

December 5, 2014

3600-2800-32640-02

Randy Wolsey
Aqua Terra Water Inc
105, 10136 – 128 Avenue
Grande Prairie, AB
T8V 1E9

Dear Mr. Wolsey,

**RE: NON-HAZARDOUS WASTE AND PRODUCED WATER DISPOSAL SPECIAL PROJECT
AMENDMENT #1
AQTWM FT ST JOHN 6-24-84-19 W6M; WA# 3060
CADOMIN FORMATION**

Approval for disposal of non-hazardous waste and produced water was issued for the subject well, Cadomin formation, on February 3, 2010. The Commission is presently amending active disposal well approvals to conform to current requirements. The subject well disposed into the Halfway formation from October 1976 to October 2009. The Halfway formation was abandoned and the well injected into the Cadomin zone from February 2010 until July 2011.

Aqua Terra has indicated the intention to reactivate this well for disposal. There are a number risk factors for this well, including lack of cement on the production casing down to 700mKB, and proximity to community ground water wells. To mitigate these risks, annual hydraulic isolation logs must be performed on the well, and a shallow groundwater sampling program must be implemented as outlined in Appendix A of this Order. For more information on groundwater sampling requirements, please contact OGC Hydrogeologist Laurie Welch at Laurie.Welch@BCOGC.ca.


Attached please find **Order 10-02-001 Amendment #1** designating an area in the Fort Saint John field – Cadomin formation as a Special Project under section 75 of the *Oil and Gas Activities Act*, for the use of a storage reservoir for the disposal of non-hazardous waste and produced water. This Order contains a number of detailed operational conditions. Additional general information regarding disposal wells is available on the Commission's website at <http://www.bcogc.ca/industry-zone/documentation/Subsurface-Disposal>.

The Ministry of Environment identifies the type of effluent approved for injection in the separate Waste Discharge Permit, granted under the Environmental Management Act.

In certain circumstances, disposal well operation may induce seismicity. The Commission advises that disposal well permit holders monitor seismic events in proximity to the well and be prepared to modify operations to mitigate induced seismicity. Permit holders may monitor seismic events through the Natural Resources Canada seismic monitoring network at <http://www.earthquakescanada.nrcan.gc.ca/recent/index-eng.php>.

Should you have any questions, please contact Ron Stefik at (250) 419-4430 or Michelle Harding at (250) 419-4493.

Sincerely,



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

Attachment

ORDER 10-02-001 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 non-hazardous waste as well as produced water, including flowback from fracturing operations, into the Cadomin formation – Fort Saint John field as a special project in the following area:

DLS Twp 84 Rge 19 W6M Section 24 - Lsds 3, 4, 5, and 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 non-hazardous waste and produced water only into the well AQTWM Ft St John 06-24-84-19; WA# 3060 Cadomin formation (disposal perforations 1066 – 1120 mKB).
 - b) Hold a valid Permit under the Environmental Management Act for the disposal of non-hazardous waste.
 - c) Not exceed an injection pressure, measured at the wellhead on the subject well, of 10,850 kPag or the pressure required to fracture the formation, whichever is lesser.
 - d) Inject only through tubing with a packer set as near as is practical above the injection interval.
 - e) Continually measure and record the wellhead casing and tubing pressures electronically.
 - f) Cease injection and notify the Commission immediately if hydraulic isolation is lost in the wellbore or formation.
 - g) Submit the annual packer isolation test report to the Commission within 30 days of the completion of the test.
 - h) Include the disposal operating hours and the maximum injection pressure values on the monthly disposal statement.
 - i) Conduct a reservoir pressure test on the formation in the subject well, prior to commencement of disposal under this Order and annually thereafter, 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.
 - j) Cease injection upon reaching a maximum formation pressure of 11,670 kPaa.
 - k) 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 operation into the Cadomin zone.
ii) Perform a hydraulic isolation log on the subject well, prior to commencement of disposal under this Order and annually thereafter, and submit results to the Commission within 30 days of the completion of logging.
 - l) Not conduct a hydraulic fracture stimulation on any formation in the subject well without prior Commission approval.
 - m) Implement a groundwater monitoring program as detailed in Appendix A.



