



February 15, 2017

4300-4100-32640-02

Florin Hategan, P.Eng.  
Exploitation Engineer  
Canadian Natural Resources Ltd.  
Suite 2500, 855 2<sup>nd</sup> Street S.W.  
Calgary, Alberta T2P 4J8

Dear Mr. Hategan:

**RE: PRODUCED WATER DISPOSAL SPECIAL PROJECT AMENDMENT #1  
CNRL ET AL GRAHAM d-6-C/94-B-09; WA #8093  
GRAHAM FIELD – BALDONNEL “A” POOL**

The subject well produced a cumulative volume of 186.3 e<sup>6</sup>m<sup>3</sup> of natural gas from the Graham field Baldonnel “A” pool, from September 1994 to May 2013. Approval Order 15-02-011 was issued in June 2015 to operate the well for produced water disposal into the Baldonnel. Disposal capacity was required to replace the well CNRL et al Graham d-A6-C/94-B-9 (WA #12191), which terminated operation in June 2015 due to seismic activity at depth associated with disposal into the Debolt formation.

However, ongoing seismicity, including a felt event of magnitude 3.2, on December 29, 2016, has resulted in renewed concern for disposal activities in the Graham field. The multi-well Graham Baldonnel “A” pool, though partially depleted, shows limited pressure communication between wells, likely affecting dissipation of disposal fluids, resulting in localized increased Baldonnel pore pressure and potential for induced seismicity. Alternatively, the events may be at Debolt depth. Dense array monitoring is required to ascertain the hypocenter of any future events.

Attached please find Order 15-02-011 Amendment #1, designating an area in the Graham field, Baldonnel formation as a Special Project under section 75 of the *Oil and Gas Activities Act*, for the operation and use of a storage reservoir for the disposal of produced water. This Order includes a new requirement for installation of a dense seismic monitoring array as well as a wellsite accelerometer.

Disposal wells are subject to regular field inspection and audit. Contravention of a condition of this Order may be subject to enforcement under section 62 of OGAA, or suspension or cancellation of the Order under section 75(2)(b).

Should you have any questions, please contact the undersigned at (250) 419-4430 or Michelle Gaucher at (250) 419-4482.

Sincerely,

Ron Stefik, Eng.L.  
Supervisor, Reservoir Engineering  
BC Oil and Gas Commission

Attachment

**ORDER 15-02-011 Amendment #1**

- 1 Under Section 75(1)(d) of the *Oil and Gas Activities Act*, the Commission designates the operation and use of a storage reservoir for the disposal of produced water, into the Baldonnel formation – Graham field as a special project in the following area:

NTS                    Map 094 - B - 9    Block C    Unit 6

- 2 Under section 75(2) of the *Oil and Gas Activities Act*, the special project designation in this Order is subject to the following conditions. The Permit Holder shall:
- a) Inject produced water only into the well CNRL et al Graham d-6-C/94-B-9; WA# 8093 – Baldonnel formation (disposal perforation 1441.0 – 1485.0 mKB MD).
  - b) Not exceed an injection pressure, measured at the wellhead on the subject well, of 10,100 kPag or the pressure required to fracture the formation, whichever is lesser.
  - c) Inject only through tubing with a packer set as near as is practical above the injection interval.
  - d) Continually measure and record the wellhead casing and tubing pressures electronically.
  - e) Cease injection and notify the Commission immediately if hydraulic isolation is lost in the wellbore or formation.
  - f) Submit the annual packer isolation test report to the Commission within 30 days of the completion of the test.
  - g) Include the disposal operating hours and the maximum injection pressure value on the monthly BC-S18 disposal statement.
  - h) Conduct an annual reservoir pressure test on the formation in the subject well, with a shut-in period of sufficient length to provide data for calculation of the reservoir pressure, and submit a report of the test within 60 days of the end of the test.
  - i) Before March 17, 2017, install and fully activate a monitoring program to observe and record seismic events within a 5 km radius of the well CNRL et al Graham d-6-C/94-B-9; WA #8093, that:
    - i. is capable of real-time monitoring;
    - ii. has a magnitude detection of 2.5Mw and greater;
    - iii. has hypocenter accuracy to within  $\pm 500$  metres;
  - j) Before March 3, 2017, install and fully activate an accelerometer within 1 km of the wellsite able to record three components of ground acceleration with a minimum detectability of 0.02g and a dynamic range of  $\pm 2g$ .
  - k) Report the results of seismicity monitoring in items i) and j), including date, time, location, magnitude, ground acceleration and depth of seismic events, to the Oil and Gas Commission (Commission) via email to Ron.Stefik@bcogc.ca and Jeff.Johnson@bcogc.ca, at 1 month intervals, commencing one month from the date that monitoring begins, or upon request. The Commission may make the results of seismic monitoring contained in the reports available to researchers on a confidential basis. Events of mag 3.0 and above will be released into the public domain.
  - l) Cease injection upon reaching a maximum formation pressure of 19,700 kPaa, measured at MPP.
  - m) i) Perform a casing inspection log on the subject well and submit results to the Commission within 30 days of the completion of logging, at an interval of not more than every 10 years, commencing from the date of initial disposal.

- ii) Perform a hydraulic isolation temperature log on the subject well and submit results to the Commission within 30 days of the completion of logging, at an interval of not more than every 5 years, commencing from the date of initial disposal.
- n) Not conduct a hydraulic fracture stimulation on any formation in the subject well without prior Commission approval.



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Ron Stefik, Eng.L.  
Supervisor, Reservoir Engineering  
Oil and Gas Commission

DATED AT the City of Victoria, in the Province of British Columbia, this 15<sup>th</sup> day of February, 2017.

Advisory Guidance for Order 15-02-011 Amendment #1

- I. A production packer must be set above the injection interval and the space between the tubing and casing filled with corrosion inhibiting fluids, as per section 16(2) of the Drilling and Production Regulation.
- II. Annual packer isolation tests are required, as per section 16(3) of the Drilling and Production Regulation.
- III. Injected fluids must be metered, as per section 74 of the Drilling and Production Regulation.
- IV. A monthly disposal statement must be submitted to the Commission not later than the 25<sup>th</sup> day of the month following the reported month, as per section 75 of the Drilling and Production Regulation.