LEISMER
RESOURCE MANAGEMENT REPORT
FOR THE PERIOD JANUARY 1 – DECEMBER 31, 2014

SUBMITTED April 2015

Summary

- Twenty seven (27) oil sands evaluation wells were drilled in 2014. The mapping enclosed within has been updated with the 2014 well data.

- The pressure trends observed through 2014 in nine observation wells equipped with Vibrating Wire Piezometers are discussed.

- Pressure measurements were taken in two (2) oil sands evaluation wells with the wireline Multi-Sample Formation Tester.

A. Introduction

This submission is the annual Resource Management Report (RMR) for the Nexen Energy ULC ("Nexen") Leismer oil sands property as required under the Chard-Leismer Decision (EUB Decision 2003-23). It is specified in the decision that the RMR is to include a review of the management of the oil sands resource, and an assessment of the effect that the pressure in the overlying gas zone has on the recovery of bitumen by SAGD (Steam-Assisted Gravity Drainage). This report is the eleventh RMR to be submitted for the property. This submission covers the period from January 1, 2014 to December 31, 2014.

B. Area Overview

Nexen's Leismer oil sands property is situated within the Athabasca Oil Sands Area of Alberta in Townships 76, 77, 78, 79 and 80; Ranges 6, 7, 8 and 9 W4M (***Figure 1)***. The property is comprised of 134 sections or approximately 34,705 hectares. The oil sands in the Lower Cretaceous McMurray Formation are the target for delineation drilling to evaluate the original bitumen-in-place on the lands and the production potential using SAGD recovery.

Leismer continues to be an integral part of Nexen's integrated Athabasca Oil Sands development strategy with commercial development planned in the future. In support of future plans, a total of 27 oil sands evaluation wells were drilled on the property in 2014, increasing the well control to 8 to 16 wells per section through a bitumen pay trend found in Sections 16, 17,18, 19, 20, 21, 28, 29, and 30 in T 77, R7W4. These sections are covered by a 3-D seismic survey. This bitumen pay trend continues through Sections 22, 23, 26, 27, 32, 33, 34, and 35 in T 77, R7W4, and Section 2 in T 78, R7W4. This part of the trend has a well density of 4 to 5 wells per section and is also covered by 3-D seismic. The remaining sections in the Leismer lease have a well density of zero to three wells per section and are covered by a grid of 2-D seismic lines.

Twenty-seven wells were drilled in 2014. The objective of these wells was to further delineate the reservoir. Of the 27 wells drilled, 15 wells were cored through the McMurray; the remaining 12 wells were not cored.

C. Land

The Nexen Leismer Property is comprised of 134 sections of oil sands leases, as shown in ***Figure 1***. There have been no changes to the land base in the reporting period.

D. Area Development

1. General Area Activity

Considerable oil sands appraisal activity has occurred over the past year on the oil sands leases west, east and south of Nexen's oil sands property. Oil sand leases to the west are operated by Grizzly Oil and StatoilHydro Canada Ltd., to the east by MEG Energy and Cenovus Energy, and to the south by Devon Energy.

2. Review of Nexen Leismer Appraisal Activity

The following is a summary of 2014 activities.

a. 2014 Appraisal Drilling

Twenty-seven (27) oil sands evaluation wells were drilled and abandoned through January to March 2014 (***Figure 1).*** The 2013-2014 drilling program occurred within T 77, R7W4M. Sections 16, 17, 18, 19, 20, 21, 28, 29, and 30 in T 77, R7W4 now have a well density of eight to fourteen wells per section and are covered by a 3-D seismic survey.

b. Future Delineation

A 37 well oil sands evaluation program was planned for the 2014-2015 winter drilling season and has since been cancelled. Leismer continues to be an integral part of Nexen's integrated Athabasca Oil Sands development strategy with commercial development planned in the future.

c. Coring Operations

Core was cut on 15 wells starting from the approximate top of the Wabiskaw Member and continuing through the entire McMurray Formation. One additional well (AC/14-17-077-07W4) had core cut through the surface and into the Joli Fou Formation in order to more accurately characterize Quaternary and Tertiary aquifers in the proposed Leismer project area.

Analysis of the core collected from the Wabiskaw/McMurray interval included Dean-Stark analysis on oil-saturated sections of generally one meter length, for determination of bulk mass oil, water and solids, and oil and water saturations. Small plug analysis was done for porosity and permeability determination at less frequent intervals.

During the 2014 delineation program, 42 frozen core samples were collected from 4 wells at Leismer (1AC/15-07-077-07W4M/00, 1AA/04-27-077-07W4M/00, 1AB/12-16-077-07W4M/00, and 1AC/14-17-077-07W4M/00) and sent to Gushor for oil analysis. Viscosity and API gravity analysis was completed on all 4 wells. Samples from well 1AC/14-17-077-07W4/00 were also analyzed for molecular composition, bulk composition (SAPP), and sulfur content. Samples which produced water upon mechanical extraction were submitted for detailed geochemical analysis at the University of Calgary.

All of the cores were described in detail in accordance with Nexen-defined facies guidelines. Image logs were run in the wells that were not cored and the images were also interpreted in accordance with Nexen-defined facies.

E. Bitumen Evaluation Results

The McMurray Formation Bitumen Pay Map ***(Figure 2)*** has been updated with Nexen's 2014 Leismer drilling results. The bitumen pay interval is defined by the following cut-offs:

- Oil saturation (S_o) greater than or equal to 50%;
- Shale volume (V_{sh}) less than or equal to 30%;

The top of the bitumen pay section is bounded by two metres or more of continuous non-pay (intervals in which the S_o is less than 50% or V_{sh} exceeds 30%) or by 4m of cumulative non-pay. Alternatively, it may be bounded by the top of the McMurray estuarine channel section, in cases where thick, bitumen-saturated sands extend to near the top of the McMurray.

The base of the bitumen pay section may be bounded by the same non-pay thicknesses as above. Alternatively, the base of the bitumen pay section may be the contact with a McMurray bottom water zone (in which So is less than 50%), or it may be the top of the Devonian, in areas where clean bitumen-saturated sands directly overlie the Devonian surface.

The mapped bitumen pay zone tends to be the stratigraphically-deepest, thickest, and most laterally-continuous pay zone. Bitumen-saturated sands found above the McMurray regional A2 and B2 mudstones, and other secondary pay zones in the reservoir interval, are not included within the mapped interval.

The aforementioned cut-offs delineate the bulk of the bitumen resource within the McMurray valley-fill that may be recovered by SAGD.

The 2014 evaluation well program further delineated the thick McMurray pay trends as mentioned above. Additional drilling programs and ongoing integration of seismic and well data sets will be required to delineate the distribution and orientation of the McMurray point bar sands before horizontal SAGD wells can be planned.

F. Region of Influence Mapping

The updated maps that determine the "region of influence" have been included. These maps have been updated with 2014 well information, and are as follows:

Figure 3**:** Wabiskaw/McMurray Gas Shut-ins and Exemptions as of Nov. 10, 2005
Figure 4**:** Wabiskaw "C" Structure
Figure 5**:** Wabiskaw "C" Gas Net Thickness (m)
Figure 6**:** McMurray Top Gas Net Thickness (m)
Figure 7**:** McMurray Gross Top Water Isopach (m)

Figures 4 through 7 are discussed in the following sections.

a. Wabiskaw "C" Structure and Wabiskaw "C" Sand Gas Net Pay Maps

The Wabiskaw "C" sand is a thin, widespread and porous unit. Wabiskaw "C" gas pools are typically aerially large, continuous, and coincident with the Wabiskaw "C" sand structural high trends (***Figure 4***). Structure on the Wabiskaw "C" sand provides a structural reference for both the Wabiskaw "C"' sand gas accumulations (***Figure 5***) and the underlying McMurray gas accumulations. The data collected from the 2014 evaluation program did not change the broad NE/SW structural trend previously mapped across the Leismer Lease.

b. McMurray Gas Net Pay Map

The McMurray Formation gas pools are shown on ***Figure 6*** and shows where gas occurs above the McMurray regional "A2" mudstone, above the McMurray regional "B2" mudstones, and in the valley-fill/channel section, and generally coincident with structural highs.

The map includes, in part, gas that is defined in the EUB Regional Geological Study Report (Report 2004-A) ("the RGS") as occurring in the "Wabiskaw "D" Valley-fill" deposits. The Wabiskaw "D" Valley-fill deposits appear to be interpreted in the RGS as occurring primarily in the McMurray channel section, and also lapping onto and across the erosional edge of the regional McMurray "A2" mudstone.

The gas pooling methodology used on this map is as follows:

- Gas-water contacts with +/- 1 meters, and
- Gas-bitumen contacts with +/- 5 meters

c. Wabiskaw "D" Valley Fill

Nexen's current position on the Wabiskaw "D" Valley-fill in the Leismer area is outlined in the Leismer RMR submitted in 2007. Although Nexen's current interpretation of the Wabiskaw does not include a Wabiskaw "D" Valley-fill, the presence of this unit does not change Nexen's interpretation that lateral and vertical pressure communication is likely through the Wabiskaw-McMurray interval via sand-to-sand contacts.

d. McMurray Gross Top Water Isopach

The numerous gas pools shown in ***Figure 6***, occurring both above the preserved regional mudstones and within the McMurray channel section, overlie broad regions of top water across the Leismer lease.

Figure 7 shows Nexen's current interpretation of water occurring in the channel section of the McMurray Formation. This map was constructed using the following cut-offs:

- Density porosity greater than or equal to 15%.
- Deep resistivity less than or equal to 10 ohm-metres.
- Shale volume less than or equal to 50%.

Nexen's interpretation is that the combination of gas pools and extensive top water forms a broad region of influence through which pressure changes can be transmitted. The 2014 evaluation program further delineated the distribution of top water in the McMurray valley-fill/channel section.

G. Assessment of Pressure Depletion in the Leismer Area

Pressure data collection occurred in 2014 with pressure measurements taken in various formations in two (2) oil sands evaluation wells with the wireline Multi-Sample Formation Tester tool. Pressure measurements were done to assess current pressures in the Wabiskaw-McMurray, as well as in possible future water source and disposal zones.

A summary of all pressures sampled from the oil sands evaluation wells is presented in ***Table 1***.

The observation well pressure data was also collected in 2014 from the existing vibrating wire piezometer (VWP) wells and will be discussed in next sections.

It is expected that pressure measurements will continue to be taken in future drilling programs, where suitable zones are encountered. New data will be used in ongoing pressure analysis to determine and monitor the impact of offsetting gas operations in the area.

Table 1: Leismer Pressure Summary

Leismer - MDT Pressure Summary				
Well	Run Date	Formation	Depth (mKb)	Measured Pressure (kPaA)
1AA/13-26-077-07W4/0	1/8/2014	Grand Rapids B	189.99	1103.84
		Grand Rapids B	201.98	1221.68
		Clearwater A	226.01	1666.63
		Clearwater A	235.02	1756.06
		Clearwater B	268.74	608.18
		Clearwater B	269.01	611
1AB/09-21-077-07W4/0	12/19/2013	Grand Rapids B	187.5	1109.97
		Grand Rapids B	202.99	1263.22
		Clearwater A	231.18	1742.28
		Clearwater A	239.99	1828.74
		Clearwater B	265	582.38
		Clearwater B	270.03	661.04
		Clearwater B	275	393.77
1AA/02-18-077-07W4	3/10/2013	UPPER GR	143.0	900
		GR B	190.0	1143
		GR B	202.0	1261
		CW A	225.0	--
		CW B - GAS	247.0	185
		CW B	261.0	241
		CW B	269.0	320
		CW B	272.0	350
		WBSK C - GAS	299.3	1981
1AA/02-19-077-07W4	2/27/2013	UPPER GR	141.0	891
		GR B	180.0	1063
		GR B	195.0	1211
		CW A	225.0	1702
		CW A	230.0	1751
		CW A	230.0	--
		CW B	260.0	--
		CW B	260.3	--
		UPPER MCM	302.4	2011
1AA/07-17-077-07W4	3/3/2013	UPPER GR	147.0	899
		GR B	192.0	1133
		GR B	207.0	1281
		CW A	226.1	1652
		CW B	247.0	--
		CW B	275.0	--
		WBSK C - GAS	300.0	1971
		MCM TOP WATER	311.6	2027
1AA/14-17-077-07W4	2/27/2013	UPPER GR	142.0	862
		GR B	189.0	1120
		GR B	203.0	1257
		CW A - GAS	223.0	1659
		CW B - GAS	247.0	--
		CW B	270.0	--
		WBSK C - GAS	297.0	1948
1AA/03-29-077-07W4	1/10/2007	GR B	190	1270.4
		CW A	223	1788.4
1AA/09-29-077-06W4	1/2/2007	GR B	235	1294.4
		CW A	270	1829.1
		CW B	300	1204.4
		MCM BOT WTR	386	2231.4
1AA/10-26-076-08W4	1/17/2007	GR B	222	1554.4
		CW A	247	1938.4
		CW B	272	834.4
		CW B	295	1057.4
1AA/09-04-078-08W4	2/20/2007	GR B	207	1171.4
		CW A	235.5	1618.4
		CW A	239	1645.4
		MCM TOP WTR	309.3	1966.4
		MCM TOP WTR	309.8	1978.4
1AA/11-01-078-08W4	2/15/2007	GR B	188.5	827
		GR B	207	1099.5
		CW A	231.5	1559.4
		CW B	273	1170.4
		WBSK C	302	1744
1AA/02-29-077-08W4	2/20/2007	GR B	203.3	1219.4
		GR B	222	1407.4
		CW A	243.5	1828.4
		MCM TOP WTR	332.5	2282.4
1AA/16-22-077-07W4	2/1/2005	WBSK C	313	1967
		MCM TOP WTR	318.3	2021
102/11-08-077-07W4	2003	WBSK C	307	2228
		WBSK C	307	2223
1AA/12-16-077-07W4	2003	WBSK C	305	2283
1AA/03-20-077-07W4	2003	WBSK C	298	2397
		MCM TOP WTR	301.6	2359
		MCM TOP WTR	305	2367
1AA/14-26-077-07W4	2003	WBSK C	304	1943
		MCM TOP WTR	312.5	2024
1AA/08-30-077-07W4	2003	WBSK C	296	2375
1AA/08-35-077-07W4	2003	WBSK C	306	2343
		MCM TOP WTR	313.5	2386
1AA/11-12-077-08W4	2003	WBSK C	312.8	2488
		WBSK C	312.9	2493
1AA/12-13-077-08W4	2003	WBSK C	302	1716
102/06-25-077-08W4	2003	WBSK C	297.8	2025
		WBSK C	297.8	2037
1AA/02-19-077-06W4	2003	WBSK C	305.9	1824
		MCM TOP WTR	312.5	1837
		MCM TOP WTR	312.5	1843
		MCM TOP WTR	317.5	1853
1AA/02-16-077-07W4	2002	WBSK C	307.8	2089
		MCM TOP WTR	317	2148
		MCM TOP WTR	317	2383
100/02-31-077-07W4	2002	WBSK C	290.2	786
		WBSK C	290.3	677
		WBSK C	290	398
1AA/10-30-077-06W4	2002	WBSK C	324	1808
		WBSK C	324.1	1801
		MCM TOP WTR	326.1	1791
		MCM TOP WTR	326.1	1790
1AA/15-01-078-07W4	2002	WBSK C	308.5	1689
100/07-13-077-08W4	2002	GR 'A'	156.5	1111
		GR 'B'	212	1474
		WBSK C	307.8	2115
		MCM BOT WTR	360.7	2602

