ALBERTA ENVIRONMENT AND PROTECTED AREAS

Guide to Groundwater Authorization

February 2023

Alberta

Open Government Portal URL.
This publication is available online at https://open.alberta.ca/publications/guide-to-groundwater-authorization

Guide to Groundwater Authorization | Environment and Protected Areas

Contents

Introduction

In Alberta, water is owned by the Crown and its use is regulated by Environment and Protected Areas (EPA) under the *Water Act*. The goal of this updated guide is to clarify the process applicants must follow when applying to conduct an activity that may impact groundwater or divert and use groundwater by:

- Listing the administrative and technical requirements that need to be met to obtain an authorization.
- Directing applicants to a monitoring and reporting system where they can report the results of conditions attached to their authorization.
- Clarifying the distinction between replacement wells and supplementary wells.
- Providing water well users with a hotline number to report complaints related to their water wells.
- Directing applicants seeking to disturb groundwater for an activity with specific authorization requirements to the appropriate policy.

1.0 Regulatory framework

1.1 Authorizations

Water Act authorizations are either approvals or licences. An approval is issued to regulate disturbances or activities in groundwater where no use of the water is intended, but it is anticipated the activity will alter, may alter, or may become capable of altering the flow, the direction of flow, or the level of water; or the activity may have an impact on the aquatic environment. A licence is issued to authorize the diversion and use of a specific volume of groundwater to be used for a specific, non-household purpose.

1.1.1 Approval

An approval authorizes activities that disturb groundwater, such as aggregate mining, construction or groundwater remediation, where the water disturbed is not needed for any use. An approval does not assign the holder a priority in time relative to other users. The approval identifies the approval holder's name and legal land location, the conditions under which the disturbance can take place and the expiry date.

1.1.2 Licence

A licence authorizes the diversion and use of groundwater. A licence provides a right in time (priority) to divert an authorized amount of water for specific purposes such as agricultural, commercial, industrial, municipal, irrigation and recreational uses. A licence identifies the licensee's name, legal land location and priority number based on the date a completed application was received; the maximum quantity of water the holder may divert annually; the maximum pumping rate; the expiry date, purpose, point of diversion, point of use, timing; and the conditions under which the diversion can take place.

Household purpose, as defined in the *Water Act*, is exempt from the requirement of a licence. Any purpose other than household, or the exemptions listed in Schedule 3 of the Water (Ministerial) Regulation, must be licensed. However, diversions of saline groundwater for any purpose are exempt from requiring a licence. Section 1(1)(z) of the Water (Ministerial) Regulation defines saline groundwater.

1.1.3 Temporary Diversion Licence (TDL)

A TDL authorizes the diversion and use of groundwater for a period of one year or less. No priority is assigned to the TDL. A copy of all water well drilling reports related to the well(s) must be included with the application as well as the length of time required for the TDL. Additional information can be found in the *Water Act*: Temporary water diversions fact sheet.

1.2 Process

The application process for obtaining a *Water Act* authorization aims to:

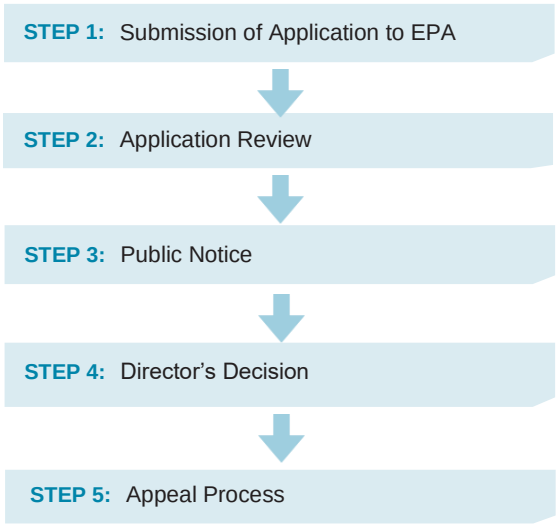
- Provide confidence in a sustainable supply of water for the applicant's needs.
- Protect the aquifer from overdevelopment.

- Protect the water supplies of household users, registrations for traditional agricultural users and prior licence holders.
- Foster beneficial use of the resource, prevent speculation in water and protect the environment.

In general, the application process consists of the five main steps shown in Figure 1. The application process may vary from the general procedure depending on the scale and the purpose of the diversion.

The Alberta Energy Regulator (AER) is responsible, under the *Responsible Energy Development Act*, for reviewing *Water Act* applications related to Alberta's energy resource industry. This includes applications for water approvals and water licences for energy operations that require water. For AER applications, the process outlined on the AER website must be followed.

