

July 13, 2022

Office of the Regulator of Oil & Gas Operations  
Government of the Northwest Territories  
PO Box 132  
Yellowknife NT  
1XA 2L9

**Attention:** Ms. Pauline de Jong  
Executive Director

### **Response to IR#3 ACW-2022-PAR-B-41-WID1733**

Paramount acknowledges receipt of your letter of June 15 regarding the above ACW. The questions raised illustrate the difficulty in designing a squeeze program prior to obtaining the necessary information (perforation interval, injection rate, etc.).

Paramount has selected a minimum feed rate of 30 liters per minute (lpm) as a target minimum needed for squeezing. Successful cement squeezes have been performed at both much lower and much higher rates, depending on wellbore conditions (unknown at this time).

It is generally accepted industry practice that the key parameter in a successful squeeze is control of the injection pressure (not the rate) of the squeeze. For example: SPE 133-PA Field Results of Cementing Operations Using Slurries Containing a Fluid -Loss Additive for Cement by J.P. Pavlich and W.W. Wahl states:

*Where bond logs have indicated the presence of voids in the cement behind the casing. the volume of the void is first calculated assuming no cement behind the pipe. This volume of cement is injected, if possible, at a low injection rate or until an injection-pressure increase is noted. (emphasis added).*

A "high pressure" squeeze is used under certain circumstances to squeeze off existing perforations which is not the purpose contemplated in the subject operations.

The 30 lpm rate was selected as a minimum to allow sufficient time to place cement prior to thickening without excessive retarder. A higher rate may be possible and would be used provided that excessive pressure is not applied, creating a cement filled fracture which would most likely be vertical and thus of no benefit in preventing potential vertical fluid migration.

As noted in the supplied program, the cement top was logged at 307mKB (above the surface casing shoe at 311mKB). Given this, it is highly unlikely that circulation can be achieved to surface, via the casing annulus, thus any injection of fluid from squeeze perforations will have to be into existing formation permeability and thus may be expected to at a limited rate unless the parting (fracture) pressure of the formation is exceeded.

Detailed steps for an injection test have been included in a contingency squeeze program which is provided separately from the abandonment program.

The abandonment program has been modified accordingly.

Paramount has corrected the typographic error on page 5 referencing MGM Energy.

Should you require additional information please me.

Sincerely,  
Paramount Resources Ltd.

A handwritten signature in black ink, appearing to read 'John Hawkins', with a long horizontal flourish extending to the right.

John Hawkins, P.Eng.  
Director Asset Retirement  
(403) 817-5074



**Application for Approval to  
Alter the Condition of a Well  
Paramount et al Arrowhead B-41**

**March 2022  
Rev 2 – July 2022**

## Introduction

**Paramount et al Arrowhead B-41** was drilled in 1989 by Shell Canada to a depth of 3080m. The openhole section was plugged back with five cement plugs, leaving 244mm intermediate casing @ 1056m and PBD inside casing of 845mKB. A cement bond log indicated the cement top as 307mKB (above the surface casing shoe @ 311mKB. The Pekisko formation was perforated at 800-816mKB and tested. It was then suspended with a Baker N-1 bridge plug at 785mKB. The plug was then pressure tested to 7MPa and capped with 30 m of cement.

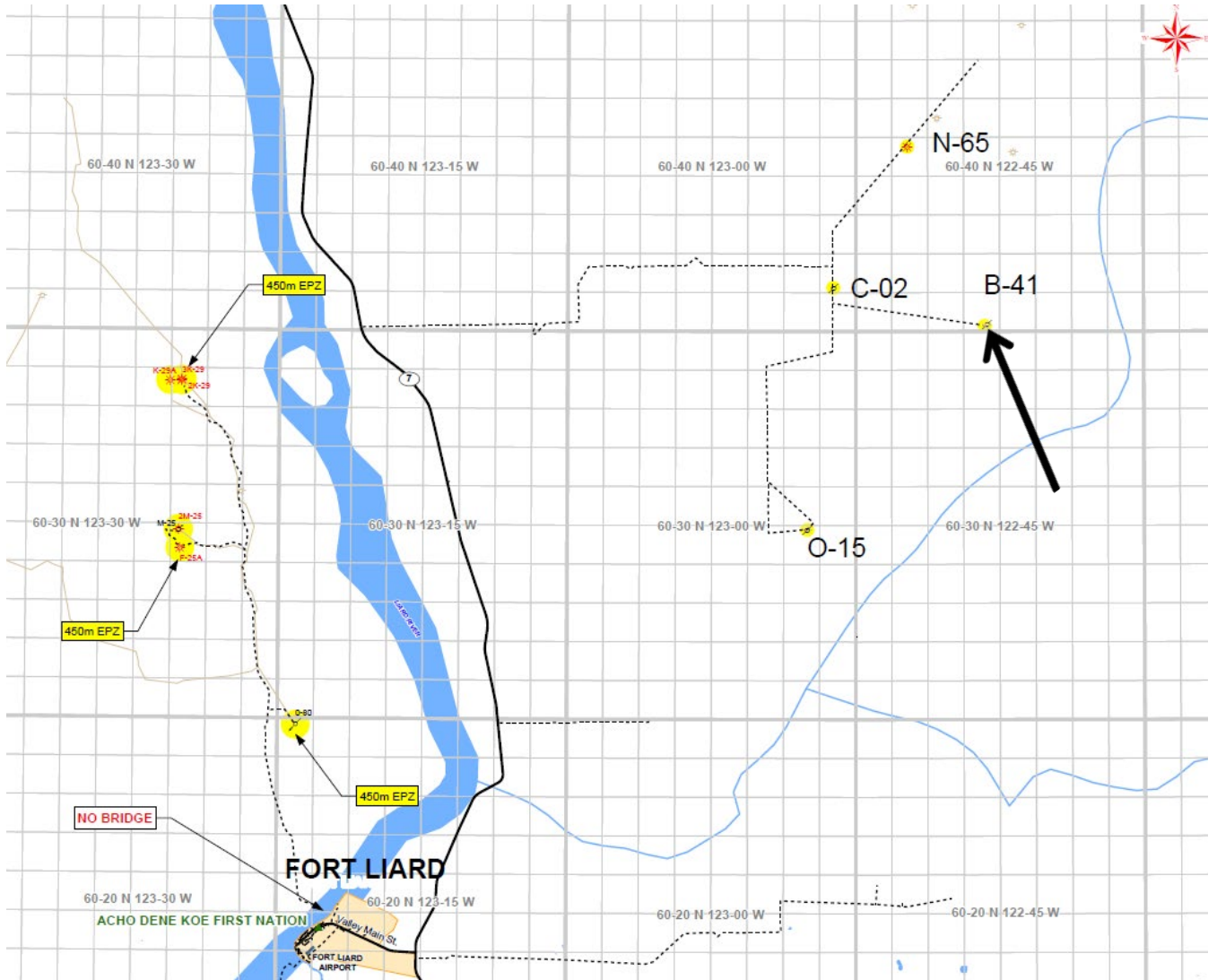
Paramount intends to abandon the B-41 well in compliance with the requirements of OROGO. Current plans are to abandon this well in conjunction with three others in the region in the winter season of 2023. Paramount has received Operations Authorization OA-2020-001-PAR for the abandonment of these wells. Circumstances and/or permitting issues may mean that it is more desirable to change the order and/or timing of the abandonments.

To improve operational efficiency and minimize environmental impact, Paramount intends to abandon these wells in conjunction with similar operations by CNRL in the same area, using the same access roads and infrastructure. Paramount intends to diligently pursue abandonment operations of these (and other) wells in OROGO jurisdiction, but to allow unexpected events to and minimize administrative overhead, PRL requests that the Well Approval be valid until April 30, 2025.