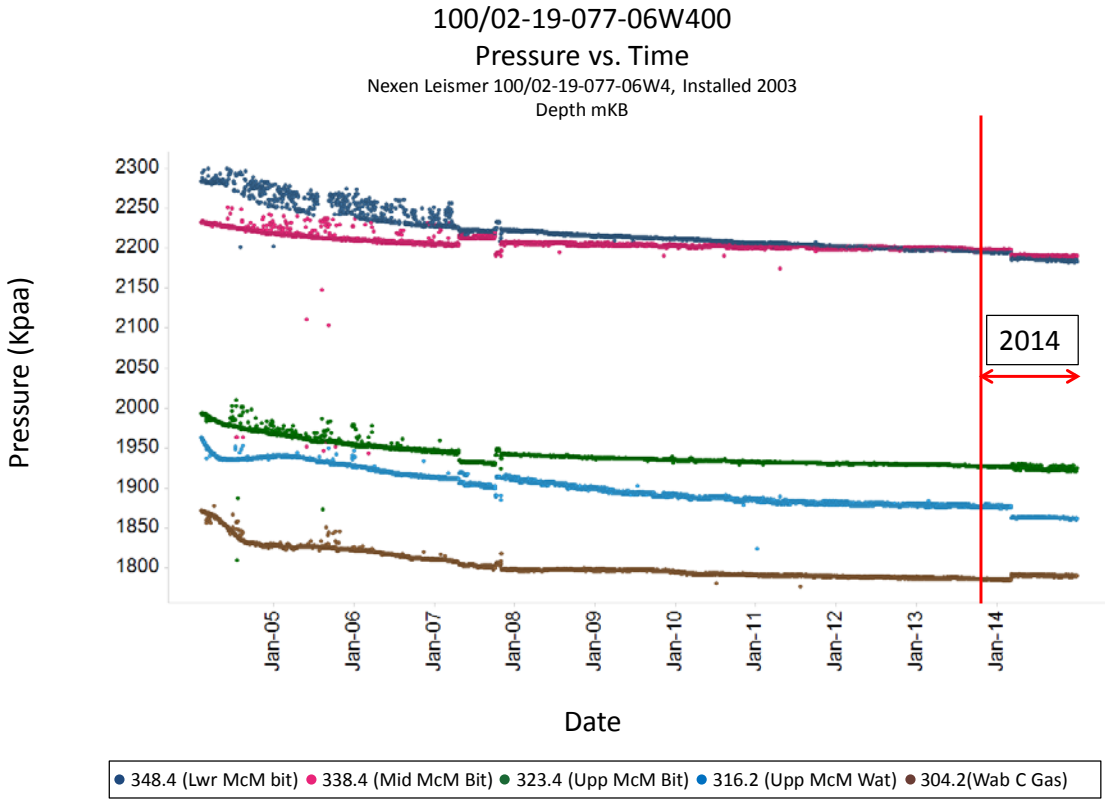
1. Pressure Monitoring Program/Vibrating Wire Piezometers

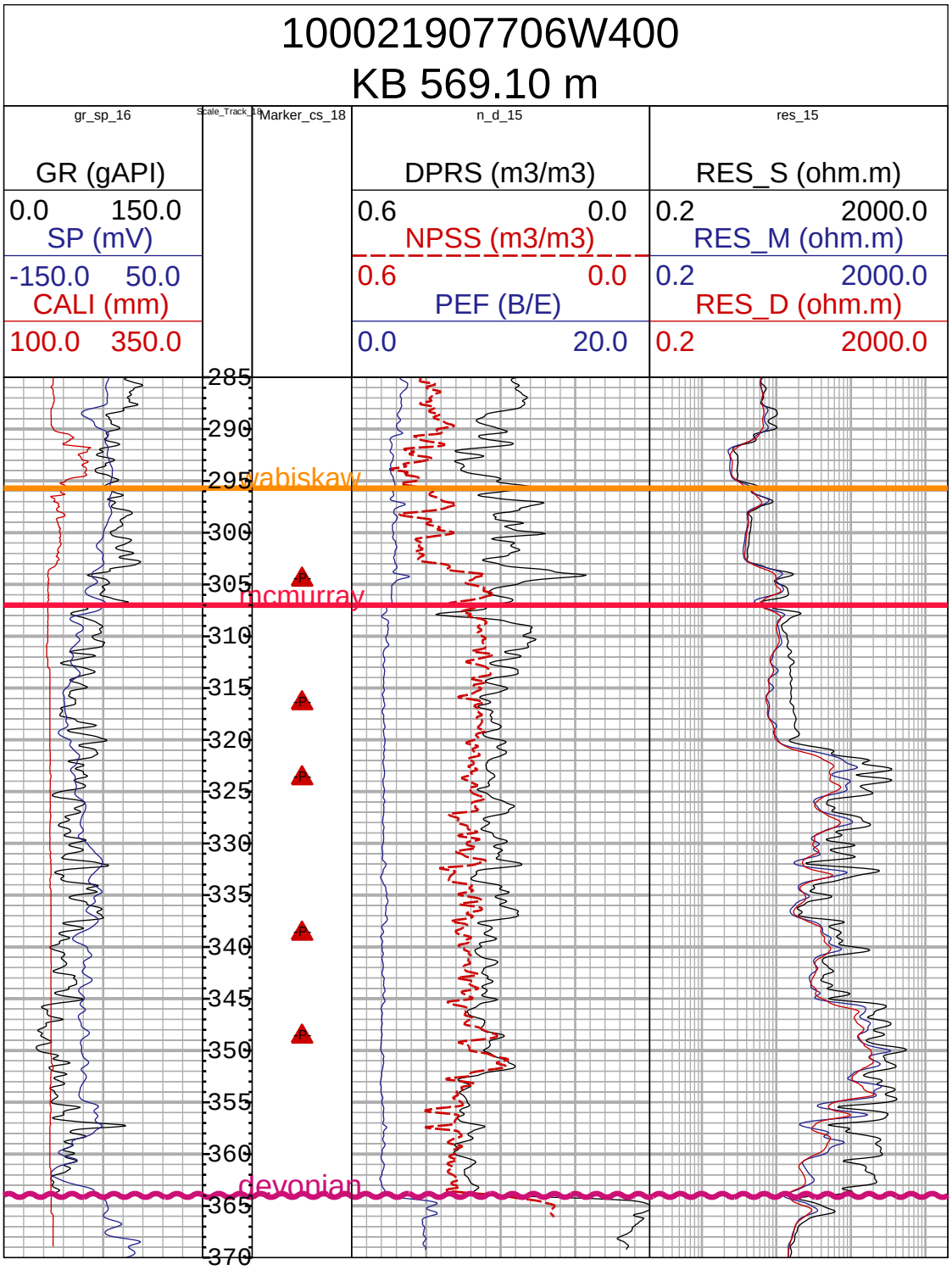
Vibrating Wire Piezometer (VWP) sensors were installed in nine (9) Leismer observation wells. The locations of these wells are shown on Figure 3. The background information has been provided in previous RMR's and therefore will not be repeated here. Updated time-based pressure plots have been included here along with updated observations and discussions regarding VWP performance. Annotated logs of each piezometer well have also been included to show the position of each VWP pressure sensor. All nine observation wells in Leismer were serviced in March 2014, including data logger and modem upgrades. Minor step changes in pressure around March 2014 have been due to the regular annual maintenance. The vendor (Thurber) also re-calibrates the VWPs and checks the batteries and regulators on a regular basis and replaces them if needed.

a. ***Nexen Leismer 100/02-19-077-06W4***

Five VWPs were installed in this well in 2003. All have remained operational through 2014.

Pressures in the lower, middle, and upper portions of the McMurray bitumen zone, McMurray top water zone, and in the Wabiskaw "C" zone have remained constant through 2014. As reported previously, the nearest offsetting gas producers, Devon 100/10-22-077-06W4, and Devon 100/02-06-078-06W4 were shut in in 2003 as a result of the Leismer-Chard gas-over-bitumen hearing decision. Devon 100/11-32-076-06W4 is currently producing gas from the McMurray formation in proximity to 02-19-077 which was not included in AER shut-in mandate (As part of the Leismer-Chard Hearing). Devon 100/09-06-077-06W4 is the other nearby producer which was producing gas from the McMurray formation until December 2010 and it has been shut-in since then. In previous reports, it was noted that the continuing slight drop in pressure in these sensors was evidence of lateral pressure communication over considerable distances. It now appears that the pressures in the monitored zones may be starting to stabilize.


100/02-19-077-06W400
Pressure vs. Time
Nexen Leismer 100/02-19-077-06W4, Installed 2003
Depth mKB
Pressure (Kpaa)
2300
2250
2200
2150
2100
2050
2000
1950
1900
1850
1800
2014
Jan-05
Jan-06
Jan-07
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Date
348.4 (Lwr McM bit)
338.4 (Mid McM Bit)
323.4 (Upp McM Bit)
316.2 (Upp McM Wat)
304.2(Wab C Gas)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Marker_cs_18
n_d_15
res_15
GR (gAPI)
0.0 150.0
SP (mV)
-150.0 50.0
CALI (mm)
100.0 350.0
DPRS (m3/m3)
0.6 0.0
NPSS (m3/m3)
0.6 0.0
PEF (B/E)
0.0 20.0
RES_S (ohm.m)
0.2 2000.0
RES_M (ohm.m)
0.2 2000.0
RES_D (ohm.m)
0.2 2000.0
285
290
295
300
305
310
315
320
325
330
335
340
345
350
355
360
365
370
wabiskaw
mcmurray
devonian

b. N*exen Leismer 100/02-31-077-07W4*

Seven VWPs were installed in this well in 2002.

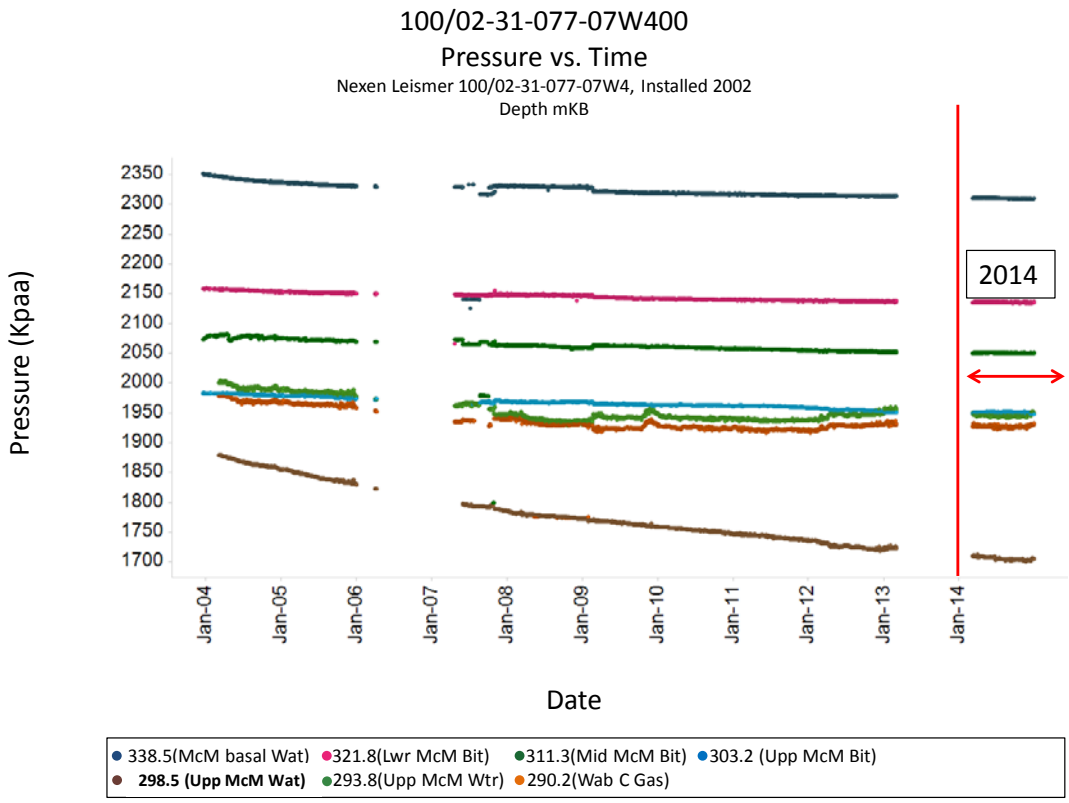
After a few month disruptions in collection of pressure data in March 2013, the well was serviced during the winter of 2013-2014 and data collection resumed in March 2014. Servicing included replacing the regulator due to high voltages measured, upgrading the logger to a CR1000 model and installing a new modem.

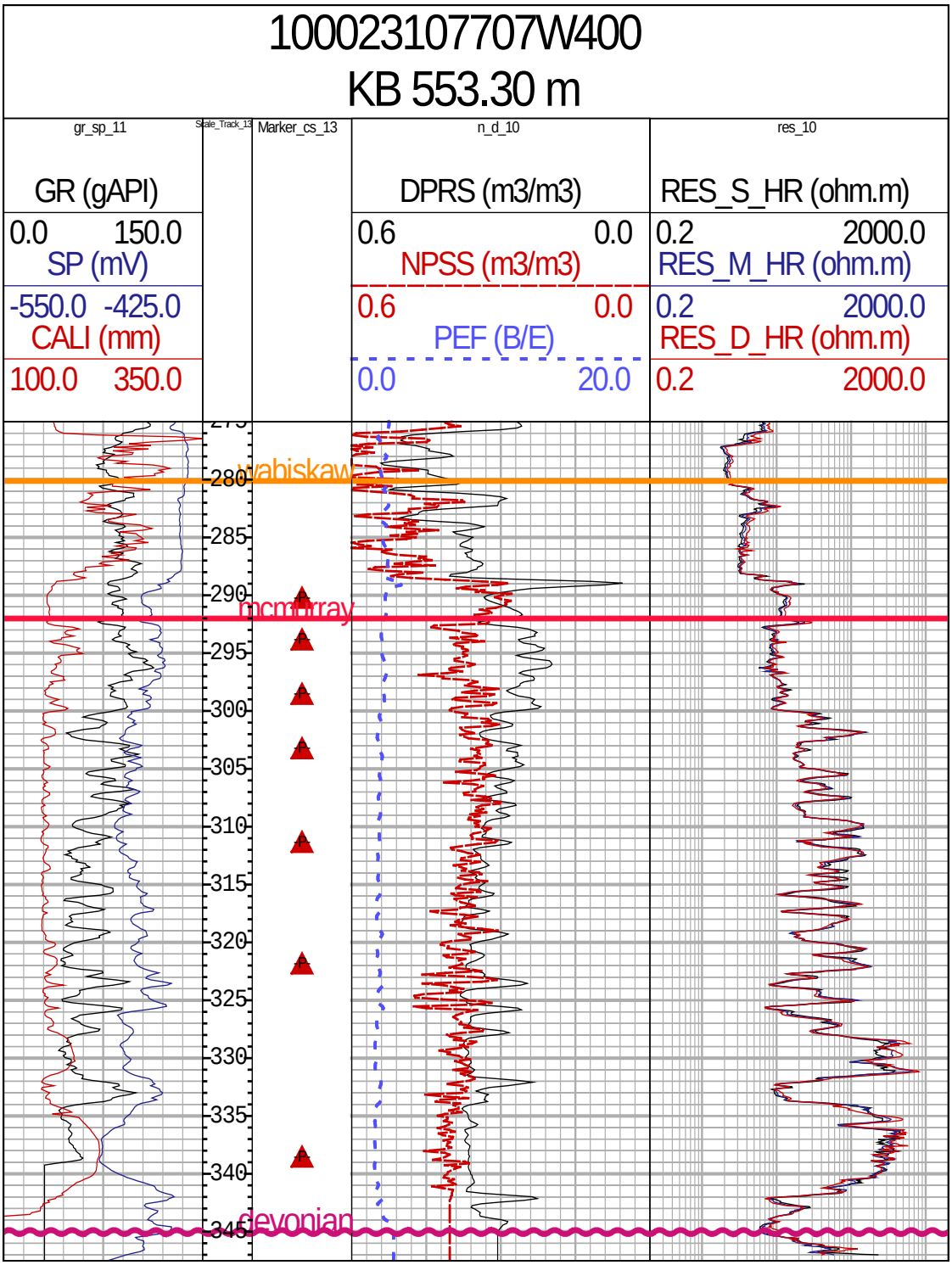
The uppermost 5 sensors in this well are positioned in the Wabiskaw “C” gas (one sensor), McMurray top water (two sensors) and McMurray bitumen (2 sensors). Sensors were also placed in the lower McMurray bitumen and in the McMurray bottom water zone.

In previous reports, pressure declines in the upper sensors at 100/02-31 were linked directly to continuing gas production from the McMurray “A” shoreface zone at the Devon 102/11-01-077-08W4 and 100/06-02-077-08W4 wells. The 102/11-01 well has been suspended since November 2011, while the 100/06-02 well has continued to produce gas until October 2012. Through the latter part of 2012, some slight pressure rebound was noted in the Wabiskaw “C” gas zone and in the McMurray top water upper sensor.

