ConocoPhillips

COPRC Dodo Canyon E-76 65-10 126-45
COPRC Mirror Lake P-20 65-00 126-45

AFE:	10351817
Network:	TBD
API:	E-76 65-10 126-45
County:	Norman Wells
Field:	Dodo Canyon
Latitude:	65 05 27.0 N
Longitude:	126 59 58.2 W

AFE:	10351817
Network:	TBD
API:	P-20 65-00 126-45
County:	Norman Wells
Field:	Mirror Lake
Latitude:	64 59 58.0 N
Longitude:	126 47 08.7 W

Well Testing Procedure

OUR WORK IS NEVER SO URGENT OR IMPORTANT THAT WE CANNOT TAKE THE TIME TO DO IT SAFELY.

* Always perform walkthrough PJHA before any work is begun.
* You have the RIGHT and the OBLIGATION to STOP unsafe acts.

Submitted 12/17/2013

Prepared by:
Alexandra Novgorodova
Reservoir Engineer

401 – 9th Avenue SW
Calgary, Alberta T2P 3H
403 532 7046 (office)
403 880 8693 (cell)
Alexandra.Novgorodova@cop.com

Distribution:
- Completions Superintendents
- COP Consultants
- COP Completion Engineers
- Steve Veltman
- Kim Clarke
- George Sperling
- Selected service companies

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PROPOSED WELL STATUS

The COPRC Dodo Canyon E-76 65-10 126-45 is a DOWNDIP horizontal well targeting the Canol formation. The well is to be drilled to a depth of 2941 meters MD (PBTD = 2941) with a lateral length of 959 meters and an average TVD of 1694 meters. The well will be kicked off at approximately 1554 meters MD and the maximum dogleg expected in the build section is 7.16 degrees/30 m (refer to Figure 1 Current wellbore Schematic).
The horizontal section will be hydraulically fractured in a number of stages. An extended flow test will then be performed on the well to evaluate the production potential of the Canol formation in this area.

The Mirror Lake P-20 65-00 126-45 well is a downdip horizontal well also targeting the Canol formation. The well is to be drilled to a depth of 3098 meters MD with a lateral length of 1000 meters and an average TVD of 1972 meters. The well will be kicked off at about 1750 meters MD and the maximum dogleg expected in the curve is 7.74^0/30 m.
The horizontal section will be hydraulically fractured in a number of stages. An extended flow test will then be performed on the well to evaluate the production potential of the Canol formation in this area.

WELL TEST DESCRIPTION

ConocoPhillips plans to drill, hydraulically fracture and test both the E-76 65-10 126-45 (E-76) well and the P-20 65-00 126 -45 well (P-20) in the winter of 2014 with the aim of achieving the following objectives:

- Establishing initial production rate for oil and gas
- Understanding the fluid composition and properties
- Understanding the variation of oil and gas rate as well as fluid composition between two geographically spaced, and potentially highly variable areas in the field (E-76 and P-20)

In order to understand the three above mentioned objectives, ConocoPhillips will be implementing a comprehensive testing program, including:

- Jet pump installation (a method of artificial lift), enabling fluid flow to surface in the event that the reservoir does not have enough energy to lift the liquids on its own
- Sampling for pressure, volume and temperature (PVT) – at least 3 samples will be collected and one will be run through the laboratory testing to determine:
    - Oil formation volume factor
    - Oil viscosity
    - Gas compressibility
    - Bubble point of the fluid
    - GOR

  All of these, and some other additional parameters are extremely important in understanding potential long-term performance of the field.

- Well flow testing strategy that incorporates the latest learnings from other ConocoPhillips unconventional shale plays and targets understanding of reservoir deliverability without a high drawdown which can potentially cause damage to productivity

Because of the high degree of uncertainty with respect to both fluid composition and hydrocarbon rate potential present in the Canol shale over the COPRC EL 470 block, the well test must be conducted in a manner that allows the reservoir to show its productivity with the minimal amount of interference from the operator.

CRITICAL INFORMATION REQUIREMENTS

Engineering and appropriate supervisors shall be notified immediately whenever the following events or situations occur during the operation:

1. Accident, near-miss, or environmental release.
2. Any situation that poses a significant threat to human life, limb, or eyesight.
3. Any situation that could result in significant damage to the environment and/or wildlife.
4. Any situation that could result in significant damage to company or vendor equipment.
5. Any situation that could result in significant additional costs being incurred (> 10% above AFE).
6. Any situation that requires any significant deviation from this procedure.

OPERATIONAL

All notifications and approvals from government regulatory agencies are to be recorded on ConocoPhillips' daily reports. The name of the individual contacted, NEB confirmation number and the subject matter of the approval or notification should be recorded.

It is expected the ConocoPhillips Supervisor will use their judgment and knowledge in executing the program and supervising the operations to ensure that all work is conducted in a safe manner that results in the greatest degree of protection possible for the on-site personnel, the public, and the environment.

The program is a guide only and cannot replace good judgment on the wellsite.

SAFETY AND ENVIRONMENT

All operations are to be conducted in compliance with applicable government regulations along with ConocoPhillips policies and procedures.
A safety meeting must be held daily and prior to conducting any potentially hazardous operation. These meetings and a walk around inspection are to be documented on the Daily Tour Sheets.
Record all accidents, injuries, spills, equipment damage and near misses on the ConocoPhillips Incident Report and forward to the Completions Superintendent immediately.

EMERGENCY RESPONSE PLAN

The supervisor and rig manager must be familiar with ConocoPhillips Corporate Emergency Response Plan. Ensure that on all wells with site specific Emergency Response Plan (ERP); crewmembers are briefed and trained about their respective duties when an ERP goes into effect.

RIG INSPECTION AND BOP DRILLS

Rig inspections are to be done at the start of every well and every week thereafter. BOP drills are to be done on every well and at least once every seven days and record them in the daily reports. Both forms are to be filled out and sent to the Completions Superintendent in Calgary and noted on the Daily Tour Sheet. OH&S Rig Inspection to be faxed in immediately.

RECORD KEEPING

Ensure the Area Office receives a copy of the tour reports, downhole diagram with wellhead details, tubing tally, rig anchor pull test charts (if applicable), logs, and fluid movement reports.

Forward ALL paper work to BRENDA MIKKELSEN – BVS Room 0844 – Calgary.

The COMPANY CODE along with the NETWORK NUMBER must be attached to all Invoices.

ADDITIONAL CONSIDERATIONS

i) Pre-Job Hazard Assessments are to be held and documented daily, and **prior to conducting EACH critical operation** such as opening up well to flow, frac stimulation, running in/out of well under pressure or any other operation so defined by the CPC Completions Consultant.

ii) **ConocoPhillips commitment to safety must be conveyed to every worker, every day**

iii) Pre-Job Hazard assessments must be done as a requirement by law and a condition of working for the company. The Hazard assessment must be done:

- At intervals that prevent the development of unsafe working conditions
- When a new work process is introduced
- When a work process or operation changes

iv) The ConocoPhillips site supervisor is accountable for ensuring the Pre-Job Hazard Assessment Form is complete. Use of an outside contractors form is acceptable as long as it meets or exceeds the OH&S regulations and ConocoPhillips safety standards.

v) Notify the ConocoPhillips site office at least 24 hours before commencing well site operations. Confirm with the ConocoPhillips production and construction staff to determine if any additional notifications or special conditions are required for nearby residents or road use.

vi) This is a **Super Tight Hole well**. Ensure all possible steps are taken to ensure only required personnel are allowed on location. A record of all personnel must be kept. Ensure all services know the status of the well and that all on-air communications on location are kept to only that required. Contact Calgary with any indication of an oilfield scout monitoring CPC's operations.

