GJ) = Energy used to make steam and blowdown in Cogen + Natural Gas imported to site + Solution gas to Cogen + Electricity consumed by site – Mixed gas to Cogen duct firing:
 - Note that the term "site" does not include Cogeneration.
- Energy used to make steam and blowdown in Cogen (GJ) = BFW Mass Flow Rate to Cogen x Hourly average difference in enthalpy between steam/blowdown and BFW.

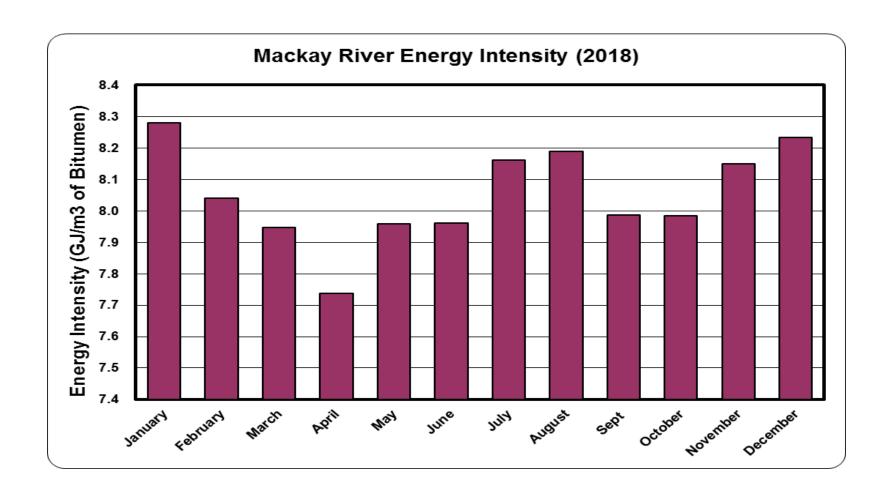


Cogeneration with TransCanada Energy

- Energy exchange: TransCanada Energy (TCE) provides steam and electricity to Suncor in exchange for BFW and a fee;
- A large portion of the steam used in the injection wells is recovered by Suncor as produced water. This produced water supplies most of the feedwater required for the HRSG.;
- A portion of the electrical power generated by the cogeneration plant is sold to Suncor for use onsite as well as at other offsite locations. In addition to the power contracted to Suncor, up to 150 MW of power is made available to Alberta consumers

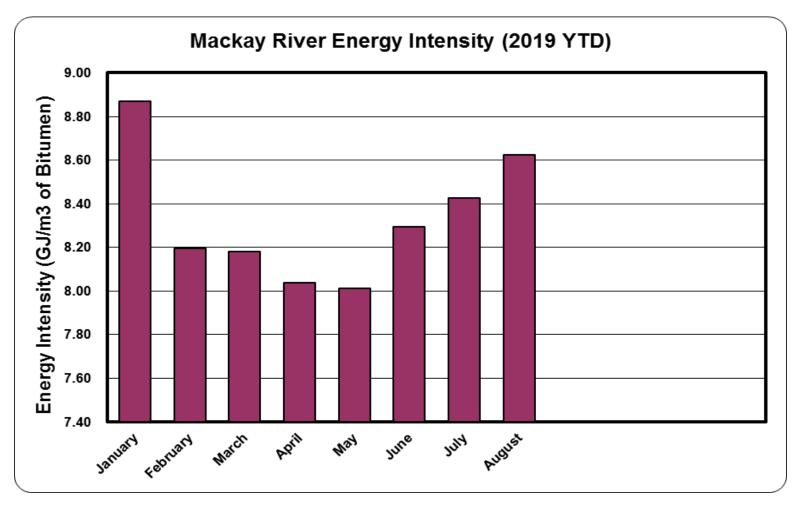


Energy Intensity (2018)





Energy Intensity (2019 YTD)







Measurement Accounting & Reporting Plan (MARP)

- Annual internal update to be finalized by November 30, 2019
- MacKay River Report Codes:
 - Battery AB BT 0067097;
 - Injection Facility AB IF 0009498;
 - Meter Station AB MS 0084090.

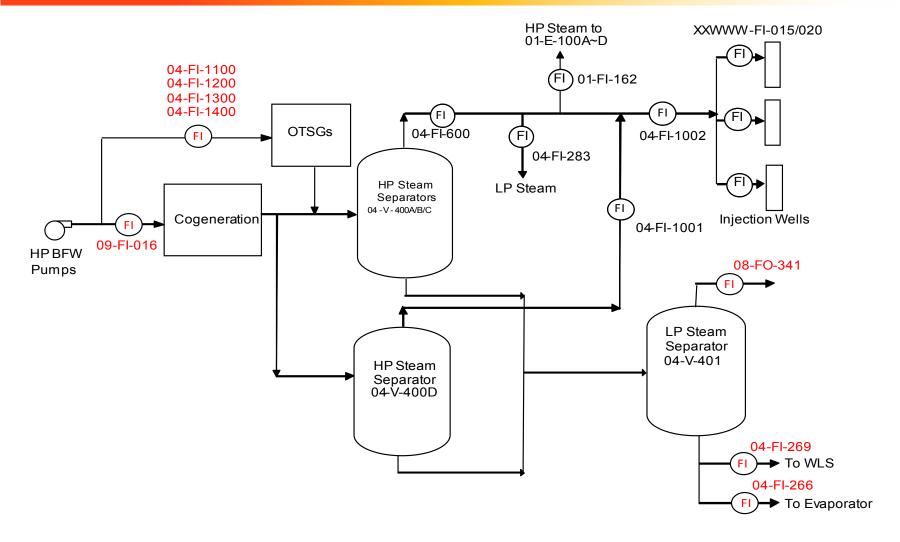


Water Balance

- Steam:
 - Primary produced steam:
 - Steam Injection to Wells = BFW to Steam Generators Boiler Blowdown Utility
 Steam LP Steam Condensate from Pads
 - Secondary produced steam:
 - Boiler feedwater to steam generators * Steam quality for individual gens



Water Balance Continued





Water Balance Continued

- Raw Water = Σ Water Source wells (3 water source wells);
- Accumulation = Closing Inventory Opening Inventory;
- Produced Water

Primary Method:

Produced water to WLS + Accumulation – Others.

Where:

- -Produced Water to WLS = 02-FI-500 + bypass + 02-FI-306;
- -Others include: Raw water, BLD Recycle, BFW to VRU.

Secondary Method:

- Produced water to Deoiled Tank ORF Backwash Flow + Accumulation Others. Where,
- -Produced water to Deoiled Tank ORF Backwash Flow = (02-FI-220 + 02-FI-240+ 02-FI-260 + 02-FI-520) (02-FI-300 + 03-FI-612 + 03-FI-610 + 07-FI-228)
- -Others include: Water Condensate from Pads, Raw water, BLD Recycle, BFW to VRU
- Water from the crystallizer is metered at the crystallizer outlet before it goes to the dryer:
 - —Truck tickets capture the volume of water trucked
 - –Volumes reported in Petrinex.



Well Testing Strategy

Test Separators are used to test all wells for production allocation

Fully compliant with Directive 017

Pad 20 Well Testing Strategy

• 13 active SAGD producers, 4 hour tests (+ purge time)

Pad 21 Well Testing Strategy

• 12 active SAGD producers, 4 hour tests (+ purge time)

Pads 22 Well Testing Strategy

- 22 active SAGD producers, 5.5 hour tests (+ purge time)
- Phase 4 (NN1 and QQ2-3) are tested via Pad 22 Test Separator
- Phase 5A (NN2-5, QQ4-5) are tested via Pad 22 Test Separator

Pads 23/24 Well Testing Strategy

- 14 active SAGD producers, 7-7.5 hour tests (+ purge time)
- Pad 24 Phase 4 (OO1-3) are tested via Pad 23 Test Separator
- Pad 24 (H1-4) are tested via Pad 23 Test Separator

Pad 25 Well Testing Strategy

- V-100 Test Separator
 - 10 active SAGD producers, 5 hour tests (+ purge time)
- V-1100 Test Separator
 - 12 active SAGD producers, 4 hour tests (+ purge time)
- V-1150 Test Separator
 - 12 active SAGD producers, 4-5 hours test (+ purge time)
 - Pad 24 Phase 5B1 (OO4-9) are tested via V-1150
 - Pad 24 Phase 5DF (OO10-15) are tested via V-1150

Pad 824 Well Testing Strategy

- 2 active SAGD producers, 7 hour tests (+ purge time)
- Wells are tested via Vx Meter

Pad 750 Well Testing Strategy

- Pad 750 Test Separator V-8350
- 16 active SAGD producers, 5 hour tests (+ purge time)



Proration of Oil and Water

Average for 2018:

Oil Factor = 0.98

Water Factor = 0.91

Average for 2019 YTD:

Oil Factor = 0.98

Water Factor = 0.98





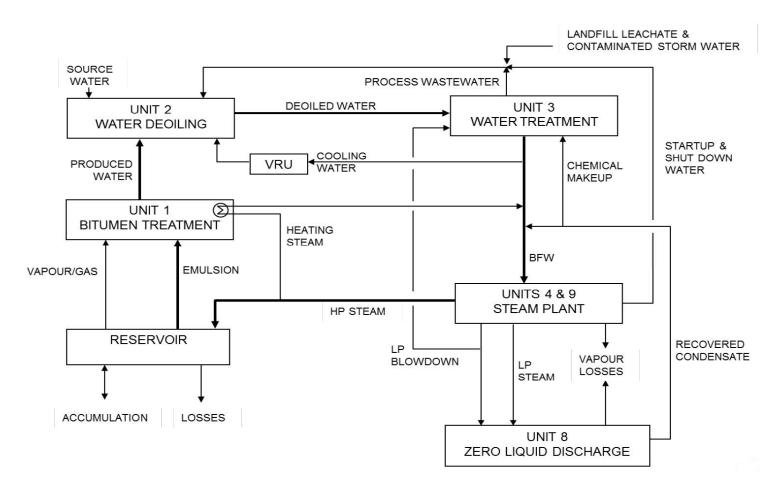
Fluctuations in Water Proration Factor

- From a subsurface perspective water, water cuts tend to change when wells are shut-in for prolonged periods of time.
 - The MacKay River project experienced a cogeneration outage where wells were down for a significant time.
 - The trend that has been noted in the past, for events such as re-start, is a 1-3% increase in water cut (I.E. producing more water compared to oil).
 - This could potentially have had an effect on the changes in water production.





CPF Water Traffic





Fresh Water

Source Water Wells

- Water Act Licence No. 00188229-03-00 (511,000 m³/year) Birch Channel Aquifer (Renewal issued August 2017):
 - 1. 13-05-093-12W4 (GD-SW-212-53; formerly WSW-1), max. rate 450 m³/day;
 - 2. 04-08-093-12W4 (GD-SW-213-86; formerly WSW-2), max. rate 1368 m³/day;
 - 3. 04-08-093-12W4 (GD-SW-215-91; formerly WSW-3), max. rate 1411 m³/day.

Domestic Water Well:

- Water Act Licence No. 00249470-01-00 (25,550 m3/y) Birch Channel Aquifer (Issued in July 2013):
 - 4. 12-05-093-12W4 (CWSW-SW-218-55), max. rate 123 m3/day.

Monthly reporting for Source Water Wells and Domestic Water Well is done through Water Use Reporting System (WURS).



Raw Water Source Wells

		Source	Well - SW-21	2-53		
Test	Parameter	Water Analysis Result (5-Oct-15)	Water Analysis Result (29-Sep-2016)	Water Analysis Result (23-Oct-2017)	Water Analysis Result (30-May-2018)	Water Analysis Result (31-May-2019)
Physical	EC (uS/cm)	855	842	805	858	864
	pH (units)	8.32	7.8	8.35	8.08	7.9
	Tot Hard as CaCo₃ (mg/L)	398	434	381	398	389
	Tot Alk as CaCO ₃ (mg/L)	363	376	369	371	376
Indicators	Chloride:D (mg/L)	<0.5	0.53	0.52	0.54	0.57
	Sulphate:D (mg/L)	111	113	111	111	108
	Iron:D (mg/L)	<0.03	5.6	<0.03	<0.01	0.1
	Manganese:D (mg/L)	0.258	0.272	0.183	0.256	0.007
	TDS-calculated (mg/L)	504	526	525	509	582*
	Calcium:D (mg/L)	105	115	95.7	104	104
	Magnesium:D (mg/L)	33	35.7	34.4	33.6	31.4
	Potassium:D (mg/L)	5.36	5.5	5.11	5.31	4.96
cations.	Sodium:D (mg/L)	31.8	30.9	33.4	31.6	107*
anions, and	Bicarbonate:D (mg/L)	363	376	438	453	459
ion balance	Carbonate:D (mg/L)	< 5	< 5	6.2	< 5	<5
	Hydroxide:D (mg/L)	< 5	< 5	< 5	< 5	<5
	Fluoride:D (mg/L)	0.205	0.25	0.237	0.259	0.236
	Ion balance % (%)	99.7	103	88.9	96.9	128*
	NO2 as N (mg/L)	<0.01	<0.01	<0.01	<0.01	<0.01
nitrogen parameters	NO3 and N (mg/L)	<0.02	<0.02	<0.02	0.029	0.02
	NO2 + NO3 as N (mg/L)	<0.022	<0.022	<0.022	<0.022	0.022
	DKN (mg/L)	-	-	-	-	
	TKN (mg/L)	-	-	-	-	-
	Tot Amm N (mg/L)	-	-	-	-	-
phenols	phenols (mg/L)	-	-	-	-	-
PAH	Naphthenic Acids (mg/L)	-	-	-	-	-

Typical water quality assessment parameters;

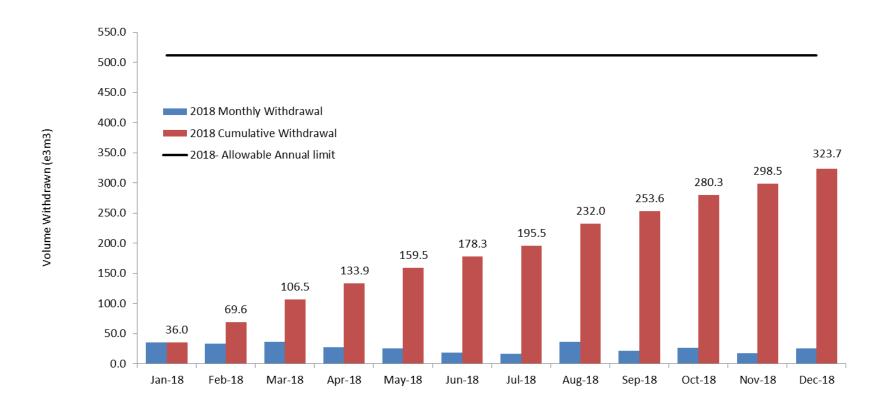
Monitoring station GD-SW-212-53 (formerly WSW-1);

Results shown are from 2015 - 2019.

There is no change in the water quality.

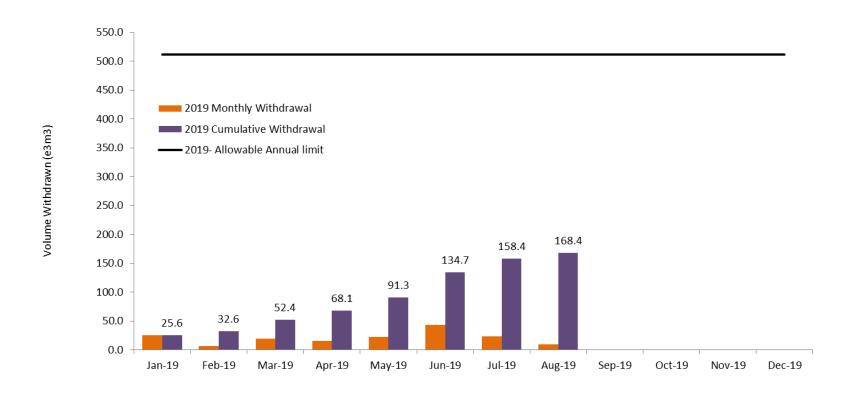


Raw Water Withdrawal – Source Wells (2018)



- Regulatory allowable limit from *Water Act* Licence No. 188229 is 511e³m³ per year;
- In 2018 MacKay River withdrawal water was from the Water Licence No. 00188229-03-00 Total 323.7 e3m3.

