



# WELL DRILLING ADVISORY

## Flowing artesian conditions

### Fort St. James, B.C.

Flowing artesian conditions exist at lower ground elevations in the District of Fort St. James, BC. Well drillers and property owners should be aware of potential complications and costs of flowing artesian wells.

### Where do flowing artesian conditions occur?

A portion of Aquifer 373 (AQ373) in the District of Fort St. James is known to have flowing artesian conditions. The area potentially under artesian pressure is located in the low-lying part of Fort St. James at the west shore of Stuart Lake. (Figure 1).

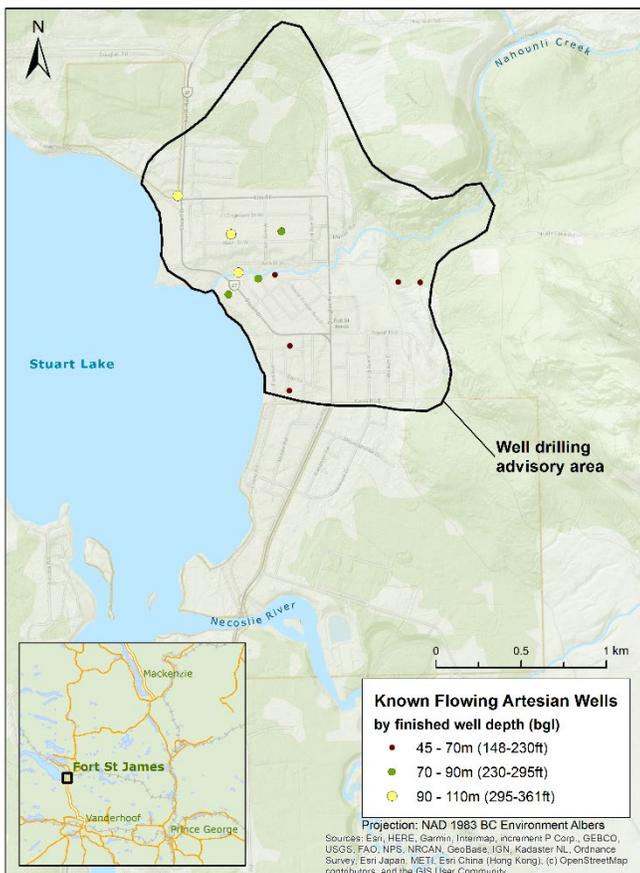


Figure 1: Fort St. James flowing artesian wells and extent of Well Drilling Advisory Area.

### What is a flowing artesian well?

A flowing artesian well is one that has been drilled into an aquifer where the pressure within the aquifer forces the groundwater to rise above the land surface naturally without using a pump. A flowing artesian well may flow on an intermittent or a continuous basis.

It is important to properly construct the well to control this flow. Controlling artesian flow conserves groundwater resources, preserves the pressure within the aquifer, and prevents damage to the natural environment (i.e., property damage, flooding, erosion and impacts to surface water). A flowing artesian well can cause substantial damage and incur significant and unexpected costs if not carefully planned and constructed. Well drillers and property owners should be prepared in advance in case flowing artesian conditions are encountered.

## Why are there flowing wells in Aquifer 373?

AQ373 is the main unconsolidated aquifer in the District of Fort St. James. It is comprised of sand and gravel of glacial or pre-glacial origin. The aquifer is confined by overlying glacial tills and lacustrine clays and is underlain by clay or bedrock. The low permeability sediments overlying the aquifer act as a confining layer, which creates a buildup of pressure by restricting flow of water out of the aquifer. The aquifer receives recharge through precipitation on the surrounding highlands and the piezometric level of the groundwater in the aquifer is likely controlled by the water levels in the recharge area. In the western area of AQ373, where the district is mainly located and the ground elevation is lower along Stuart Lake, the groundwater table is known to occur above the ground surface, causing the flowing artesian conditions (Figure 2).