FIGURE 1: EPA APPLICATION PROCESS



1.2.1 Submission of application to EPA

Applications are submitted electronically through the online Digital Regulatory Assurance System (DRAS). The submitted application, along with the supporting documentation, is assigned to the appropriate district office for review. The amount of supporting information required varies with the scale and the purpose of the groundwater diversion (see Appendix 2). A map of EPA district offices is provided in Appendix 4.

1.2.2 Application review

Once the application is submitted and received by the appropriate district office, EPA will review the application to ensure that the requested quantity of water can be diverted from the aquifer without adversely affecting existing household, registered and licensed water users. If the application is deficient, the applicant will be asked to provide the missing information. If there are concerns outside of EPA's jurisdiction, the applicant may be referred to other agencies for compliance. In addition, licence fees may be required.

For the purpose of a confined feeding operation (CFO), the applicant may choose to use the one-window provincial application process for CFOs administered by the Natural Resources Conservation Board (NRCB) or to apply directly to EPA. For more information on CFOs, go to https://www.nrcb.ca/confined-feeding-operations.

1.2.3 Public notice

Once an application is deemed complete, notice of application may be required. This provides an opportunity for directly affected parties to submit statements of concern (SOCs) within a period specified in the notice.

The applicant or applicant's representative must respond, in writing, to directly affected SOC filers. A copy of all correspondence must be filed with EPA. All parties submitting a SOC and who are directly affected will have their statements considered prior to issuance of an authorization. SOCs must be submitted within seven days of the notice of application for an approval and 30 days for a licence. However, the director may specify a longer period for submission of SOCs. All accepted SOCs are referred to the applicant or applicant's representative.

1.2.4 Director's decision

Upon review of the application, the director makes a decision on the application.

1.2.5 Appeal process

Following the director's decision, the applicant and directly affected SOC filers are sent a notice of decision. They may appeal the decision made by the director to the Environmental Appeals Board.

1.2.6 Licence fee

Licence applications may be subject to a fee as defined in Section 168 of the *Water Act*.

1.2.7 Unit system

Supporting measurements and calculations submitted with an application must use the metric system of measurement.

2.0 Authorization requirements

The applicant must submit an electronic application through DRAS when applying for either an approval, a licence or a TDL. When applying for an approval, supporting documentation should include a description of the proposed activity and potential impacts to the aquifer resulting from that activity. When applying for a licence or a TDL, supporting documentation must justify the need for the diversion and the capability of the aquifer to sustain the quantity of water required without adversely affecting existing household, registered and licensed water users. That document may include a report as outlined in Section 2.2.

2.1 The application

Applications for approvals, licences, amendments and cancellations for groundwater diversions are to be submitted in DRAS and must include **all** of the following information:

- applicant's name, email address and telephone number
- point of diversion - legal land location of the proposed diversion site(s) (include surface elevation and GPS coordinates of the diversion source (well or spring), street address and lot block plan if available)
- point of use
- purpose for groundwater use (agricultural, oilfield injection, municipal, etc.)
- water well drilling report
- timing of diversion (e.g. seasonal, annual)
- yearly water requirement (indicate if seasonal use)
- maximum pumping rate (instantaneous rate)
- professional consultant's report (if required)

Note: For applications related to agriculture (livestock watering), additional resources can be found at https://www.alberta.ca/water-act-forms.aspx.

2.2 The report

When a groundwater evaluation report is submitted as supporting documentation for an application, the report must be prepared by a qualified groundwater specialist who is a member of the Association of Professional Engineers and Geoscientists of Alberta (APEGA).

For licence applications on smaller volume diversions, such as a water requirement less than 3650 cubic metres (m^3)/year (10 m^3/day) or a TDL, the applicant may not be required to provide a detailed groundwater evaluation report prepared by a member of APEGA with their application but their application must include a copy of all water well drilling reports, a field verified survey and water chemistry analyses related to the relevant well(s) (see Appendix 2).

2.2.1 Regional context

The regional context presents the setting of the proposed diversion site. It describes the landscape, surficial geology and bedrock geology. The description should include the main surface water settings (major rivers, lakes, wetlands), known hydrostratigraphic units and their characteristics, such as the groundwater flow pattern, typical ranges of hydraulic

conductivities, storativities/specific storage, hydraulic head, hydraulic gradients and an overall discussion on the regional groundwater quality.

2.2.2 Local context

The local context depicts the setting at the proposed diversion site and its immediate vicinity. In addition to the proposed site's water well driller's report, information on the local geology in the vicinity of the proposed site may be found in the Alberta Water Well Information Database. The local context provides an overview of the areal extent and variability of the aquifer unit(s) and the water use trend. Cross sections and maps should be included to show the water elevation range and the possible hydraulic relationships among the source aquifer, other aquifer units in which surrounding wells are completed and the possible connectivity between the source aquifer and nearby surface water bodies.