Raw Water Withdrawal – Source Wells (2019 YTD)

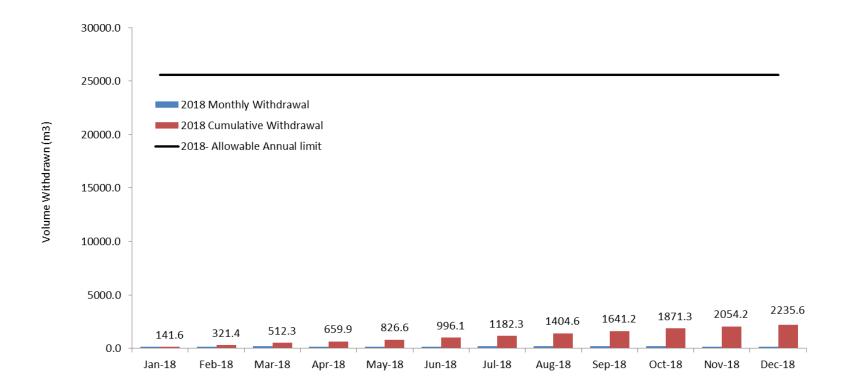


Regulatory allowable limit from *Water Act* Licence No. 188229 is 511e³m³ per year



Domestic Well (2018)

The total withdrawal in 2018 was 2235.6m³

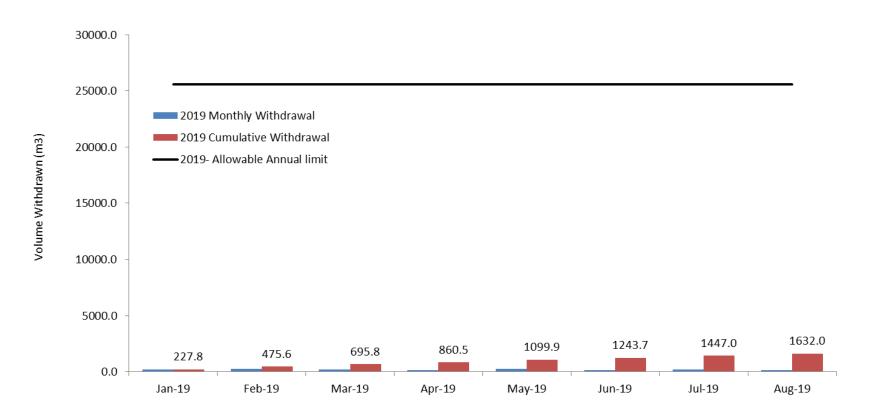


Regulatory allowable limit from Water Act Licence No. 249470 is 25,550m³ per year



Domestic Well (2019)

The total withdrawal in 2019 YTD is 2,235.6m³





Overall Facility Water Balance

	Overall Facility Water Balance									
	Inlet Streams				Outlet Streams					Water
	Produced Water	Fresh Water		Produced Water	Steam	Disposal	Produced Water		Fresh Water	Balance
	PW1 (m3)	FW1 (m3)	FW4 (m3)	PW4 (m3)	INT (m3)	DIT(m3)	PW5 (m3)	PW7 (m3)	FW5 (m3)	%
Sep-18	446,122.2	21,578.6	33	24,181.7	488,444.5	2,475.8	25,334.4	878.6	31.6	-3.7%
Oct-18	428,907.1	26,766.7	31.6	25,334.4	491,353.0	2,029.0	24,124.4	234.6	26	-6.1%
Nov-18	437,573.6	18,217.9	26	24,124.4	472,104.9	29.1	23,144.9	687.6	33.7	-2.4%
Dec-18	498,356.0	25,183.2	33.7	23,144.9	541,977.2	452.1	23,372.4	361.1	30.4	-3.1%
Jan-19	443,414.0	25,580.1	30.4	23,372.4	496,237.2	-	24,513.2	703.6	32.1	-4.8%
Feb-19	458,259.9	7,032.2	32.1	24,513.2	489,384.5	-	24,354.6	590.5	34.1	-4.6%
Mar-19	511,244.2	19,789.0	34.1	24,354.6	543,083.8	39.6	23,534.4	1182.7	26.7	-2.0%
Apr-19	488,582.1	15,787.3	26.7	23,534.4	502,402.0	253.0	24,183.1	4695.3	34	-0.2%
May-19	481,464.0	23,243.6	34	24,183.1	515,378.2		23,098.4	2393.3	29.5	-1.8%
Jun-19	444,907.7	43,396.7	29.5	23,098.4	509,195.6	234.1	24,308.8	1069.4	35	-3.8%
Jul-19	362,590.1	23,703.6	35	24,308.8	396,544.8	3,638.6	25,694.7	469.9	26.1	-3.1%
Aug-19	313,803.7	260,305.7	26.1	25,694.7	346,086.9	366.3	24,874.5	799.6	26.2	-5.3%



Overall Facility Water Balance

Below are a set of definitions of the terms used in the water balance table provided in this presentation

Freshwater

- REC (FW1): The sum of all freshwater streams received. MacKay River receives fresh water from three source water wells.
- INVOP (FW4): Fresh water tank opening inventory. This volume is carried forward from last month's closing inventory.
- INVCL (FW5): Fresh water tank closing inventory. This volume takes into consideration levels in Fresh water tanks.

Steam

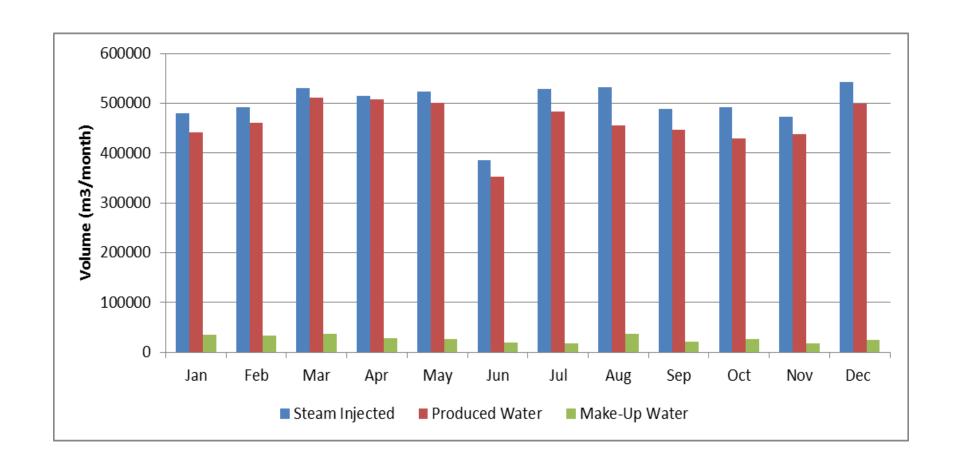
• INJ (INT): The total steam injected at the wells. Steam is metered by subtracting total BFW feed to all OTSG and Cogen at MR minus the total blowdown.

Water

- REC (PW1): The water received from the wells...
- INVCL (PW5): Water tank closing inventory. This volume takes into consideration levels in water tanks.
- INVOP (PW4): Water tank opening inventory. This volume is carried forward from last months closing inventory.
- INJ (DIT): Water disposed from the facility.
- UTIL (PW7): Water Stream used at the injection facility for utility and waste steam and not recovered due to venting.

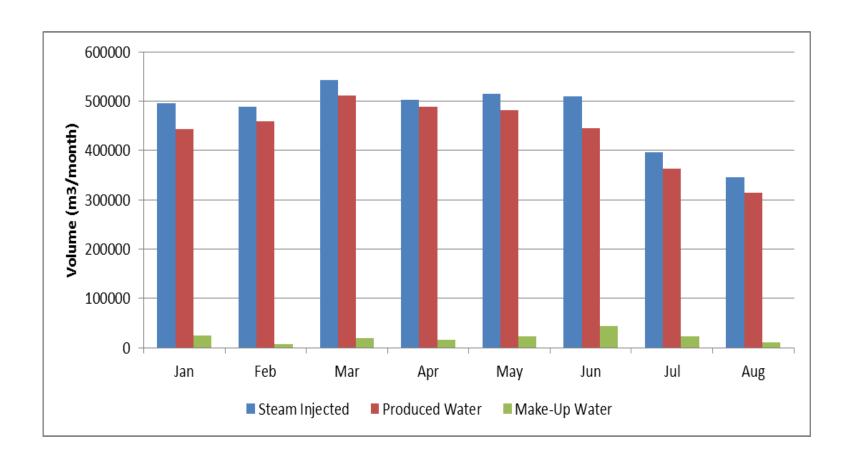


Water Balance (2018)



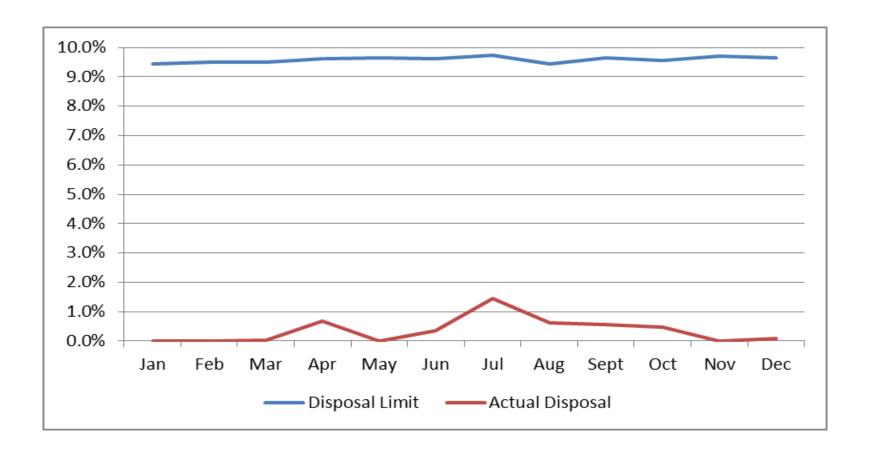


Water Balance (2019 YTD)