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

DATED AT the City of Victoria, in the Province of British Columbia, this 5th day of December 2014.

Advisory Guidance for Order 10-02-001

- 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 25th day of the month following the reported month, as per section 75 of the Drilling and Production Regulation.

Order 12-02-022 Amendment #1 Appendix A – Groundwater Monitoring Requirements

Integrity Ft St John 6-24-84-19 (WA# 3060) Non-Hazardous Waste and Produced Water Disposal

Monitoring Well Requirements and Screened Intervals

- Three shallow monitoring wells are required to be installed prior to initiating disposal operations under this Order.
- Monitoring wells shall be located north, southeast, and southwest relative to WA 3060.
- The monitoring wells shall be screened using a 3 m length screen across the water table or at the shallowest porous zone containing groundwater to allow for the collection of a representative groundwater sample from this zone (depth to be determined during drilling).
- All monitoring wells shall be installed at a distance of at least 20 m from WA 3060 but no greater than 50 m from WA 3060.

Requirements for Drilling and Monitoring Well Construction

Drilling and monitoring well construction shall be completed using standard procedures for environmental investigations. Suitable monitoring well design and installation procedures for environmental investigations can be referenced in: *British Columbia Field Sampling Manual for Continuous Monitoring and the Collection of Air, Air-Emission, Water, Wastewater, Soil, Sediment, and Biological Samples (2003)*.

- Monitoring wells shall be drilled, constructed, and abandoned under the supervision of a qualified groundwater professional registered with the Association of Professional Engineers and Geoscientists of BC (APEGBC).
- Monitoring wells shall be drilled, constructed, and abandoned using procedures that mitigate potential impacts to the environment.
- The needs and requirements for blow out prevention must be assessed prior to drilling, and appropriate measures implemented where applicable.
- If artesian conditions are encountered during drilling, flow shall be adequately controlled.
- Drilling wastes or any water produced during drilling shall not be discharged to surface water bodies, cause erosion of land, flooding of neighbouring property, or deposition sediment into streams.
- Subsurface geological conditions encountered during drilling shall be logged from the ground surface to the total drilling depth, through field observations of samples or drill cuttings, or appropriate geophysical logging, to identify depth intervals of aquifers, porous zones containing groundwater, aquitards, and zones of low permeability.
- Monitoring wells shall be designed and constructed to isolate aquifers and water-bearing zones using appropriately located seals comprised of appropriate sealant.
- The monitoring well riser pipe or casing shall extend at least 0.3 m above the ground surface, if practical.

- The locations and elevations of the top of the riser pipe/casing and the ground surface shall be surveyed (elevations relative to geodetic datum, locations in UTM coordinates).
- An effective and permanent surface seal and well cover shall be constructed to prevent contaminants from the surface or shallow subsurface zone from entering the monitoring well or the aquifer, and to protect the monitoring well from damage. Surface seals shall be appropriately placed outside the monitoring well riser pipe or casing, and consist of appropriate sealant, extending from within 0.3 m of the ground surface to a minimum depth of 4.5 m below the ground surface, or 1 m into competent bedrock if bedrock is encountered at depths shallower than 4.5 m.
- Appropriate measures for flood proofing and the prevention of ponded or accumulated water in the vicinity of the monitoring well shall be implemented.
- Monitoring wells shall be registered with the Provincial Wells Database:
http://www.env.gov.bc.ca/wsd/data_searches/wells/
- Upon abandonment, all equipment and materials, including casing, liner, and riser pipe, shall be removed, or if removal is not practical, cut off at least 0.5 m below ground level.
- Upon abandonment, the well/borehole shall be completely filled with appropriate sealant, cement grout, or appropriate backfill materials along its entire length so as to preclude any vertical movement of liquids within the well or in annular space surrounding the outer well casing or between casings, and to seal off water-bearing zones. Materials at the ground surface, up to 0.5 m depth, shall be appropriate for the intended use of the land.
- Well abandonment procedures shall be documented with the well record registered with the Provincial Wells Database.