WELL OUTLINE

WELL NAME:	COPRC Dodo Canyon E-76 65-10 126-45
SECURITY CLASSIFICATION:	Super Tight
UWI:	300E766510126450
DRILLING RIG:	Beaver Rig #2
ELEVATIONS:	GL: 268.2m KB: 274.2m (kb to GL estimated at 6.0m) Elevations are based on a surveyed ground level and estimated KB to GL distance. Confirm actual ground level and that KB to GL elevation difference is correct.
SURVEY PLAN FILE:	COPRC Dodo Canyon E-76 65-10 126-45
DIRECTIONAL PLAN:	Horizontal Well
TOTAL DEPTH:	2881m MD (1683m TVD)
LICENCE NO:	OA-1211-002
CLASSIFICATION:	Exploratory – Category I
ERP:	Corporate ERP
DRILLING E.P.Z. RADIUS:	Not Applicable
DRILLING RELEASE RATE:	0.0m^3/s (0.0% H_2S)
OBJECTIVE:	Canol
NETWORK NO:	10351817
TARGET DAYS:	25.47 days plus 8.63 days to MIRU
AFE AMOUNT:	Move, Drill & Case: $6,820,000
MINERAL RIGHTS:	PNG from Surface to base Hume (all sections)

WELL CONFIGURATION:

HOLE SIZE	CASING	DEPTH
609.6mm	508mm Conductor line pipe	20m
311.15mm	244.475mm, 53.57 kg/m, J-55, LTC	600m
222.25	177.8mm, 38.69 kg/m, P-110, LTC	1,845m
155.6mm	114.3mm, 17.26 kg/m, P-110, LTC	2,881m

WELL NAME:	COPRC Mirror Lake P-20 65-00 126-45
SECURITY CLASSIFICATION:	Super Tight
UWI:	300P206500126450
DRILLING RIG:	Beaver Rig #2
ELEVATIONS:	GL: 268.2m KB: 274.2m (kb to GL estimated at 6.0m) Elevations are based on a surveyed ground level and estimated KB to GL distance. Confirm actual ground level and that KB to GL elevation difference is correct.
SURVEY PLAN FILE:	COPRC Mirror Lake P-20 65-00 126-45
DIRECTIONAL PLAN:	Horizontal Well
TOTAL DEPTH:	3098m MD (1972m TVD)
LICENCE NO:	OA-1211-002
CLASSIFICATION:	Exploratory – Category I
ERP:	Corporate ERP
DRILLING E.P.Z. RADIUS:	Not Applicable
DRILLING RELEASE RATE:	$0.0m^3/s$ (0.0% H_2S)
OBJECTIVE:	Canol
NETWORK NO:	10351817
TARGET DAYS:	25.5 days plus 6.7 days to MIRU
AFE AMOUNT:	Move, Drill & Case:
MINERAL RIGHTS:	PNG from Surface to base Hume (all sections)

WELL CONFIGURATION:

HOLE SIZE	CASING	DEPTH
609.6mm	508mm Conductor line pipe	20m
311.15mm	244.475mm, 53.57 kg/m, J-55, LTC	600m
222.25	177.8mm, 38.69 kg/m, P-110, LTC	2098 m
155.6mm	114.3mm, 17.26 kg/m, P-110, LTC	3098 m

CONTACTS

KEY CPC CONTACTS

Position	Name	Office	Cell
Completions Superintendent	Derrick Cove	780-832-0613	780-831-1314
Completions Engineer	Theron Lagarde	403-260-1097	403-710-9753
Drilling Operations Lead	Guy Goodine	403-260-8343	403-512-5212
Completions Team Lead	Jim Rau	403-260-1960	403-816-0756
Well Testing Specialist	Steve Veltman	403-260-1084	403-660-3727
VP WEO	Pierre Gagnon	403-260-1061	
Reservoir Engineer	Alexandra Novgorodova	403-532-7046	403-880-8693
Geologist	Trevor Gray	403-532-3553	403-813-7200
Reservoir Engineer	Kim Clarke	403-532-7460	403-540-9081
Drilling Waste Coordinator	Erin Reilly	403-260-2173	403-510-1828
Asset Team Lead	Eric Hanson	403-233-3250	
Completions Supervisors	Myles Hayn		780-402-0500
	Chris Kendall		780-518-3284
Construction	Bill Pepper	867-587-4171	403-816-5073

NEB CONTACTS:

Name	Position	Office	Home
NEB 24-hour Incident Cell		403-807-9473	
NWT/Nunavut Spill Phone Line		867-920-8130	
NWT/Nunavut Spill Fax Line		867-873-6924	
Transportation Safety Board Hotline		867-997-7887	
Rick Turner	Operations Technical Specialist	403-299-3868	403-540-3754
Abul Kabir	Drilling Engineer/ Conservation Officer	403-292-5048	403-510-5754
Saadat Javeed	Drilling Engineer/ Conservation Officer	403-221-3033	403-680-5861
Christy Wickenheiser	Environmental Specialist	403-299-3869	403-809-9352
John Korec	Environmental Specialist	403-292-6614	403-818-2403
Don Logan	Environmental Specialist	403-299-3676	403-921-2854
Patrick Smyth	Chief Conservation Officer	403-221-3014	403-608-4225
Brian Nesbitt	Chief Safety Officer	403-299-2771	403-629-6362