For ease of review and completeness, this application will follow the format of the OROGO "Roadmap for applications".

## Area of Application

The well is located northeast of the hamlet of Fort Liard and east of NWT highway 7.



# **General Requirements for a Well Approval**

## **Engagement - Consultation with Existing/Asserted Aboriginal Rights Holders Constitution Act 1982 - 35**

Paramount has consulted with the Aboriginal rights holders affected or potentially affected by these operations.

No concerns were raised by any of the parties involved.

The area of operations is separated from the community of Fort Liard by approximately 40 km from the hamlet of Fort Liard respectively and accessible only by purpose-built winter road.

The Engagement Plans and Engagement Records were supplied as part of the supporting information for the application for Operations Authorization for this project.

## **Well Approval Application Form (AACW)**

The original of this form is attached to the covering letter and a copy included as Appendix 1

# **Requirements of the Oil and Gas Drilling and Production Regulations (OGDPR)**

## **Requirement for a Well Approval – OGDPR S.10**

The operations contemplated under this program (well abandonment) require a Well Approval. This document is provided in support of Paramount's application for a Well Approval for the abandonment of Paramount et al Arrowhead B-41

## **Application to Drill - OGDPR S.11**

This application does not include any new drilling and thus this section of the OGDPR does not apply.

## **Application to Abandon a Well - OGDPR S.12**

The following is a summary of the abandonment program for Arrowhead B-41

Paramount has reviewed the records for the subject well. A cement bond log dated March 18, 1998 shows the cement top at 307mKB (above the surface casing shoe at 311mKB) and cement bond below this point. As the bond log was only run over the perforated (now abandoned) zone and at the surface casing shoe, a cement bond log will be run from plug back TD (approximately 755mKB) to surface and evaluated for the need for and practicality of additional perforation and cement squeeze operations.

There is a compliant zonal abandonment of the Pekisko and open hole below it (bridge plug and 30 meters of cement with open hole plugs, including across the casing shoe), the program consists of pressure testing the existing casing and plug and displacing the well to fresh water (currently reported as inhibited water), followed by surface cut and cap. The full program is provided in the appendices, along with current and proposed abandonment diagrams.

Current plans are to start construction of a winter road in December 2022 (subject to weather conditions). Downhole abandonment operations are planned to start late January 2023 and are estimated to take about 4 days. As there are a total of four wells to be abandoned in the area, the exact order of operations and wells may vary but it is planned to abandon all four wells by the end of March 2023.

Operations are subject to weather and site conditions, and to the availability of equipment and suitable personnel. For this reason, the timing, duration, and even order of the operations may change from those below.

## **Conditions for Abandonment- OGDPR S.56**

The abandonment of this well, as described above and in the program in Appendix 2 will comply with the requirements of OGDPR section 56.

### **Monitoring of Suspended Well - OGDPR S.57**

It was not possible to perform a formal gas migration test during the inspection in 2021, but there were no signs of gas migration and specifically no indications of gas bubbles in the water filled cellar. A gas migration test will be performed during the summer of 2022. Prior to and during abandonment operations, the well and immediately surrounding area will be monitored for surface casing vent flows and gas migration outside of the casing. Neither event was observed during any shut-in well inspections to date. If any indication of gas migration of surface casing vent flow is observed, operations will be suspended, the program will be modified to address the issue, and OROGO will be notified.

Once the well has been cut and capped and reported as permanently abandoned no further monitoring is anticipated.

### **Offshore Well- OGDPR S.58**

As this is not an offshore well, this section of the OGDPR does not apply.



## **Other Requirements**

### **The Well Suspension and Abandonment Guidelines and Interpretation Notes**

The abandonment of this well, as described above and in the program in Appendix 2 will comply with the *Well Suspension and Abandonment Guidelines and Interpretation Notes* provided by OROGO.

### **Information Disclosure Consent**

This form for the Arrowhead B-41 operations is included as Appendix 3. The form for the information associated with the Operations Authorization was included with that application.

## **Appendices – Supplied Separately**

**Appendix 1** Well Approval Application Form (AACW)

**Appendix 2** Abandonment Program – B-41  
Current Downhole Diagram  
Proposed Downhole Abandonment Configuration

**Appendix 3** Information Disclosure Consent Letter



**ABANDONMENT PROGRAM**  
**OROGO Compliant Suspended Well**  
**OROGO LEVEL II WELLBORE**  
**PARAMOUNT ET AL ARROWHEAD B-41**  
**WID # 1733**  
**POTENTIAL H<sub>2</sub>S: 0.0%**

**PROCEDURE APPROVAL & DISTRIBUTION**

**DATE:** March 22, 2022  
Rev:1 Added bond log May 19, 2022

**WELL NAME:** PARAMOUNT ET AL ARROWHEAD RIVER B-41

**COORDINATES** 60° 30' 08.4931" N 122° 53' 16.9292" W

**UWID:** 300/B-41-6040-12245/0

**OPERATIONS AREA:** Liard East **PROVINCE:** NWT

**OBJECTIVE:** Abandon wellbore in accordance with OROGO guidelines and approved ACW.

**AFE NUMBER:** **POU WI (%): 50%**

**POU Supplier Coding:** PR210-9231-xxx (Abandonment program)

**REGULATORY APPROVALS REQUIRED: YES**

**TYPE:** OROGO Operations Authorization OA-2020-001-PAR (2020/12/09)  
ACW

**AUTHORIZATION RECEIVED by:** **DATE:**

**PROCEDURE COMPLIES WITH CONDITIONS OF AUTHORIZATION:** YES  NO

**TYPE OF WORK:** Abandonment

**PROCEDURE COMPLIES WITH PARAMOUNT RESOURCES LTD. POLICIES ON:**

- 1) Paramount Well Control Manual
- 2) AER Servicing BOP Class III well.

**DISTRIBUTION:**

**FIELD:**

**CALGARY:**

Richard Bean/Corey Thomson/Well Files

**PREPARED BY:**  
Revised

Richard Heenan, P.Eng. - Consultant  
Richard Heenan, P.Eng. - Consultant

DATE: May 19, 2022  
DATE: March 22, 2022

**REVIEWED AND APPROVED BY:**

 Tim Wood for  
Corey Thomson – Completions Engineer

DATE: May 25, 2022

 Tim Wood, Manager ARO & Workover

DATE: May 25, 2022

 John Hawkins, Director ARO

DATE: May 26, 2022



## ABANDONMENT PROGRAM

### OBJECTIVE

Abandon well to OROGO requirements in same time frame as CNRL project to achieve cost efficiencies.  
Cut and cap well.

### REPORTING

- All rig calls and Daily Reports are to be directed to Corey Thomson (Engineer ARO)
  - Office: 403-261-1250
  - Cell: 403-835-4447
  - E-mail: [Corey.Thomson@paramountres.com](mailto:Corey.Thomson@paramountres.com)

### PROGRAM SUMMARY

- Read & record SIP(s). Investigate status of SCVF/GM.
- MIRU Service rig
- Perform bond log from PBSD to surface
- RIH with 73.0mm tubing and circulate to fresh water
- Perform perforation and squeeze if needed
- Lower fluid level to 50m to prevent freezing due to permafrost
- Rig out rig and equipment.
- Cut and cap the casing strings with vented cap.

### WELL HISTORY

The well was drilled on Exploration License EL 113.