Groundwater sampling frequency and procedures

Water quality sampling shall be conducted using standard environmental sampling protocols in accordance with the *British Columbia Field Sampling Manual for Continuous Monitoring and the Collection of Air, Air-Emission, Water, Wastewater, Soil, Sediment, and Biological Samples (2003)*, and as follows:

- The groundwater sampling program shall be completed under the supervision of a qualified groundwater professional registered with APEGBC.
- A minimum of two (2) baseline samples shall be collected at each monitoring well to establish baseline groundwater quality. The samples shall be collected at time intervals of at least 48 hours but not greater than 7 days. If inconsistent results are indicated for the two baseline samples as determined by a qualified professional, a third round of baseline sampling shall be conducted for analysis of the parameters indicating inconsistent results.
- Following the baseline sample collection period, groundwater sampling shall be conducted from each monitoring well on a monthly basis during the first year of operation, and quarterly thereafter, unless approval is obtained from the Commission to vary this sampling schedule.

- Groundwater sampling shall continue on a quarterly basis for a period of one year after disposal well abandonment, unless approval is obtained by the Commission to vary this sampling schedule.
- Groundwater sampling events shall include an appropriate quality assurance/quality control (QA/QC) program including field duplicates and field blanks.
- Groundwater samples shall be collected using standard environmental sampling procedures that ensure that the sample is representative of the aquifer at the zone of sampling and the sample is not cross-contaminated during sampling.
- Samples shall be transferred to appropriate sampling containers and preserved in the field as necessary for each analytical parameter.
- Samples shall be submitted, using appropriate storage and transportation procedures, with appropriate chain of custody documentation, within 48 hours of collection, for analysis at a certified laboratory.

Groundwater analytical parameters

- Baseline groundwater samples shall be analyzed for: physical parameters (which include colour, electrical conductivity, hardness, pH, total dissolved solids, and turbidity), anions and nutrients (which include alkalinity, chloride, fluoride, nitrate, nitrite, sulfate), total and dissolved metals, dissolved gases (C1-C3), benzene, ethylbenzene, toluene, and xylenes (BETX), volatile petroleum hydrocarbons (VPH), polycyclic aromatic hydrocarbons (PAH), and light and heavy extractable petroleum hydrocarbons (LEPH/HEPH).
- If dissolved methane is detected at concentrations greater than 2 mg/L, more detailed isotopic analyses shall be conducted for one representative baseline sample to differentiate between biogenic and thermogenic sources. Methane isotopic sampling shall be conducted using protocols described in: *The Free Gas Sampling Standard Operating Procedure for Baseline Water Well Testing (2009), prepared for Alberta Environment and Sustainable Resource Development.*
- Monthly groundwater samples shall be analyzed for pH, total dissolved solids, anions and nutrients, cations, total metals, VPH, and LEPH/HEPH.
- Once annually, commencing one year after operation of the disposal well is initiated under this order, groundwater samples shall be analyzed for the same suite of parameters as the baseline samples.
- The groundwater analytical program may be revised over time, with approval of the Commission, based on the analytical results.

Groundwater level monitoring

- Groundwater level monitoring shall be completed under the supervision of a qualified groundwater professional registered with APEGBC.
- Static groundwater levels prior to initiating disposal activities under this order shall be established over the baseline period in each monitoring well.

- Once disposal operations under this order have commenced, groundwater levels in the monitoring wells shall be measured daily using an electronic data logger or by hand measurement.
- The date and time of initiation of disposal operations under this order shall be recorded.

Reporting

- A baseline groundwater report shall be prepared by a qualified groundwater professional registered with APEGBC and submitted in pdf format to the Commission within 30 days of commencing disposal operations under this order . The baseline report shall: provide a description of historical and existing site activities and locations, document monitoring well drilling and monitoring well installation procedures; provide graphical monitoring well diagrams indicating construction details and geological observations, provide monitoring well location and elevation data; provide a map indicating monitoring well locations relative to the disposal well; and document sampling and water level monitoring procedures, dates, times, and results. Analytical results shall be presented in table format and laboratory analytical reports shall be retained on file by the permit holder.
- Once disposal operations have commenced under this order, monitoring data shall be submitted monthly to the Commission within 30 days of the last day of each month. The dates and times of groundwater sampling, analytical results, daily water level measurements, and daily injection volumes shall be reported. Analytical results shall be presented in table format, and original laboratory analytical reports shall be retained on file by the permit holder.