FIGURE 1: CURRENT WELLBORE SCHEMATIC

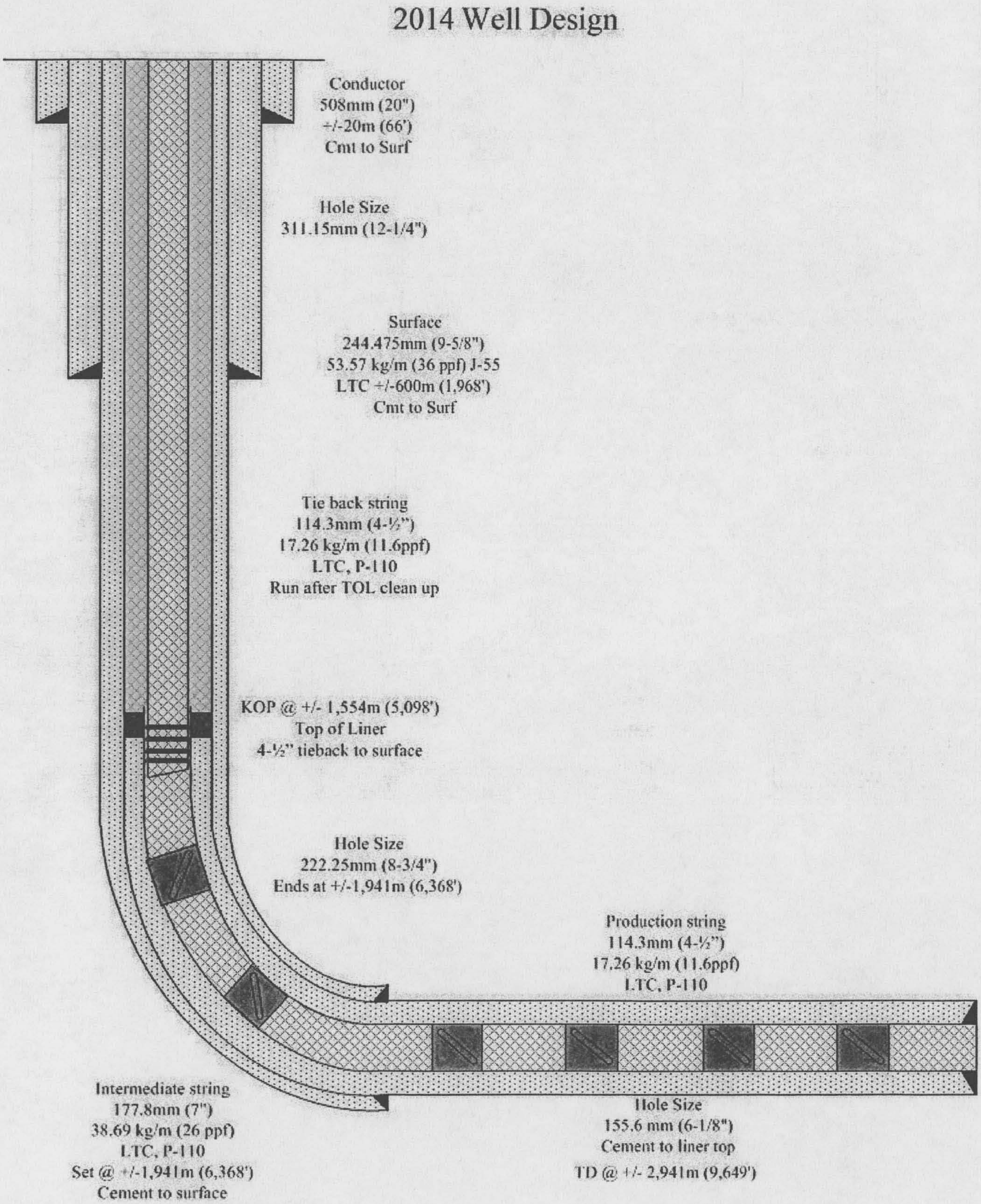


FIGURE 2: PLOT (SURFACE USE) PLAN

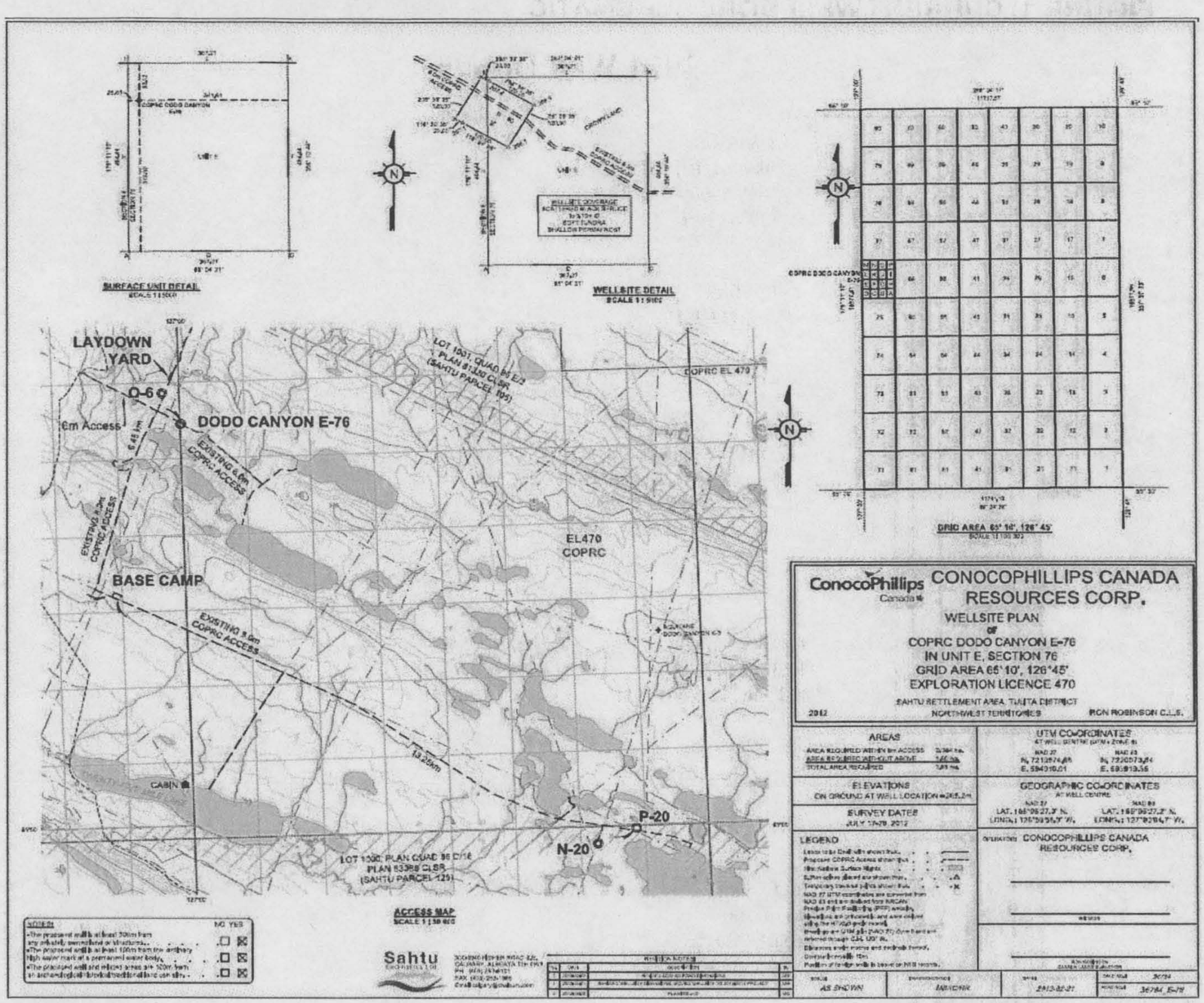
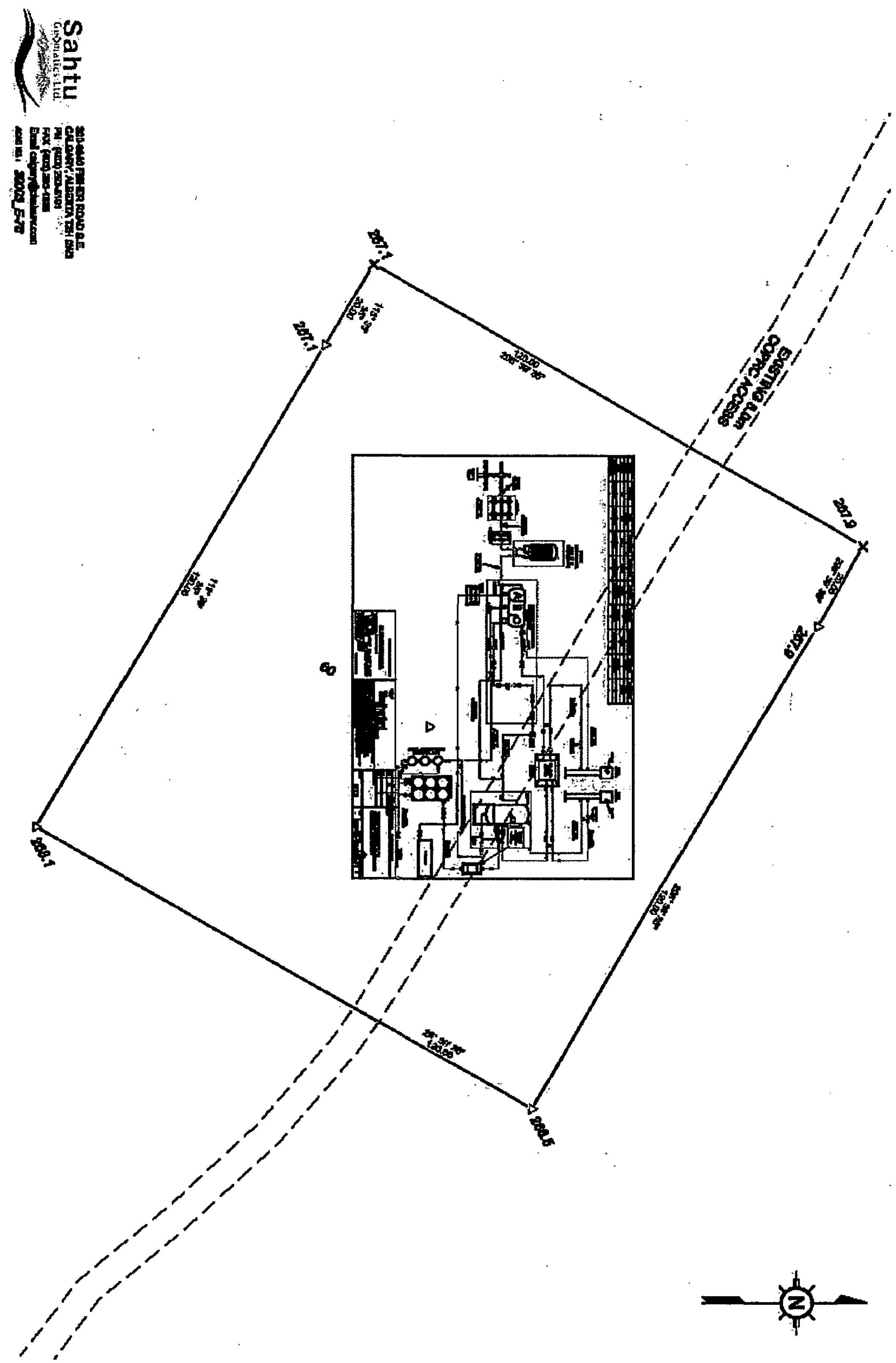


FIGURE 3: EQUIPMENT LAYOUT ON WELL SITE



WELL TESTING OPERATIONS

MOVE IN RIG UP

1. Perform site inspection per COP inspection checklist.
2. MIRU Weatherford test equipment and related surface rentals, including the following:
   - 2" 10K dual choke manifold and lines
   - Line heater
   - High pressure test separator (4 phase)
   - Low pressure test separator (3 phase)
   - Flocculation tank
   - (21) Flow back tanks
   - Jet pump pumping unit
   - (2) Flame arrestors,
   - (2) 60' flare stacks
   - Back pressure valve and pressure relief valve
   - H_2S safety equipment (monitors set @ 10 ppm)
   - Chemical treating lines (if required)
   - H_2S Scavenger and emulsion dispersant (if required)

   Note: All liquids will be metered; liquid hydrocarbon will be hauled to treatment in Norman Wells, while flowback fluid will be hauled for disposal in Rainbow Lake. All gas will be metered and flared.
3. Pressure test all equipment to 1.4 MPa low and 34.5 MPa high for 10 minutes each.
4. Function test remaining equipment prior to flowback operations commencing.
5. Perform site inspection and report results of inspection on daily completions report in Wellview.