ATCO Drilling Rig #48 was moved onto the location starting on January 17, 1989. The well spudded on January 22, 1989, at 0600 hours. The 444.5 mm surface hole was drilled to 311 mKB with a gel caustic fluid system there were no losses to the formation during the drilling of the surface hole. Surface casing of 339.7 mm, 81.1 kg/m + 90.8kg/m, K-55 ST&C casing was run and set at 311 mKB. The surface casing was cemented with 53 tonnes 0:1:0 'G' cement plus 1% CaCl<sub>2</sub> with good cement returns throughout the job and 5m<sup>3</sup> cement to surface.

The intermediate hole was then drilled with a gel caustic system to 1065m. No issues or notable losses were encountered. A 244.5mm 53.6kg/m K-55 x STC intermediate casing string was run to bottom and set at 1065m. It was cemented in place with 51 tonnes of 0:1:0 Class 'G' cement with 0.75% Hallad, full returns were experienced throughout the job but no cement to surface was witnessed. A bond log (Schlumberger-1989-03-12) confirmed the cement top at 307mKB.

The main hole was drilled using an air drilling system to a depth of 2504mKB at which point the hole was turned over to mud for the purpose of evaluation down hole and a gel chemical system was used from this point to TD. When the hole was flipped over to mud minor sloughing was experienced but no significant problems were experienced. A core sample was removed from 2855.0-2887.8mKB as part of the evaluation en route to bottom. Once TD was achieved 5 cement plugs were utilized to plug the well back to 845mKB.

The drilling rig was released March 24, 1989 at 2359hrs.

The well was an unsuccessful test of the Devonian Hume/Prequile formation. The Basal Quartz at 622-653mKB was successfully tested (DST) with a 6m pay zone. The highlight of the drilling phase was a successful air drilling interval of 1056-2504mKB at an average rate of penetration of 21.2 meters per hour. In total it took a total of 62



days to drill, evaluate and suspend the well

## **WELL COMPLETION:**

The Pekisko formation was perforated and evaluated from 800-816mKBm, an acid wash and brief flow back was conducted prior to suspending the well with a Baker N-1 bridge plug at 785mKB the plug was then pressure tested to 7MPa and capped with 30 m of cement. The well has been left in this state since 1989.

August 19, 2021 Shut-in Well Inspection. SICP = 0 kPa. SITP = N/A (no tubing). SCVF passed. Formal gas migration test was not conducted. No indication of bubbles in water filled cellar.

The well remains shut in and secured.

## **SAFETY**

A safety meeting is to be held with all service company personnel prior to each job. Wellsite supervisor must notify Contractors of known hazards of which Contractor(s) may be unaware. Wellsite supervisor must ensure that workers are aware of their responsibilities and duties under OH&S regulations and that workers comply with regulations. All service companies supplying materials will review Material Safety Data Sheets at this meeting for all products supplied and maintain these Material Safety Data Sheets available for worker's examination on location in compliance with WHIMIS regulations. All safety meetings will be recorded on the Paramount daily report and on the daily tour sheet.

Whenever possible, plan and conduct all workover procedures in a manner which will avoid the mixing of air & hydrocarbons in the well bore and connected surface piping. If mixing does occur, purge prior to pressurizing or exposing mixture to any other possible source of ignition.

Rig anchor locations if required will be approved by Paramount Wellsite Supervisor prior to installation.

## **REGULATIONS**

All applicable regulations, including, but not limited to the specific approved OROGO ACW approval, OROGO Well Suspension and Abandonment Guidelines, Oil and Gas Occupational Safety and Health Regulations (NWT) and Occupational Health and Safety (OHS) Regulations (NWT) are to be strictly adhered to. Written instructions must be posted in doghouse or other conspicuous area prior to the wellsite supervisor leaving the lease. Wellsite supervisor must designate, in writing (see attached Form), a competent person to carry out principal contractor's responsibilities. All verbal notifications and approvals from government regulatory agencies will be recorded on Paramount's daily report sheet. The name of the individual contacted, and the subject matter of approval or notification should be recorded on same.

Paramount shall provide all staff and contractors for this program with the OROGO 24-hour incident reporting phone number (867-445-8551) prior to commencing any work or activity.

Paramount shall submit to OROGO an updated operator contact list for this program prior to any work or activity by email at [orogo@gov.nt.ca](mailto:orogo@gov.nt.ca).

Paramount shall submit to OROGO certificates and inspection documents for any service rig, well control and associated equipment (including boilers) at least 10 days prior to the rig commencing work by e mail at [orogo@gov.nt.ca](mailto:orogo@gov.nt.ca).



Paramount shall submit all reports required under the Oil and Gas Drilling and Production Regulations in a timely manner to OROGO by email at [orogo@gov.nt.ca](mailto:orogo@gov.nt.ca). Daily abandonment reports are to be submitted by 1 pm the following day.

Paramount shall submit to OROGO, completed Change of Well Status form 30 days after the service rig release date or when the abandonment operation has been finished.

### **WORK ORDERS/FIELD TICKETS**

Delivery and field tickets for all work, services performed, or materials purchased must be signed by a Company wellsite supervisor. Record the AFE number and well location on all purchase and work tickets.

### **MATERIAL TRANSFERS**

All materials shipped to this location that are not used must be transferred to an appropriate warehouse point. Transfers of any tubular materials must include complete tally. Company wellsite supervisor will complete such transfers and forward both copies to Calgary office for approval and further handling.



# PARAMOUNT ET AL ARROWHEAD RIVER B-41 ABANDONMENT

## WELL DATA AND WELLBORE CONFIGURATION

### WELL DATA:

<b>Surface Location:</b>	LAT: 6707374N, LONG: 506069E (10N)
<b>Bottomhole Location:</b>	LAT: 6707394N, LONG: 506041E (10N)
<b>UWI:</b>	300/B-41-6040-12245/00
<b>Profile:</b>	Slight Deviation
<b>BGWP:</b>	600m GL (Default)
<b>WID#:</b>	1733
<b>OPERATING LICENCE#</b>	<b>NWT-OL-2014-014</b>
<b>LAND USE PERMIT#</b>	<b>LUP MV2020A0010</b>
<b>WATER LICENCE #</b>	<b>MV2020L1-0007</b>
<b>OROGO OA#</b>	<b>OA-2020-001-PAR</b>
<b>OROGO ACW#</b>	<b>TBD</b>
<b>Spud Date:</b>	January 22, 1989
<b>Rig Release Date:</b>	March 24, 1989
<b>KB:</b>	520.0m
<b>GL:</b>	
<b>KB-GL:</b>	7.6m
<b>PBTD Original:</b>	834.0m KB
<b>TD:</b>	3080.0m KB MD
<b>TD:</b>	3078.7m KB TVD

**CONDUCTOR:**                   **Hole size 610mm to 10m.**  
508mm heavy wall conductor pipe set at 10m and cemented in place with 40 sacks of construction cement.

**SURFACE:**                   **Hole size 444.5mm to 311m**  
36 Jts. 339.7mm 81.1kg/m + 90.8 K-55 Range 3, ST&C landed at 311m KB. Cemented with 53 Tonnes (40.3m<sup>3</sup>) 0:1:0 G cement plus 1% CaCl<sub>2</sub>. 5m<sup>3</sup> of cement returns.