2.2.3 Well completion details

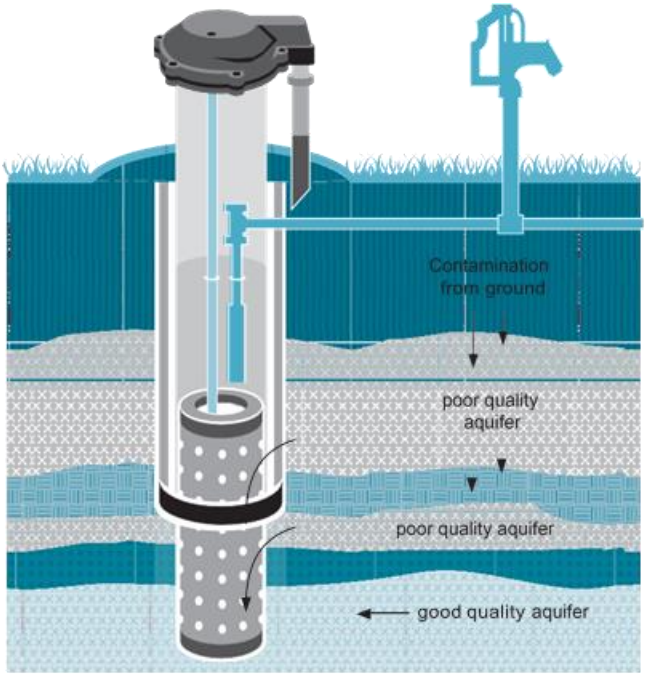
Water wells must be completed in accordance with the construction requirements specified in the Water Wells and Ground Source Heat Exchange Systems Directive (Wells Directive), which is incorporated in Part 7 of the Water (Ministerial) Regulation. Drilling reports, either originals or printouts from the Alberta Water Well Information Database, signed by a certified driller, must be provided. Additionally, a drawing of the well construction details must show the water production zone(s).

2.2.4 Multiple aquifer completion wells

Section 3.2.10 of the Wells Directive provides specific construction requirements for wells that are to be licensed. Multiple aquifer completion (Figure 2) is prohibited. Also, where it is difficult to determine whether multiple water-bearing zones encountered in the borehole are hydraulically connected (therefore considered a single aquifer), well completion is limited to a maximum of 7.62 consecutive metres of slotted or screened section. Additionally, the annulus of the well must be filled, full length, from the top of the water-bearing zones identified as the production zone for the well, up to ground surface with bentonite or cement grout.

As a guideline for determining whether multiple water-bearing zones are separate units (i.e., not hydraulically connected) one should consider the confining layer thickness separating each water-bearing zone, in conjunction with evaluation of field measurements to identify significant differences in water chemistry or static water levels between water-bearing zones.

FIGURE 2: EXAMPLE OF MULTIPLE AQUIFER COMPLETION



2.2.5 Groundwater under the direct influence of surface water (GWUDI)

In Alberta, water quality is protected under the *Environmental Protection and Enhancement Act* (EPEA). Waterworks systems using "high-quality groundwater" must not be under the direct influence of surface water. High-quality groundwater is defined in the Potable Water Regulation. Groundwater sources that are determined to be GWUDI require treatment equivalent to that

required for surface water sources as specified in Section 1.2.1 of the Standards and Guidelines for Municipal Waterworks, Wastewater and Storm Drainage Systems. Refer to Appendix 1-E entitled Assessment Guideline for Groundwater Under the Direct Influence of Surface Water (GWUDI) for determining whether a groundwater source is GWUDI.

2.2.6 Field-verified survey

The radius of the field-verified survey is 1.6 km or more depending on the geological and hydrogeological conditions, the quantity of groundwater required by the proposed project and the number of water users in the area. If it is not possible to contact landowner(s) in person during the survey, an explanatory letter left for those who were not contacted in person is recommended. Details of efforts to contact landowners must be documented in the report supporting the application.