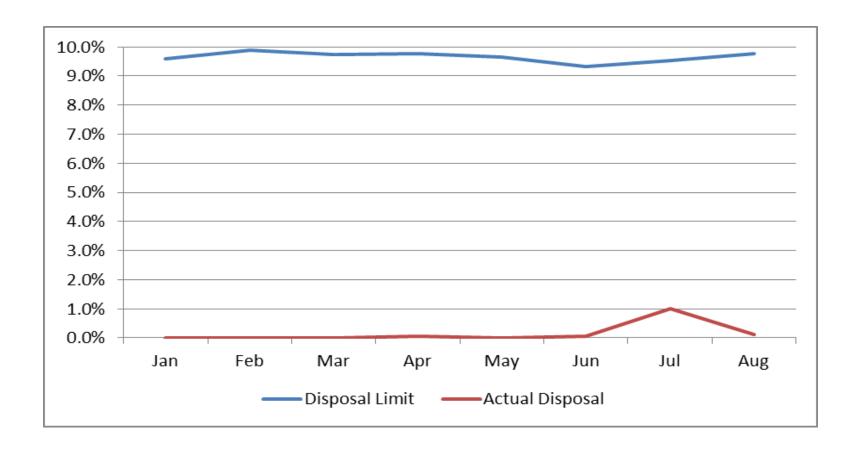


Water Disposal % (2018)



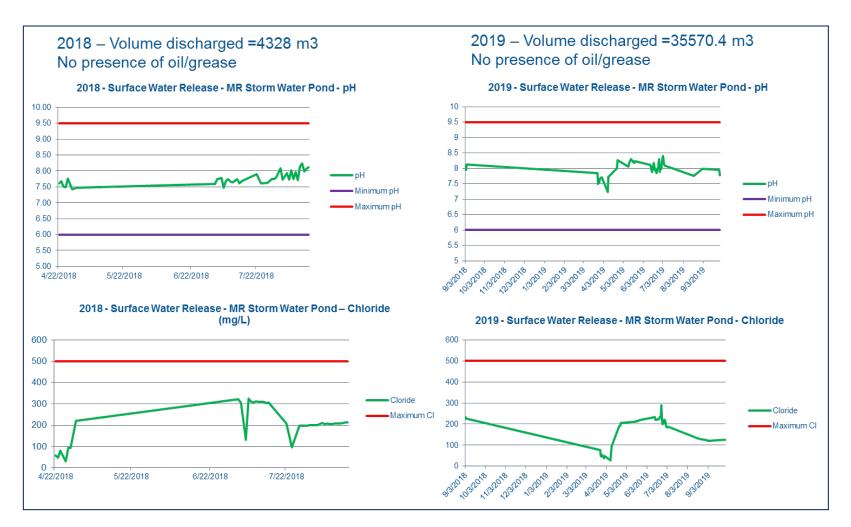


Water Disposal % (2019 YTD)





Summary of Industrial Run-Off Monitoring Results





Low Pressure Blowdown Recycle (2018 & 2019 YTD)

Blowdown Recycle = 100%:

- Blowdown treated in the Water Plant:
 - YTD: 48,832.8 m³/month
 - 2018: 53,501.7 m³/month
- Blowdown treated in the Zero Liquid Discharge (ZLD) Plant:
 - YTD: 42,130.1 m³/month
 - 2018: 39,515.07 m³/month

Trucked volumes from Diversion Lagoon:

- 2018: 19,628.5 m³ (January 1,2018 December 31, 2018);
- 2019: 4,531.6 m³ (January 1,2019 August 31, 2019).

Note: The diversion lagoon is filled by crystallizer concentrate during purges *and* by landfill leachate after periods of rain.



MacKay River Landfill / Waste Management

AER Approval WM-072E Class II Oilfield Landfill – Waste Streams :

- Warm lime Softener Sludge residual from the water treatment plant (Unit 200) = solids, lime and polymers
- Salt Waste Residual from the evaporator Unit 800 waste = salt brine dust.

Volumes of solids (salt/lime) to landfill					
Year	Volume (m³)				
2015	28,019				
2016	20,685				
2017	22,651				
2018	26,477				
*2019	17,749				

Total of Leachate removed from landfill						
Year	Volume (m ³)					
2015	14,465					
2016	25,988					
2017	26,943					
2018	29,231					
*2019	12,517					

Source: Annual Landfill Report

Source: Annual Landfill Report

*Volumes estimated in September 2019

- Waste services contract in place:
 - Addresses hazardous, scrap metal, domestic waste.



MacKay River Landfill / Volume of fill Survey

Status: Closed, repairs Completed in 2018. **PHASE PHASE** Status: Active operations Approved Volume: 92,000 m3 Current Volume: 48,000 m3 PHASE 3 PHASE 3 WEST **EAST** Cell A

Status: Pilot project closure completed in 2018. 5 years approval for dewatering ongoing.

Approved Volume: **86,000 m3**Current Volume: **77,000m3**

Status: Active operations

Approved Volume: 93,870 m3 Current Volume: 45,000 m3



Volumes / forecasts current as of April, 2019 (Source: photogrammetric data captured by drones)

Off-Site Brine Water Disposal

Location of disposal site:

 Since September 2018, Suncor has commenced sending waste fluids to Whiteswan facilities, AB IF 0139976, AB WP 0139656 and AB WP 0142079 interchangeably;

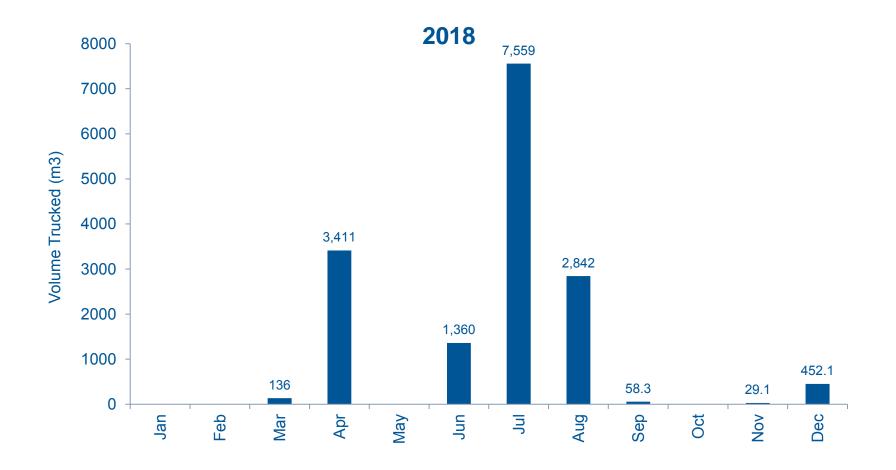
Petrinex Facility code	Facility Name	LSD	SEC	TWP	RGE	M
AB IF 0139976	WSE Atmore 11-23 Disposal Well	11	23	67	18	W4
AB WP 0142079	Conklin Waste Management Facility	15	12	77	9	W4
AB WP 0139656	Atmore Waste Management Facility	11	23	67	18	W4

- Brine water is disposed of off-site when the diversion tank and diversion lagoon reach capacity and the ZLD system cannot process the boiler blowdown from Unit 400.
- Water sources in the diversion lagoon include: precipitation, leachate from the MacKay River Landfill and excess boiler blowdown water during upset conditions.