**INTERMEDIATE#1:**       **Hole size 311mm 1056m.**  
57 Jts. 244.5mm 53.6kg/m K-55 Range 3, STC landed at 1056m KB. Cemented with 51 Tonnes 0:1:0 G cement plus 0.75% Hallad. No cement returns to surface - **logged at 307mKB.** (Schlumberger-1989-03-12)

**MAIN HOLE:**               **Hole Size 216mm to 3080m**  
Open hole plugged back +/- 200m into intermediate casing with cement plugs  
Plug #1A: 3080-2975mKB utilizing 4m<sup>3</sup> of Class 'G' cement + 40% silica flour  
Plug #1B: 2925-2850mKB utilizing 75m<sup>3</sup> of Class 'G' cement + 40% silica flour  
Plug #2: 2665-2365mKB utilizing 38.76m<sup>3</sup> of Class 'G' cement + 40% silica flour  
Plug #3: 1850-1775mKB utilizing 2.74m<sup>3</sup> Class 'G' cement + 40% silica flour  
Plug #4: 1500-1425m<sup>3</sup> utilizing 3m<sup>3</sup> of Class 'G' cement + 40% silica flour  
Plug #5: from 1089-845mKB using 9.58m<sup>3</sup> of Class 'G' cement – confirmation run found cement top at 849mKB





**PERFORATIONS:** 800-816mKB

**Formation Tops**  
**geoSCOUT Ref Elev(m): +520.0**

Formation	TVD (m)	Elev (m)
Kscatter	454	66
Kgarbutt	503	17
Kbs_ss	610.2	-90.2
Mdebolt	653	-133
Mpekisko	810	-290
Mbanff	834.3	-314.3
Mexshaw	1348.8	-828.8
Dkotcho	1366.9	-846.9
Dtetcho	1759.5	-1239.5
Dtrout_rv	1804.8	-1284.8
Dkakisa	1869.1	-1349.1
Dft_smpsn	1902.1	-1382.1
Dmuskwa	2530.9	-2010.9
Dslave_pt	2551.7	-2031.7
Dwatt_mtn	2659.3	-2139.3
Dkeg_rv	2662.3	-2142.3
Darnica	2859.9	-2339.9
Cambrian	3070.7	-2550.7
T.D.	3078.7	-2558.7

**Capacities:**

Capacity of 244.5 mm 38.69 kg/m casing: 27.46m<sup>3</sup> (681m PBTD)  
 Annular Capacity of 244.5mm Casing/339.7mm, 81.11kg/m Casing = 0.033695m<sup>3</sup>/m

**Tubing/Casing Data:**

	Surface Casing	Int. Casing #1	Int. Casing #2	Liner	Work String
Size O.D. (mm)	339.7	244.5			73
Weight (kg/m)	91.1/81.10	53.6			9.67
Grade	K-55	K-55			J-55
Connection	ST&C	ST&C			EUE
Drift I.D. (mm)	313.92	222.63			59.61
I.D. (mm)	317.88	226.59			62.0
Capacity (m <sup>3</sup> /m)	0.080637	0.038840			0.003019
Collapse (MPa)	7.8	14			53.0
Burst (MPa)	18.8	24			49.6
Tension (daN)	243 000	188 000			44 300



Annular Volume (m <sup>3</sup> /m)					
Depth (mKB)	311	1056			785m (To reach PBTD).

**Reservoir Data:**

Formation	Pekisko (perf'd)	Basal Quartz (DST)
Perforations	800-816 mKB	N/A
Reservoir Pressure	9,065 kPa**	4,950 kPa
Reservoir Temperature	35 °C	33°C
H <sub>2</sub> S	0ppm	0ppm

\*\* From Test Notes



## **ABANDONMENT PROGRAM**

1. Submit certificates and inspection documents for any service rig, well control and associated equipment (including boilers) at least 10 days prior to the rig commencing work by e mail at [orogo@gov.nt.ca](mailto:orogo@gov.nt.ca).
2. Ensure application to alter well has been submitted and approved prior to commencing work. Ensure a copy of the approved application to alter is on site and available.
3. The Wellsite Supervisor is responsible to notify (or verify notification has been completed) the OROGO, a minimum of 24 hrs prior to any well servicing abandonment operation.
4. Flaring: No flaring is anticipated.  
NOTE: Per the Operations Authorization the volume and composition of any gas flared or vented must be reported on the daily report and submitted to OROGO.  
**Any release of gas (vented) over 1m<sup>3</sup> per day or flared over 0.040 E3m<sup>3</sup>/day (40m<sup>3</sup>) or a duration of over 4 hours must be reported to OROGO as an incident under section 75 of the NWT OGDPR.**
5. Paramount shall provide all staff and contractors for this program with the OROGO 24-hour incident reporting phone number (867-445-8551) prior to commencing any work or activity.
6. Complete lease inspection. Note the condition of the lease, record any clean-up operations required and record any other noteworthy findings on the first morning report. Coordinate the transportation arrangements for the tanks and fluid with respect to other activity in the surrounding field.
7. Prepare location for Service Rig. P-Tank and flare stack & support equipment. Source 900m of 73mm, 9.67 kg/m J-55 EUE tubing for abandonment operations.
8. Ensure surface casing vent piping is exposed to determine if it is open and intact.  
Perform SCVF bubble-test.  
Record SITP and SICP.  
Check and monitor LEL and H<sub>2</sub>S levels at wellhead.  
Investigate for evidence of gas migration (GM) at surface.  
Record SICP, SICP, SVCF and GM results on daily report.  
Contact Calgary Office for program modification if SCVF or H<sub>2</sub>S is detected.  
  
Note: There are no flowlines present on location.
9. MIRU service rig complete with a 280mm 35 MPa (11" 5000#) Class III BOP stack. 73 mm rams, kill spool, rig pump, clean tank, and related auxiliary equipment to OROGO, OH&S and PRL regulations and guidelines. Ensure Corporate Policies and Procedures are followed prior to commencing operations (see attached). Space out equipment in accordance with OROGO and OH&S requirements.
  - Ensure all necessary safety equipment is strategically positioned, on site and tested to ensure proper operating condition prior to commencing with the workover operations.
  - All personnel must be familiar with the operation of all emergency equipment. Safety and BOP drills are to be conducted on a regular basis and recorded on the "Daily Completion / Workover Report"
  - Conduct a complete inspection of the service rig per requirements of AER Directive 37 and PRL guideline policy. Identify and remediate any deficiencies prior to initiating completion operations
  - Conduct an operational and safety meeting prior to installing BOPs onto the wellhead and pressure testing.



10. Haul in approximately 35 m<sup>3</sup> of fresh water. Haul in tubing work string, 800 meters of 73mm, 9.67kg/m J-55 EUE tubing string. Ensure bits, scrapers, and pressure test packer for 244.5mm 53.5 kg/m casing is available.
11. Conduct daily pre-job safety meeting and equipment inspection.

Install the working spool and BOPs onto the BOP test stump. If required warm up the BOP stack with steam. Function test the blind rams and pipe rams on the test stump. Close the blind rams and pressure test the working spool, the blind rams and BOP flange to **1.4MPa** and **21MPa** for **10 minutes** each. Install a ported tubing pup and stabbing valve through the BOPs on the BOP test stump. Pressure test the pipe rams and stabbing valve to **1.4MPa** and **21MPa** for **10 minutes** each. Pressure test the annular preventers to low of **1400 kPa** and a high of **7,000 kPa**.  
Record results in daily report and tour book.

12. Conduct an accumulator function test.  
Recharge the accumulator, shut off the pump and record the accumulator pressure.  
Close each ram and record the start and end pressures and the time to close each ram.  
Close annular on a tubing joint.  
Rams must close in 30 seconds and annular in 60 seconds.  
Final accumulator pressure must be 8400 kPa or greater.  
Record results in daily report and tour book

Recharge the accumulator and record the time for the accumulator to recharge to the original pressure.  
Accumulator must recharge in 5 minutes.  
Record results in daily report and tour book

Ensure that hand wheels are available and are the correct type and size for all the BOP rams.  
Record the number of turns to close each ram manually in tour book and on daily report.