FLOW TESTING OPERATIONS

The objective of the 2014 flow test is to understand reservoir deliverability without damaging productivity by drawing down on the well with excessive bottomhole pressure change. To achieve this objective, the following general guidelines will be used and modified as needed once well is brought online:

1. Flowback tubing through 1002 iron and choke manifold to closed top and contained tanks until gelled flowback fluid is recovered.
2. If well is liquid loaded, pressure test 2 1/16" lubricator to 1.4 MPa low and 34.5 MPa high for 10 minutes each. RIH with slickeline and swab cups and pull swabs to unload the well. Continue swabbing until directed otherwise by Completions Engineer.
3. Once initial flow is seen, flow the well with no restriction while monitoring the bottomhole pressure via live readout of pressure gauge.
4. The reservoir may be charged from hydraulic fracturing and initial bottomhole pressure may be above expected reservoir pressure. Once reservoir pressure is reached, choke the well back.

After choking the well back, produce it to a 15% drawdown from initial reservoir pressure. Maintain drawdown constant while taking PVT and other required samples.

6. If swabbing deemed ineffective. RIH with slickline and open sliding sleeve. POOH with slickline. RIH with slickline and set jet pump in sliding sleeve.
7. Use the same 15% drawdown criteria to operate jet pump.
8. Find choke size (or jet pump injection rate) that produces constant flow. Keep the well on constant choke for duration of the operations.
9. Use jet pump to unload and produce well. Clean up well by pumping back to closed-top and contained tanks. Bypass 4 phase separator until gelled flowback fluid recovered and hydrocarbon production noted

Table 1: Jet pump vendor contact information

Jet pump vendor	**Weatherford**
Contact	**Lee Edmond**
Telephone number:	403-660-5286
Email:	Lee.Emond@CA.Weatherford.com

Note: Compare rig tally to jet pump vendor tally and correct for differences to ensure that Wellview matches the schematic provided by the jet pump vendor. Jet pump vendor shall include tally in post job report emailed to Completions Engineer.

10. Flow the Canol for clean up and evaluation. Once the sand cut has dropped to zero, MIRU slickline and set tandem recorders in the 'X' nipple in the On/Off. After clean up, well will be conditioned to obtain PVT samples. Well will be flowed at low rates, as specified by the Reservoir Engineer.
11. PVT samples will be collected by production at the frequency specified by the Reservoir Engineer - see PVT Sample Collection Schedule.
12. Run required TRRC tests and fluid sampling. See "Fluid Sampling" section of procedure.
13. Record daily/hourly fluid volumes. Record in Wellview and on flow test report. Email reports twice daily to:

    Stephen.M.Veltman@conocophillips.com

    Alexandra.Novgorodova@conocophillips.com

    Theron.N.Lagarde@conocophillips.com

    George.Sperling@conocophillips.com

    Russ.Bone@conocophillips.com

Please note that this well testing program may change based on operational parameters during the hydraulic fracturing operations and the initial flowback period.

Jet pump will be used during the operations only is the well does not deliver flow on its own – it will be used purely as an artificial lift mechanism, only when needed.

14. Rig down, move out and release all equipment. Lock fence and wellhead. Haul all remaining flowback and produced fluid for treatment and disposal. Ensure all debris is removed.

PVT TESTING

In order to understand the fluid properties of the Canol reservoir, ConocoPhillips is planning to collect a series of PVT samples and perform in-depth analysis on one representative sample. A representative from Corelab will be on-site from the time of completions until the last sample is taken (well performance-driven). The sampling program is as follows:

1. Capture 2 full oil sample (1L) and 2 full gas sample (20L) from the high-pressure separator as soon as live oil is seen (estimated to be seen between 2 days and 2 weeks from start of production).
2. Start monitoring oil and gas performance by using a cumulative oil vs. cumulative gas plot
3. Once the GOR starts showing a trend, capture 2 samples of oil and gas from the high-pressure separator.
4. As GOR stabilizes, capture 2 more samples of oil and gas from the high-pressure separator.
5. Capture 2 samples of oil and gas from the high-pressure separator as instructed by the COP testing representative and continue to flow test the well.

One of the samples captured, all will be transported to the Corelab lab in Edmonton, and one will be analyzed for composition. The analysis may include – but it not limited to the following:

1. Routine oil and gas analyses
2. Compositional analysis of selected separator gas through C10+
3. Sample validation through bubble point
4. Separator pressure to 0 psig flash
5. Water content of stock tank liquid
6. Calculation of separator liquid composition
7. Calculation of reservoir fluid composition
8. Single stage atmospheric flash (produces GOR, API, shrinkage, flash gas gravity)
9. Compression of separator gases for recombination
10. Physical recombination to prescribed property
11. Single-stage flash of reservoir fluid
12. Liquid analysis through C36+
13. Calculation of reservoir fluid composition
14. Constant composition expansion
15. Constant volume depletion (if applicable)
16. Pressurized viscosity

The final PVT procedure will be determined once at least one sample is collected, and will be guided by an internal ConocoPhillips PVT expert.

Beyond the PVT testing, which will entail in-depth laboratory experiments as well as hypothetical fluid recombination work, other samples will be taken for basic analysis once the well starts producing flowback followed by hydrocarbon. The following is a schedule of field samples to be taken by Weatherford during flow testing operations:

1. Measure oil API and check for H_2S content once an hour until well flow rate stabilizes
2. Once well flow rate is stable, measure oil API and H_2S content once per day

Beyond field measurements, ConocoPhillips will also be implementing a testing procedure of oil, gas and water to be taken for standard compositional analyses in the laboratory. Oil, gas and water samples will be collected twice per week for the first 2 weeks, followed by once per week subsequently.

FLARING WHILE TESTING

In its September 2013 Application for Well Approvals of the 2013 Exploration Drilling Program for the EL470, ConocoPhillips provided an expected flaring or incineration volume of of 1.0 to 1.5 mmscf/d – or 28,000 to 43, 000m^3/d for each of the 2014 horizontal wells. This estimate was based on data available to the team at the time and due to that lack of information at the time, assumptions were made with regards to fluid, including the GOR (gas-oil ratio) – which is a big driver in gas production. Previous modeling was done on the Norman Wells field fluid – but with data from the core indicating a significantly different fluid type, these assumptions must be updated.

Two main uncertainties drive gas production: well productivity and fluid properties. In order to understand the ranges in these, ConocoPhillips performed a probabilistic simulation study varying the following parameters:

- Rock properties (thickness, porosity, water saturation, matrix permeability)
- Stimulation properties (ultimate height of fractures, number of stimulated regions, fracture half-length, extent to which the near-wellbore area is stimulated)

All of the above parameters greatly affect the productivity of the well. In particular, permeability and fracture half-length – the two biggest unknowns for the Canol shale – have a major effect on productivity. The gas rate results of the study are seen in Figure 4 and Table 2 below and demonstrate the large uncertainty present. Note that the "P50" profile refers to the 50th percentile results – or the most likely scenario given assumptions that were made in the modeling.

FIGURE 4. SEMI-LOG PLOT OF MODELED GAS RATES (SEMI-LOG GAS RATE IN MSCF/D VS. DAYS) OVER 60 DAYS OF PRODUCTION.

