

May 14, 2019

3600-2800-32640-02

Nicholas Haddow, Regulatory Specialist
AQT Water Management (Canada) Inc.
700 – 1816 Crowchild Trail NW
Calgary, AB T2M 3Y7

Dear Mr. Haddow:

**RE: PRODUCED WATER AND NON-HAZARDOUS WASTE DISPOSAL
SPECIAL PROJECT APPROVAL; AMENDMENT #3
MAXIMUM WELLHEAD INJECTION PRESSURE
AQTWM FT ST JOHN 11-12-084-19 W6M; WA# 3010
FORT ST JOHN FIELD – CADOMIN FORMATION**

The Commission is in receipt of AQT Water Management (Canada) Inc.'s request for review of the decision to issue Order 16-02-002 Amendment #3 and I understand that you have received further information with respect to that process from the review officer that has been assigned to the matter. As the decision maker for the Order, I write to provide you with my rationale for revising the approved maximum wellhead injection pressure (MWHIP) contained in the Order.

The Commission regularly audits disposal well data and amends approval orders based on relevant new information. An increase in disposal fluid density has been noted for a number of disposal wells, likely due to the recycling of hydraulic fracture fluid being disposed, resulting in adjustments to MWHIP values. A static gradient was conducted in the well AQTWM Ft St John 6-24-84-19 (WA 3060) on December 12, 2018; the test measured a fluid gradient of 11.510 kPa/m. The subject well, AQTWM Ft St John 11-12-84-19 (WA 3010), and AQTWM Ft St John 6-24-84-19 (WA 3060) are located approximately 2.7 km apart and are connected to the same disposal facility (BCIF 0000287). Both wells are injecting disposal fluid into the Cadomin formation.

As noted in Water Service Well Summary Information (<https://bcogc.ca/node/5997/download>), *variability in disposal fluid density, due to salinity or composition, requires use of a hydraulic wellbore gradient to calculate a conservative wellhead pressure.* The Water Service Well Summary Information further states: *The well operator is responsible for adjusting the wellhead injection pressure to a lower value if a higher density/gradient value fluid is being disposed.*

The revised MWHIP outlined in condition 2c) of the Order was calculated using a gradient of 11.5 kPa/m and the fracture gradient value from 2016. This revision reflects the higher density fluid originating from BCIF 0000287 and ensures that injection of this fluid will not result in pressures that will fracture the formation. The calculations were made as follows:

Maximum Wellhead Pressure =

(Fracture Gradient x TVD Top Perf x 0.9) – (Fluid Gradient x TVD Top Perf) + Frictional Pressure Loss

Amendment #1 (21.7 kPa/m x 1027.8 m x 0.9) – (10.5 kPa/m x 1027.8 m) + 200 Kpa
= 9481 kPa

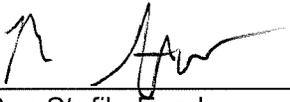
Amendment #3 (21.7 kPa/m x 1027.8 m x 0.9) – (11.5 kPa/m x 1027.8 m) + 200 kPa
= 8453 kPa

Preventing fracture of the formation is imperative; ensuring containment of the fluid within the disposal zone. Furthermore, hydraulic isolation between porous zones is required by Section 22 of the *Drilling and Production Regulation*.

The formation pressure measurement required under condition 2k) of the Order monitors the static reservoir pressure of the Cadomin formation. The maximum pressure limit of 11,485 kPaa in condition 2i) is the 'fill-up' pressure of the reservoir. This limit provide confidence in containment of the fluids over time and limits the risk of casing collapse in offsetting wells. This pressure is not considered in the calculation of the maximum wellhead injection pressure.

I trust this information provides sufficient explanation of the rationale for the revised MWHIP. Should you have any questions, please contact Kathryn Archibald at (250) 419-4406 or the undersigned at (250) 419-4430.

Sincerely,



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