13. Note: all zones have been previously abandoned and there is a permanent bridge plug and cement at 755m KB.

Ensure the well is dead. Remove wellhead top section and nipple up the rig BOPs.  
**Note: BOPs will be nipped up on 11" 5000# flange**

14. There is no tubing hanger in the 244mm spool.  
Pressure test the pump lines and connections to 1400 kPa and 21 MPa high.

15. Fill the hole with fresh (non-saline) water and close the blind rams and pressure test the BOP connection to the wellhead and the casing (**and inherently the bridge plug @ 785mKB and associated cement cap**) to **1.4MPa** (low) and **7MPa** (high) for **10 minutes** each.  
Record results in daily report and tour book

16. Rig up wireline and run cement bond log from PBDT (approximately 785mKB) to surface.  
Re-run with 7MPa pressure pass if bond is questionable.

Perform field evaluation of bond and possible perforation/squeeze zone(s)  
Forward log to Calgary office for formal evaluation.

Continue to proceed with replacing wellbore fluid and topping off existing plug while the practicality of a squeeze is evaluated.

Note: Previous bond log indicates cement top a 307mKB, but does not cover most of the production casing.



17. RIH with 73mm tubing and displace to fresh (non-saline) water using reverse circulation.  
Record on daily report and in tour sheet "well completely displaced to fresh (non-saline) water".  
Use this exact wording.  
Pull tubing from hole.
18. Confirm if cement squeeze is required – if needed follow the procedure in the supplement provided under separate cover.  
**Intervals and maximum pressure TBD**
19. Install a water-tight cap on the end of tubing (e.g., a short piece of tubing with a steel plate welded on it).
20. RIH with tubing to 500m.  
This will displace 2m<sup>3</sup> of water to lower final fluid level to 50m to prevent freezing due to permafrost.  
POOH.  
Do not fill hole.  
  
Remove BOPs and rig out.  
Cover exposed flange securely if well is not to be immediately cut and capped.
21. Prepare "as built" downhole abandonment diagram – using attached proposed diagram as a guide.

#### **Surface Abandonment:**

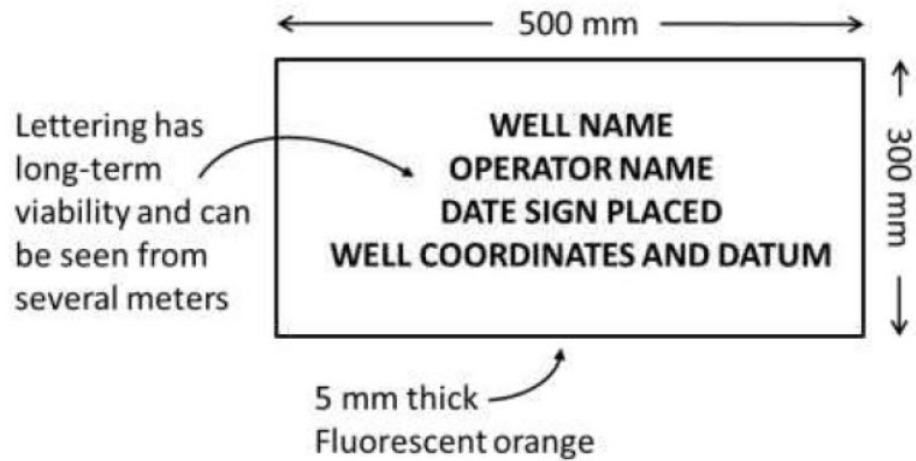
Cut and cap the casing strings at least 1 m below ground level with vented cap as per the procedure below or with Hydro jet vented cap system.

22. Confirm LEL and H<sub>2</sub>S are zero. Reconfirm no indications of gas migration.
23. Excavate a 2.5m deep bell hole around the wellhead ensuring that walls of the bell hole are sloped at a maximum of 45 degrees for safe entry and egress and to prevent sloughing in.
24. Confirm surface casing vent is open.  
Cut a small hole 30 cm below the surface casing bowl and investigate for trapped gas and fluids. Check and monitor LEL and H<sub>2</sub>S levels.  
Attach wellhead to lifting unit (rig, backhoe, picker, etc.). Pull slight tension  
Weld cut three (3) windows in the surface casing to access the innermost casing string ensuring that 50% of the circumferential metal remains to prevent possible collapse of the surface casing from the weight of the wellhead. While exercising caution, weld cut the innermost string.  
  
NOTE:  
Innermost string can be expected to suddenly drop once completely cut.  
Do not place pry bars, hands or fingers in the windows.
25. Complete weld cut of the surface casing, lift and remove wellhead from bell hole.
26. Stitch weld (non-sealing) steel plate "surface casing and production casing.  
Weld inscribe the LSD on top of the steel plate and document with a digital photograph.
27. Install abandoned well sign as below.  
Verify well coordinates (decimal format to 4 decimal places) in header with handheld GPS field measurement – use NAD 83 Datum  
Record well coordinates on daily report.  
A buried 5 gallon pail filled with cement may be helpful in supporting the well sign (as below)



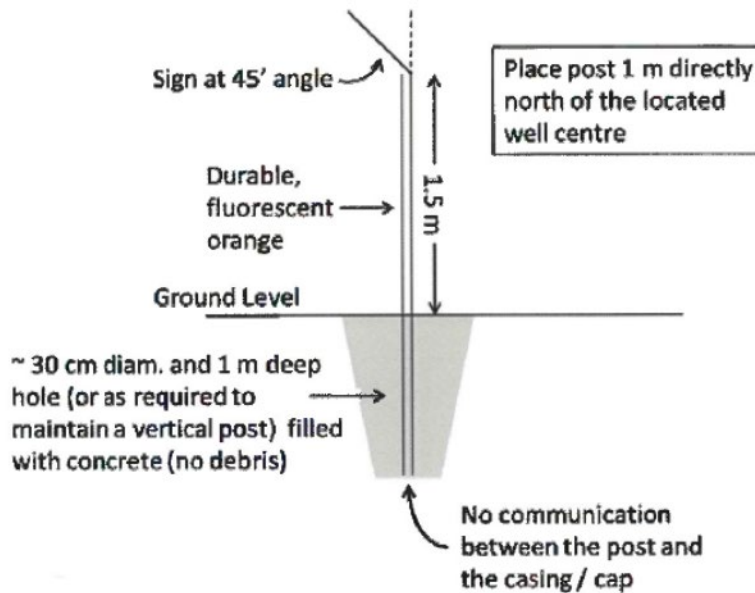
DO NOT WELD SIGNPOST TO CASING.

### Sign Requirements



### Well Suspension and Abandonment Guidelines and Interpretation Notes

#### Post Requirements



28. Prepare field sketch of lease indicating well location, signpost (1 meter north of well) and any relevant features. Submit with daily report.
29. Backfill and compact the excavation, clean up lease and rig out and release all services.