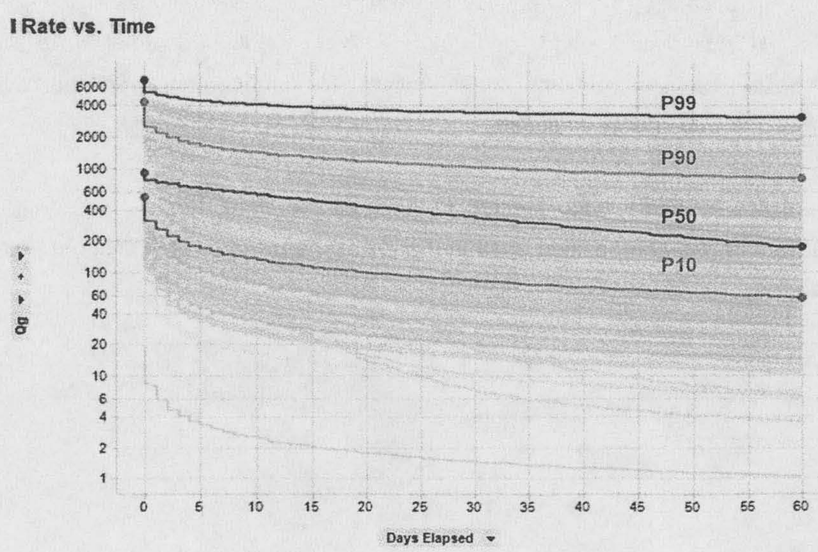


Table 2. Summary of modeling results over 60 days of production

Case	Max Gas Rate	Average Gas Rate	Total Gas Produced
--	mscf/d	mscf/d	mmscf
P10	530	160	6.2
P50	1,000	545	23
P90	4,345	1,565	70
P99	7,150	4,233	219

As a quality flow test is the main objective of ConocoPhillips' 2014 winter program, in order to determine the potential productivity of the Canol shale, ConocoPhillips is planning to avoid choking the well back if possible. Given the new understanding of the reservoir, the maximum expected gas rate anticipated is over 7 mmscf/d or 198 e^3m^3/d. COPRC is notifying the NEB that a maximum flow rate of 10 mmscf/d or 283,168 e^3m^3/d is required, in order to ensure that no limits are surpassed. As seen in the modeling type curves, ConocoPhillips does expect that the gas rate will decrease during the well test.

AIR QUALITY DISPERSION MODELLING ASSESSMENT

A screening level dispersion modelling assessment was done for the flow rates in Table 2 to determine the potential downwind effects from the flaring program at the E-76 and P-20 well sites. This was accomplished by using the Alberta Energy Regulator (AER) Flaring Spreadsheet (ERCBFlare.xls Version 1.05) to calculate the effective parameters for the two 18.3 m (60.0 ft) flare stacks with an inside diameter at the stack tip of 152.4 mm (6.0 inches). Dispersion models cannot explicitly account for flare stacks; therefore, they are treated as conventional stacks using pseudo-parameters. Specific pseudo-parameters, including stack height and diameter, were calculated based on a 25% radiation loss. The pseudo stack height is adjusted to account for the flame length. The diameter is adjusted to produce a plume rise representative of the amount of thermal energy available.

It was assumed that half of the flow rate was directed to each of the flare stacks and that they would be flaring simultaneously. Table 3 shows the gas composition used in the assessment and Table 4 summarizes the effective stack parameters used in the modelling.

Table 3: Representative Gas Composition from the Norman Wells Oil Field

Gas Composition (mole fraction)	Raw Gas
H_2O	0.0000
H_2	0.0000
He	0.0000
N_2	0.0000
CO_2	0.0000
H_2S	0.0000
CH_4	0.6536
C_2H_6	0.2046
C_3H_8	0.0930
i-C_4H_{10}	0.0116
n-C_4H_{10}	0.0209
i-C_5H_{12}	0.0000
n-C_5H_{12}	0.0163
n-C_6H_{14}	0.0000
C_7^+	0.0000
CO	0.0000
NH_3	0.0000
Note: Gas Analyses from GSC 1947-01 Norman Wells Oil Field, NWT, Canada, Stewart J.S. (Geol. Survey of Canada)	

Table 4: Effective Stack Parameters for the Flare Stacks at E-76 and P-20

Case	Flow Rate	Effective Height	Pseudo Diameter	Pseudo Velocity	Estimated Temperature
		m	m	m/s	K
P10	Qmax	19.07	10.57	0.134	1,294.87
	Qavg	18.35	6.73	0.100	1,294.04
	Qmin	18.10	4.33	0.100	1,292.86
P50	Qmax	19.81	10.58	0.253	1,295.13
	Qavg	19.10	10.57	0.138	1,294.88
	Qmin	18.26	5.95	0.100	1,293.78
P90	Qmax	22.92	10.58	1.100	1,295.49
	Qavg	20.58	10.58	0.396	1,295.27
	Qmin	19.09	10.57	0.138	1,294.88
P99	Qmax	24.48	10.58	1.811	1,295.57
	Qavg	22.84	10.58	1.072	1,295.49
	Qmin	19.65	10.57	0.226	1,295.09

Notes: Effective Parameters calculated using ERCBFlare.xls version 1.05
Qmax = ½ of Max Gas Rate in Table 2
Qavg = ½ of Average Gas Rate in Table 2
Qmin = Qmax/8
Assumed Ambient Air Temperature: 278.15 K

The emissions from the flares were calculated using factors from the U.S. EPA AP-42 document for the Criteria Air Contaminates (CACs) of nitrogen oxides (NO_X), carbon monoxide (CO), and fine particulate matter ($PM_{2.5}$). Table 5 shows the emissions used in the screening modelling.

Table 5: Criteria Air Contaminate Emissions for the Flare Stacks at E-76 and P-20

Case	Flow Rate	NO_X	CO	$PM_{2.5}$
		g/s	g/s	g/s
P10	Qmax	0.14	0.74	0.26
	Qavg	0.04	0.22	0.08
	Qmin	0.02	0.09	0.03
P50	Qmax	0.26	1.39	0.50
	Qavg	0.14	0.76	0.27
	Qmin	0.03	0.17	0.06
P90	Qmax	1.11	6.05	2.17
	Qavg	0.40	2.18	0.78
	Qmin	0.14	0.76	0.27
P99	Qmax	1.83	9.96	3.57
	Qavg	1.08	5.90	2.11
	Qmin	0.23	1.24	0.45

.es: Calculated from U.S. EPA AP-42 Chapter 13 for NO_X and CO. $PM_{2.5}$ emission factors were obtained from EPA FIRE version 6.22, April 21, 1991 (Landfill Gas Flaring) as per CAPP 2007 A Recommended Approach to Completing the NPRI for the Upstream Oil and Gas Industry.

Screening level dispersion modeling was completed using the United States Environmental Protection Agency SCREEN3 model to assess the potential downwind ground level concentrations of NO_X, CO, and $PM_{2.5}$ from the proposed flaring activities. The SCREEN3 model is a Gaussian plume dispersion model that is suitable for screening level analysis of single emission sources. SCREEN3 uses a matrix of screening meteorological data to establish a conservative or worst-case estimate of short-term air quality impacts. The SCREEN3 model was modified to remove the stack tip downwash calculation in the model as this is already accounted for in the ERCB Flare spreadsheet calculations.

Using Canadian Digital Elevation Data (CDED), the local terrain within a 7 km radius was extracted and the closest distance to each of the elevation contours was used to generate a "worst-case" terrain profile. Using this profile any contours above the stack height were considered to be complex terrain and those below were considered simple terrain. These values were used to run the U.S. EPA SCREEN3 model in the Simple + Complex mode to evaluate the effects of terrain on the dispersion of the CACs.

The higher of the simple terrain and complex terrain results were used in the summary tables below (Tables 6. U.S. EPA conversion factors were used to adjust hourly concentrations to 8-hour and 24-hour predictions for comparison to the ambient air quality criteria. All of the predicted concentrations are well below the NWT AQS for all of the CACs. The highest concentrations tended to occur during stable, night-time, meteorological conditions (PG Stability Class F) at a wind speed of 2 m/s which would impinge on the terrain between 2.2 km to 6.7 km from the flare stacks, although all values remained well below NWT AQS. The simple terrain results show that the maximum predicted concentrations tended to occur between 369 m to 1,126 m from the flare stacks under unstable meteorological conditions (PG Stability Classes A, B, and C).