At a minimum, the field-verified survey must consist of:

- Plan(s) showing the ownership and locations of all currently used water wells, springs, and/or dugouts within a minimum 1.6 km radius of the project site.
- A table containing (insofar as possible):
  - owners'/lessees' names
  - legal land location of the groundwater source (if the groundwater source is a well or a spring, then also provide the surface elevation and GPS coordinates)
  - type of water source (e.g., wells, springs, dugouts, etc.)
  - well status (e.g., producing, standby, observation, abandoned, etc.)
  - well depth
  - original non-pumping water level including date and current non-pumping water level
  - well completion details including completion interval (open hole, perforated, or screened)
  - depth to the top of the water-producing zone and the amount of available head
  - maximum pumping rate and current usage
  - purpose of use (e.g., household, livestock, industrial, etc.) and current water daily/annual requirements
  - distance of well(s) from the proposed groundwater usage site
  - summary of historical groundwater quality analyses, if available

The field survey provides the opportunity for the applicant to inform their neighbours and take note of any concerns that may be addressed in the report supporting the application. When the potential for conflict exists, the applicant and potentially affected neighbours may reach an agreement at this stage. An example of a field-verified survey table form is included in Appendix 1.

2.2.7 Yield test

The yield test(s) must be conducted on the proposed production well(s) to determine the hydraulic properties of the aquifer, to help assess potential groundwater boundary conditions and to determine the long-term sustainable yield of the aquifer in the vicinity of the well. The selection of the yield test method must be based on the hydrogeology of the proposed test site, as identified in Section 2.2.2.

During the yield test, the proponent must do **all** of the following:

- Obtain water samples to be analyzed as described in Section 2.2.10.
- Record field parameters, including all of the following:
  - date and time of sampling and a brief description of the weather conditions
  - water temperature
  - pH
  - electrical conductivity
  - colour and odour, if any.
- Test at a discharge rate not less than the anticipated maximum production rate.
- Limit variation in pump rate to ± 5% of the desired test rate.
- Continue the pumping long enough to identify any limiting boundary conditions (refer to Appendix 2 for recommended minimum yield test durations).
- Take recovery measurements for at least as long as the proposed production well(s) is pumped, or until the water level has recovered at least within 90 per cent of the pre-test non-pumping water level, whichever comes first.

Example Field Journal entry

- Not deposit any harmful substance at the test site or in any water body receiving discharge.
- Not discharge groundwater to the land surface where it may impact the results of the yield test, adversely affect soils or vegetation, or cause any other environmental damage (not following this step could result in prosecution).

2.2.8 Water level monitoring frequency

Water levels measured in the production well(s) and observation wells must be recorded to the nearest 1 cm during the pumping and recovery phases of the aquifer test. The monitoring frequency and the accuracy of the water level measurements must be adequate to determine aquifer parameters.

After cessation of pumping, the water level must also be measured while the well "recovers" after the pumping period. Monitoring frequency during the recovery period should be similar to the frequency during the pumping period and recorded for at least the same length of time as the well was pumped or until the water level has recovered at least within 90 per cent of the pre-test non-pumping water level, whichever comes first. Continued monitoring of recovery beyond this time may allow more reliable estimates of long- term sustainable yield and is recommended.

A water level monitoring frequency of one minute is recommended when using data loggers. For manual water level reading, the following is recommended as an example of appropriate monitoring frequency.

TABLE 1: RECOMMENDED MANUAL GROUNDWATER LEVEL READING FREQUENCY

Time after pumping started/stopped	Monitoring frequency
0 – 10 minutes	Every minute
10 – 30 minutes	Every 5 minutes
30 – 100 minutes	Every 35 minutes
100 minutes – 12 hours	Every hour
12 hours – 24 hours	Every 2 hours
24 hours – 36 hours	Every 4 hours
36 hours – 48 hours	Every 6 hours
48 hours – 72 hours	Every 8 hours
After 72 hours	Every 12 hours

2.2.9 Observation wells

The applicant must refer to Appendix 2 to determine the number of observation wells required during the yield test and for long-term monitoring (a condition of the licence). This requirement depends on the groundwater diversion volume, the anticipated pumping rate and the potential impacts the proposed water diversion may have on surrounding water well users. Depending on the geological and hydrogeological conditions and the proposed groundwater withdrawal rate at the diversion site(s), the director may require the installation of additional observation wells for monitoring purposes.

When required, an observation well(s) should be installed at a suggested distance of between 15 m and 150 m from the proposed production well, or at least three times the aquifer thickness. The offset distance will also depend upon the aquifer type (e.g., confined, semi-confined, unconfined), intended pumping rate, anticipated drawdown based on the drilling reports, or any policy/regulation specifying other requirements. Therefore, other distances may be considered depending on site-specific conditions.

Observation well(s) must be completed in the same aquifer as the proposed production well and any other aquifer or aquitard if required.

In the absence of a dedicated observation well, it may also be advisable to monitor household or licensed groundwater diversion and/or observation wells in other aquifers.

Water levels in the observation well(s) should be monitored on a schedule similar to the monitoring of levels in the pumped well.