## CORPORATE CONTACTS

Paramount Resources Ltd.  
2800, 421 - 7<sup>th</sup> Avenue, SW  
Calgary, AB  
T2P 4KP

### ARO (Calgary):

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Richard Bean Abandonment Supt-Staff E-mail: <a href="mailto:richard.bean@paramountres.com">richard.bean@paramountres.com</a>	(403) 303-1929	(403) 793-4586	(403) 261-1349

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### MORNING REPORTS (Calgary):

	<u>Business</u>	<u>Cellular</u>	<u>Fax</u>
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## CORPORATE POLICY & PROCEDURES

- All operations carried out on behalf of the Operator shall be conducted in a safe and efficient manner in compliance with the Operator's safety regulations and all applicable acts and regulations.
- The Operator expects that all operations conducted will be designed to protect and maintain the quality and integrity of the environment and comply with all environmental acts and regulations.
- All contractors on location must have as a minimum a valid H<sub>2</sub>S ticket (if necessary), WHMIS, and be fully covered by the NWT Worker's Compensation Board (WCB) where applicable, carry a minimum of \$5,000,000 liability insurance.
- Before commencing operations, the Wellsite Supervisor will complete a list of nearest available emergency services. This list along with a detailed and accurate description of directions to the location is to be posted in a conspicuous and accessible location known to all personnel.
- Any excavation or installation of anchors (if required) on location shall follow Paramount's Ground Disturbance Requirements:
  - a. Contact 1<sup>st</sup> Call (Review Paramount's Grey book)
  - b. Prior to excavation – obtain Ground Disturbance Permit
    - i. If pipeline in area, arrange for Hydrovac and hand expose lines within 5 meters of excavation.
- Prior to commencing operations, the Wellsite Supervisor shall:
  - Read and record SIP(s). Examine surface casing vent for blow or suction, record and report findings. Check and monitor LEL and H<sub>2</sub>S levels at wellhead and investigate for evidence of gas migration at surface.
- Before commencing operations, the Wellsite Supervisor in conjunction with the Rig Manager will conduct an initial rig inspection using a CAODC or equivalent inspection form. A detailed rig inspection is to be completed weekly thereafter. Confirmation of these inspections is to be recorded on both the morning report and tour report.
- Have on-site access to the AER Drilling/ Servicing Regulations - Directive 36, Workplace Health and Safety Regulations, NWT Oil and Gas Operations Act, NWT Drilling and Production Regulations, OROGO Well Suspension and Abandonment Guidelines.
- The Wellsite Supervisor and Rig Manager will conduct daily walk-around inspections and complete a daily rig inspection report in an effort to identify deficiencies regarding well control and safety related items.
- The Wellsite Supervisor must ensure that all pertinent data (tubulars, logs, tests etc.) are properly recorded on the tour sheets and that samples, where required are collected as required by well licence. Also, the Wellsite Supervisor must ensure that trip sheets are properly completed and maintained.
- During cold weather operations, the Wellsite Supervisor must ensure that Precautions are taken to prevent freezing of the bleed-off and kill lines
- The Wellsite Supervisor must ensure that all personnel are advised and instructed not to trespass off the demised property.
- Safety meetings are to be held every day with wellsite personnel and recorded on both the morning reports and tour reports. Pre-job safety/orientation meetings are to be held prior to commencing new or non-routine work at which time the Wellsite Supervisor shall advise all personnel of known hazards, special precautions and procedures. Hazard assessments must be conducted in accordance to Workplace Health and Safety Regulations and documented accordingly.
- BOP equipment will be function tested at least once daily and any equipment found defective should be made serviceable before operations are resumed. Blowout prevention drills are to be performed weekly and are to be recorded on both the morning reports and tour reports. **All appropriate Certifications for equipment used will be on-site and available for review.** Communicate this information with the contracted services.





- The Wellsite Supervisor will ensure that service companies supplying products and/or materials that require Material Safety Data Sheets review and advise wellsite personnel with the potential hazards associated and the appropriate emergency response to be undertaken when handling the same. As well, in compliance with WHMIS regulations, all MSDS are to be posted in a conspicuous and accessible place know to all personnel for their information and emergency reference. Site Specific Orientation to all personnel on-site must be given for all chemicals and materials used.
- The Wellsite Supervisor will ensure that dangerous goods shipped or received are classified, packaged, marked, labeled and documented in compliance with the Transportation of Dangerous Goods Regulations. If required, placards must be attached to vehicles transporting dangerous goods. All shipping documents must be forwarded to the Calgary office for filing.
- The Operator expects full compliance with all conditions detailed on the Land Use Permit and Water Permit, OA and ACW.
- During the absence of the Wellsite Supervisor, a qualified and competent alternate shall be designated, in writing, to carry out the principal Contractor's responsibilities. Written instructions must be posted in a conspicuous and accessible location known to all personnel prior to the Wellsite Supervisor leaving the location.
- All verbal notifications and approvals received on location from any regulatory agency must be documented and recorded on both morning reports and tour reports and should include a contact name from the agency, phone number and details of the subject matter.

Daily reports shall be prepared by the Wellsite Supervisor and e-mailed (faxed) to the Operator's Calgary office by 07:00Hrs. every morning.

- All field tickets and other supporting documentation submitted for materials purchased and/or services rendered require a correct AFE# and accurate identification of the well location along with the Wellsite Supervisor's signature indicating acceptance to the same.
- All rental equipment must be accounted for and returned promptly upon conclusion of operations. Rental Sheets must be utilized.
- All surplus material and/or equipment must be accounted for and either returned for credit or material transferred to the appropriate warehouse point accordingly. Disposition of scrap material must be documented.
- All Accidents or Incidents shall be reported immediately to the Calgary Office - Attention: Corey Thomson or Richard Bean Complete the Paramount Safe Incident Report and conduct the necessary Investigations immediately. Fax copy to Calgary within 6 hours of incident.
- Ensure that all garbage and debris has been removed from the location. and that any environmental concern has been addressed. Contact the Construction foreman with any concerns.
- Prepare a final wellbore diagram with all pertinent information recorded.
- Forward all paperwork including field logs and computer data files to the Calgary office including copies of all field logs. A paper and digital copy of all Paramount operation reports should be provided. All field tickets, Material Transfers, Incident Reports, well test reports, rig inspection reports and service reports shall be included with the operation report package.