Table 6: Estimated Maximum 1-hour Average Downwind Ground-Level Carbon Dioxide (CO) Concentrations by SCREEN3

Case	Flow Rate	Flow Rate		Flaring 2 x 18.3 m (60 ft) x 152.4 mm (6") Stacks	NWT AAQS	AAAQO	BCAQO&S			NAAQO		
							Level A	Level B	Level C	Maximum Desirable	Maximum Acceptable	Maximum Tolerable
		$10^3m^3/d$	MMCFD	μg/m³	μg/m³	μg/m³	μg/m³	μg/m³	μg/m³	μg/m³	μg/m³	μg/m³
P10	Qmax	15.05	0.530	22.9	15,000	15,000	14,300	28,000	35,000	15,000	35,000	
	Qavg	4.54	0.160	20.4								
	Qmin	1.88	0.070	15.5								
P50	Qmax	28.39	1.000	23.2								
	Qavg	15.47	0.545	22.9								
	Qmin	3.55	0.130	19.3								
P90	Qmax	123.35	4.345	24.2								
	Qavg	44.43	1.565	23.6								
	Qmin	15.42	0.540	22.8								
P99	Qmax	202.98	7.150	27.9								
	Qavg	120.17	4.233	24.2								
	Qmin	25.37	0.890	23.1								

Notes:
Stack Pseudo Parameters were calculated using the assumption that half of the flow rate would be directed to each flare stack. Predicted concentrations were multiplied by 2 to account for the stacks operating concurrently during flaring operations.

U.S. EPA SCREEN3 (13043) was run in the Complex Terrain + Simple Terrain mode and the highest concentrations predicted by the model were used after the complex results were multiplied by a factor of 4 to convert them from 24-hour average concentrations to 1-hour concentrations.

U.S. EPA SCREEN3 (13043) was modified to remove the Stack Tip Downwash Calculation as this is accounted for in the calculation of the pseudo stack height in the ERCB Flare V1.05 used to calculate the flare stack modelling parameters

Table 7: Estimated Maximum 8-hour Average Downwind Ground-Level Carbon Dioxide (CO) Concentrations by SCREEN3 (Calculated from 1-hour Predictions)

Case	Flow Rate	Flow Rate		Flaring 2 x 18.3 m (60 ft) x 152.4 mm (6") Stacks	NWT AAQS	AAAQO	BCAQO&S Level A	BCAQO&S Level B	BCAQO&S Level C	NAAQO Maximum Desirable	NAAQO Maximum Acceptable	NAAQO Maximum Tolerable
		$10^3 m^3/d$	MMCFD	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³
	Qmax	15.05	0.530	16.0	6,000	5,000	5,500	11,000	14,300	6,000	15,000	20,000
P10	Qavg	4.54	0.160	14.3								
	Qmin	1.88	0.070	10.8								
	Qmax	28.39	1.000	16.2								
P50	Qavg	15.47	0.545	16.0								
	Qmin	3.55	0.130	13.5								
	Qmax	123.35	4.345	16.9								
P90	Qavg	44.43	1.565	16.5								
	Qmin	15.42	0.540	16.0								
	Qmax	202.98	7.150	19.5								
P99	Qavg	120.17	4.233	17.0								
	Qmin	25.37	0.890	16.2								

Notes:
Stack Pseudo Parameters were calculated using the assumption that half of the flow rate would be directed to each flare stack. Predicted concentrations were multiplied by 2 to account for the stacks operating concurrently during flaring operations.

U.S. EPA SCREEN3 (13043) was run in the Complex Terrain + Simple Terrain mode and the highest concentrations predicted by the model were used after the complex results were multiplied by a factor of 4 to convert them from 24-hour average concentrations to 1-hour concentrations.

Predicted 8-hour average concentrations were calculated by multiplying the 1-hour concentrations by a factor of 0.7 as per U.S. EPA Guidance Document "Screening Procedures for Estimating the Air Quality Impact of Stationary Sources, Revised" (1992)

U.S. EPA SCREEN3 (13043) was modified to remove the Stack Tip Downwash Calculation as this is accounted for in the calculation of the pseudo stack height in the ERCB Flare V1.05 used to calculate the flare stack modelling parameters

Well Name: COPRC Dodo Canyon E-76 65-10 126-45
COPRC Mirror Lake P-20 65-00 126-45

ConocoPhillips
ENGR DOC 2012.07

Table 8: Estimated Maximum 1-Hour Average Downwind Ground-Level Nitrogen Dioxide (NO_2) Concentrations by SCREEN3

Case	Flow Rate	Flow Rate		Flaring 2 x 18.3 m (60 ft) x 152.4 mm (6") Stacks	NWT AAQS	AAAQO	BCAQO&S			NAAQO		
							Level A	Level B	Level C	Maximum Desirable	Maximum Acceptable	Maximum Tolerable
		$10^3 m^3/d$	MMCFD	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$
P10	Qmax	15.05	0.530	4.2	400	300					400	1,000
	Qavg	4.54	0.160	3.8								
	Qmin	1.88	0.070	2.9								
P50	Qmax	28.39	1.000	4.3								
	Qavg	15.47	0.545	4.2								
	Qmin	3.55	0.130	3.6								
P90	Qmax	123.35	4.345	4.4								
	Qavg	44.43	1.565	4.3								
	Qmin	15.42	0.540	4.2								
P99	Qmax	202.98	7.150	5.1								
	Qavg	120.17	4.233	4.5								
	Qmin	25.37	0.890	4.2								

Notes:

Stack Pseudo Parameters were calculated using the assumption that half of the flow rate would be directed to each flare stack. Predicted concentrations were multiplied by 2 to account for the stacks operating concurrently during flaring operations.

U.S. EPA SCREEN3 (13043) was run in the Complex Terrain + Simple Terrain mode and the highest concentrations predicted by the model were used after the complex results were multiplied by a factor of 4 to convert them from 24-hour average concentrations to 1-hour concentrations.

Assumes 100% conversion of NO_X to NO_2

U.S. EPA SCREEN3 (13043) was modified to remove the Stack Tip Downwash Calculation as this is accounted for in the calculation of the pseudo stack height in the ERCB Flare V1.05 used to calculate the flare stack modelling parameters

Table 9: Estimated Maximum 24-Hour Average Downwind Ground-Level Nitrogen Dioxide (NO_2) Concentrations by SCREEN3

Case	Flow Rate	Flow Rate		Flaring 2 x 18.3 m (60 ft) x 152.4 mm (6") Stacks	NWT AAQS	AAAQO	BCAQO&S			NAAQO		
							Level A	Level B	Level C	Maximum Desirable	Maximum Acceptable	Maximum Tolerable
		$10^3 m^3/d$	MMCFD	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$
P10	Qmax	15.05	0.530	1.1	200						200	300
	Qavg	4.54	0.160	0.9								
	Qmin	1.88	0.070	0.7								
P50	Qmax	28.39	1.000	1.1								
	Qavg	15.47	0.545	1.0								
	Qmin	3.55	0.130	0.9								
P90	Qmax	123.35	4.345	1.1								
	Qavg	44.43	1.565	1.1								
	Qmin	15.42	0.540	1.0								
P99	Qmax	202.98	7.150	1.4								
	Qavg	120.17	4.233	1.1								
	Qmin	25.37	0.890	1.1								

Notes:
Stack Pseudo Parameters were calculated using the assumption that half of the flow rate would be directed to each flare stack. Predicted concentrations were multiplied by 2 to account for the stacks operating concurrently during flaring operations.

U.S. EPA SCREEN3 (13043) was run in the Complex Terrain + Simple Terrain mode and the highest concentrations predicted by the model were used after the Simple Terrain predictions were multiplied by a factor of 0.4 to convert them from 1-hour average concentrations to 24-hour concentrations as per U.S. EPA Guidance Document "Screening Procedures for Estimating the Air Quality Impact of Stationary Sources, Revised" (1992).