Generally from January to December 2014, the lowermost 5 sensors have shown a flat trend. The 303.2 mKB sensor has also remained relatively unchanged through this time, as in the past; this may be related to its position in a muddy zone in the upper McMurray causing local isolation from the pressure effects seen by the other upper sensors.

It was previously noted that the 298.5 mKB McMurray top water sensor shows the lowest McMurray pressure recorded at any of the Nexen Leismer VWP wells. Two possible reasons for this pressure behavior are: a) the piezometers may not be in correct order as the temperature shows the same anomaly. The vendor (Thurber) will have a field visit in Winter 2015 to investigate the problem and verify the reliability of measuring equipment; b) It seems that two nearby wells (100/06-30-077-07W4 and 102/07-26-078-04 located 2-3 km south of 100/02-31) have been producing gas commingled from the Clearwater and McMurray formations since 1999 and the McMurray was isolated (squeezed) later (date is unknown). This may be the reason for the lower pressure initially at 298.5 KB (Upper McMurray sensor) prior to starting pressure monitoring in this well in 2002. This sensor also started showing some slight pressure rebound through the latter part of 2012 and was relatively stable through the beginning of 2013.


100/02-31-077-07W400
Pressure vs. Time
Nexen Leismer 100/02-31-077-07W4, Installed 2002
Depth mKB
Pressure (Kpaa)
2350
2300
2250
2200
2150
2100
2050
2000
1950
1900
1850
1800
1750
1700
2014
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Date
338.5(McM basal Wat)
321.8(Lwr McM Bit)
311.3(Mid McM Bit)
303.2 (Upp McM Bit)
298.5 (Upp McM Wat)
293.8(Upp McM Wtr)
290.2(Wab C Gas)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Marker_cs_13
n_d_10
res_10
GR (gAPI)
0.0 150.0
SP (mV)
-550.0 -425.0
CALI (mm)
100.0 350.0
DPRS (m3/m3)
0.6 0.0
NPSS (m3/m3)
0.6 0.0
PEF (B/E)
0.0 20.0
RES_S_HR (ohm.m)
0.2 2000.0
RES_M_HR (ohm.m)
0.2 2000.0
RES_D_HR (ohm.m)
0.2 2000.0
wabiskaw
mcmurray
devonian
280
285
290
295
300
305
310
315
320
325
330
335
340
345

c.

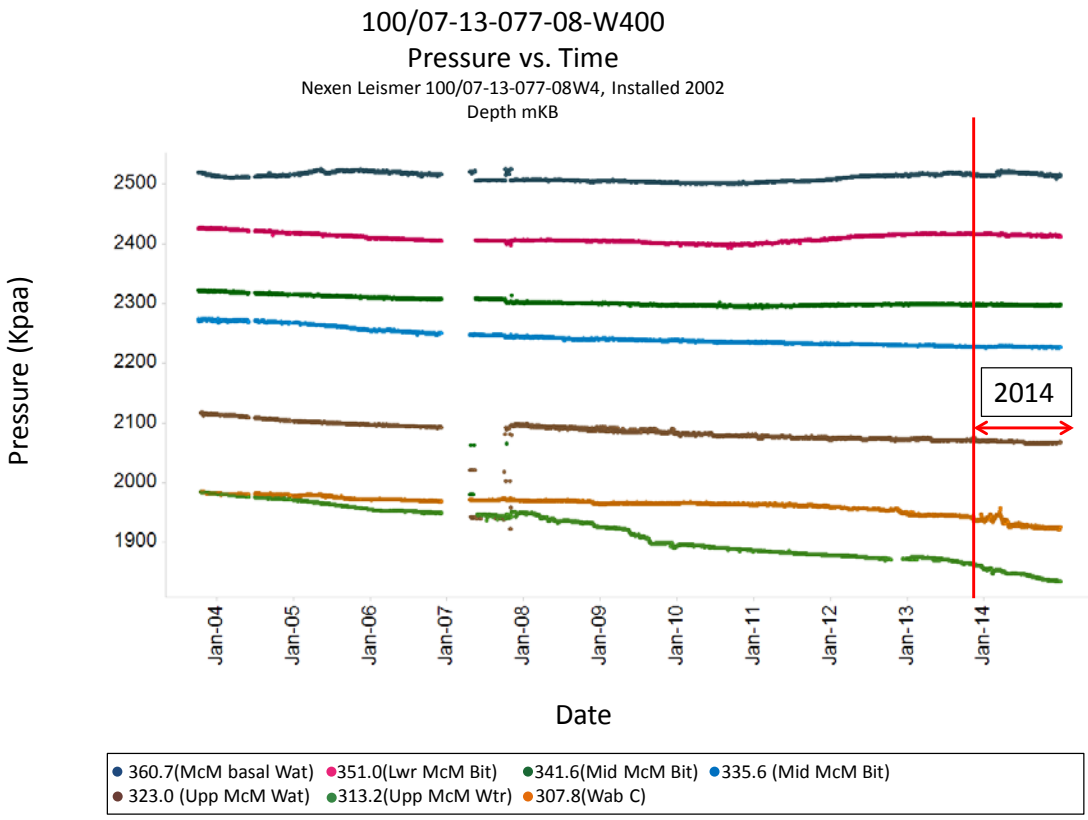
Nexen Leismer 100/07-13-077-08W4

Seven VWPs were installed in this well in 2002. All have continued to transmit data through 2014.

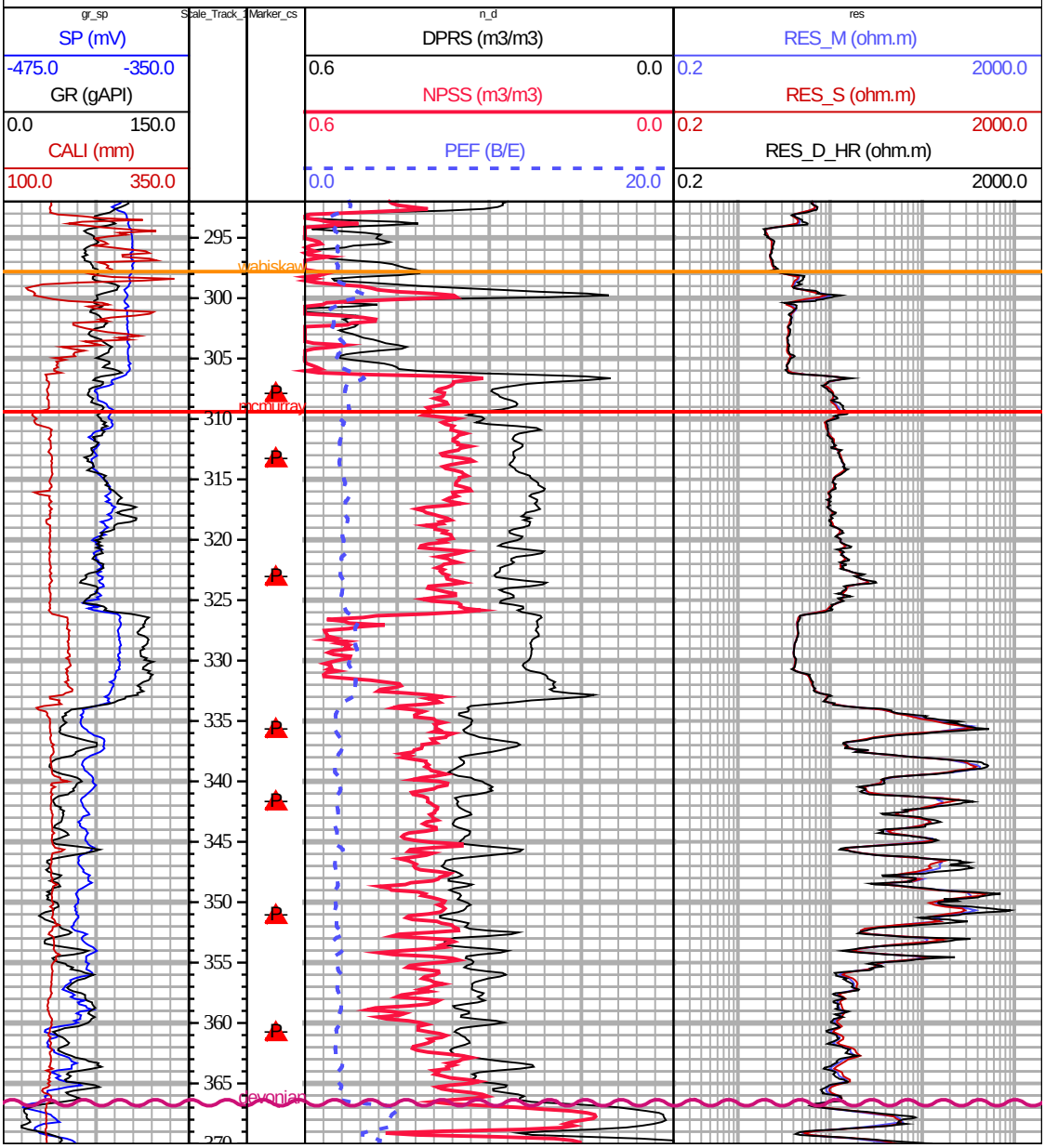
The upper 4 sensors, located in the middle McMurray bitumen zone, McMurray top water and Wabiskaw "C" have continued to show losses in pressure of 1 to 4 kPa through 2014. The most pronounced pressure decline is observed in the McMurray top water at the 313.2 mKB sensor (a decrease of about 30 kPa). As was reported in previous RMRs, the continued pressure decline is interpreted to be the ongoing effects of gas production at the offsetting Devon gas wells, 100/06-02-077-08W4 (shut-in since October 2012) and 102/11-01-077-08W4 (102/11-01-077-08W4 was a commingled McMurray-Clearwater producer from 1980 until the McMurray formation was squeezed and plugged back after the Leismer-Chard Hearing Decision. A pressure test on the bridge plug is recommended to verify the complete isolation of McMurray formation). The pressure decline rate has increased in 2014 and this may be due to the slight gas production from Upper McMurray formation in 100/07-14-077-08W4 and 102/11-01-077-08W4 (There has been mention in the completion report (Ref. AccuMap) that the McMurray formation has been plugged back in both wells but there may still be some gas production due to leakage of bridge plugs).

The lower 3 sensors, located in the McMurray bottom water and the lower and middle bitumen zones have shown slight pressure decreases of 1 to 2 kPa through 2014.

The uppermost sensor at 307.8 mKB is in the Wabiskaw "C" sand, which does not contain producible gas at this location. The zone has low permeability due both to the nature of the Wabiskaw lithology as well as to some bitumen saturation (visible in core). Higher pressure (though still declining) in this zone, as compared to that in the underlying 313.2 mKB McMurray sensor, indicates that it is less well-connected with the source of pressure depletion than is the higher-permeability (high water saturation) upper McMurray.


100/07-13-077-08-W400
Pressure vs. Time
Nexen Leismer 100/07-13-077-08W4, Installed 2002
Depth mKB
Pressure (Kpaa)
2500
2400
2300
2200
2100
2000
1900
2014
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Date
360.7(McM basal Wat)
351.0(Lwr McM Bit)
341.6(Mid McM Bit)
335.6 (Mid McM Bit)
323.0 (Upp McM Wat)
313.2(Upp McM Wtr)
307.8(Wab C)

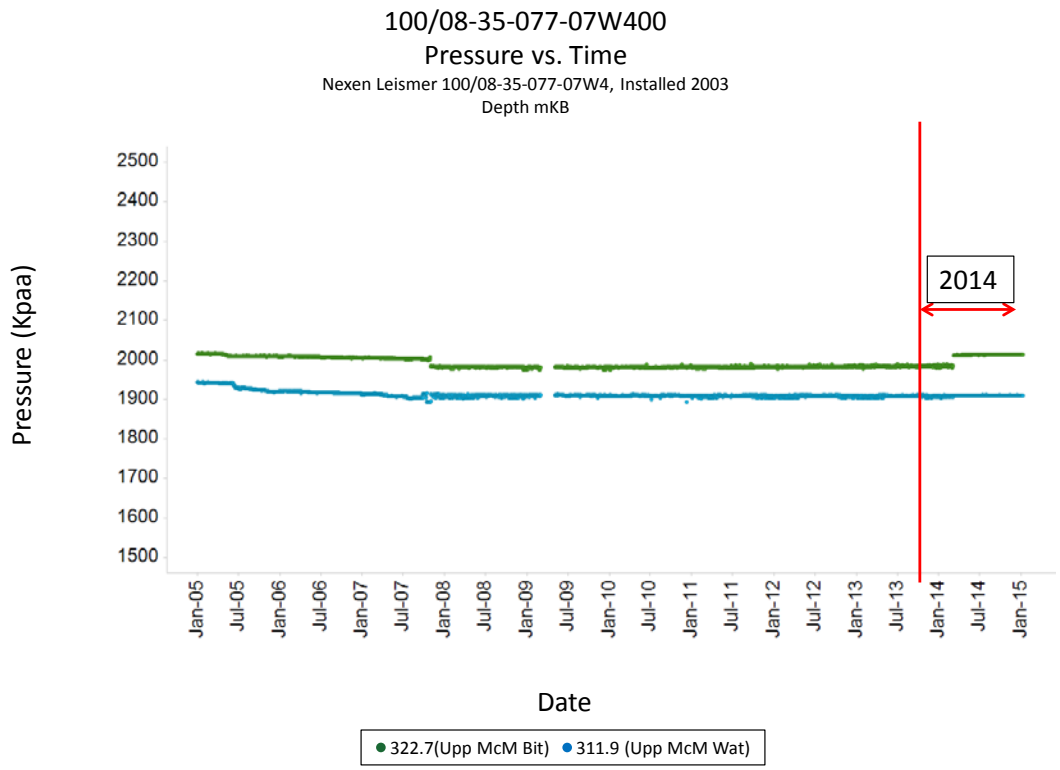
100071307708W400
KB 559.50 m

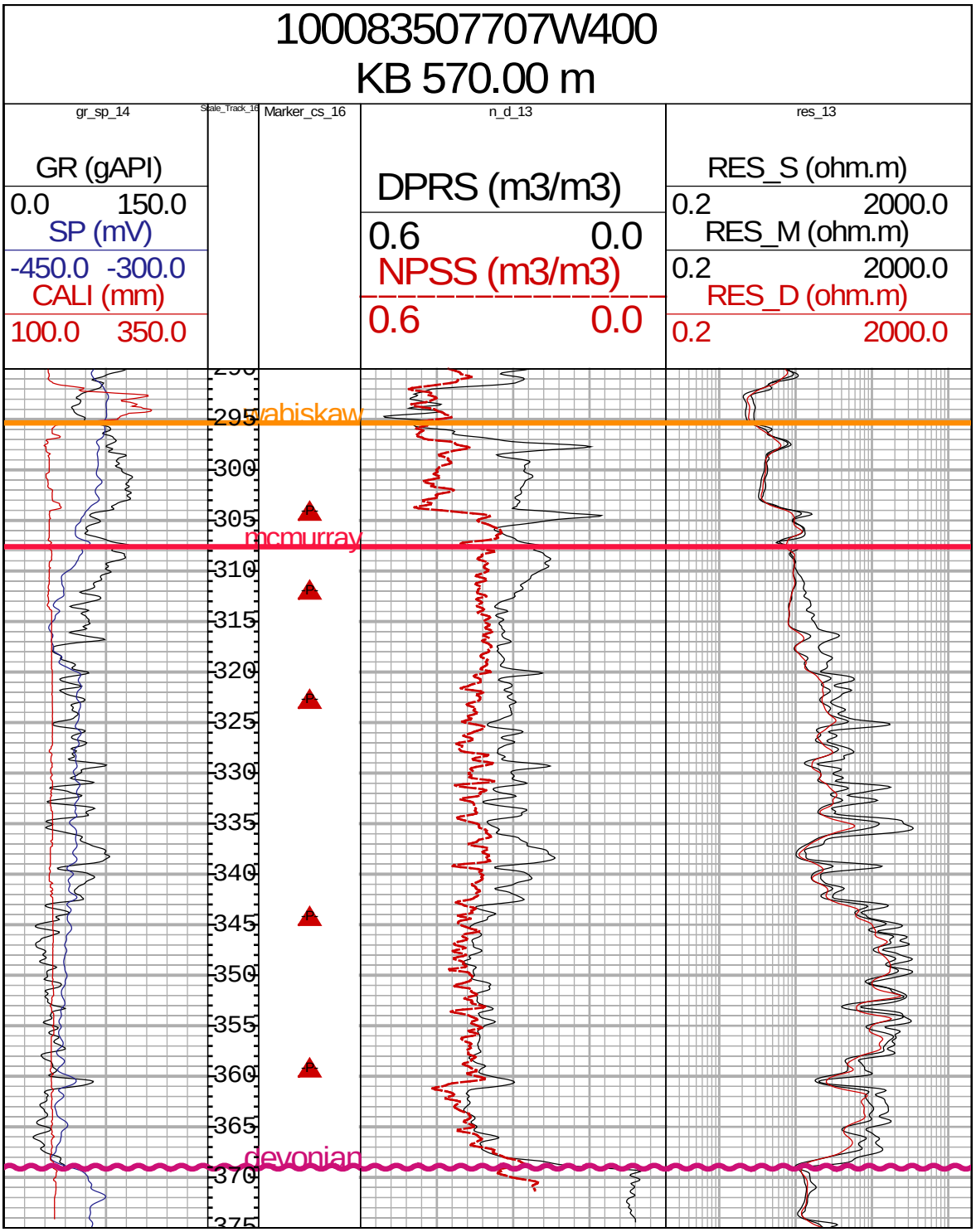


d. Nexen Leismer 100/08-35-077-07W4

Five VWPs were installed in this well in 2003. As has been reported in previous RMRs, three of the sensors failed through time and have been removed from the pressure-time plot.