## Alternate Cut and Cap Operation

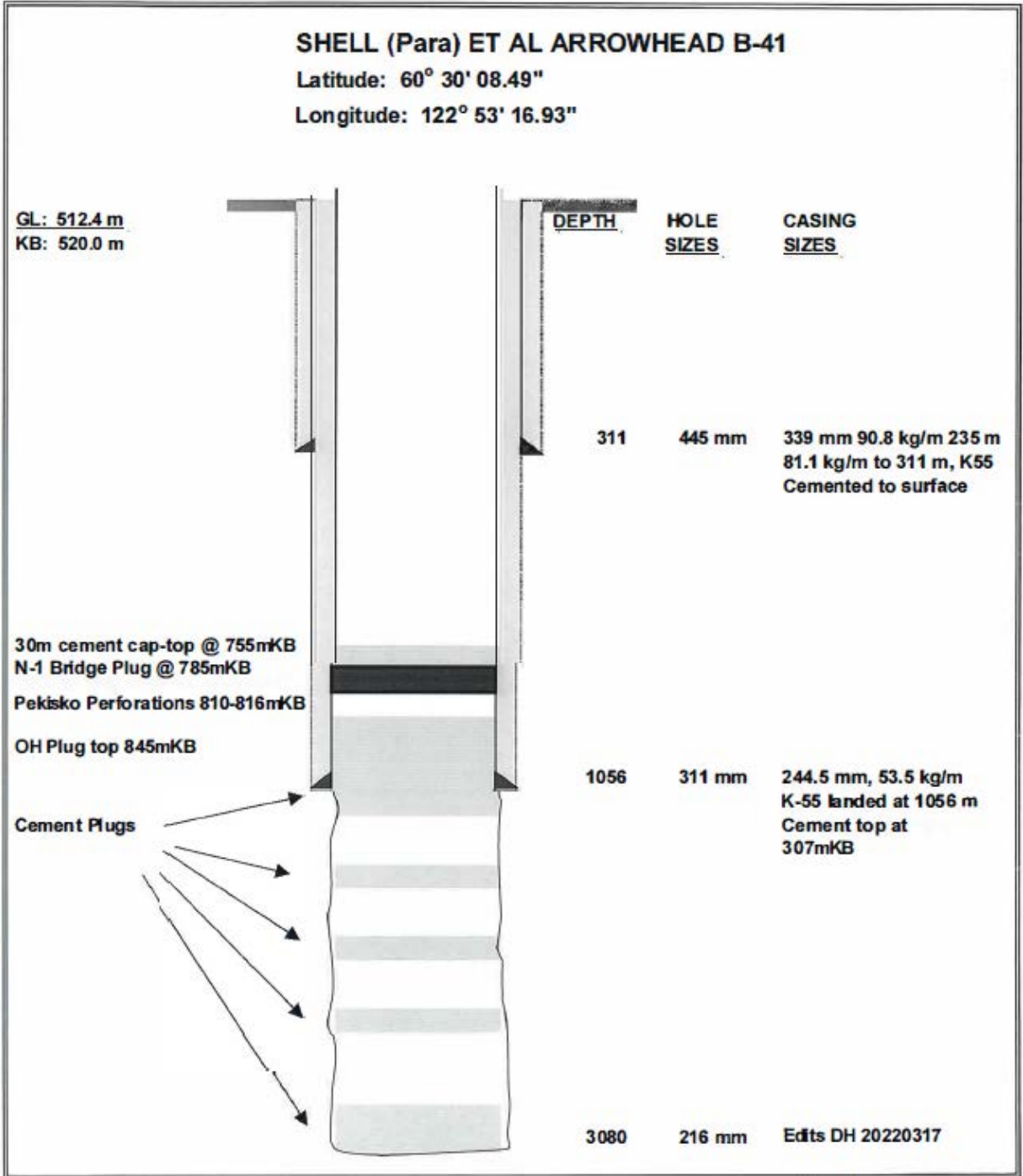
If available, a proprietary Hydrojet cut and cap system may be used to cut the casing(s) a minimum of 1 m below ground level and install a vented (non-sealing) cap on the casing stub below ground level once all downhole operations have been completed and tested as per the program.

In summary the steps are:

- Remove wellhead from the top of the well (down to surface casing bowl flange)
- Place the hydraulic pipe cutter inside the innermost casing
- Apply high-pressure water and abrasive to the cutting tip (typically 1-2m below grade).
- Rotate the cutting tip to sever the casing from the inside out.  
(Typically it takes 20 minutes to an hour to complete the cut)
- Remove tool and pull the casing stub out of the ground.
- Compression fit vented cap to the below-ground casing strings.  
(Welded options are available for jurisdictions where this is required)
- Backfill the hole (typically about the diameter of the surface casing drill bit)
- Install independent well signpost as per OROGO requirements (detailed above).

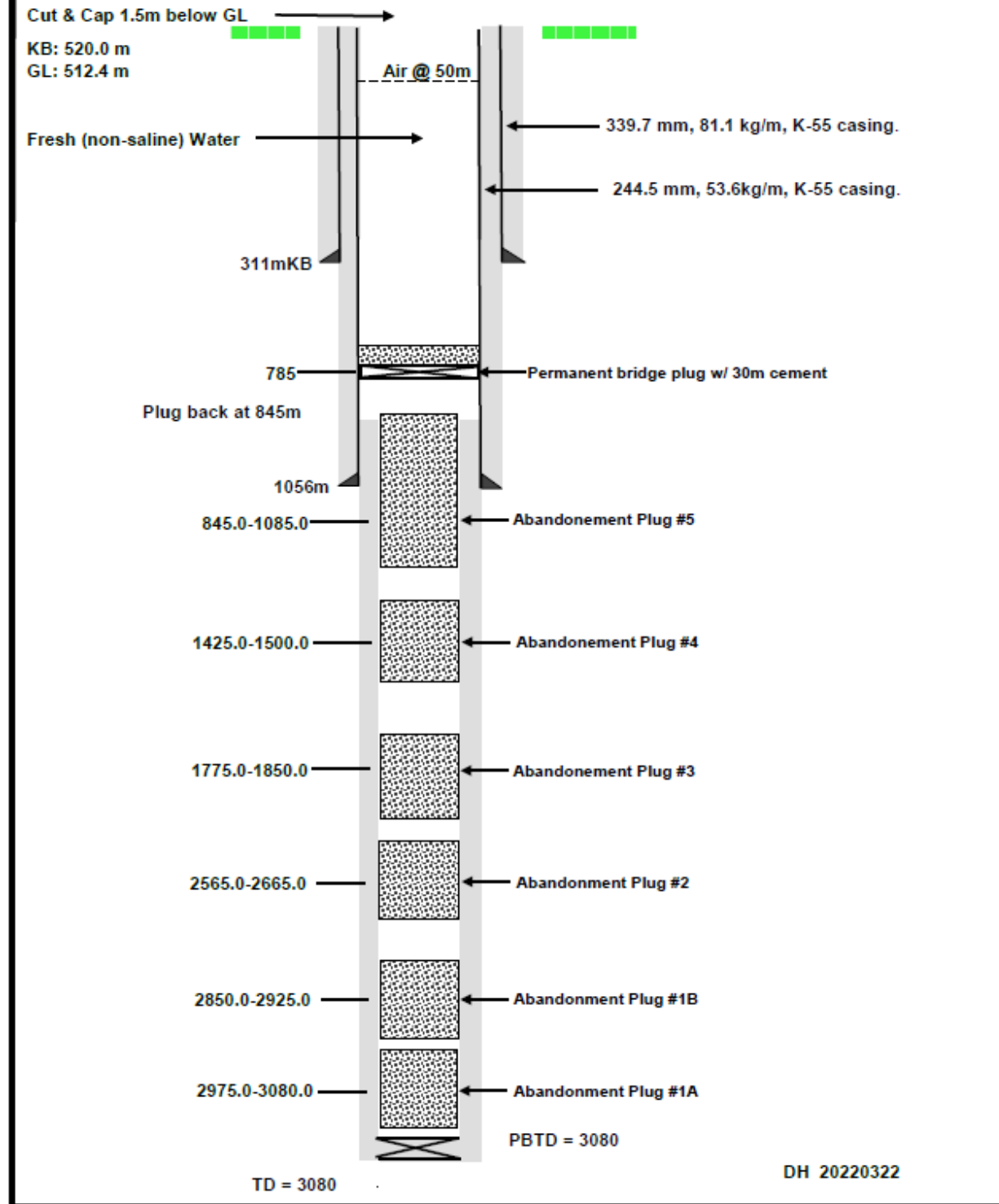


Current Wellbore as of 1989



# PARAMOUNT ET AL ARROWHEAD B-41

## Proposed Abandonment



**Current Wellhead**

Paramount Resources Ltd  
300/B-41-040-12245/00  
19-Aug-2021

Flow Tee Block  
2 9/16" x 2 9/16" x 2 1/16"  
x 10K x BX153 / BX 152  
S/N: 699997-0029-49

Tubing Valve: McElroy, 10K, 2 1/16"

Master Valve: McElroy, 10 K, 2 9/16",

Flange: 2 9/16", 10K

Flange: 11", APT, 5K, R54,

Flange: 13 5/8", API-21 MPa, R57

Casing Valve:  
McElroy, 5K, 2 1/16"

13 5/8", API - 21 MPa, R57. S/N M57710-1



**Supplement -- Cement Squeeze Procedure  
including perforations and acid (if required)  
(applicable to Arrowhead B-41, N-65, O-15, C-02 – as and if required)**

This procedure will be utilized if the bond log indicates insufficient isolation between zones or insufficient protection of uphole potable ground water in the subject well.