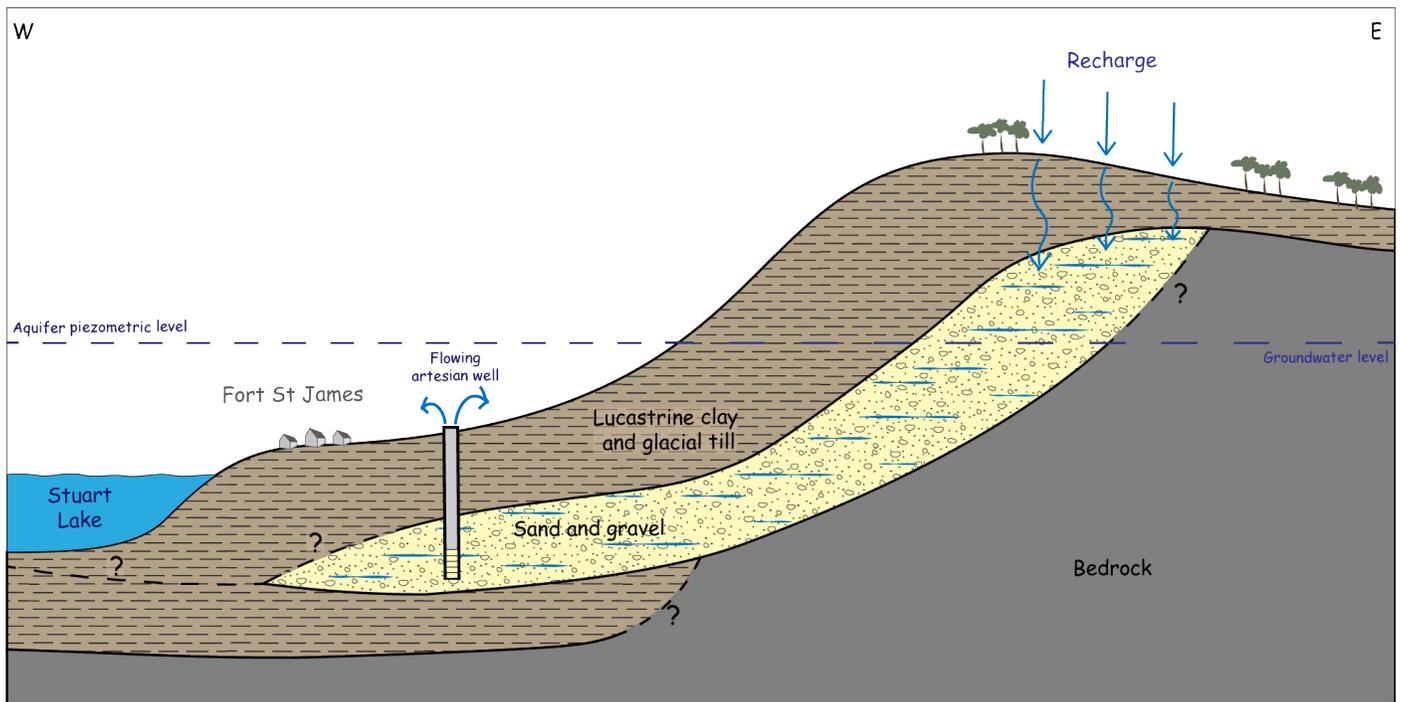


Figure 2: Simplified schematic of the AQ373. The piezometric level is related to the groundwater pressure in the aquifer and it is described as the imaginary height that the water level will rise in a well penetrating a confined aquifer. Not to scale

## Do all wells in the area encounter flowing artesian conditions?

Flowing artesian conditions are expected to primarily occur in the western area of the aquifer near Stuart Lake, where the ground elevation is lower. Wells with flowing artesian conditions are typically located where the ground elevation is less than 720 metres above sea level and are approximately 45 to more than 100 metres deep. However, flowing artesian conditions may occur elsewhere in AQ373, particularly in areas with lower ground elevations. Wells located at higher elevations have lower likelihood of experiencing flowing artesian conditions.