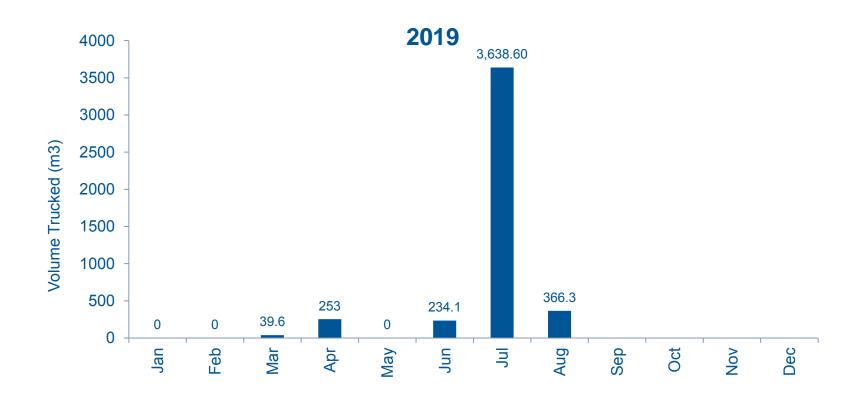
Off-Site Brine Water Disposal (2018)





^{*} Volumes reported via Petrinex

Off-Site Brine Water Disposal (2019 YTD)





^{*} Volumes reported via Petrinex

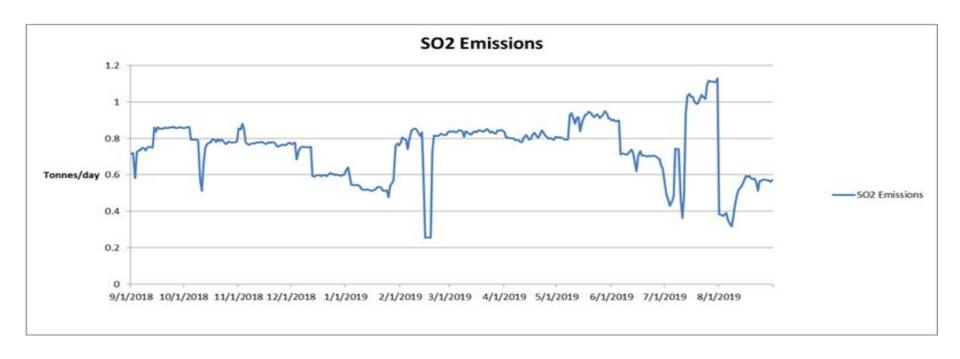


Sulphur Production

- Currently there are no sulphur recovery facilities at the MacKay River Project;
- All produced H2S is burnt off in the overall process;
- Present trends indicate an SRU will not be required for the Project;
- Suncor will continue to monitor the sulphur trends.

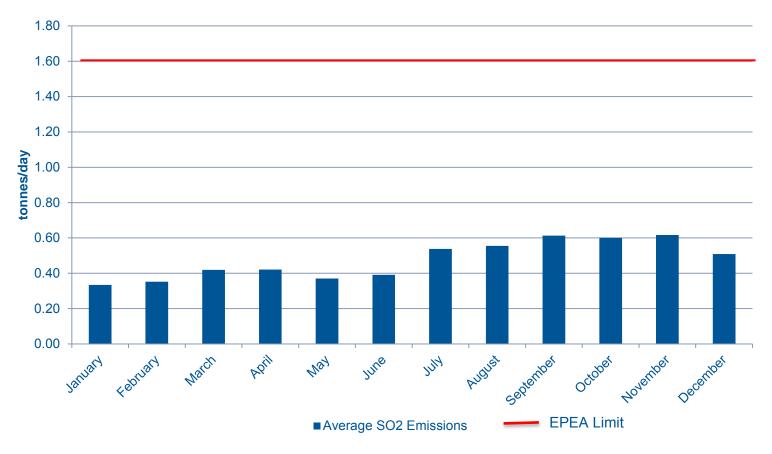


Chart of Daily SO2 Emission Rates





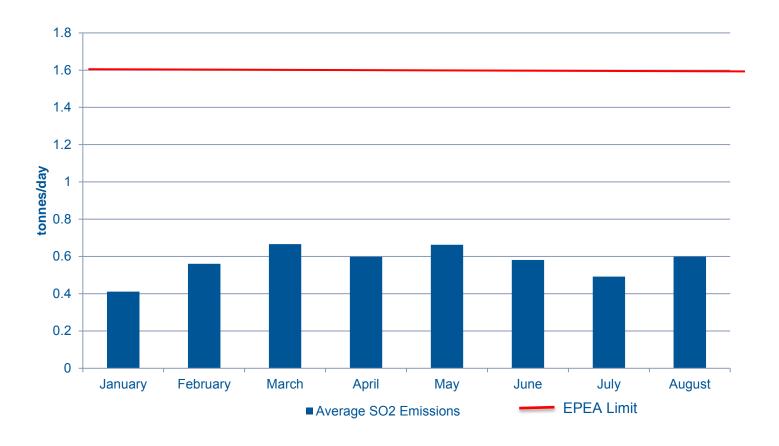
Sulphur Dioxide Emissions (2018)



^{*} SO₂ emissions are based engineering estimations that use H2S results from monthly produced gas samples



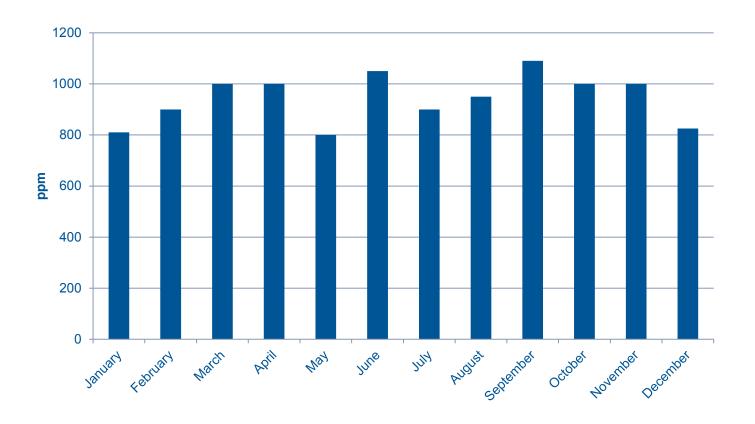
Sulphur Dioxide Emissions (2019 YTD)



^{*} SO₂ emissions are based engineering estimations that use H2S results from monthly produced gas samples



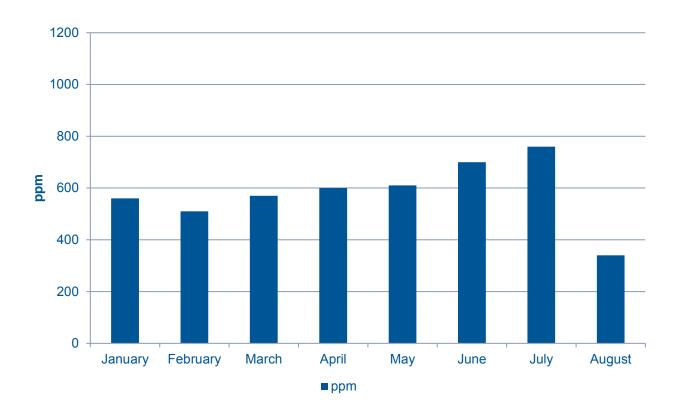
H₂S Concentration (2018)



^{*} H₂S concentrations are measured in monthly produced gas samples.



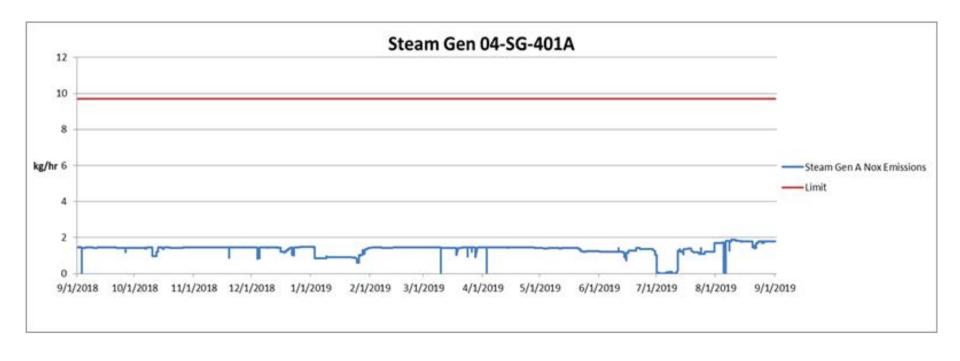
H₂S Concentration (2019 YTD)



^{*} H₂S concentrations are measured in monthly produced gas samples.

