



November 21, 2014

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: PROPOSED DISPOSAL WELLS**  
**CNRL ET AL GRAHAM d-006-C/94-B-09; WA #8093**  
**CNRL ET AL GRAHAM a-085-K/94-B-08; WA #8251**  
**GRAHAM – BALDONNEL FORMATION**

Commission staff have reviewed your submission dated October 6, 2013, requesting an opinion on the suitability of the subject well locations for proposed produced water disposal into the Baldonnel formation.

Both wells are completed in the Graham field Baldonnel "A" multi-well gas pool, from which production commenced in January 1993. Production to-date of  $1.23 \times 10^6 \text{ m}^3$  of gas and  $353.7 \times 10^3 \text{ m}^3$  of water has resulted in a pressure drop from the initial pressure of 16 Mpa to approximately 10 Mpa. However, it should be noted that a pressure survey of several wells conducted in July 2009 indicated unequal pressure depletion and likely limited communication within the pool. This may affect disposal success.

Produced water associated with Graham Baldonnel gas has been disposed of in the Debolt formation through the well CNRL et al Graham d-A6-C/94-B-09 (WA 12191) since January 2002. Detection of seismic activity originating near the depth of the Debolt formation in the Graham field has necessitated investigation of other disposal opportunities. The Commission anticipates termination of disposal in the Debolt formation in favor of suitable alternatives.

The two noted locations being considered for Baldonnel disposal anticipate rates of approximately  $50 \text{ m}^3/\text{d}$  per well. Each location will be considered individually, based on wellbore integrity and injectivity testing results, though the Commission concurs that the d-6-C location appears to be the better disposal location with respect to reservoir quality.

Approval to dispose of produced water may be granted for depleted hydrocarbon reservoirs. Depleted or partially depleted gas reservoirs, such as the Baldonnel A, are favorable disposal candidates over saline aquifers given there is already considerable knowledge on the size and extent of the reservoir and demonstrated ability to contain fluid. Water injection may also result in favorable pressure support to enhance remaining hydrocarbon recovery.

Disposal approval as an OGAA Section 75 Special Project may be granted once the wells are tested to ensure suitability of disposal operation. An application for disposal would have to address remaining Baldonnel "A" reserves recovery including any potential for further recovery and a mitigation plan if disposal demonstrates a negative impact on the recovery of gas

reserves. The Commission may deem a temporary approval the prudent method to evaluate water disposal effects on gas recovery. Other key application information will be the reservoir pressure, cement and casing integrity, a plan to address up-hole Gething perforations in a-85-K and injectivity results on each well. Continued monitoring of area seismic activity will be required to confirm seismicity reduction.

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

Sincerely,



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