The sensors in the upper McMurray bitumen at 322.7 mKB and in the McMurray top water at 311.9 mKB are recording pressures that appear to be reasonable. The pressures at the sensors at 322.7 mKB and 311.9 mKB have been stable in 2014 with measurements of 2,012 and 1,910 kPa respectively. The two sensors are 10.8m apart, and are showing a difference between them of approximately 102 kPa which is in agreement with the difference from the expected gradient of 10 kPa/m (108 kPa).



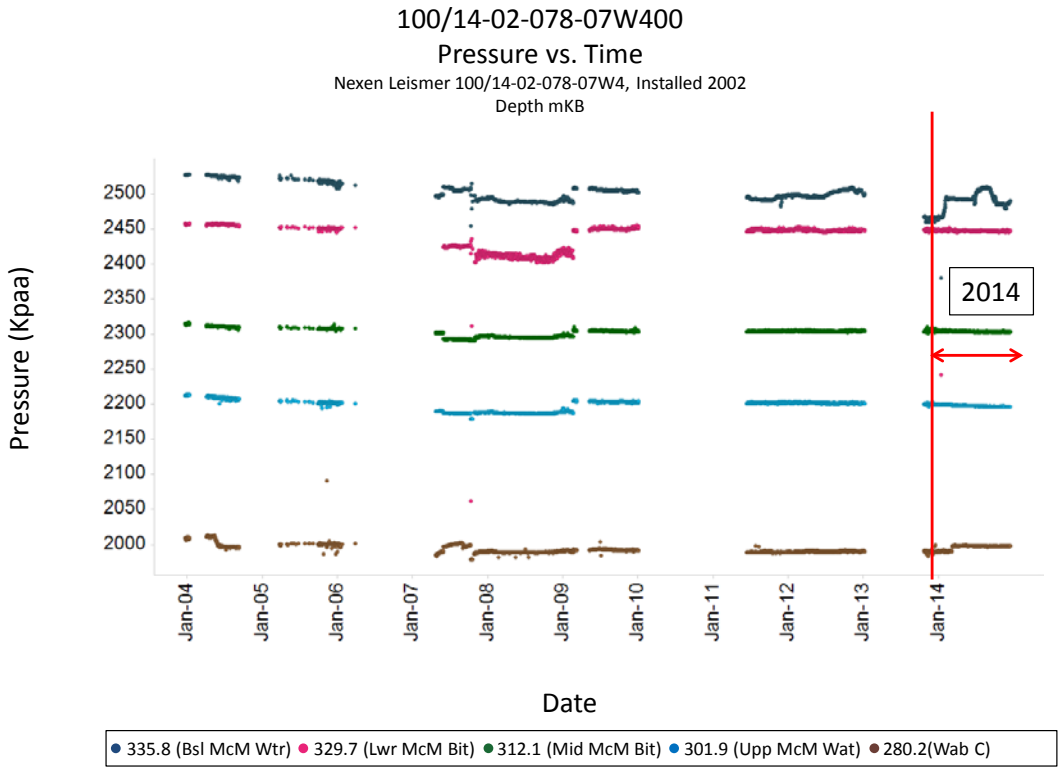

100083507707W400
KB 570.00 m
gr_sp_14
GR (gAPI)
0.0 150.0
SP (mV)
-450.0 -300.0
CALI (mm)
100.0 350.0
Scale_Track_16
Marker_cs_16
n_d_13
DPRS (m3/m3)
0.6 0.0
NPSS (m3/m3)
0.6 0.0
res_13
RES_S (ohm.m)
0.2 2000.0
RES_M (ohm.m)
0.2 2000.0
RES_D (ohm.m)
0.2 2000.0
295
wabiskaw
300
305
mcmurray
310
315
320
325
330
335
340
345
350
355
360
365
devonian
370

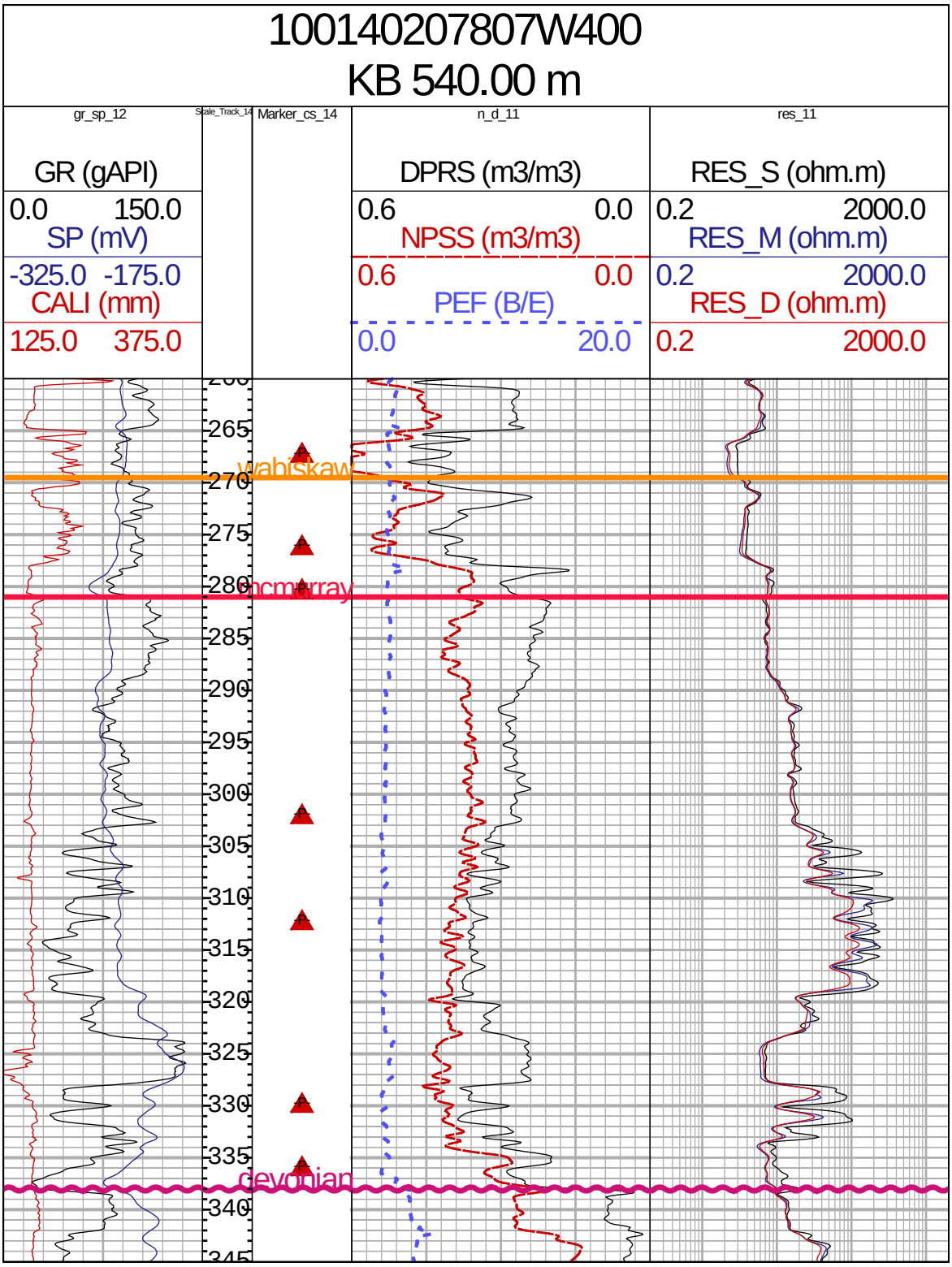
e. Nexen Leismer 100/14-02-078-07W4

Seven VWPs were installed in this well in 2002. As was reported in previous RMRs, two sensors were believed to have been damaged during installation and are not shown on the pressure-time plot below.

The five operational sensors are situated in the McMurray bottom water zone at 335.8 mKB; in the McMurray bitumen at 329.7 mKB, 312.1 mKB, and 301.9 mKB; and in the Wabiskaw "C" gas zone at 280.2 mKB. 2014 shows a continuation of the established pressure trends and does not demonstrate any major pressure changes.

Operational challenges have caused missing datasets and poor performance in past. As mentioned earlier, all of the Leismer observation wells were serviced in March 2014, including data logger and modem upgrades. Thurber also re-calibrated the VWPs and checked the battery and regulator and replaced them as needed.

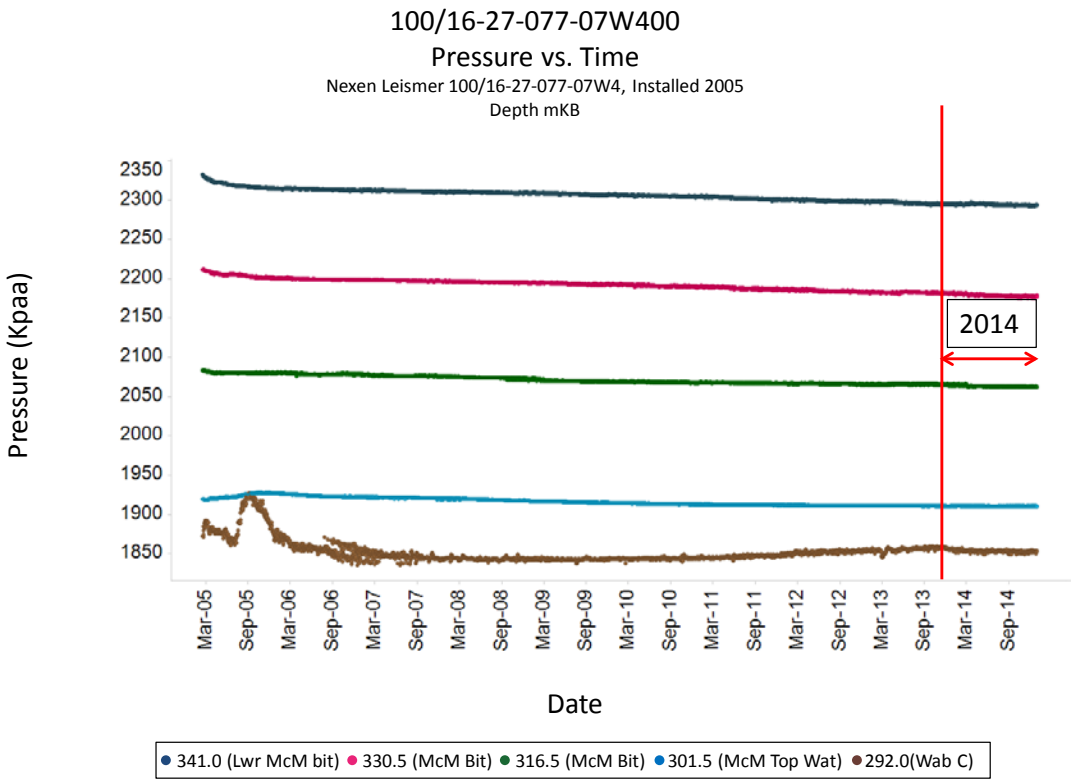


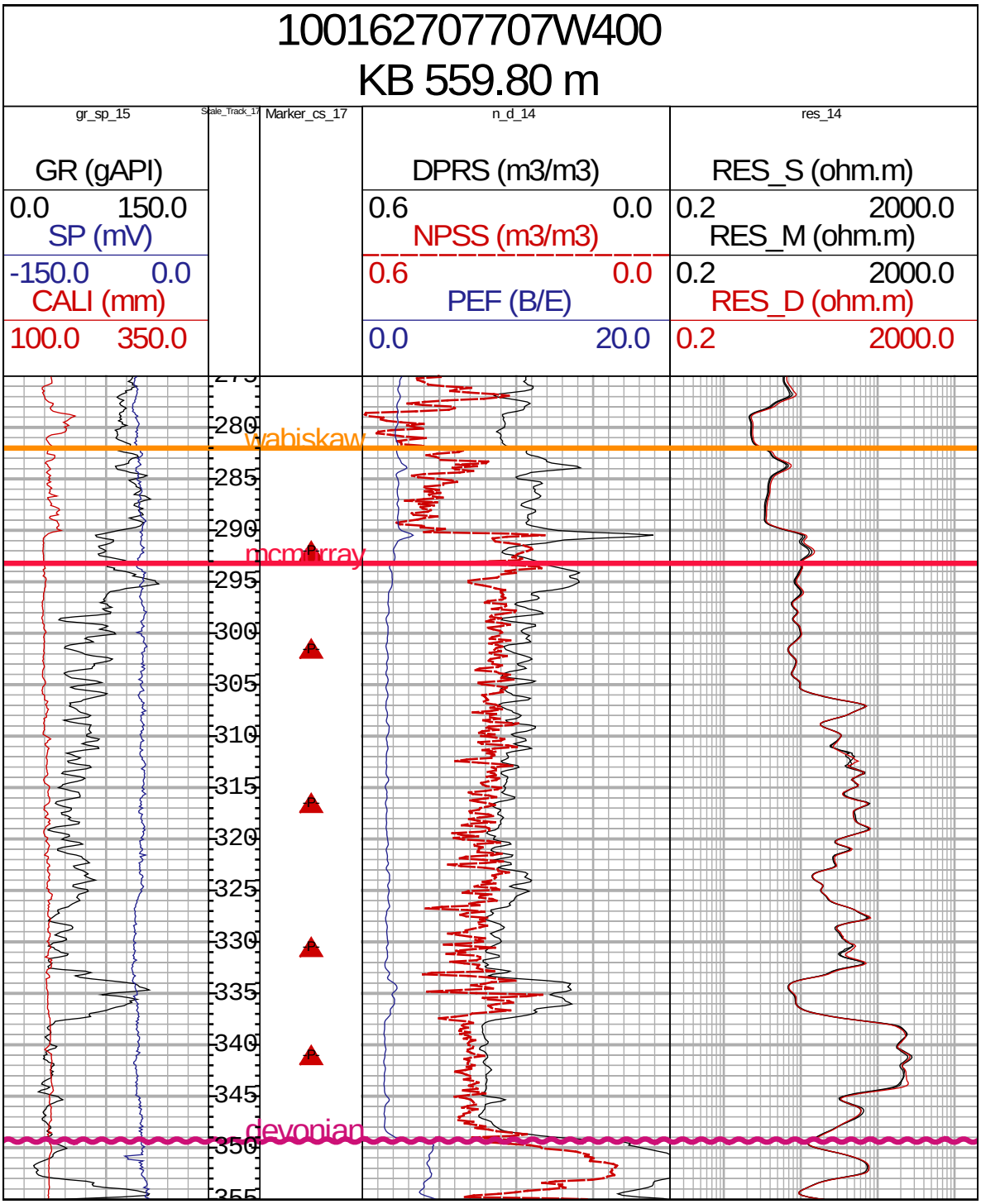

100140207807W400
KB 540.00 m
gr_sp_12
GR (gAPI)
0.0 150.0
SP (mV)
-325.0 -175.0
CALI (mm)
125.0 375.0
Scale_Track_14
Marker_cs_14
n_d_11
DPRS (m3/m3)
0.6 0.0
NPSS (m3/m3)
0.6 0.0
PEF (B/E)
0.0 20.0
res_11
RES_S (ohm.m)
0.2 2000.0
RES_M (ohm.m)
0.2 2000.0
RES_D (ohm.m)
0.2 2000.0
265
270
275
280
285
290
295
300
305
310
315
320
325
330
335
340
345
wabiskaw
mcmurray
devonian

f. ***Nexen Leismer 100/16-27-77-07W4***

Five VWP sensors were installed in this well in 2005.