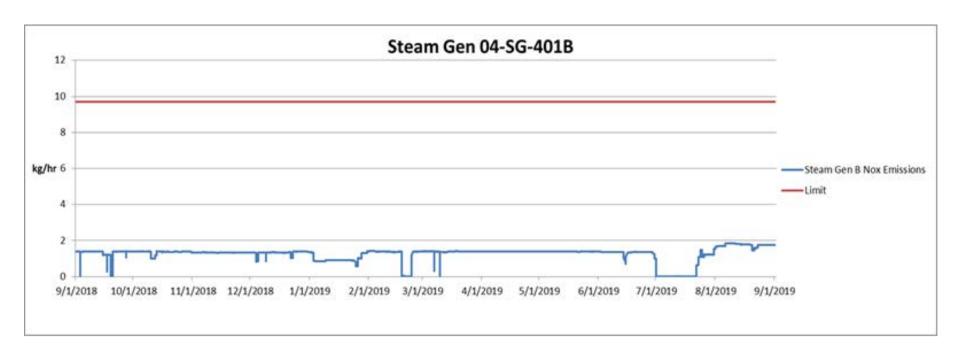


Daily NOx Emissions; Steam Gen 04-SG-410A



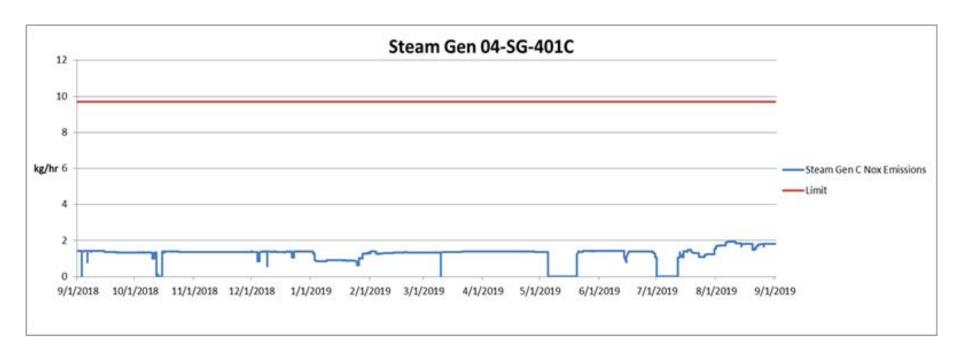


Daily NOx Emissions; Steam Gen 04-SG-410B



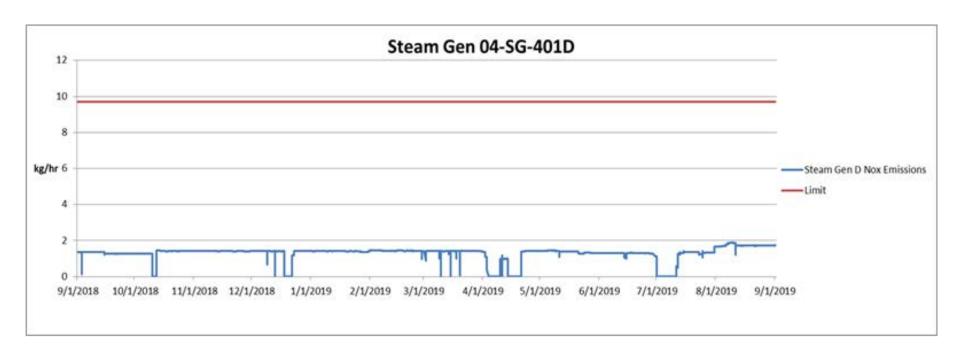


Daily NOx Emissions; Steam Gen 04-SG-410C



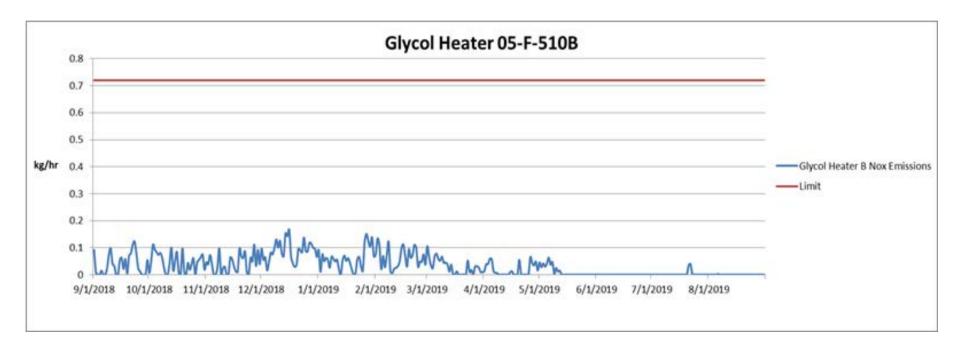


Daily NOx Emissions; Steam Gen 04-SG-410D



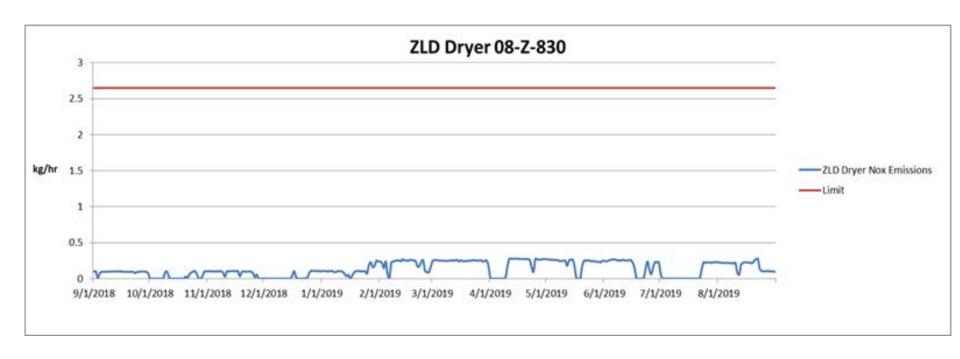


Daily NOx Emissions; Glycol Heater 05-F-510B



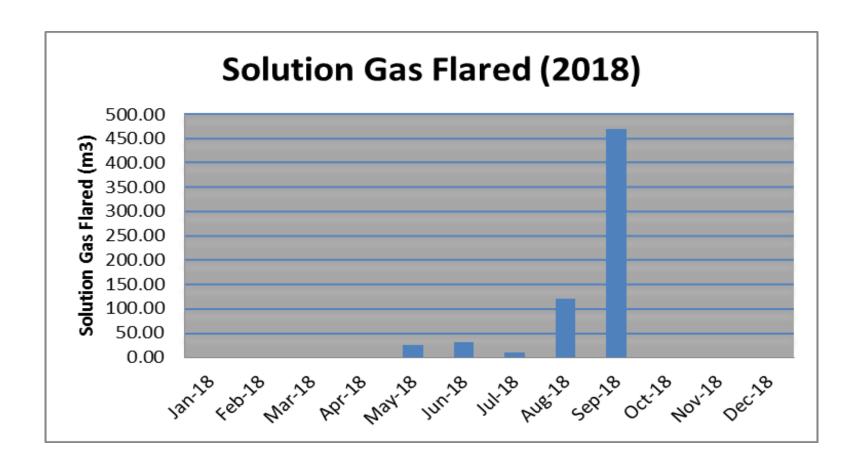


Daily NOx Emissions; ZLD Dryer 08-Z-830



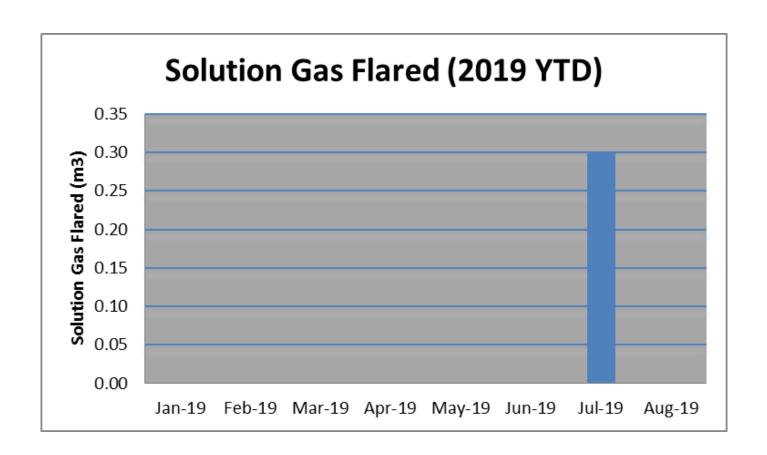


Solution Gas Flared (2018)



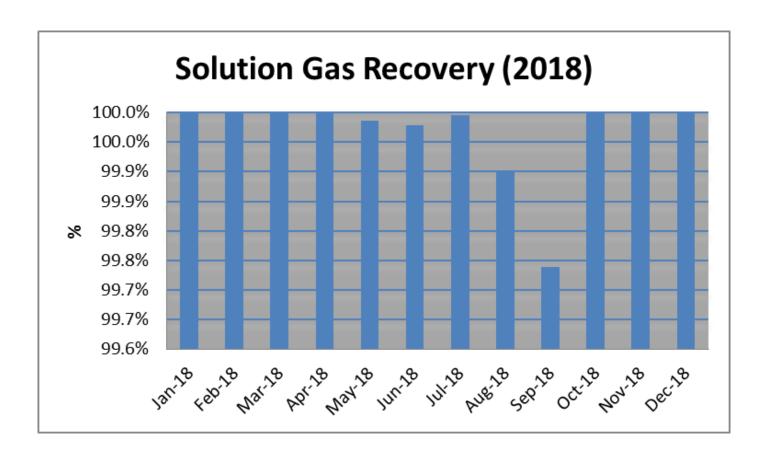


Solution Gas Flared (2019 YTD)



