

Water Use in Utica Shale Gas Development



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OVERVIEW

Water is used in the drilling and hydraulic fracturing of natural gas wells in Québec.

During the drilling process, water along with clay and other additives are used to carry the drill cuttings to the surface and to cool and lubricate the drill bit. Approximately 1,000 cubic metres of water are used to drill a horizontal Utica shale gas well.

During the completion process, water is used with sand and pumped under high pressure into the shale to create fractures or cracks to help the gas contained in the shale to flow. Hydraulic fracturing of a Utica shale gas well currently uses approximately 12,000 cubic meters of water. Between 30% - 50% of this water is recovered and during commercial development will be recycled to fracture future wells. Currently, the water is treated and disposed at approved facilities in accordance with government regulations.

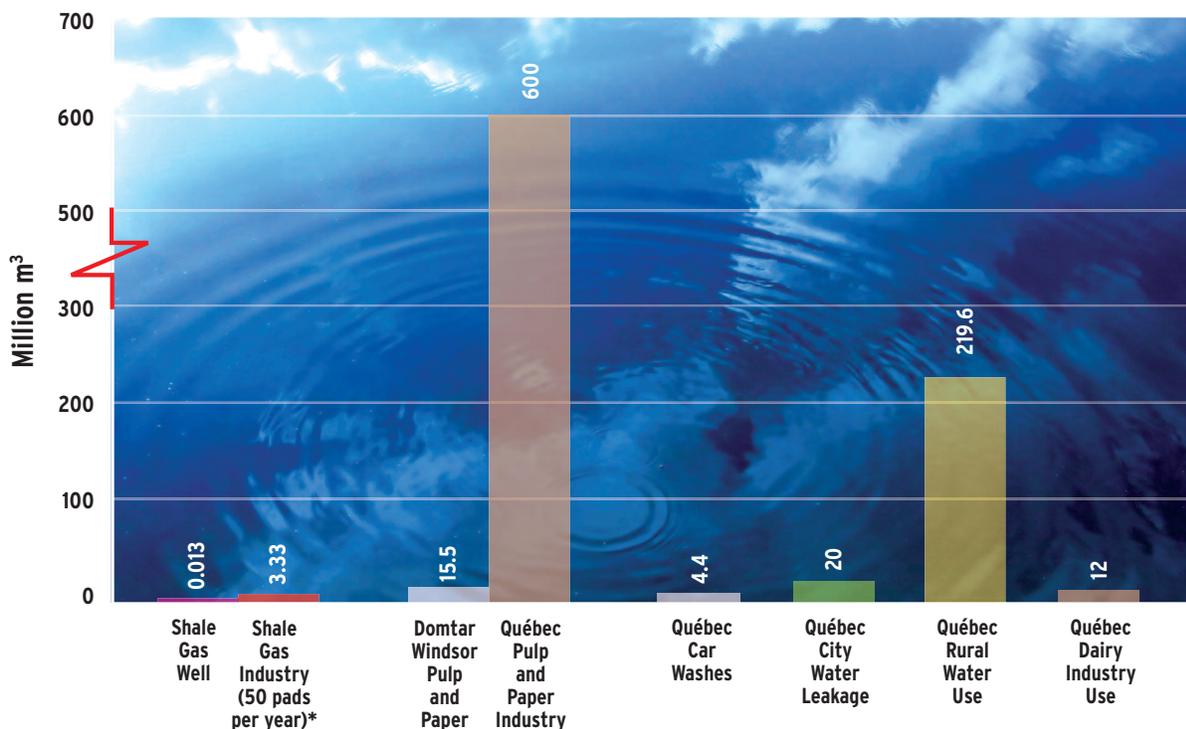
WATER USAGE

Based on independent analysis, the potential water volumes used for a 400 well shale gas development program is seen as a small portion of total water used within the province. For example, the projected water usage by the shale gas industry under this scenario represents 1.5% of the rural water intake in Québec. Of note, the city of Québec loses six times as much water annually from its municipal water system.

To put the water usage and highly diluted frac fluid additives in context, the average person in Québec uses 386 litres of water per day. The average household in Québec uses approximately 70 Mcf of natural gas per year. Based on estimated 12 million litres of frac fluid (99.5% water and sand and 0.5% additives) to frac and produce 2.5 Bcf from a Utica shale gas well, it takes less than one litre of water and one teaspoon or 5 ml of additives per day to heat a home with natural gas from shale.

Water use for shale gas development is a one time use per well, as opposed to an ongoing annual requirement.

Annual Water Use in Québec



* Estimate based on 8 wells per pad

WATER SOURCES

The water used in the drilling and hydraulic fracturing process comes from local surface water, not from underground fresh water sources. These include rivers, creeks and lakes. Water is typically transported to location by temporary pipelines and occasionally by trucks.

Government approval is required to obtain water for these operations. This ensures there is no impact on other users or the watershed in the region.

FRESHWATER PROTECTION

Questerre does not conduct any hydraulic fracturing operations in fresh water aquifers. All hydraulic fracturing conducted by Questerre to date has been conducted at depths of 1,000 - 2,000m below fresh water aquifers.

There are approximately 23,000 water wells listed in the MDDEP database in rural Québec where Questerre is expected to conduct the majority of their operations. Of these wells, the database indicates that about 7% of the wells are drilled deeper than 80m, and the majority (73%) are completed at depths above 45m. A review by an independent engineering firm reports the distribution of well depths and the depth of the shale resource suggest that the potential risk to shallow water supplies by hydraulic fracturing, assuming the industry exercises care and control of the fracturing process is not significant.

Hydraulic fracturing operations conducted in accordance with best industry practices by Questerre do not contaminate fresh water sources.

Independent studies have confirmed the presence of natural gas in the St. Lawrence Lowlands at depths of less than 500m (Pinet et. al., 2008). This shallow natural gas continually migrates to the fresh water aquifers that supply water wells and results in measurable volumes of natural gas in these wells (St. Antoine et al., 2003). Questerre and its partners engage an independent engineering company to test water wells in the area surrounding its operations and gather baseline data to confirm that they are unaffected by the drilling and hydraulic fracturing processes.

To minimize the risk of spills and leakage, specially designed containment tanks or ponds are constructed on location for the water used during the fracture stimulation process. Currently, fluid recovered from the fracture stimulation is tested by an independent third party to ensure it meets the requirements of regional treatment facilities. In compliance with best industry practices and existing regulations, any spills of frac water are immediately cleaned up and are unlikely to lead to chronic effects to groundwater.



Construction of containment tank for hydraulic fracturing operations

FLOW BACK CHEMISTRY

Fluid recovered from hydraulic fracturing of Utica shale wells has been independently analyzed. The test data and results are submitted to the government and the approved municipal water treatment facilities. Initial analysis indicates that the flow back water is benign.

The data collected to date shows that the flow back fluid is less saline than sea water and contains minute levels of heavy metals. The test includes but is not limited to aluminum, antimony, arsenic, bismuth, cadmium, cobalt, chromium, iron, lead, nickel, molybdenum, tin, vanadium, and zinc.