The sensor installed in the Wabiskaw "C" gas at 292.0 mKB shows a pressure decrease of roughly 5 kPa, possibly due to slight pressure equilibration through the surrounding area. The pressure at 301.5 mKB in the upper water section of the McMurray Formation has not changed through 2014. The remaining 3 VWP sensors, located within the McMurray bitumen zone recorded slight pressure decreases of 2 to 5 kPa through 2014.



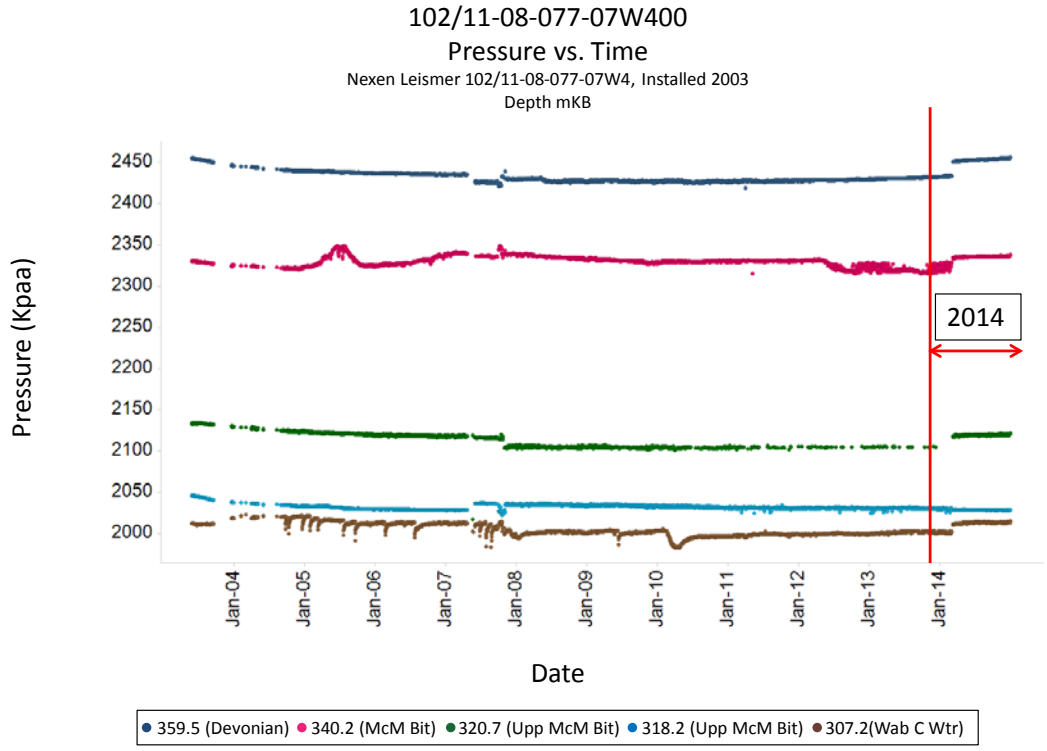

100162707707W400
KB 559.80 m
gr_sp_15
Scale_Track_17
Marker_cs_17
n_d_14
res_14
GR (gAPI)
0.0 150.0
SP (mV)
-150.0 0.0
CALI (mm)
100.0 350.0
DPRS (m3/m3)
0.6 0.0
NPSS (m3/m3)
0.6 0.0
PEF (B/E)
0.0 20.0
RES_S (ohm.m)
0.2 2000.0
RES_M (ohm.m)
0.2 2000.0
RES_D (ohm.m)
0.2 2000.0
280
wabiskaw
285
290
mcmurray
295
300
305
310
315
320
325
330
335
340
345
devonian
350

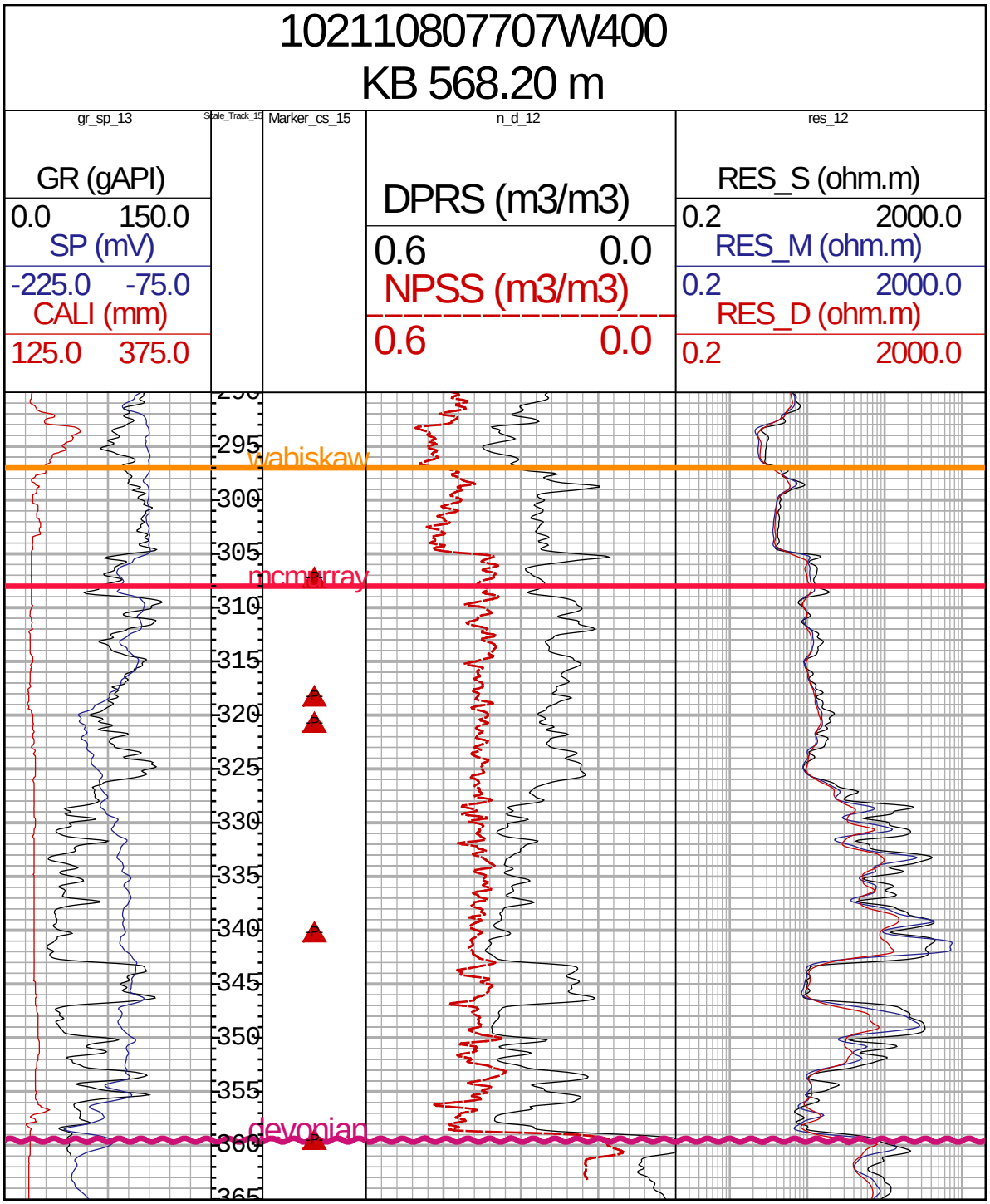
g. ***Nexen Leismer 02/11-08-077-07W4***

Five VWP sensors were installed in this well in 2003.

The uppermost sensor, located in the Wabiskaw “C” wet sand (307.2 mKB) has increased by 2 KPa over 2014. The pressure at 318.2 mKB in the upper McMurray bitumen zone has remained constant. The pressure in the McMurray bitumen at 320.7 mKB and 340.2 mKB has slightly increased by 2 kPa over 2014. The sensor at 359.5 mKB in the Devonian has shown an increase in pressure of 4 kPa through 2014.

Previous reports noted evidence of direct pressure communication between the subject well and the offsetting Devon gas well, 102/11-01-077-08W4, based on pressure responses at the subject well that corresponded to operational events at the gas well. The 02/11-01 gas well was suspended in November 2011. Well 02/11-08 may now be showing direct response to activities at the Devon gas well 100/06-02-077-08W4. The 100/06-02 gas well was re-started March 2012 after a one year shut-in, and the pressure in the McMurray bitumen sensor at 340.2 mKB showed a decline in pressure shortly thereafter. The production of 100/06-02 gas well stopped in October 2012 and hence the pressure in this well at 340.2 mKB (McMurray Bitumen) has increased and stabilized at the same level as early 2012.



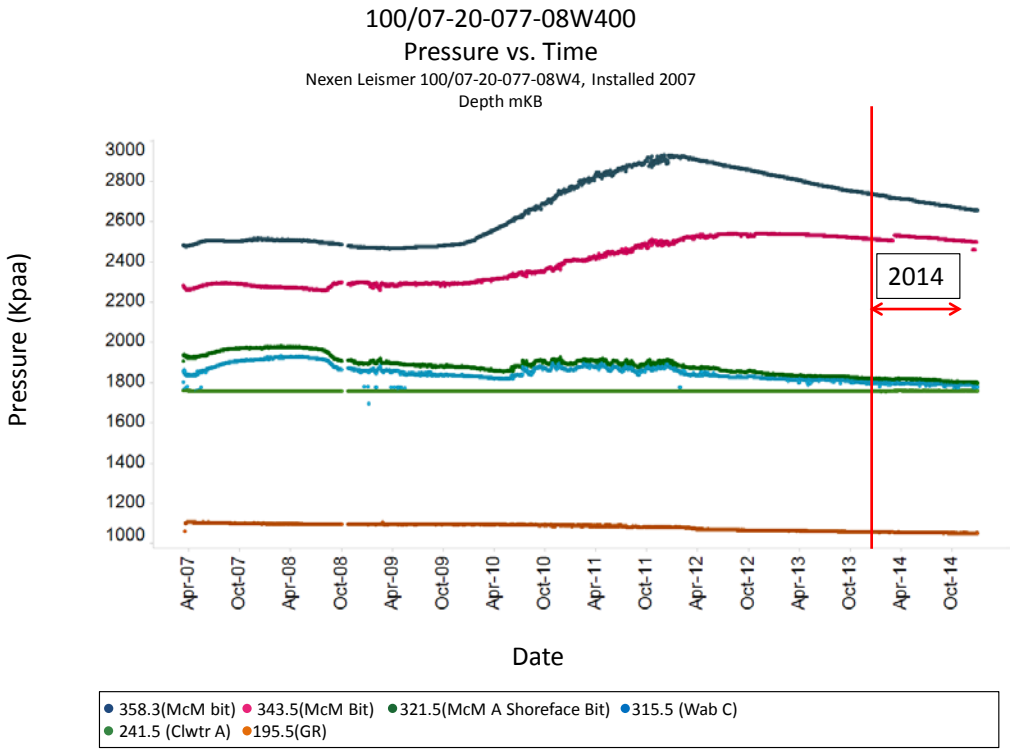

102110807707W400
KB 568.20 m
gr_sp_13
GR (gAPI)
0.0 150.0
SP (mV)
-225.0 -75.0
CALI (mm)
125.0 375.0
Scale_Track_15
Marker_cs_15
n_d_12
DPRS (m3/m3)
0.6 0.0
NPSS (m3/m3)
0.6 0.0
res_12
RES_S (ohm.m)
0.2 2000.0
RES_M (ohm.m)
0.2 2000.0
RES_D (ohm.m)
0.2 2000.0
295
wabiskaw
300
305
mcmurray
310
315
320
325
330
335
340
345
350
355
devonian
360
365

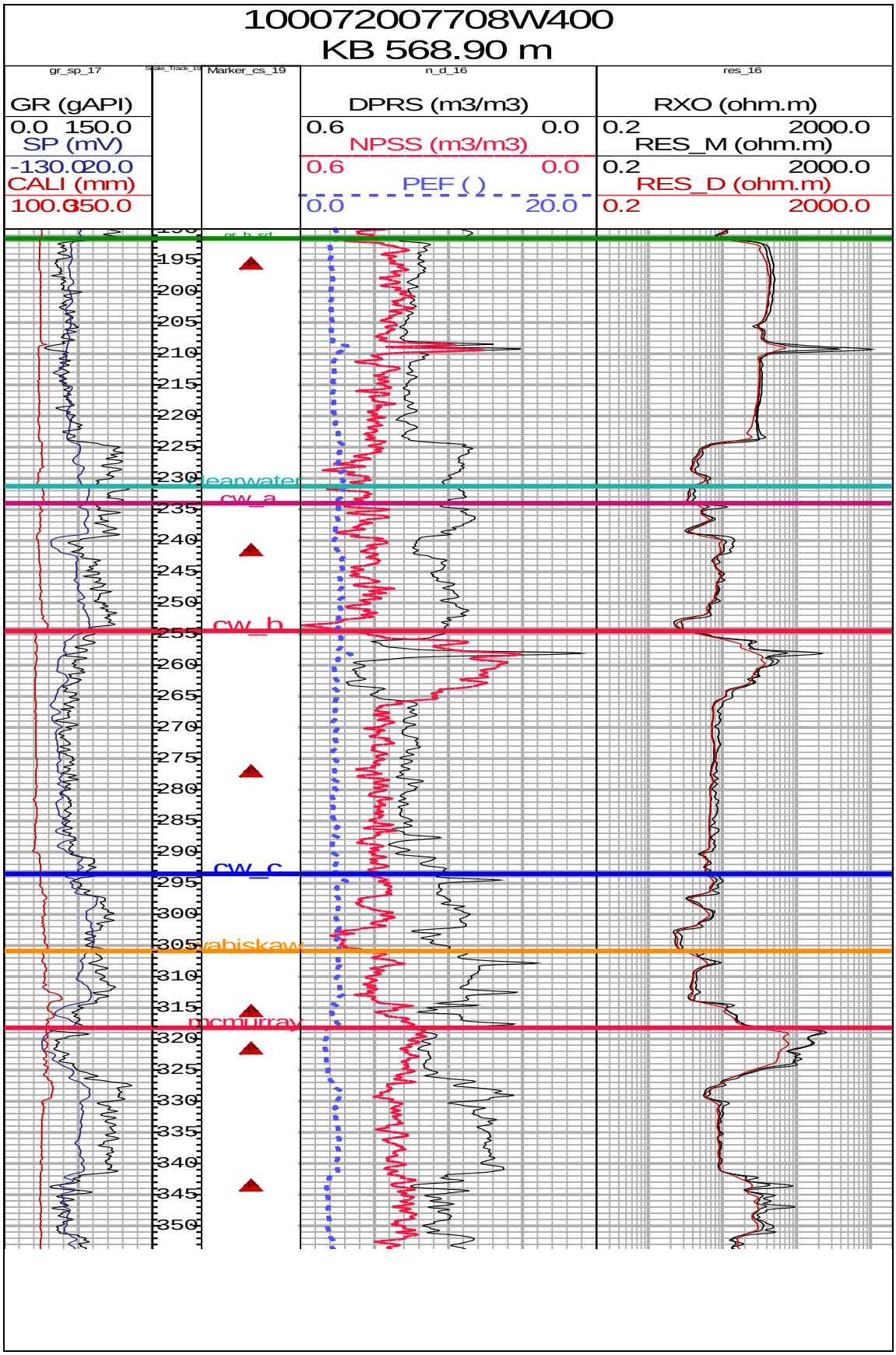
h. Nexen OBS Leismer 100/07-20-077-08W4

Seven VWP sensors were installed in this well in 2007. The sensor at 277.0 mKB in the Clearwater “B” sand appears to have failed and has been removed from the plot. (Note: The 257.5 mKB Clearwater “B” sensor at 100/15-17-077-07W4 well is considered to be the correct reference point for Clearwater B pressure in this area.) The main observed influences on this well are operations at Petrobank’s Whitesands Project 3.5 kilometers to the southwest in Section 12-77-9W4, and regional pressure depletion in the Wabiskaw-McMurray and Clearwater “B” due to gas production. Note that operations at the Whitesands Project were suspended in September of 2011.