Assumes 100% conversion of NO_X to NO_2

U.S. EPA SCREEN3 (13043) was modified to remove the Stack Tip Downwash Calculation as this is accounted for in the calculation of the pseudo stack height in the ERCB Flare V1.05 used to calculate the flare stack modelling parameters

Table 10: Estimated Maximum 1-Hour Average Downwind Ground-Level Fine Particulate Matter ($PM_{2.5}$) Concentrations by SCREEN3

Case	Flow Rate	Flow Rate		Flaring 2 x 18.3 m (60 ft) x 152.4 mm (6") Stacks	NWT AAQS	AAAQO	BCAQO&S			NAAQO		
							Level A	Level B	Level C	Maximum Desirable	Maximum Acceptable	Maximum Tolerable
		$10^3m^3/d$	MMCFD	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³
P10	Qmax	15.05	0.530	8.2		80						
	Qavg	4.54	0.160	7.3								
	Qmin	1.88	0.070	5.5								
P50	Qmax	28.39	1.000	8.3								
	Qavg	15.47	0.545	8.2								
	Qmin	3.55	0.130	6.9								
P90	Qmax	123.35	4.345	8.7								
	Qavg	44.43	1.565	8.4								
	Qmin	15.42	0.540	8.2								
P99	Qmax	202.98	7.150	10.0								
	Qavg	120.17	4.233	8.7								
	Qmin	25.37	0.890	8.3								

Notes:
Stack Pseudo Parameters were calculated using the assumption that half of the flow rate would be directed to each flare stack. Predicted concentrations were multiplied by 2 to account for the stacks operating concurrently during flaring operations.

U.S. EPA SCREEN3 (13043) was run in the Complex Terrain + Simple Terrain mode and the highest concentrations predicted by the model were used after the complex results were multiplied by a factor of 4 to convert them from 24-hour average concentrations to 1-hour concentrations.

U.S. EPA SCREEN3 (13043) was modified to remove the Stack Tip Downwash Calculation as this is accounted for in the calculation of the pseudo stack height in the ERCB Flare V1.05 used to calculate the flare stack modelling parameters

Table 11: Estimated Maximum 24-Hour Average Downwind Ground-Level Fine Particulate Matter ($PM_{2.5}$) Concentrations by SCREEN3

Case	Flow Rate	Flow Rate		Flaring 2 x 18.3 m (60 ft) x 152.4 mm (6") Stacks	NWT AAQS *	AAAQO	BCAQO&S **	NAAQO CWS *
		$10^3m^3/d$	MMCFD	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$
P10	Qmax	15.05	0.530	2.1	30	30	25	30
	Qavg	4.54	0.160	1.8				
	Qmin	1.88	0.070	1.4				
P50	Qmax	28.39	1.000	2.1				
	Qavg	15.47	0.545	2.1				
	Qmin	3.55	0.130	1.7				
P90	Qmax	123.35	4.345	2.2				
	Qavg	44.43	1.565	2.1				
	Qmin	15.42	0.540	2.0				
P99	Qmax	202.98	7.150	2.6				
	Qavg	120.17	4.233	2.2				
	Qmin	25.37	0.890	2.1				

Notes:
Stack Pseudo Parameters were calculated using the assumption that half of the flow rate would be directed to each flare stack. Predicted concentrations were multiplied by 2 to account for the stacks operating concurrently during flaring operations.

U.S. EPA SCREEN3 (13043) was run in the Complex Terrain + Simple Terrain mode and the highest concentrations predicted by the model were used after the Simple Terrain predictions were multiplied by a factor of 0.4 to convert them from 1-hour average concentrations to 24-hour concentrations as per U.S. EPA Guidance Document "Screening Procedures for Estimating the Air Quality Impact of Stationary Sources, Revised" (1992).

U.S. EPA SCREEN3 (13043) was modified to remove the Stack Tip Downwash Calculation as this is accounted for in the calculation of the pseudo stack height in the ERCB Flare V1.05 used to calculate the flare stack modelling parameters

*The 3-year average of the annual 98th percentile of the daily 24-hour average concentrations.

** based on annual 98th percentile value.

REPORTING REQUIREMENTS

As per NEB regulations, the following data associated with the flow test will be provided to the NEB by ConocoPhillips within 60 days of end of respective operations:

- Daily flow reports, including pressures and flow for all phases
- Summary of flow test including pressures and flow for all phases
- Daily completion/testing reports while the testing operation is ongoing
- Summary of build-up data from downhole gauges scheduled for retrieval in December of 2014 (submission of data in 2015)

COP TRACKING GUIDELINES AND EXPECTATIONS

ConocoPhillips will be receiving and tracking the following during testing operations:

- Daily operational (completion) reports
- Daily separator reports
- Live production data
- Daily summaries of production

;ACHMENT A
COPRC ADW Authorization

National Energy Board | Office national de l'énergie

File: WID #2081; 2082
28 November 2013

Greg A. Gersib
Vice-President
Canada Exploration
ConocoPhillips Canada Resources Corp.
401 – 9th Avenue SW
Calgary, AB T2P 2H7

Dear Mr. Gersib:

ConocoPhillips Canada Resources Corp. (ConocoPhillips) Approval to Drill a Well (ADW):

- **COPRC Dodo Canyon E-76 (WID 2082)**
- **COPRC Mirror Lake P-20 (WID 2081)**

ConocoPhillips is hereby granted approval to drill the above referenced wells. Please find the attached ADW forms for the proposed work and note that the ADWs are subject to the terms and conditions provided on the attachment. In addition, the well approvals are granted under Operations Authorization OA-1211-002 and are subject to the terms and conditions of that OA.

Any change or deviation from the approved program will require the additional specific approval of the Chief Conservation Officer.

These oil and gas activities are subject to the *Canada Oil and Gas Drilling and Production Regulations*, the *Canada Labour Code, Part II* and the *Oil and Gas Occupational Safety and Health Regulations.*

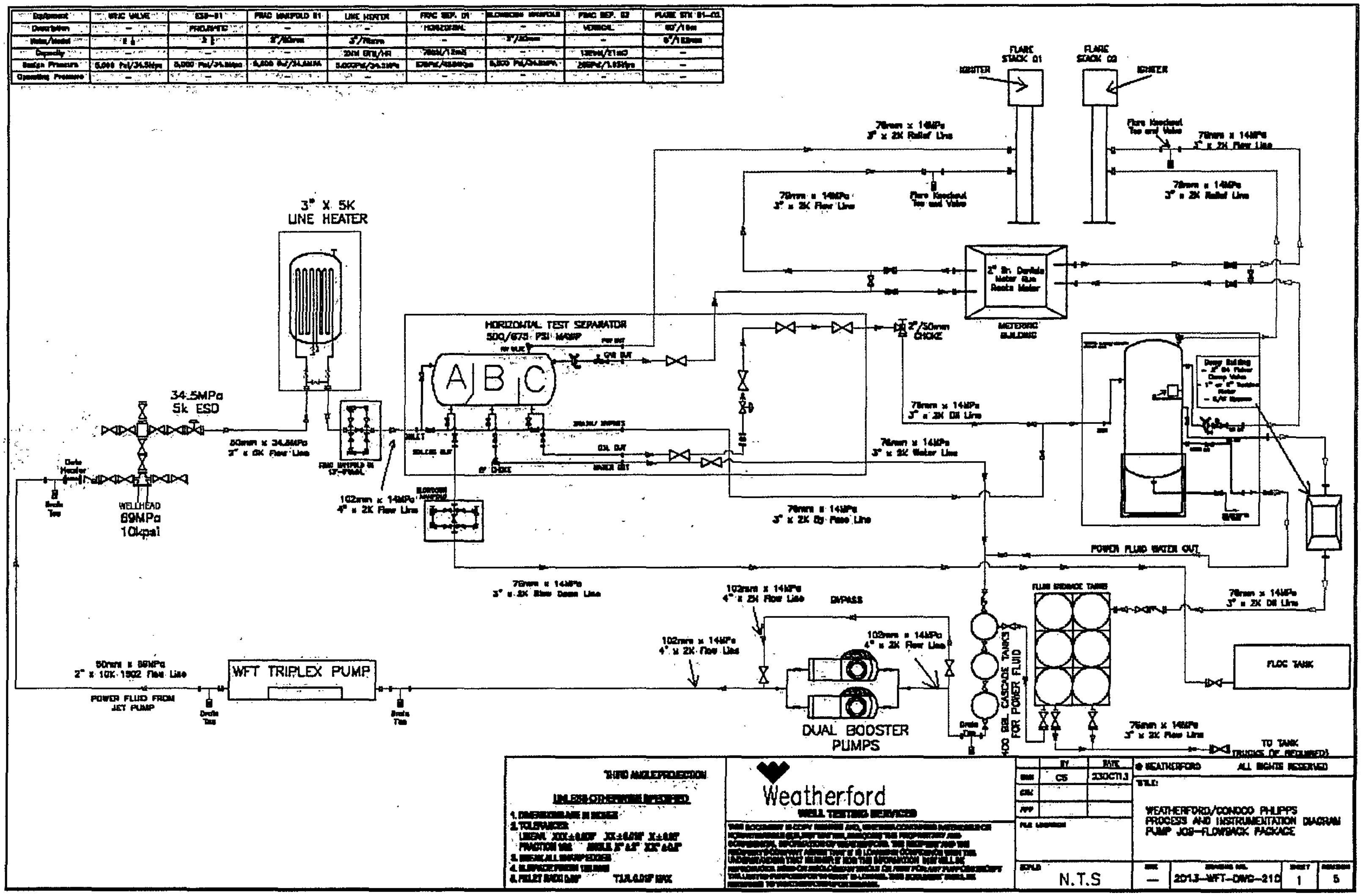
If you have any questions, please contact Abul Kabir at 403-292-5048 or abul.kabir@neb-one.gc.ca.