2.2.10 Groundwater quality assessment

The applicant must provide a water quality assessment when submitting an application for a licence or an approval. The assessment is needed to determine the suitability of the water for its intended use. It also provides a benchmark against which the future water quality may be compared.

The analysis of a water sample collected from the proposed production well should be analyzed for a suite of parameters referred to as routine analysis. Detailed analysis is required for municipal systems. A list of parameters included in the routine and detailed water analyses is provided in Table 2. The results of analyses should be reported, for each parameter, as total quantity, not dissolved quantity. Depending on the intended use of the groundwater, analysis of additional parameters may also be requested by the director.

The results of these water analyses may trigger the need for an approval or registration under the *Environmental Protection and Enhancement Act* if the water quality results indicate the need for treatment to make the water safe to consume. The results may trigger additional review from other departments and additional regulatory requirements.

The Federal-Provincial-Territorial Committee on Drinking Water establishes the Guidelines for Canadian Drinking Water Quality (GCDWQ).

Additionally, in Alberta, groundwater quality guidelines exist for:

- Aquatic life, which set the groundwater quality acceptable for discharge in a surface water body hosting aquatic life.
- Livestock watering, which set the groundwater quality acceptable for livestock watering.
- Wildlife watering, which set the groundwater quality acceptable for discharge into a surface water body from which wildlife may drink.
- Irrigation, which set the groundwater quality acceptable for irrigation.
- Eco soil contact, which describe the groundwater quality acceptable for discharge in areas of shallow groundwater hosting terrestrial plants and soil invertebrates.

These guidelines are summarized in the Alberta Tier 1 Soil and Groundwater Remediation Guidelines.

2.2.11 Wells completed to 150 m or more

Any water well, regardless of its purpose, that is drilled to a depth of 150 m or more requires a well licence issued by the AER. This includes a well being used to supply water for domestic or stock watering purposes. **This requirement is in addition to the licensing requirements of this guide.**

TABLE 2: LIST OF PARAMETERS FOR GROUNDWATER QUALITY ANALYSIS

List of parameters for groundwater quality analysis (reported as total quantity)

Routine analysis	Detailed analysis		Bacteriological analysis
Bicarbonate (HCO3)	Arsenic (As)	Phosphorus (P)	E. coli (CFU/100 mL)
Sulphate (SO4)	Bicarbonate (HCO3)	Potassium (K)	Coliforms–Total (CFU/100 mL)
Calcium (Ca)	Calcium (Ca)	Sodium (Na)	
Temperature	Carbonate (CO3)	Sulphate (SO4)	
Carbonate (CO3)	Chloride (Cl)	Sulphide (H2S)	
Total Dissolved Solids	Colour (TCU)	Total Alkalinity	
Chloride (Cl)	Copper (Cu)	Total Dissolved Solids (TDS)	
Total Alkalinity	Fluoride (F)	Total Hardness	
Electrical Conductivity	Iron (Fe)	Turbidity (NTU)	
Total Hardness	Lead (Pb)	Zinc (Zn)	
Fluoride (F)	Magnesium (Mg)		
Iron (Fe)	Manganese (Mn)		
Magnesium (Mg)	Mercury (Hg)		
Manganese (Mn)	Metals (total)		
Nitrite + Nitrate (NO2 + NO3)	Nitrite + Nitrate (NO2 + NO3)		
pH	Nitrogen-Ammonia (NH3)		
Potassium (K)	Total Kjeldahl Nitrogen (TKN)		
Sodium (Na)	pH		

2.3 Yield test data interpretation

Completion of the appropriate duration of yield test must be done in accordance with Appendix 2.

The quantitative assessment of aquifer parameters (transmissivity, storativity, etc.), available head and long-term yield is based on the following:

- Aquifer type and assumptions, which typically include the following:
  - the aquifer has an infinite areal extent
  - the aquifer is bounded by a less permeable bed below in the case of an unconfined aquifer, and above and below in the case of a confined or leaky confined aquifer
  - the aquifer is homogeneous, isotropic, and of uniform thickness
  - flow is horizontal and laminar
  - water is released from storage instantaneously with a decline in head
  - the aquifer is pumped at a constant discharge rate
- Identification and location of any known or suspected aquifer boundary causing the test data to diverge from the appropriate aquifer model. The following conditions may cause departures from confined aquifer response resembling an aquifer response to either recharge or no-flow (barrier) boundaries:
  - leakage from adjacent aquifers
  - change in aquifer thickness
  - change in aquifer permeability
  - cessation (or initiation) of pumping in a nearby well that is hydraulically connected to the same aquifer
  - change in discharge rate during the test
  - facies change
  - secondary porosity (e.g., fracture porosity)
  - delayed yield in unconfined aquifers (resembling recharge)
  - barometric and diurnal effects—may be significant when there is minimal drawdown
- Aquifer test data interpretation, performed using whichever is the most appropriate model for the particular aquifer type and hydrogeological conditions. The applicant or consultant is responsible for providing the specified data and defending the choice of analysis used. The two main approaches for analyzing test data are:
  - Analytical solutions (Figure 3) using simplified mathematical equations so that solutions to the groundwater movement may be obtained by analytical methods. The proper analytical solution should be used for the particular aquifer in question, such as Theis or Cooper-Jacob for a confined aquifer, Neuman (or alternates) for unconfined aquifers, etc. Once the aquifer parameters have been estimated, these same analytical solutions may be used to predict drawdowns at different distances and times, in order to evaluate impacts.
  - Numerical models (Figure 4), especially useful for analyzing aquifers having irregular boundaries, complex structures and variable pumping or recharge rates.
- Theoretical long-term yield (Q_{20}), representing the amount of water that may be sustained by the aquifer in the vicinity of the tested well for 20 years, without lowering the water below the top of the aquifer for confined aquifers, or without resulting in a drawdown of more than two-thirds of the saturated thickness of an unconfined aquifer.

EPA has adopted and encourages the preferred use of the Modified Moell method (Maathuis and van der Kamp, 2005) described below to evaluate the long-term safe yield (Q_{20}) for any type of aquifer including confined, leaky, unconfined, buried valley aquifers, etc., including wells where large drawdowns occur at the beginning of the pumping period. The use of the Modified Moell method must be consistent with the appropriate aquifer model. Rationale for the chosen aquifer model must be provided with supporting data. For continuity, EPA will continue to accept the use of the Farvolden method (Figure 5) to evaluate the long-term safe yield for confined aquifers only that are consistent with the limitations of the Theis method.

The available head (Ha) for a confined aquifer is the distance between the non-pumping water level and the top of the aquifer.

For unconfined aquifers, the available head (Ha) is two-thirds of the initial saturated thickness of the aquifer.

The available head is measured at the proposed production well.

Note: For confined aquifers, the water level must not be drawn down by pumping to a level below the top of a confined aquifer. The water level drawdown in a well produced by pumping in an unconfined aquifer must not be more than two-thirds of the aquifer's saturated thickness measured at the time of first groundwater evaluation.

Note: The maximum daily pumping rate is determined by the maximum pumping rate during the aquifer test or the Q_{20} value, whichever is less.