**In the area of known artesian conditions, the depth to AQ373 ranges from 45 m to 100 m.**

## Flowing artesian wells in Fort St. James

A review of the BC GWELLS database indicates that there are 11 wells in the District of Fort St. James with reported flowing artesian conditions at the time of drilling. There is one flowing artesian well located approximately 2 km northeast of Fort. St James, within the footprint of AQ373. This well is 12.5 m (41 feet) deep and is not likely constructed within the deeper aquifer AQ373. The flowing artesian conditions in this well are likely controlled by local topography. Artesian wells in AQ373 are known to flow at flow rates up to 27,490 m<sup>3</sup>/day (4200 US gallons per minute). Locations of known artesian wells can be accessed through [iMapBC](#).

## Preparing for drilling in the Fort St. James area

### *Qualifications and experience*

In B.C., anyone constructing a well<sup>1</sup> (with some exceptions for shallow excavated wells) must be registered as a well driller or be working under the supervision of a registered well driller or a professional (engineer or geoscientist, with competency in hydrogeology or geotechnical engineering). Registered well drillers must also be classified and have the qualifications required to work on the class of well that they are working on (e.g., water supply wells, geoexchange wells, dewatering wells, etc.)

**Water well drillers in BC must be registered and must be qualified to work on the particular class of well that they are working on.**

Regardless of the class of well being drilled, if artesian conditions are encountered and the well has the likelihood to flow, a well driller or a professional who is qualified in respect of the activity must be engaged to stop or control the flow. To be qualified, a well driller or professional must have competency in stopping or controlling artesian flow (as a result of training, experience, knowledge and skills) and have the equipment required to deal with flowing artesian conditions. A well driller may also undertake that activity if supervised by another registered well driller or a professional, who has competency in stopping or controlling artesian flow.

### **Controlling artesian flow means that the entire flow:**

- Must be conveyed through the well's production casing;
- Can be stopped indefinitely without leakage outside of the production casing;
- Must not pose a threat to property, public safety or the environment.

### **Flow is not considered controlled if:**

- Water is surfacing outside the well casing or in another location nearby;
- The flow cannot be stopped (e.g., with a valve shut-off or packer assembly);
- There is subsurface erosion (i.e., evident if flowing water is muddy or murky).

<sup>1</sup> A well is defined in the *Water Sustainability Act* as: an artificial opening in the ground made for the purpose of (a) exploring for or diverting groundwater, (b) testing or measuring groundwater, (c) recharging or dewatering an aquifer, (d) groundwater remediation, (e) use as a monitoring well, (f) use as a closed-loop geoexchange well, or (g) use as a geotechnical well.

If a person constructing a well (other than a qualified well driller or professional) encounters flowing artesian conditions that person, or the property owner, must engage a well driller who is qualified, or a professional, to ensure that any artesian flow is stopped or brought under control.

### ***Assuming artesian flow***

It is important to understand that geologic conditions are highly variable and information may not be available near the proposed drilling locations; therefore, neither the presence nor absence of flowing artesian conditions can be known with certainty prior to drilling. Therefore, when drilling into the confined aquifer in the Fort St. James area, it should always be assumed that flowing artesian conditions will be present and assume a precautionary approach (e.g. installing and sealing a permanent surface casing of sufficient length). The well driller and property owner must be prepared for the resulting costs, planning time, materials, expertise and equipment needed to construct the well to control or stop any artesian flow.

To manage the uncertainty, well drillers should always conduct a pre-drilling assessment. This could include:

- Assessing the physical setting of the proposed well (e.g., in a valley or area where nearby water is at a higher elevation),
- Consulting with local groundwater professionals, experienced well drillers, or residents to learn of other flowing wells or springs in the area,
- Examining well records from the BC [GWELLS](#) database (available at [apps.nrs.gov.bc.ca/gwells/](https://apps.nrs.gov.bc.ca/gwells/)) and the Groundwater Wells layer using mapping tools (e.g., [BC Water Resources Atlas](#) or [iMapBC](#)).
- Reviewing professional hydrogeologic reports in the Ecological Reports Catalogue (EcoCat) that may identify flowing artesian aquifers ([www.env.gov.bc.ca/ecocat/](http://www.env.gov.bc.ca/ecocat/)).