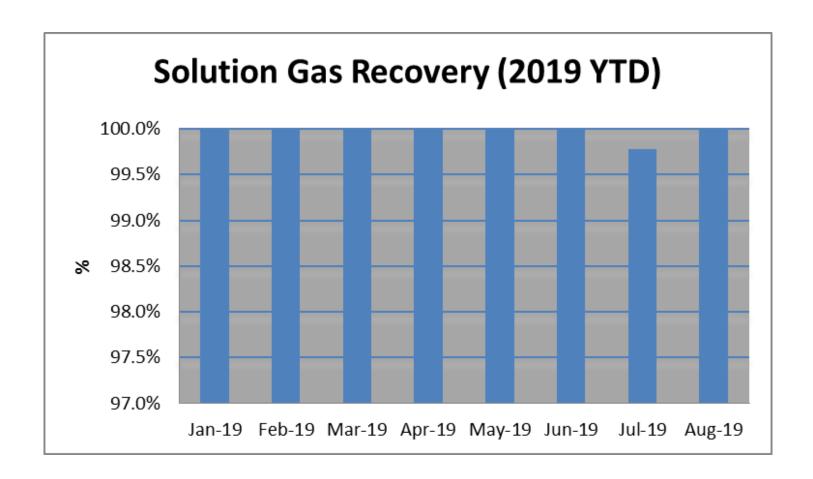


Solution Gas Recovery (2018)





Solution Gas Recovery (2019 YTD)







Greenhouse Gas Emissions (GHG)

Submitted the annual CCIR report to Alberta Environment & Parks and GHG report to Environment Canada:

GHG calculation methodology developed to improve transparency

Total direct emissions for 2018:

- 398,673 tonnes of CO₂equiv;
- Total direct emissions have been reported to AEP

Total indirect emissions for 2018:

- 640,638 tonnes of CO₂equiv;
- Total indirect emissions have been reported to AEP

Total regulated emissions (direct + indirect) for 2019 (Budget):

- 1,004,802 tonnes of CO₂equiv*;
- Total emissions will be reported to AEP under CCIR policy

In-situ sector emissions intensity benchmark:

0.3504 tCO₂e/m³

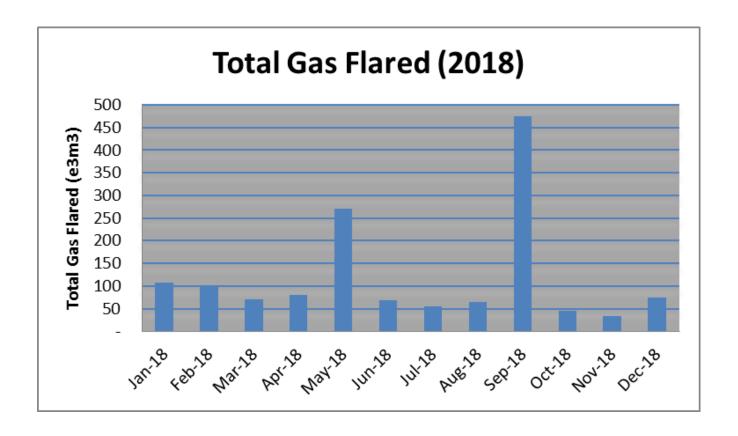


Ambient Air Monitoring

- WBEA Air Monitoring Stations:
 - Ambient air quality data available for viewing on WBEA website.
- Passive Air Monitoring:
 - Four passive air monitoring stations at MacKay River;
 - Monthly passive air monitoring performed by a site representative and sample analysis reports submitted to AER by Suncor for H₂S and SO₂;
 - In 2018 passive sampling results showed: average H2S concentration was 0.06 ppb and average SO2 was 0.33 ppb;
 - In 2019 (YTD) passive sampling results showed: average H2S concentration was 0.06 and average SO2 was 0.37 ppb.

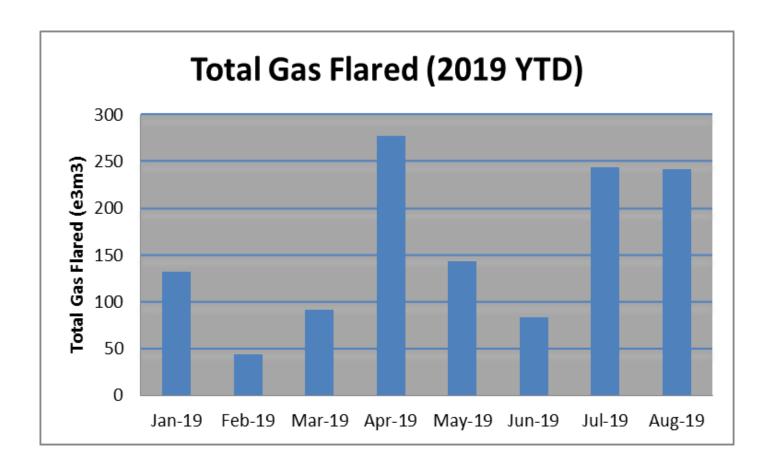


Total Flared Gas (2018)



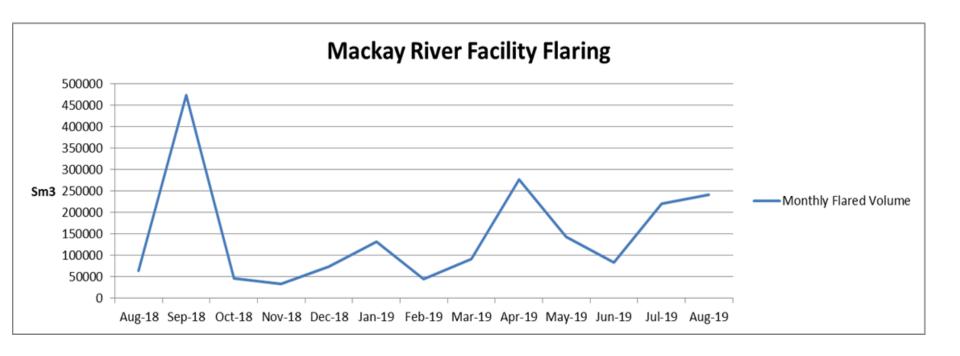


Total Flared Gas (2019 YTD)





Total Flared Gas; August 2018 to August 2019



Total Gas Flared (Sm3/month)												
Aug-18	Sep-18	Oct-18	Nov-18	Dec-18	Jan-19	Feb-19	Mar-19	Apr-19	May-19	Jun-19	Jul-19	Aug-19
64485.5	473873	45696.7	33755.85	74399.04	132690.6	44137.43	91218.98	277383.6	143072.8	83063.13	220435.6	242307.7



Regulatory Compliance (2018 and 2019 YTD)

2018:

- February 01, 2018: AER Pipeline detail operation Inspection(Colon Sheppard);
- March 13, 2018 AHS-Drinking Water System Inspection (Dominic Gniewek);
- July 16, 2018 AEP- Human/Bear conflict inspection at MacKay River (Abigail Culleton);
- Oct 2018, 2018 AER Wildlife Management at Mackay River (Patrick Traudt);
- Sep 25, 2018 AER Landfill, CPF and PAD inspection (Phoebe Thompson).

2019:

- March 19, 2019 AER-Dover and Best site decommissioning inspection(Barbara Saunders);
- Sep 25, 2019 –AER- Gate Control Program Inspection (Broc Butler)
- Sep 25, 2019 –AER- Culvert Inspection AOSTRA road(Broc Butler)



Incident Summary (2018–2019 YTD)

2018

- AER Reportable Releases for 2018 (YTD Sept 30):
 - 5 reportable spills;
 - 7 reportable flaring events.
- Voluntary Self Disclosures 2018 (YTD Sept 30):
 - Tear in the liner of Landfill Phase III W cell A
 - Tear in the liner of Landfill Phase III E cell B
 - Leachate head over the limit of 300 mm

2019

- AER Reportable Releases for 2019 (YTD Sept 30):
 - 3 reportable spills;
 - 12 reportable flaring events.
 - 5 contravention reports
- Voluntary Self Disclosures 2019 (YTD Sept 30):
 - Phase II Cell B NE Seepage



Scheme Approval Amendments

- Amendment 8668A
 - Changed annual average volume to 33,000 bpd (5,250 m³/d)
- Amendment 8668B
 - · Increase to project area
- Amendment 8668C
 - Additional project area
 - Approval to inject non-condensable gas
- Amendment 8668D
 - Additions to project area
 - Increase to annual average volume to 72,964 bpd (11,600 m³/d)
- Amendment 8668E
 - Approval to drill four well pairs
- Amendment 8668F
 - Approval to change approval holder from Petro-Canada to Suncor
- Amendment 8668G
 - Approval to undertake amendments & modifications to CPF systems
 - Approval tie-in 6 well pairs to well testing facilities
- Amendment 8668H
 - Approval to conduct non-condensable gas injection test on Pad 21 wells
- Amendment 8668I
 - Approval to conduct non-condensable gas injection at the Section 16 Test Project