FIGURE 3: ANALYTICAL GRAPH

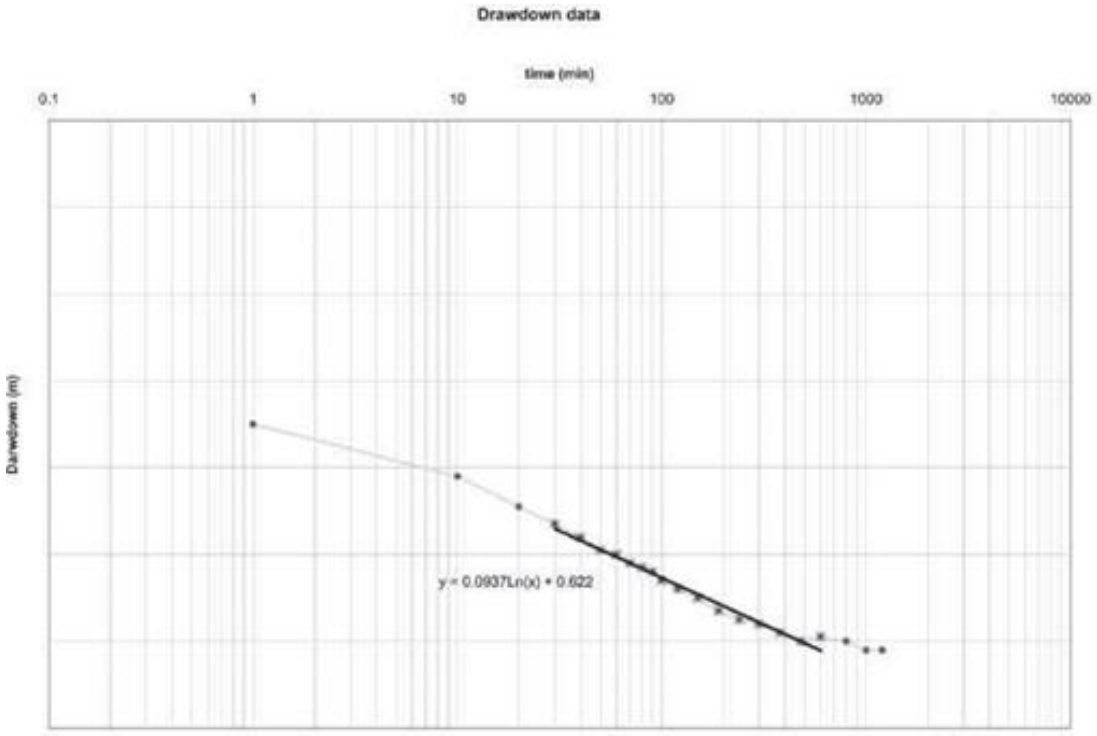


FIGURE 4: NUMERIC METHOD

EXAMPLE OF A NUMERICAL SOLUTION (SPREADSHEET SOLUTION)

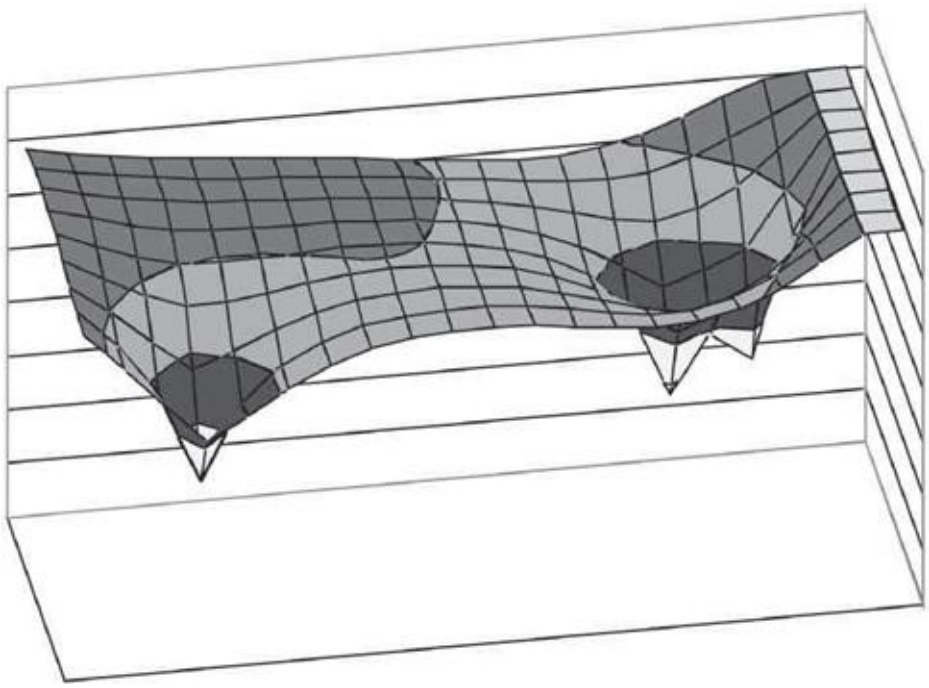


FIGURE 5: FARVOLDEN METHOD AND MODIFIED MOELL METHOD

Farvolden Method (confined aquifers only)

$$Q_{20}=(0.68)T(H_a)x0.7$$

Modified Moell Method (Maathuis and van der Kamp)

$$Q_{20}=\frac{0.7 \times Q \times H_a}{S_{100\,min}+(S_{20\,yrs}-S_{100\,min})_{Theor}}$$

Where,

H_a	Available head (m)
S_{100min}	Measured drawdown at 100 minutes (m)
Q	Well pumping rate during the yield test (m^3/day)
Q_{20}	Sustainable yield for a 20-year period (m^3/day)
$(S_{20yrs}-S_{100min})_{Theor}$	The difference between the calculated theoretical drawdown after 20 years of pumping at Q (m^3/day) and the calculated theoretical drawdown after 100 minutes of pumping at Q (m^3/day)
T	Transmissivity (m^2/day)
0.7	70% safety factor

2.3.1 Impact on the aquifer, the environment, and other users

Upon collecting and processing of data, the applicant or the consultant acting on the applicant's behalf must consider **all** of the following when assessing both the long and short-term impacts that could potentially occur as a result of the applicant diverting groundwater:

- Aquifer characterization determined from the analysis of aquifer test data, water quality data, field-verified survey data and other hydrogeological reports and data (e.g., fracture-dominated flow, limited areal extent, strong dynamic flow regime, extensive diversion from other projects, strong natural discharge, limited or abundant recharge, confined/unconfined conditions, etc.).
- Interference with other groundwater and surface water users.
- Proximity of surface water bodies (e.g., springs, dugouts, dams, sloughs, creeks, rivers, etc.).
- Evaluation of distance/time drawdown graphs and the calculation of the potential well interference effects. The aquifer model used to arrive at Q_{20} should also be used to estimate the distance at which well interference may occur after 20 years of pumping.
- Predicted drawdown in the wells compared to available head.
- Evaluation of technical/hydrogeological or other valid concerns expressed in any response to public consultation (including SOCs) regarding the proposed diversion of groundwater by the project.