The 343.5 mKB and 358.3 mKB sensors in the middle and lower McMurray bitumen zones continue to show response to suspension of Toe-to-Heel Air Injection (THAI) at the Whitesands project; the pressure at these sensors has decreased by 32 kPa and 82 kPa through 2014, respectively. Additionally, the pressures at 321.5 mKB and 315.5 mKB, located in the McMurray “A” shoreface bitumen zone and the Wabiskaw “C”, have also declined through 2014, presumably related to the suspension of the THAI project. The pressures at these two sensors have decreased by 16 kPa and 19 kPa respectively through 2014.

The sensor in the thin Clearwater “A” sand at 241.5 mKB has remained constant through time, which appears reasonable as this zone has not seen large volumes of gas nor source water production in this area.

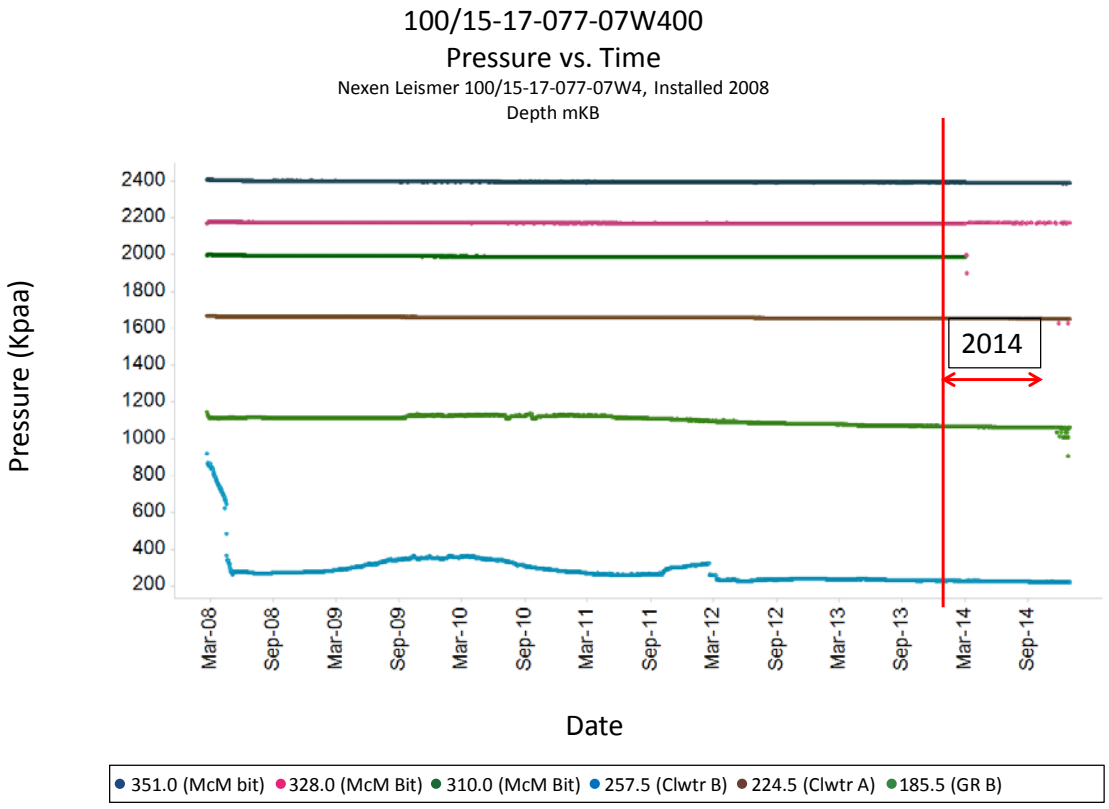

100/07-20-077-08W400
Pressure vs. Time
Nexen Leismer 100/07-20-077-08W4, Installed 2007
Depth mKB
Pressure (Kpaa)
3000
2800
2600
2400
2200
2000
1800
1600
1400
1200
1000
2014
Apr-07
Oct-07
Apr-08
Oct-08
Apr-09
Oct-09
Apr-10
Oct-10
Apr-11
Oct-11
Apr-12
Oct-12
Apr-13
Oct-13
Apr-14
Oct-14
Date
358.3(McM bit)
343.5(McM Bit)
321.5(McM A Shoreface Bit)
315.5 (Wab C)
241.5 (Clwtr A)
195.5(GR)

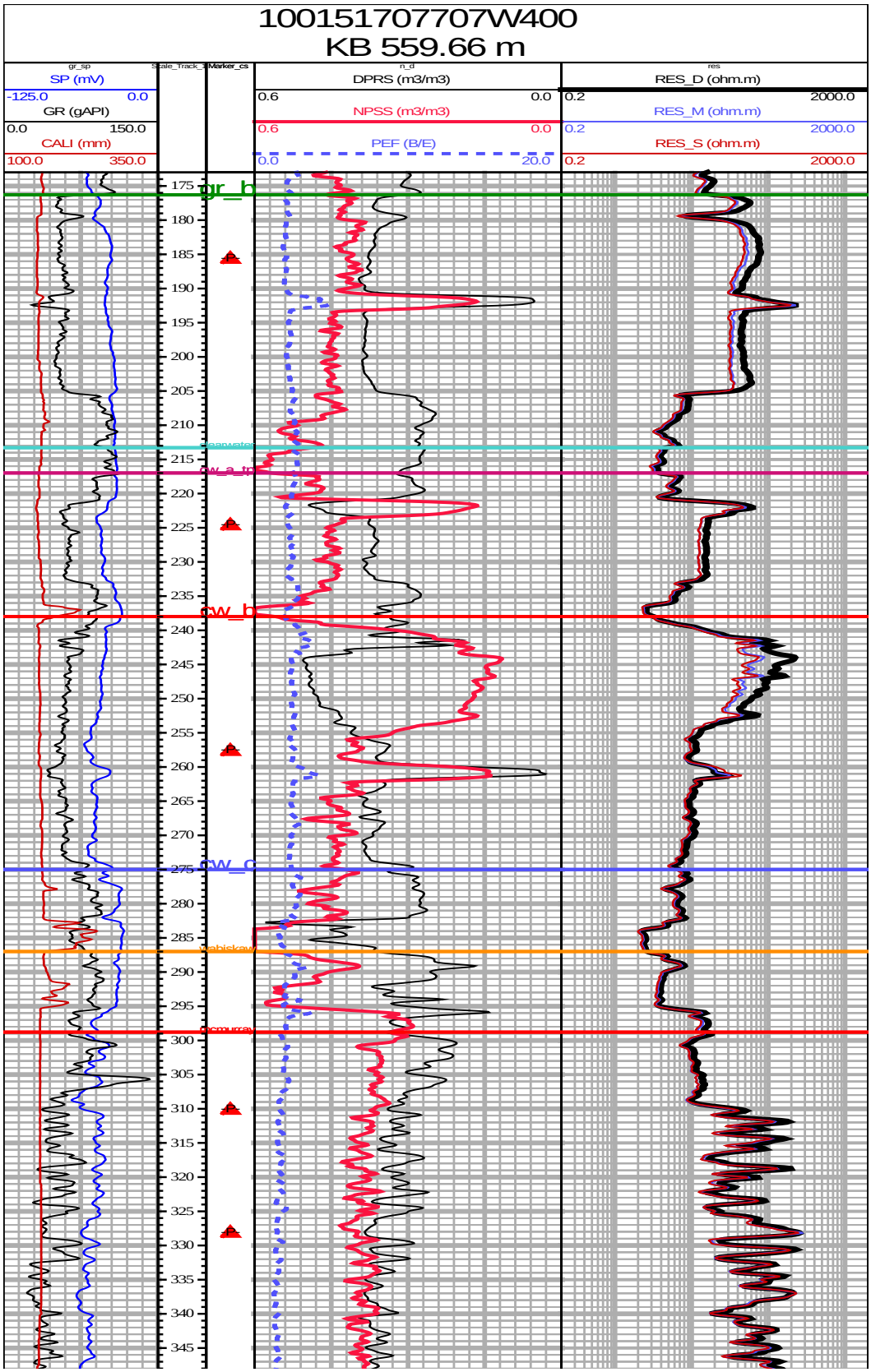

100072007708W400
KB 568.90 m
gr_sp_17
Scale_Track_19
Marker_cs_19
n_d_16
res_16
GR (gAPI)
0.0 150.0
SP (mV)
-130.0 20.0
CALI (mm)
100.0 350.0
DPRS (m3/m3)
0.6 0.0
NPSS (m3/m3)
0.6 0.0
PEF ( )
0.0 20.0
RXO (ohm.m)
0.2 2000.0
RES_M (ohm.m)
0.2 2000.0
RES_D (ohm.m)
0.2 2000.0
gr_h_sd
195
200
205
210
215
220
225
230
leanwater
cw_a
235
240
245
250
255
cw_b
260
265
270
275
280
285
290
cw_c
295
300
305
wabiskaw
310
315
mcmurray
320
325
330
335
340
345
350

i. Nexen Leismer 100/15-17-077-07W4

Six VWP sensors were installed in this well in 2008. The Clearwater "B" is a very significant gas accumulation with significant production in this area. The Clearwater "B" sensor, located at 257.5 mKB, showed a pressure decrease of 7 kPa during 2014 and is considered representative of the highly depleted Clearwater "B" pressure in this area.

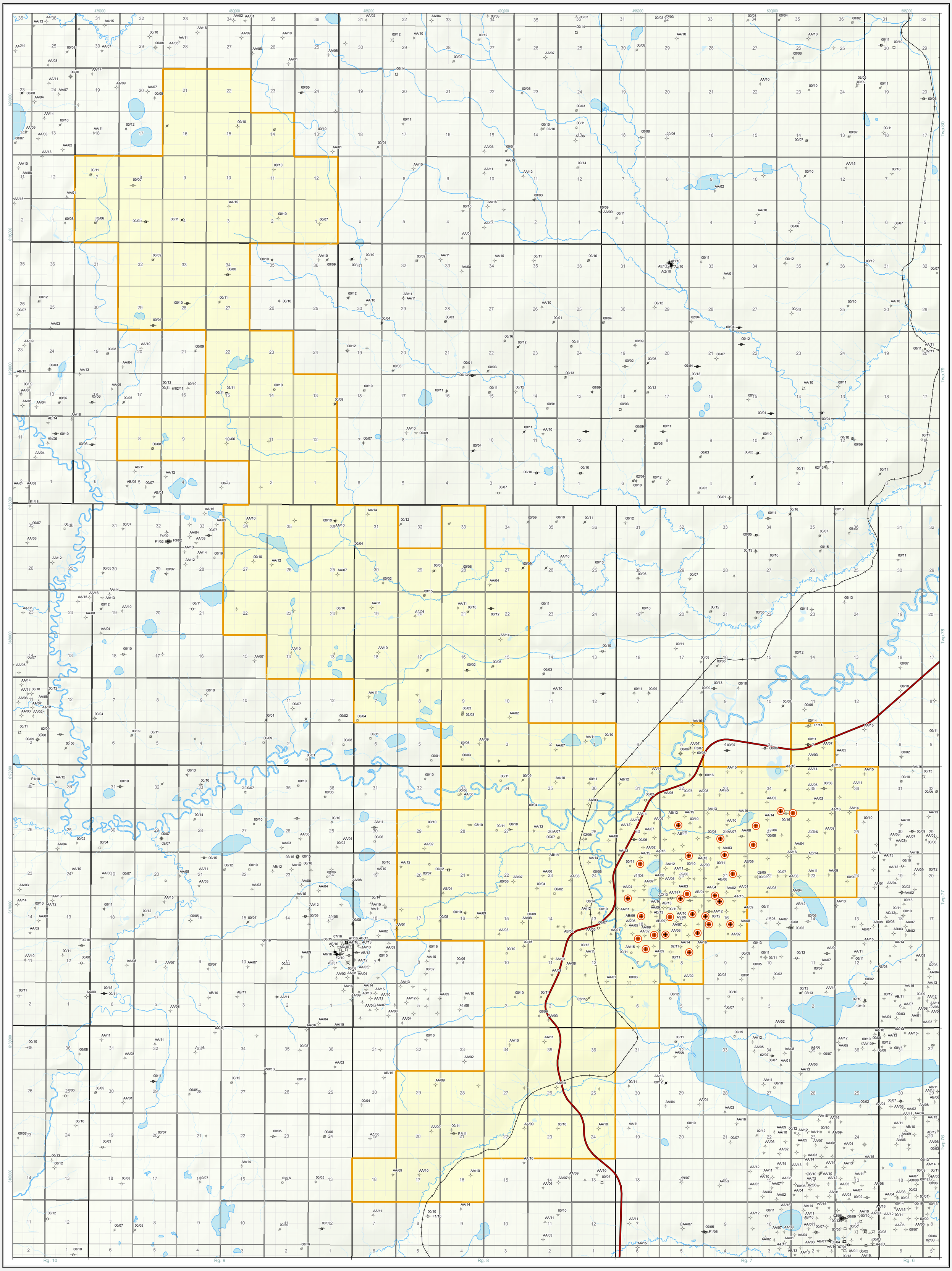
The sensors in the McMurray bitumen at 351.0 mKB and 328.0 mKB, and immediately below the McMurray top water at 310.0 mKB, have shown a flat trend through time that has continued through 2014, with a slight decrease of 3 kPa in the sensor at 351.0 mKB. The Clearwater "A" sensor at 224.5 mKB has also shown very little variation through time, with a decrease of 3 kPa observed in 2014. The Grand Rapids "B" sensor, located at 185.5 mKB showed a pressure decrease of 10 kPa during 2014, possibly due to water withdrawals for use in steam generation at the various SAGD projects in the area.



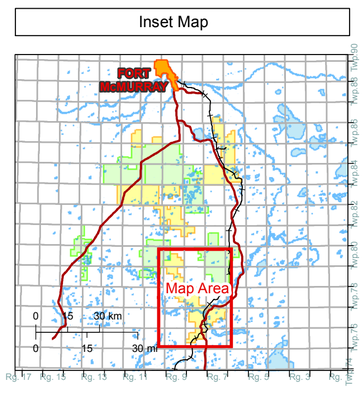

100151707707W400
KB 559.66 m
gr_sp
SP (mV)
-125.0
0.0
GR (gAPI)
0.0
150.0
CALI (mm)
100.0
350.0
Scale_Track_1
Marker_cs
n_d
DPRS (m3/m3)
0.6
0.0
NPSS (m3/m3)
0.6
0.0
PEF (B/E)
0.0
20.0
res
RES_D (ohm.m)
0.2
2000.0
RES_M (ohm.m)
0.2
2000.0
RES_S (ohm.m)
0.2
2000.0
gr_b
cw_a_top
cw_b
cw_c
Wabiskaw
McMurray
175
180
185
190
195
200
205
210
215
220
225
230
235
240
245
250
255
260
265
270
275
280
285
290
295
300
305
310
315
320
325
330
335
340
345

Conclusions

The 2014 oil sands evaluation program, as discussed herein, demonstrates Nexen's ongoing commitment to bitumen resource evaluation and development of the Leismer property. As has been noted, resource evaluation and pressure monitoring activities have continued through the 2014 work program, and are expected to continue, as required. Nexen maintains the position taken at the Chard-Leismer Hearing that a single broad region of influence may exist over the entire Leismer lease area permitting pressure responses to be transmitted over long distances, and Nexen believes that the pressure data collected since the hearing continues to support that conclusion.