- Amendment 8668J
 - Approval to transfer portions of the Dover project area into the MacKay River project area
- Amendment 8668K
 - Approval to tie-in 16 well pairs to well testing facilities
- Amendment 8668L
 - Approval to the remove the limiting factor of a mole percent restriction for the B Pattern non-condensable gas injection test on Pad 21
- Amendment 8668M
 - Approval to inject chemical into Pad 22 wells
- Amendment 8668N
 - Approval to abandon 3 wells and suspend 1 well on Pad 20
- Amendment 86680
 - Approval to change Phase 5F well trajectories
- Amendment 8668P
 - Approval to develop Pads 750/751/28 and add 2 sections to project area
- Amendment 8668Q
 - · Approval to conduct a pilot of water treatment technologies
- Amendment 8668R
 - Approval to abandon well G1I
- Amendment 8668S
 - Approval to conduct chemical injection test on Pad 21 (D-Pattern Injectors)



Scheme Approval Amendments

- Amendment 8668T
 - · Pad 819 Approval
- Amendment 8668U
 - Maximum Operating Pressure Approval
- Amendment 8668V
 - NCG Expansion Project and Phase 5D/F Chemical Injection Approval
- Amendment 8668W
 - MR CPF Expansion Project and Directive 081 Waiver Approval
- Amendment 8668X
 - · Administrative reissue approval
- Amendment 8668Y
 - WHIP for Phases 5B2, 5D and 5F Patterns approval
- Amendment 8668Z:
 - Pad 828 change from 3 well pairs to 2 wells pairs and correction of well UWIs on Pad 21 Chemical Injection Test (D-Pattern Injectors) approval issued December 10, 2014.
- Amendment 8668AA:
 - Phase 1 NCG design amendment approval issued December 19, 2014.
- Amendment 8668BB:
 - Phase 2 and Phase 3 Chemical Co-Injection (E, F and G Patterns) approval issued January 1, 2015.

- Amendment 8668CC:
 - Approval for E1P Sidetrack well issued January 27, 2015.
- Amendment 8668DD:
 - Approval for NN6P Sidetrack well issued February 3, 2015.
- Amendment 8668EE:
 - Approval for VX[™] multiphase meter on Pad 824 issued February 19, 2015.
- Amendment 8668FF:
 - Approval for NCG Test at OO5I well on pad 24 issued March 17, 2015.
- Amendment 8668GG:
 - Approval to conduct CO2 Co-Injection at the OO9 well pair on Pad 24 issued April 13, 2015.
- Amendment 8668HH:
 - CO2 Co-Injection amendment to change to OO8 well pair on Pad 24 issued.
- Amendment 8668II:
 - Pad 824 Thermal Compatibility Assessment approval issued July 14, 2015.
- Amendment 8668JJ:
 - Approval for NCG Test at OO7I issued July 29, 2015.
- Amendment 8668KK:
 - Approval for an alternate MOP Strategy Trial.
- Amendment 8668LL:
 - · Approval for C2IPB Sidetrack Well.
- Amendment 8668MM:
 - Approval for Pad 750 Thermal Compatibility Assessment.



Scheme Approval Amendments

- Amendment 8668NN:
 - · Approval to increase MWHIP for all operating wells.
- Amendment 866800:
 - · Approval to alter DA, DB, DC and DF Pattern MWHIPS;
- Approval to adjust CO2 co-injection rate;
 - Approval to extend chemical co-injection test at the D pattern wells on Pad 21.
- Amendment 8668PP:
 - · Approval for abandonment of A3I.
- Amendment 8668QQ:
 - Approval to change Clause 32.
- Amendment 8668RR:
 - CO2 Extension
- Amendment 8668SS:
 - Phase 2 and 3 NCG Injection
- Amendment 8668TT:
 - Temporary Increase to BH MOP for Unloading
- Amendment 8668UU:
 - Subsurface Heating Pilot
- Amendment 8668VV:
 - MOP Increase QQ2 to QQ16
- Amendment 8668WW:
 - MWHIP Increase
- Amendment 8668XX
 - MOP Increase QQ Wells

Amendment 8668YY:

Field Wide NCG

Amendment 8668ZZ:

6 Month MOP Trial QQ Wells

Amendment 8668AAA

ER Pilot

Amendment 8668BBB

Thermal Assessment for Pad 751

Amendment 8668CCC

Addition of Sustaining Pad 826



Amendments Made in Reporting Year

- Amendment 8668YY:
 - Field Wide NCG
- Amendment 8668ZZ:
 - 6 Month MOP Trial QQ Wells
- Amendment 8668AAA
 - ER Pilot
- Amendment 8668BBB
 - Thermal Assessment for Pad 751
- Amendment 8668CCC
 - Addition of Sustaining Pad 826



Current Amendments / Applications

- As of August 31, 2018, there were two applications under review related to the MacKay River project:
 - Amendment 8668BBB
 - Thermal Assessment for Pad 751
 - Amendment 8668CCC
 - Addition of Sustaining Pad 826



Environmental Initiatives

Suncor provides funding and support to the Oil Sands Monitoring Program and its governance structure and is also an active member of:

- The Wood Buffalo Environmental Association (WBEA) and its continued work through OSM;
- The Alberta Biodiversity Monitoring Institute (ABMI) and its continued work through OSM;
- The Athabasca Watershed Planning and Advisory Council (AWC-WPAC);
- The Canadian Oil Sands Innovation Alliance (COSIA);
- Mining Association of Canada Toward Sustainable Mining initiative;
- Oil Sands Spill Coop Area Y;
- Alberta Association of Conservation Offsets (AACO).

Suncor is in ongoing consultation with:

- Regional stakeholders;
- Aboriginal Communities and the local Municipality.



Land Disturbance and Reclamation (EPEA)

- A Project-Level Conservation, Reclamation & Closure Plan (PLCRCP) was submitted to the AER October 31, 2018
 - Followed AER's SED 001 (AER, 2016)
 - Presented a project-level reclamation material balance and a realistic schedule for reclamation and closure
 - Authorized by AER March 7, 2019
 - Subsequent EPEA approval amendment issued April 17, 2019



Land Disturbance and Reclamation (EPEA)

- Activities completed in 2018:
 - 0.8 ha of land disturbed at SML 140005 borrow pit for wellpad construction (the SML falls within the Dover Project but is used for MacKay River construction)
 - 0.5 ha of reclaimed land re-disturbed for WMF maintenance activities
 - 0 ha of land reclaimed
- Activities planned for 2019:
 - Vegetation using local trees & shrubs at:
 - Pad 40 Remote Sump ~ 4.6 ha
 - Recreation Area ~ 0.3 ha
 - Field work to assess abandoned wells & other sites that may be Ready for Reclamation
 - Develop relevant Conservation & Construction Plans, as per SED 001 (AER, 2016)
 - Clear vegetation in support of AGP for Wellpad 751 West/East
 - Re-reclaim the 0.5 ha of land at the WMF



Regulatory Compliance

- As noted earlier Suncor has communicated with the AER regarding:
 - Landfill:
 - Berm Expansion, Waste Pilot project, temporary placement of tanks
- Suncor Energy Inc. is in compliance with all regulatory approvals, decisions, regulations and conditions as described in Decision Report 2000-50; specifically pertaining to:
 - Plant and waste management facility location,
 - Ground level ozone and VOC monitoring,
 - Groundwater monitoring wells,
 - Surface water quality monitoring, and
 - Participation in Regional Initiatives.



Summary of Key Learnings (Operations)

- Continued focus on Suncor's Safety Task force initiatives driving and reinforcing correct behaviours:
 - Primary focus on operational discipline and leadership;
 - Dedication to improving onsite process and personal safety.
- Continual focus on process indicators continues high performance of reliability:
 - Record consecutive days without unplanned steam outages;
 - Record consecutive days of on-spec boiler feed water.
- Many learnings from a safety and onsite performance perspective post 2016 wildfire at Mackay River- well performance, pipeline availability, etc.;
- Focus on brine dryer operation has significantly reduced offsite disposal.
 Further improvements and efficiencies to be realized.





Future Plans

Project Description	Comments	Status		
Mackay River optimization .	Unlocking throughput availability with improvements and testing to design	Currently being evaluated.		
Pad 750 ramp up	Continue with ramping up production from Pad 750	Ongoing		
Pad 751 development and construction	Sustaining production	Currently in development		
Pad 819 development and construction	Sustaining production	Currently in development		
Considering installations of flow control devices (FCD)	Improve SOR and reduce emission	Currently under evaluation		