Yours truly,

Patrick Smyth
Chief Conservation Officer

Well Name: COPRC Dodo Canyon E-76 65-10 126-45
COPRC Mirror Lake P-20 65-00 126-45

ATTACHMENT B
Weatherford Well Testing Equipment Layout Plan



TACHMENT C
Weatherford Inspection Summary Report

Weatherford

December 9, 2013

Equipment Maintenance, Integrity Management and OCP.

Weatherford Maintenance Program Condensed, Highlighting Primary Flow Components.

Vessels:

Owner User Program AQP-8137, Weatherford currently has two Alberta Certified In-Service Inspectors with API 510 certification.
Regulatory inspection intervals are set as per ABSA AB506 Document.
Interval Inspection dates set by Weatherford are at ½ of regulatory set interval.
ie: Mandatory Interval 4 years – Weatherford Interval 2 years.
Regulatory inspections as per Weatherford's PEIMS thorough Inspection guideline require full volumetric inspection of vessel and process piping with an internal and external visual inspection.
Half interval is a volumetric inspection only.

PRV's:

Weatherford Policy for PRV service is yearly.
Inspected as per Weatherford's operational control plan (OCP) Pre Job Check List, any irregularities ie: service tag missing or seal broken to be sent in immediately for service.

Flow Line and Inlet Piping of Vessel:

Constructed to ASME B31.3, API 6A, IRP4 recommended practices.
All piping, tee's and inlet to be visually inspected before and after every job.
All piping to be Ultrasonically Inspected after every job with the following exception:

- Staying with the same oil company going from job to job with no down time in between and flow condition are within normal operating parameters as reported by the Supervisor.

Pre flow Inspection is conducted as per occupational control plan (OCP) Pre Flow Check Check List and documented in job files.

Weatherford Canada Partnership
6027 Edgar Industrial Drive
Red Deer, Alberta T4P 3R2
Canada

403/346-8840 Direct
403/347-0340 Operations Fax
403/346-5630 Accounting Fax

www.weatherford.com

ATTACHMENT D

Weatherford Horizontal Separator Certificate of Inspection

Weatherford

INFORMATION ONLY

PRESSURE EQUIPMENT INSPECTION TRAVEL SHEET

UNIT NUMBER: FS018

(A) NUMBER: 3105441	CRN NUMBER: M9152.2		SERIAL NUMBER: PT4628	
NUMBER	FUNCTION	MANUAL REFERENCE	COMMENTS	SIGNATURE AND DATE
1.0	Inspection Performed By		Wayne Halliday	May 02, 2010
2.0	Category of Inspection		Thorough	May 02, 2010
3.0	Manufacture Data Report, Drawings Available		Yes	May 02, 2010
4.0	Current Ultrasonic Inspection	April 29, 2010	Yes	May 02, 2010
5.0	PSV Service up to Date	May 4, 2010	Yes	May 02, 2010
6.0	Pressure Equipment Cleaned		Yes	May 02, 2010
7.0	External Assessment, Noted on PVIR		Yes	[illegible]
8.0	Confined Space Entry Permit Completed		Yes	May 02, 2010
9.0	Internal Inspection, Noted on PVIR		Yes	[illegible]
10.0	Pressure Equipment Fit for Service, AB-10 or AB-40	May 02, 2010	Fit For Service	[illegible]
11.0	Update Grade and Inspection Interval from Results		4	June 7, 2010
12.0	PVIR Completed	June 7, 2010	Yes	[illegible]
13.0	ESR Updated	June 7, 2010	Yes	[illegible]
14.0	Data Base Updated	June 7, 2010	Yes	[illegible]

ATTACHMENT E
Corelab Procedures for Surface Sampling of Gas

Core Lab

TITLE	
SURFACE SAMPLING HIGH PRESSURE LIQUID INTO EVACUATED CYLINDERS	
CONTROL NO: CA-FLDP-M01	APPROVED BY: Jonathan Cheesman/Douglas Craig
REVISION NO: 4	LAST REVIEW DATE: 2013-06-13

1.0 Reference:

1.1 Identification

CA-FLDP-S01 (Basic Safety for Sampling into Pressurized Cylinders)
CA-FLDP-M04 (Surface Sampling Gas into Evacuated Cylinders)
CA-FLDP-M05 (Surface Sampling High Pressure Liquid By Liquid Displacement)

2.0 Safety:

2.1 Hazard Assessment Control Number: CG-RSK-FLD-020

2.2 Overall Hazard Description: Low

2.3 **Identified Hazards:**

- 2.3.1 Potential exposure to non-ambient temperature and pressure.
- 2.3.2 Exposure to flammable gases.
- 2.3.3 Operation of motor vehicle.
- 2.3.4 Potential exposure to noise, vibration, dust, and/or odours.
- 2.3.5 Manual handling of tools required.
- 2.3.6 Other workers potentially exposed to hazards.
- 2.3.7 Potential hazards associated with working alone.

2.4 **Preventative Maintenance:**

- 2.4.1 Daily bump gas test required for 4-head monitor.

3.0 **Quality Control:**

3.1 Not applicable.

4.0 **Primary Duties:**

4.1 A two phase system within the cylinder is the safest and most desirable condition. A two phase system will convert to an unsafe single phase system if one or more of the following conditions are allowed to occur:

1. Sample container is agitated while filling.
2. Containers being filled are colder than the separator.
3. Containers are left on the pressure source for an extended length of time.

4.2 When the sample liquid flashes to a two phase condition, it does not alter the composition of the sample. Therefore, it is not necessary to ensure the cylinder is completely full.

ATTACHMENT F

Corelab Sampling and Analytical Procedures

1. Separator gas samples will be collected, following the procedure outlined in CA-FLDP-M04.
2. Separator hydrocarbon samples will be collected, following the procedure outlined in CA-FLDP-M01.
3. Atmospheric hydrocarbon and water samples collected in 1 gallon DOT approved steel cans.
4. Samples shipped to Calgary for analysis.
5. Gas samples are typically analyzed to C7+, although C12+ is available, to give insight into aromatic content for benzene emissions.
6. Hydrocarbon liquids analyzed to C30+.
7. K-Plot will be generated. This will determine if the separator was in equilibrium at the time of sampling, whether the samples were collected from the proper sample points, that no leaks occurred, and that the analysis was conducted properly. Additionally, gases will be checked for air contamination levels and a graph of carbon number vs. mole % constructed for the hydrocarbon liquid to ensure that no frac fluid contamination exists. These steps will determine if the sample quality is sufficient to allow for PVT work.
8. Samples will be transported to Core Lab Houston office for analysis, until the Calgary location acquires a cryogenic distillation unit.
9. Gas and liquid samples will be recombined, based on GLR data from the flow tests. Field GLR data needs to be corrected for the actual gas gravity of the collected samples, as this can have a significant effect on the GLR.
10. A portion of the recombined sample will be transferred into a high pressure PVT cell and heated to reservoir pressure. Saturation pressure will be determined and compared to reservoir pressure as a quality check.
11. Relative volume measurements will be carried out.
12. As the well is expected to produce light fluids with a high GLR, a constant volume depletion should be carried out, whether the reservoir is a gas or an oil system.
13. At several depletion pressures, a gas sample will be generated, the volume measured, and the composition determined.
14. If the reservoir fluid is a volatile oil, a pressurized viscosity and a separator test to field conditions will be included.