The interval to be perforated will be provided after evaluation of the bond log on site and discussion with Calgary office.

**Ensure OROGO is informed if squeeze is required and of planned squeeze interval before commencing operations.**

**1) Perforation**

- a) Conduct a pre-job safety/orientation meeting with all personnel on location detailing the planned operations, personnel responsibilities, and safety precautions.  
Ensure radios and sources of electrical interference are turned off and perforating unit is properly grounded.
- b) Makeup and RIH with 127mm x 0.6m UZI **circulation** gun with 6 gm charges at 118 spm (Owen HSC-2500-302S Circulation charges penetration = 0.375 inches and EH diameter = 0.19 inch). Note the gun comes in 0.3m lengths.  
Perforation interval **TBD**\_\_\_\_\_mKB. Correlate to the bond log previously run and ensure gun is not positioned across a collar.  
(Note: ensure spare guns are on lease for use if required).  
**Ensure circulation charges are used.**
- c) POOH with perf assembly and confirm shots fired..

**2) Injection Test**

- a) Conduct a pre-job treatment safety/orientation meeting with all personnel on location detailing the program, pressure limitations, personnel responsibilities and safety precautions.  
Pressure test surface lines and equipment to 1,400kPa (low) and 21,000kPa (high) and hold each for 10 mins.
- b) Fill casing with fresh water and attempt to squeeze/circulate outside the casing with fresh water. Begin at as low a rate as practical (e.g. 50 lpm depending on equipment capability.)
- c) Establish circulation to surface if possible – monitor surface casing vent for indications of flow or communication.  
Monitor injection pressure - Do not exceed estimated parting pressure - BHP of 18 kPa/m at perforations – equaling a surface pressure of (**TBD**\_\_\_\_\_kPa with fresh water and perforations at **TBD**\_\_\_\_\_ mKB).

If flow/returns are noted at the surface casing, rig for circulation and continue to circulate until returns are clean. Circulating rate may be increased as desired, not exceeding pressure above or if returns decrease/slow down decrease surface pressure/pumping rate

- d) If there are no indications of communication to surface (the expected result based upon cementing data available) perform step rate injection test.

Attempt injection at slow rate (e.g. 50 lpm) – continue injection until pressure stabilizes (minimum 5 minutes). Monitor pressure buildup and do not exceed estimated parting pressure calculated above (\_\_\_\_\_ kPa surface pressure).

- e) If stabilized pressure/injection rate is established at slow rate, perform step rate injection test, increasing at approximately 100 lpm (depending on equipment) per step for approximately 5 minutes.

Stop increasing steps when one of the following is reached.

- 500 lpm injection rate with water (considered unlikely)
- estimated parting pressure indicated above (\_\_\_\_\_ kPa)
- a discernable “break” (decrease) in pressure Vs injection rate

This is the maximum injection pressure to be used in squeezing cement.

If pressure at lowest injection rate reaches estimated parting pressure with negligible injection rate, shut down pump and observe bleed-off rate. After 50% bleed-off, pressure up again to determine the volume bled of and calculate the bleed-off rate.

Note: if lower pump rates are available they may be used to determine injection rate(s)

If no bleed off (less than 100 kPa in 15 minutes) contact Calgary office for instructions.

Target feed rate is 30liters/minute or more. If this cannot be achieved proceed to acidize as below.

30 lpm allows up to 1m<sup>3</sup> fluid to be squeezed in ½ hour – actual squeeze rate of cement would be anticipated to be slower due to increased viscosity and solids content.

If feed rate is 30 liters/minute or more skip to set cement retainer.

### 3) Acidizing Procedure (if required)

- a) RIH with 73mm tubing to 1m below perforations.
- b) Rig for acid job, including shower truck and provision for neutralizing and disposing of spent acid.
- c) Conduct a pre-job treatment safety/orientation meeting with all personnel on location detailing the program, pressure limitations, personnel responsibilities and safety precautions.  
Pressure test surface lines and equipment to 1,400kPa (low) and 21,000kPa (high) and hold each for 10 mins.
- d) “Pickle” the tubing.  
Circulate one tubing volume of acid to end of tubing  
15% HCl (or “Synthetic acid” – e.g. Stingray HCR 2000/7000) – do not over displace.  
Wait 30 minutes.  
Reversed circulate the spent acid, neutralize for disposal.
- e) Mix 1m<sup>3</sup> 15% HCl (or “Synthetic acid” – e.g. Stingray HCR 2000/7000).  
Circulate acid to bottom of tubing.  
Close pipe rams and squeeze acid into perforations.  
Do not exceed 18kPa/m gradient (\_\_\_\_\_kPa as calculated above)  
Reverse out any spent acid & neutralize for disposal at approved facility.  
POOH.

### 4) Cement Squeeze Procedure

- a) RIH on wireline with cement retainer and correlated to the bond log.  
Set retainer within +/- 2.0m above the perforations.  
Ensure retainer is not positioned across a casing collar.  
Fill casing with fresh water and pressure test casing and retainer to 7.0MPa and hold for 10.0mins. Rig out wireline unit.
- b) Pick up and RIH with stinger on tallied 73mm work string sting into retainer and perform function and pressure tests.  
Sting into retainer and open – confirm feed into formation with fresh water.  
Pull out of retainer and close – pressure test to 7MPa surface pressure.
- c) Tie in cementers with squeeze manifold and chart recorder.  
Conduct a pre-job treatment safety/orientation meeting with all personnel on location detailing the program, pressure limitations, personnel responsibilities, and safety precautions.

Pressure test surface lines and equipment to 1,400kPa (low) and 21,000kPa (high) and hold each for 10 mins.

- d) Mix, pump and circulate cement design to tubing bottom.  
Cement volumes anticipated to be 0.25 m<sup>3</sup> "Microfine cement" and 1.5m<sup>3</sup> Class G.  
Target API fluid loss +/- 100cc (calculated from generic testing is acceptable – specific batch testing not required).  
Microfine may be eliminated if good injection rates are obtained - Confirm with Calgary office and cement company.

Confirm minimum 3 hours setting time for cement at estimated temperature based on estimated well temperature.

Catch and retain cement samples and monitor for "setting" conditions.

Record and report same. (Downhole setting will be faster due to temperature.)

- e) Sting back into the retainer and squeeze cement – maximum 1.0 m<sup>3</sup> into formation.

*Hypothetically this volume would result in 30m height in 311/244 mm annulus and 100m height in 216/178mm annulus – these volumes are not realistic as the annulus is unlikely to be completely void of cement and the injection of 1.0 m<sup>3</sup> is optimistic – the cement volumes selected were chosen to provide a realistic minimum volume to ensure quality cement is delivered to the perforation interval rather than annular height.*

Target final squeeze pressure is 7MPa at surface (minimum per OROGO).

Use hesitation technique if needed to achieve this pressure (not anticipated).

- f) Pull out of retainer & set balanced cement plug with remaining cement.  
Ensure a minimum of 0.5m<sup>3</sup> cement remains in the casing (25 vertical meters) – top up with additional cement if needed.
- g) Pull out of stinger and backwash string with clean with fresh water.
- h) When surface samples have set, pressure test plug to 7MPa for 10 minutes.  
RIH and tag cement top – minimum set down weight 1800Dan – minimum 15m cement above retainer. (Top up if needed.)  
Record results in Daily Report and in Tour Book

- 5) POOH and continue with program.

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