BC Oil & Gas COMMISSION

December 18, 2018 9045-7400-32640-02

James Armstrong
Encana Corporation
P.O. Box 2850, 500 Centre St SE
Calgary, AB, T2P 2S5

Dear Dr. Armstrong:

RE: PRODUCED WATER DISPOSAL SPECIAL PROJECT APPROVAL, AMENDMENT #1
GROUNDWATER MONITORING REQUIREMENTS
ECA ECOG ETSHO d-C70-J/94-O-08; WA# 24469
HORN RIVER FIELD – DEBOLT FORMATION

Thank you for submitting the report for annual groundwater sampling at Encana's disposal well site ECA ECOG ETSHO d-C70-J/94-O-08 (WA 24469), dated October 3, 2018, prepared by Millennium EMS Solutions Limited.

The sampling was conducted in accordance with annual groundwater sampling requirements outlined in Appendix A of the Special Project Approval Order (Order) for this well, with modifications to the analytical parameters approved by the Commission on August 11, 2017.

Please find attached Special Project Approval Order 10-02-004, Amendment #1, Appendix A, which reflects the approved changes to the groundwater analytical program. The Commission considers that the previously submitted reference groundwater monitoring report for this well (dated June 21, 2017) provides sufficient reference data for a range of organic and inorganic analytical parameters, and that ongoing monitoring for a subset of these parameters is appropriate in this case to monitor for consistency in groundwater chemistry over time. As per #10 in Appendix A of the Order, at any time based on the review of this file, the Commission may require additional sampling or additional analytical parameters. Should Encana wish to terminate the Order, the groundwater sampling requirements will be reviewed at that time.

Sincerely,

Laurie Welch, P.Geo., Hydrogeologist
BC Oil and Gas Commission

cc: Ron Stefik, Eng.L. Supervisor, Reservoir Engineering, BC Oil and Gas Commission
Ramona Stoica, Encana

Attachment

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Appendix A – Groundwater Monitoring Requirements

ECA ECOG Etsho d-C70-J/94-O-02 (WA 24469) Produced Water Disposal

1. One groundwater monitoring well shall be installed by December 31, 2017 within 50 m of the disposal well. The monitoring well shall be installed to a depth within the saturated groundwater zone, below the water table, to enable the collection of representative samples of groundwater from the well, to a maximum depth of 30 m.

2. During drilling of the monitoring well, geological conditions shall be logged.

3. A minimum of one representative "reference" groundwater sample shall be collected from the monitoring well following installation and appropriate development/purging.

4. The sample shall be submitted for laboratory analysis for analytical parameters including:

    - Major Cations and Anions (HCO_3, CO_3, SO_4, NO_2, NO_3, Cl, Ca, Mg, K, Na, Fe, Mn)
    - Total Dissolved Solids (TDS)
    - Alkalinity
    - pH
    - Electrical Conductivity
    - Hardness
    - Dissolved Metals
    - Dissolved Gases (C1-C3)
    - Benzene, Ethylbenzene, Toluen, Xylenes (BETX)
    - Volatile Hydrocarbons (VH_w) (C6 to C10)
    - Volatile Petroleum Hydrocarbons (VPH_w) (C6 to C10 - BETX)
    - Extractable Petroleum Hydrocarbons C10-C19 (EPH_{w10-19})

5. The static water level shall be measured following development/purging and prior to sampling.

6. A reference groundwater monitoring report shall be submitted to the Commission within 60 days of the date of groundwater sampling. The report, pdf format, shall include: a graphical monitoring well log showing construction details and geological conditions, a site plan showing the location of the monitoring well relative to the disposal well and other site infrastructure, documentation of the UTM coordinates of the monitoring well (NAD1983) and monitoring well top elevation, descriptions of the procedures used in drilling and installing the monitoring well and for sampling, record of the measured static water level in the well, tabulated analytical results, and the laboratory analytical report.

7. Long term monitoring shall involve the collection of one representative groundwater sample from the monitoring well on an annual basis, and analysis for the following parameters:

    - Major Cations and Anions (HCO_3, CO_3, SO_4, NO_2, NO_3, Cl, Ca, Mg, K, Na, Fe, Mn)
    - Total Dissolved Solids (TDS)
    - Alkalinity
    - pH
    - Electrical Conductivity

8. Annual sampling shall commence one year after the collection of the reference groundwater sample. The analytical results shall be submitted to the Commission annually within 60 days of sample collection by eSubmission, if available, or by Email to Hydrogeology@bcogc.ca. Long term groundwater monitoring shall be implemented over the period extending from the date of reference groundwater sampling until one year after ceasing disposal and until authorized by the Commission.

9. Monitoring well installation and groundwater sampling procedures for this program shall be consistent with standard practices for environmental investigations such as those outlined in the British Columbia Field Sampling Manual (2013) http://www2.gov.bc.ca/assets/gov/environment/research-monitoring-and-reporting/monitoring/emre/field_sample_man2013.pdf

10. At any time during this program, the Commission may require re-sampling to confirm a result or further investigation which may include additional sampling and/or additional analytical requirements.