Inset Map



Legend

WELL TOPHOLE
- Abandoned
- Bitumen
- Gas
- Gas - Abd
- Gas - Susp
- Injection
- Injection - Abd
- Location
- Oil
- Oil & Gas
- Oil & Gas - Abd
- Oil - Abd
- Oil - Susp
- Service
- Service - Abd
- Suspended
- Tight
- Unknown
- COREHOLE LOCATION
- RAILROAD
- HIGHWAY

WATERBODY
- PERENNIAL
- NONPERENNIAL

LEASE BOUNDARY
- Leismer

Coordinate Reference System Information

Coordinate System: NAD 1983 UTM Zone 12N
Projection: Transverse Mercator
Datum: North American 1983
False Easting: 500,000.0000
False Northing: 0.0000
Central Meridian: -111.0000
Scale Factor: 0.9996
Latitude Of Origin: 0.0000
Units: Meter

N

0 0.25 0.5 1
Kilometre
0 0.25 0.5
Miles

1:60,000

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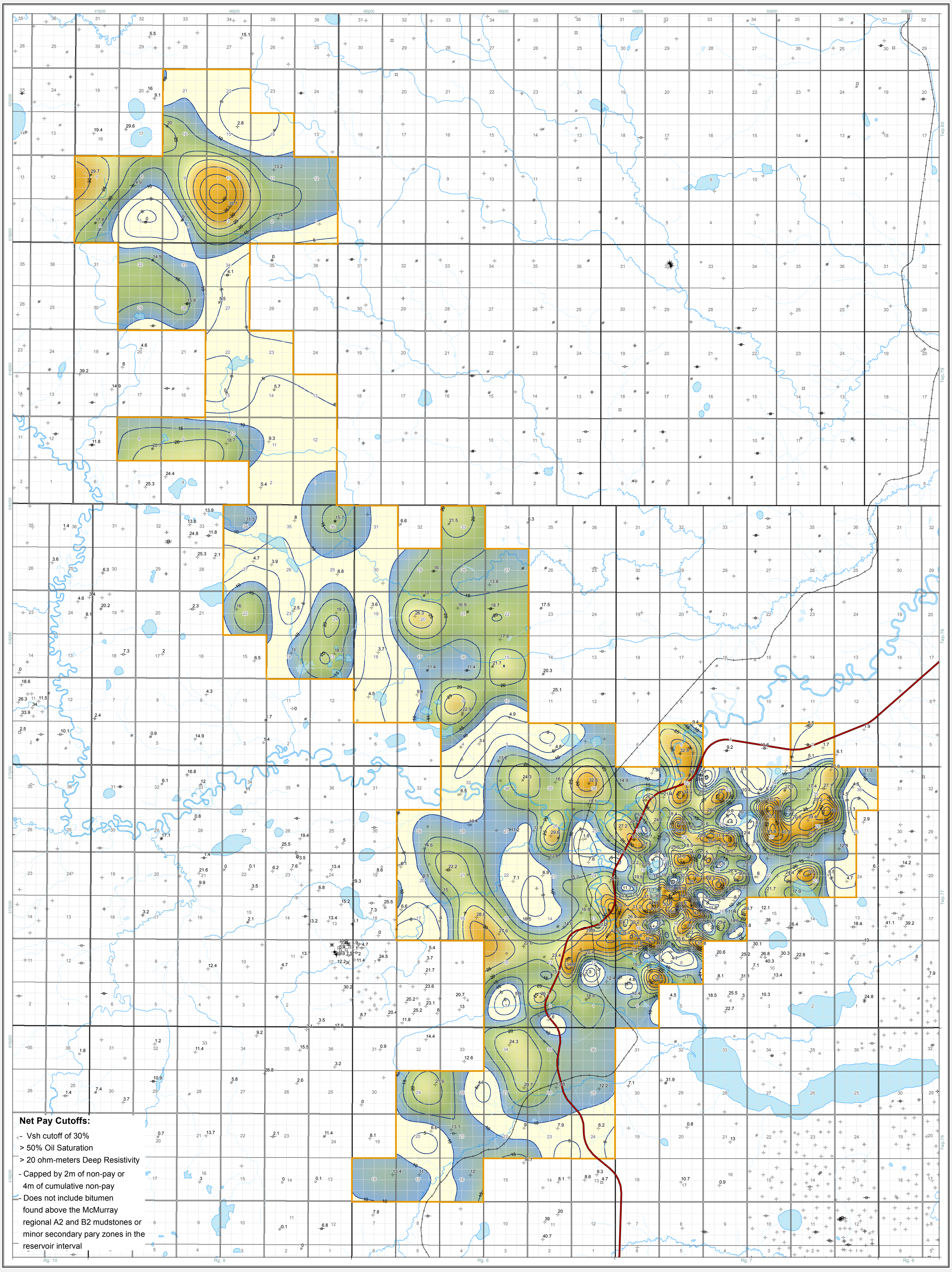
OILSANDS - LEISMER

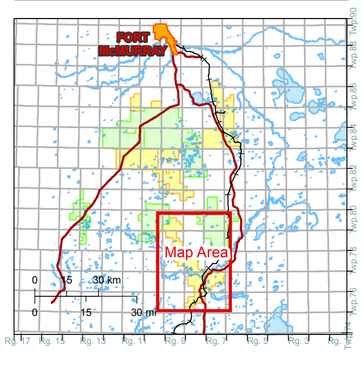
Figure 1: 2013-14 Core Hole Program

Requested By: L PACHOLKO
Created By: W MEINEN
Dept.: OILSANDS

Date: March 17, 2015
Plot Date: April 27, 2015
File No.: CA18494.mxd



Inset Map



Legend

2M PAY MARKER

WELL TOPHOLE

Nexen Top Hole Locations

- Abandoned
- Bitumen
- Gas
- Gas - Abd
- Gas - Susp
- Injection
- Injection - Abd
- Location
- Oil
- Oil & Gas
- Oil & Gas - Abd
- Oil - Abd
- Oil - Susp
- Service
- Service - Abd
- Suspended
- Tight
- Unknown
- RAILROAD
- HIGHWAY

LEASE BOUNDARY

- Leismer

WATERBODY

- PERENNIAL
- NONPERENNIAL
- 2M PAY CONTOUR - 5m Int.

MCMR ISOPACH

High : 52.8

Low : 10.0

Coordinate Reference System Information

Coordinate System: NAD 1983 UTM Zone 12N
Projection: Transverse Mercator
Datum: North American 1983
False Easting: 500,000.0000
False Northing: 0.0000
Central Meridian: -111.0000
Scale Factor: 0.9996
Latitude Of Origin: 0.0000
Units: Meter

N

0 1 2 4
Kilometre

0 0.5 1 2
Miles

1:60,000

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OILSANDS - LEISMER

Figure 2: McMURRAY FORMATION BITUMEN PAY

Requested By: L PACHOLKO
Created By: W MEINEN
Dept.: OILSANDS

Date: March 17, 2015
Plot Date: April 14, 2015
File No.: CA18497.mxd

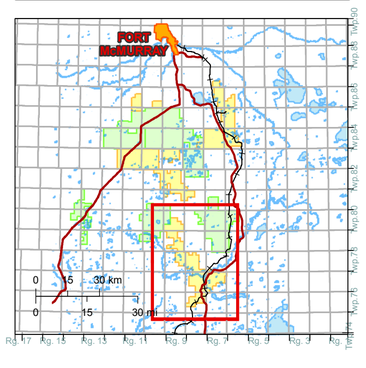
PIEZOMETER WELLS (UWI)

100071307708W400
100023107707W400
100140207807W400
10211087707W400
100083507707W400
100021907706W400
100162707707W400
100072007708W400
100151707707W400

PRODUCING AND / OR SHUT IN ZONES INTERVAL

W1 - WBSK C SAND
W - WBSK D CHANNEL SAND
M - McM A1 SEQ
Mc - McM CHANNEL
Mc1 - McM A2 SEQ
M1 - McM B1 SEQ

Inset Map



Legend

PIEZOMETER - Wabiskaw / McMurray
PIEZOMETER - Misc. Formations
Production Allowed
Approved for Gas Production
Recommended for Shut-in
Denied for gas production

Nexen Top Hole Locations
Abandoned
Bitumen
Gas
Gas - Abd
Gas - Susp
Injection
Injection - Abd
Location
Oil
Oil & Gas
Oil & Gas - Abd
Oil - Abd
Oil - Susp
Service
Service - Abd
Suspended
Tight
Unknown

CONKLIN
LEISMER
PINGLE
RAILROAD
HIGHWAY

HYDROLOGY
PERENNIAL
INTERMITTENT

WATERBODY
PERENNIAL
NONPERENNIAL

Coordinate Reference System Information

Coordinate System: NAD 1983 UTM Zone 12N
Projection: Transverse Mercator
Datum: North American 1983
False Easting: 500,000.0000
False Northing: 0.0000
Central Meridian: -111.0000
Scale Factor: 0.9996
Latitude Of Origin: 0.0000
Units: Meter

N

0 0.5 1 2 3 4
Kilometre

0 0.5 1 2
Miles

1:70,000

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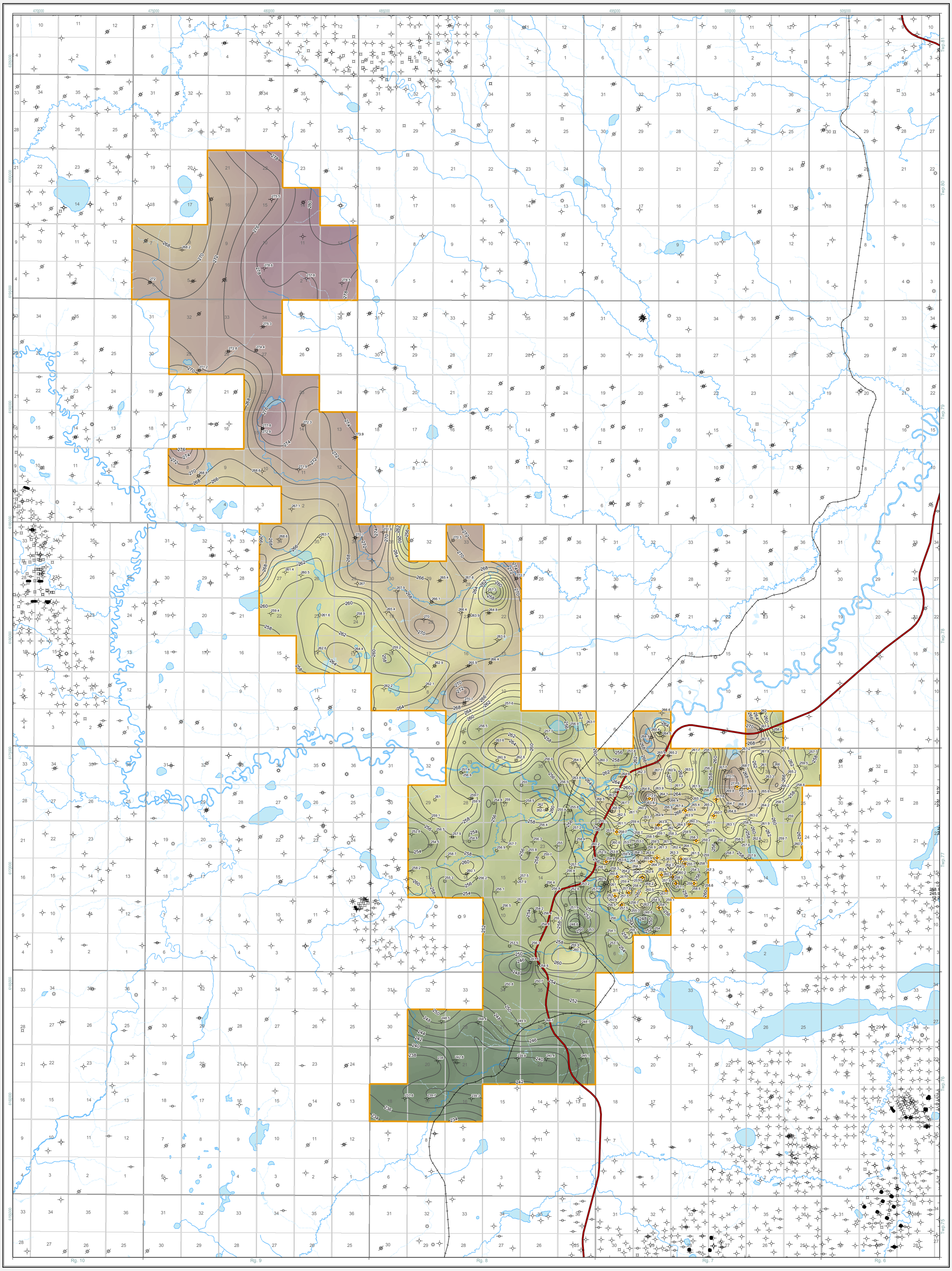
OILSANDS - LEISMER

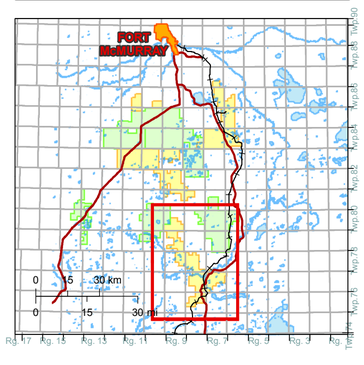
FIGURE 3: WBSK - McM GAS SHUT-INS AND EXEMPTIONS AS OF NOV. 10, 2005

Requested By: L PACHOLKO
Created By: W MEINEN
Dept.: OILSANDS

Date: April 22, 2015
Plot Date: April 22, 2015
File No.: CA18593.mxd



Inset Map



Legend

- CONKLIN
- LEISMER
- PINGLE

Nexen Top Hole Locations

- Abandoned
- Bitumen
- Gas
- Gas - Abd
- Gas - Susp
- Injection
- Injection - Abd
- Location
- Oil
- Oil & Gas
- Oil & Gas - Abd
- Oil - Abd
- Oil - Susp
- Service
- Service - Abd
- Suspended
- Tight
- Unknown
- NEXEN 2014 WELL
- RAILROAD
- HIGHWAY

HYDROLOGY

- PERENNIAL
- INTERMITTENT

WATERBODY

- PERENNIAL
- NONPERENNIAL

WABISKAW 'C' STRUCTURE

Value

High : 281.0

Low : 233.8

WABISKAW 'C' STRUCTURE -2m contours

Coordinate Reference System Information

Coordinate System: NAD 1983 UTM Zone 12N
Projection: Transverse Mercator
Datum: North American 1983
False Easting: 500,000.0000
False Northing: 0.0000
Central Meridian: -111.0000
Scale Factor: 0.9996
Latitude Of Origin: 0.0000
Units: Meter