### ***Preparing and budgeting***

It is the responsibility of the well driller to advise the property owner of potential hazards associated with uncontrolled artesian flow (e.g., potential for erosion, flooding, subsidence) and the associated costs. The property owner and well driller should always have an agreement in place ahead of time to minimize any misunderstandings in the event that flowing artesian conditions are encountered.

### **Considerations for Property Owners**

- Ensure the [driller](#) or [professional](#) you hire is registered with the Province, qualified and experienced with flowing artesian conditions. Obtain multiple quotes.
- Have an agreement in place with the driller to deal with flowing artesian conditions.
- Recognize the real risks and your liability to neighbours and others if uncontrolled flows cause damage.

### **Considerations for Well Drillers**

- Ensure you have experience and equipment to deal with flowing artesian conditions.
- Always assume flowing artesian conditions will be encountered in AQ373.
- Inform property owners of potential risks and associated costs of flowing artesian wells prior to drilling.

Although preparing and constructing a well for flowing artesian conditions costs more than one in non-flowing conditions, it is substantially less than the ensuing costs to repair damages or to decommission an uncontrolled flowing well. In B.C., the cost to decommission a high pressure, high flow well that was not constructed to handle flowing artesian conditions can easily reach hundreds of thousands of dollars and possibly millions of dollars; in comparison, installing a permanent surface casing of sufficient length to control the flow before drilling into the flowing artesian aquifer can cost tens of thousands of dollars.

### **Constructing a well for flowing conditions**

Assessing the geological and hydrogeological environment will help determine the best construction process for wells that may encounter flowing artesian conditions:

- For bedrock aquifers, the bottom of the casing should be sealed securely into the bedrock to ensure the flowing water can not rise up through the annular space of the well.
- For sand and gravel aquifers, a permanent outer casing should be grouted into the lowest confining layer before the inner production casing is drilled into the aquifer. An annular seal should be installed between the two casings to ensure flowing water can not rise up between the casings.

Drilling methods such as digging, boring, driving, augering and jetting may not be conducive to controlling flowing artesian conditions when encountered; cable tool, air rotary, or mud rotary methods have been used more successfully. Plastic casings are not recommended for use in flowing artesian conditions.

For additional information on assessing, controlling, or decommissioning flowing artesian wells refer to:

- Province of B.C.'s Flowing Artesian Well Brief for The Well Owner:  
[www2.gov.bc.ca/assets/gov/environment/air-land-water/water/water-wells/flowing\\_artesian\\_wells.pdf](http://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/water-wells/flowing_artesian_wells.pdf)
- Government of Ontario, Water Supply Wells – Requirements and Best Management Practices Handbook (Chapter 12): [www.ontario.ca/page/water-supply-wells-requirements-and-best-practices](http://www.ontario.ca/page/water-supply-wells-requirements-and-best-practices)
- Michigan Department of Environmental Quality's Flowing Well Handbook:  
[www.michigan.gov/documents/deq/deq-wb-dwehs-wcu-flowwellhandbook\\_221323\\_7.pdf](http://www.michigan.gov/documents/deq/deq-wb-dwehs-wcu-flowwellhandbook_221323_7.pdf)

### **Legislation and regulatory information**

To learn more about the applicable regulations, please see:

- *Water Sustainability Act*, Sections 52 and 53:  
[www.bclaws.ca/civix/document/id/complete/statreg/14015](http://www.bclaws.ca/civix/document/id/complete/statreg/14015)
- Ground Water Protection Regulation Guidance Manual (June 2019):  
[www2.gov.bc.ca/assets/gov/environment/air-land-water/water/water-rights/gwpr\\_guidance\\_manual\\_signed.pdf](http://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/water-rights/gwpr_guidance_manual_signed.pdf)

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