N

0 0.5 1 2 3 4
Kilometre

0 0.5 1 2
Miles

1:70,000

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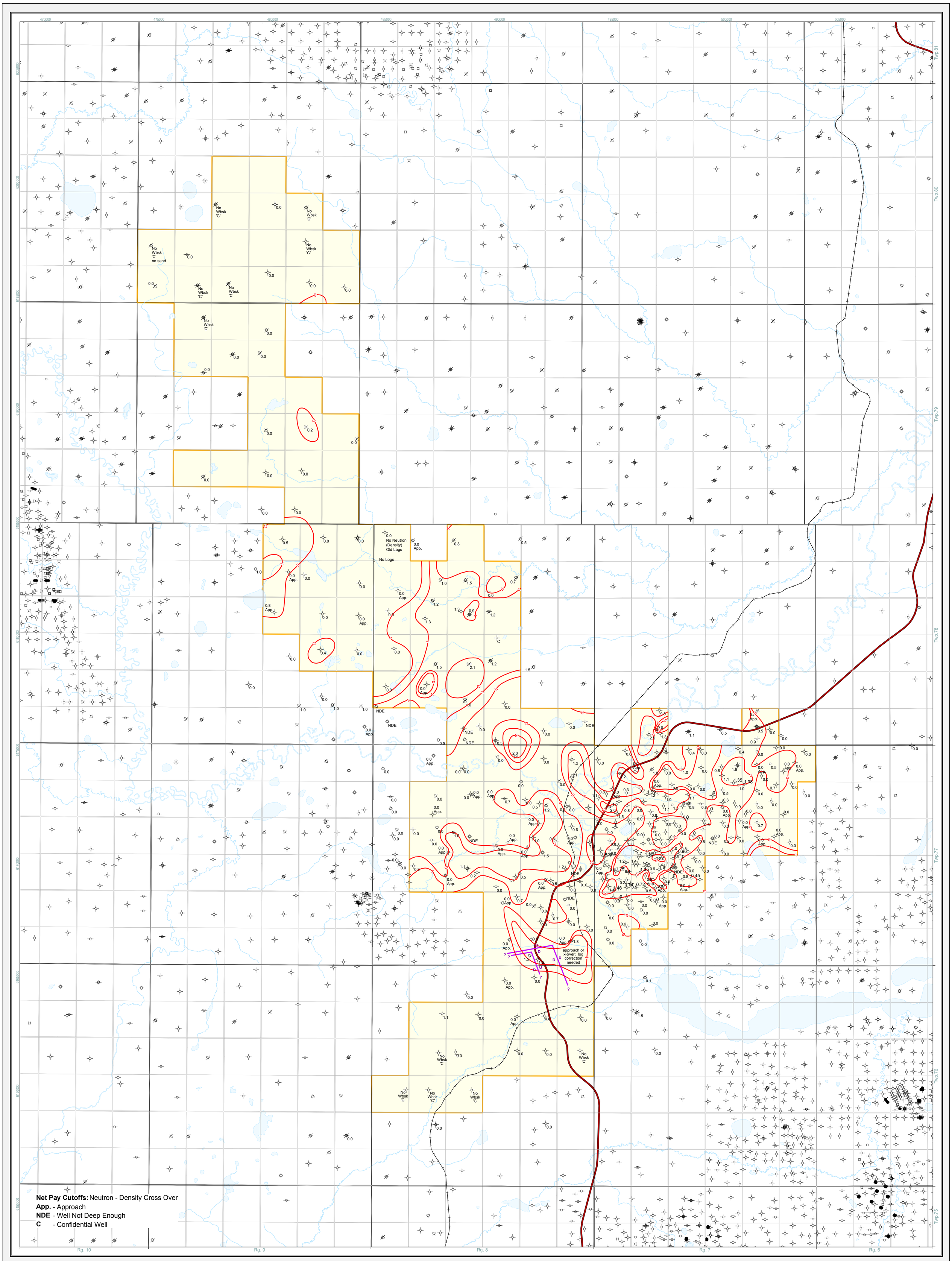
OILSANDS - LEISMER

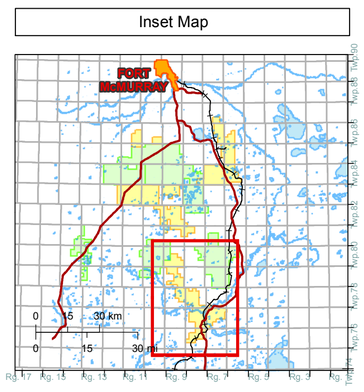
Figure 4:
WABISKAW 'C' Structure (m)

Requested By: L PACHOLKO
Created By: W MEINEN
Dept.: OILSANDS

Date: Mar 31, 2015
Plot Date: April 14, 2015
File No.: CA18545.mxd



Inset Map



Legend

Legend

Abandoned	Injection - Abd	Oil - Susp	RAILROAD	**WBSK C TOP GAS CONTOUR**
Bitumen	Location	Service	HIGHWAY	FAULT
Gas	Oil	Service - Abd	PERENNIAL	GAS PAY
Gas - Abd	Oil & Gas	Suspended	WATERBODY	
Gas - Susp	Oil & Gas - Abd	Tight	PROJECT AREA	
Injection	Oil - Abd	Unknown		

Coordinate Reference System Information

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Datum: North American 1983
False Easting: 500,000.0000
False Northing: 0.0000
Central Meridian: -111.0000
Scale Factor: 0.9996
Latitude Of Origin: 0.0000
Units: Meter

N

0 0.5 1 2 3 4
Kilometre

0 0.5 1 2
Miles

1:70,000

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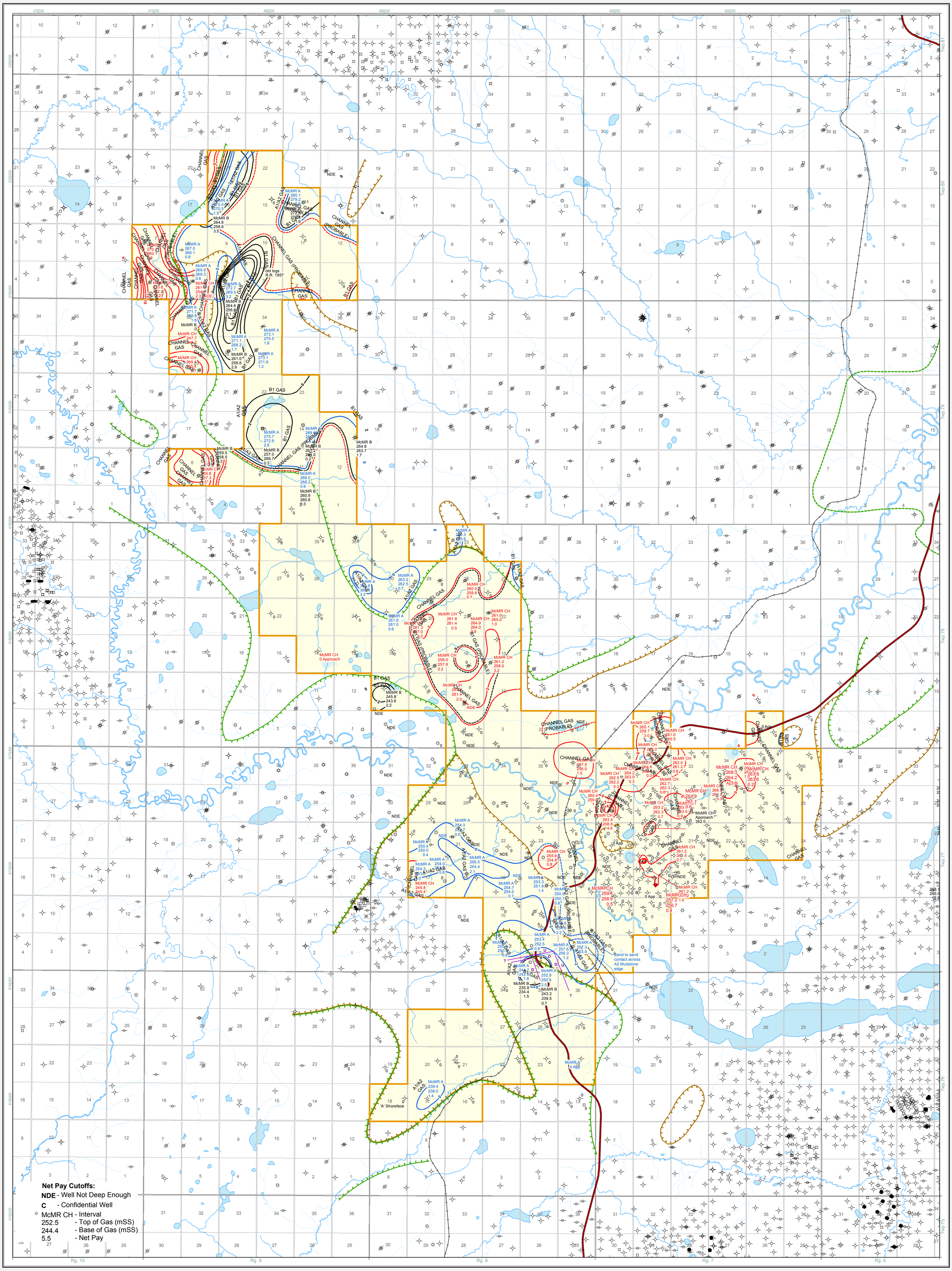
OILSANDS - LEISMER

Figure 5: Wabiskaw 'C' Net Gas Thickness (m)

Requested By: L PACHOLKO
Created By: W MEINEN
Dept.: OILSANDS

Date: March 31, 2015
Plot Date: April 9, 2015
File No.: CA18546.mxd



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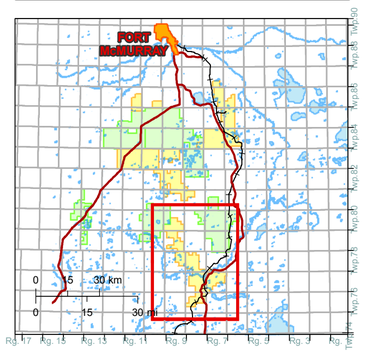

Legend

- CONKLIN
- LEISMER
- PINGLE

Nexen Top Hole Locations

- Abandoned
- Bitumen
- Gas
- Gas - Abd
- Gas - Susp
- Injection
- Injection - Abd
- Location
- Oil
- Oil & Gas
- Oil & Gas - Abd
- Oil - Abd
- Oil - Susp
- Service
- Service - Abd
- Suspended
- Tight
- Unknown
- RAILROAD
- HIGHWAY
- Bitumen Zero Edge

HYDROLOGY

- PERENNIAL
- INTERMITTENT

A1/A2 GAS CONTOUR

- A1/A2 GAS
- A1/A2 GAS (PROBABLE)

CHANNEL GAS CONTOUR

- FAULT
- CHANNEL GAS
- CHANNEL GAS (PROBABLE)

B1 GAS CONTOUR

- B1 GAS
- B1 GAS (PROBABLE)

GEOLOGIC BOUNDARY NAME

- McMURRAY A2 MUDSTONE EDGE
- McMURRAY B2 MUDSTONE EDGE

WATERBODY

- PERENNIAL
- NONPERENNIAL

Coordinate Reference System Information

Coordinate System: NAD 1983 UTM Zone 12N
Projection: Transverse Mercator
Datum: North American 1983
False Easting: 500,000.0000
False Northing: 0.0000
Central Meridian: -111.0000
Scale Factor: 0.9996
Latitude Of Origin: 0.0000
Units: Meter

N

0 0.5 1 2 3 4
Kilometre

0 0.5 1 2
Miles

1:70,000

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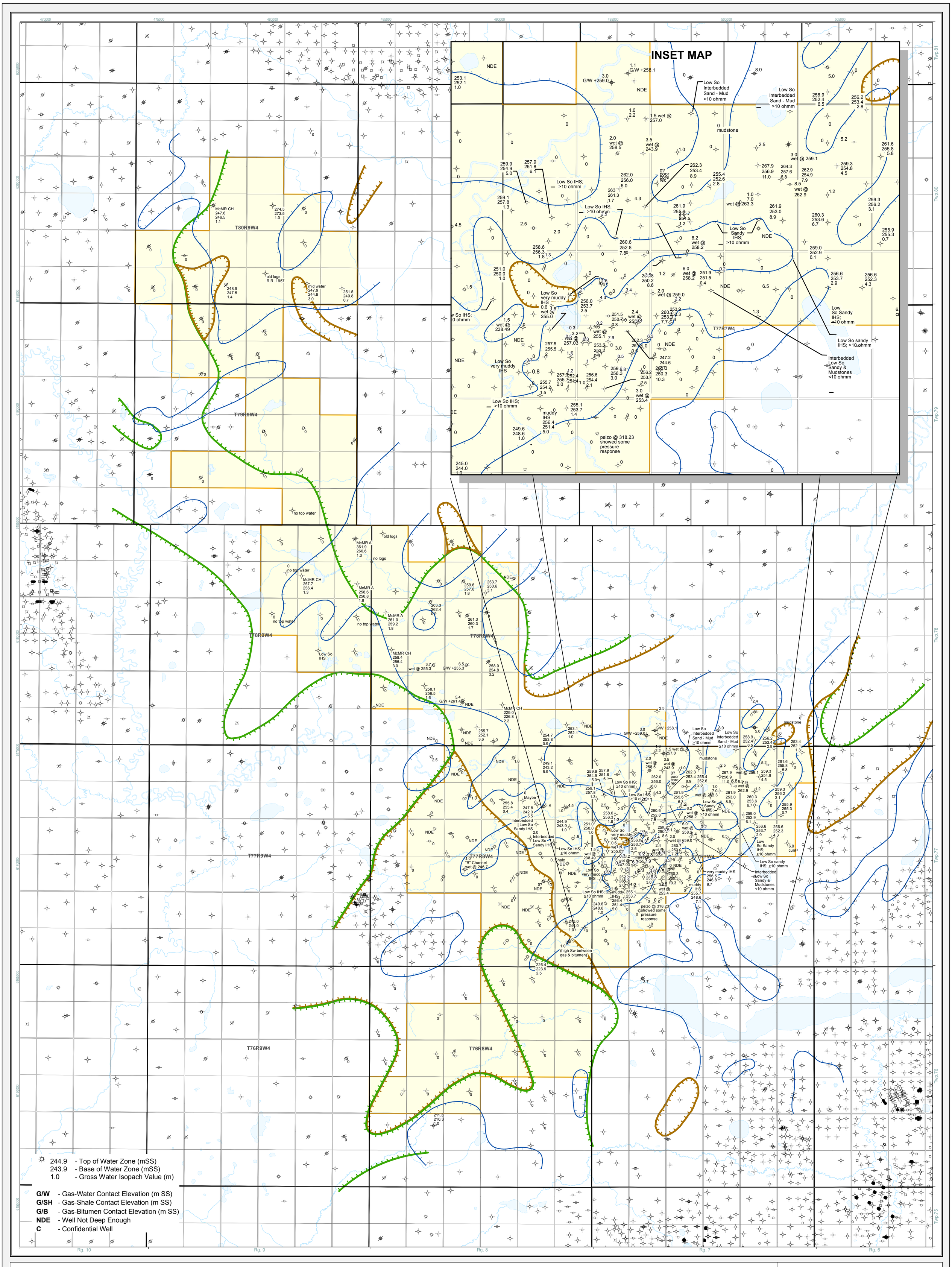
OILSANDS - LEISMER

FIGURE 6: McMurray Top Gas Net Thickness (m)

Requested By: L PACHOLKO
Created By: W MEINEN
Dept.: OILSANDS

Date: March 31, 2015
Plot Date: April 27, 2015
File No.: CA18547.mxd



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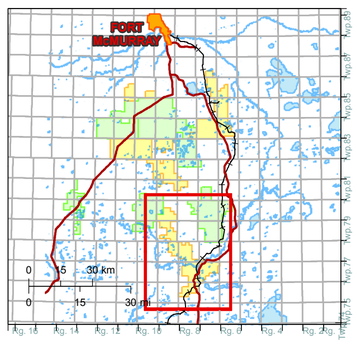

Legend

Legend

fig_7_mcmr_top_water

- Abandoned
- Bitumen
- Gas
- Gas - Abd
- Gas - Susp
- Injection
- Injection - Abd
- Location
- Oil
- Oil & Gas
- Oil & Gas - Abd
- Oil - Abd
- Oil - Susp
- Service
- Service - Abd
- Suspended
- Tight
- Unknown
- Piezometer Well
- GROSS TOP WATER
- McMURRAY A2 MUDSTONE EDGE
- McMURRAY B2 MUDSTONE EDGE
- HYDROLOGY
- WATERBODY
- LEASE BOUNDARY

Coordinate Reference System Information

Coordinate System: NAD 1983 UTM Zone 12N
Projection: Transverse Mercator
Datum: North American 1983
False Easting: 500,000.0000
False Northing: 0.0000
Central Meridian: -111.0000
Scale Factor: 0.9996
Latitude Of Origin: 0.0000
Units: Meter

N

0 0.5 1 2 3 4
Kilometre

0 0.5 1 2
Miles

1:70,000

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Figure 7: McMurray Gross Top Water Isopach (m)

Requested By: L PACHOLKO
Created By: W MEINEN
Dept.: OILSANDS

Date: March 31, 2015
Plot Date: April 9, 2015
File No.: CA18550.mxd