- Identification of any other environmental/hydrogeological issues requiring referral to other agencies; specific monitoring requirements may be required to address such specific concerns.
- Suitable models to properly assess groundwater flow systems and aquifer sustainability during the entire projected groundwater diversion period. These should be consistent with the model used to arrive at Q_{20}.
- Evaluation of erosion potential and changes in fish habitat due to discharges from groundwater wells that may be required for large-scale mine or pit drainage projects.
- Local sub-basins with sensitive water bodies (i.e., small ratio of contributing area to surface area) or rare biota to be specifically identified and protected.
- Areas adjacent to protected wetlands or “special places” specifically identified and evaluated as sensitive areas.
- Evaluation of effects caused by increased groundwater recharge needed in recharge dominated flow systems or for drought sensitive local water bodies.
- Changes in water quality as a result of the diversion (e.g., increased metal mobility, anaerobic/aerobic changes, salinity increase, etc.).
- Potential for groundwater-surface water connectivity; in areas of the province that have an Approved Water Management Plan, such as the South Saskatchewan River Basin (SSRB), an assessment of the potential for such a connection is required to inform the director whether a licence can be issued. Criteria that can be used to determine the potential for a groundwater-surface water connection may include, but are not limited to, stratigraphic cross-sections, water chemistry analyses, yield test analyses, water levels, isotopic analyses and travel time calculations.

Note: If authorization to divert groundwater is required for more than one well, and the wells are completed in the same aquifer, an assessment of the drawdown at the point of maximum interference must be provided.

3.0 Monitoring and reporting

Monitoring and reporting requirements may be established for groundwater diversions. These conditions may be updated or amended at any time within the licence/approval term at the discretion of the director. The licensee must record, at the required frequency, and report within the required timeframe, to the director the results of the conditions attached to the licence and must provide any other information required by the director.

Reporting is to be submitted electronically through DRAS for authorizations issued via DRAS. For authorizations issued prior to DRAS, reporting is to continue through the Water Use Reporting System (WURS). WURS was initiated as part of EPA’s commitment to transparency to allow the public access to water volume, rate, level and chemistry data. For more information on electronic reporting visit https://www.alberta.ca/water-use-reporting-system.aspx.

Monitoring, reporting and other conditions attached to a licence or an approval are used to measure the achievement of a specific outcome. These performance measures help ensure a sustainable, reliable supply of quality water for Albertans.

Monitoring conditions may include:

- monitoring other selected wells in the area
- constructing and monitoring additional observation wells
- continuous or frequent monitoring of production volume, rate, water level and chemistry
- low-level shut-off requirements
- annual water use reports

4.0 Replacement and supplementary wells

4.1 Replacement water well

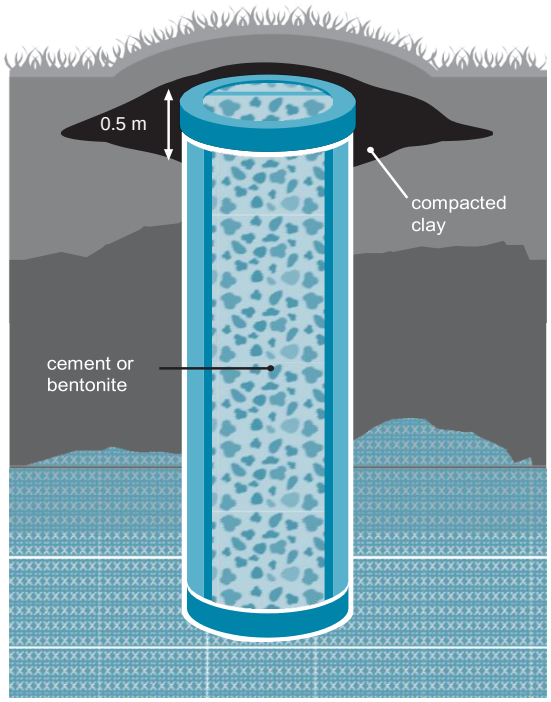
A replacement well is a well that is drilled to replace an existing well.

For a new well to qualify as a replacement well, it must have **all** of the following:

- be constructed in the same quarter-section as the original well
- be completed in the same aquifer as the original well
- be constructed in accordance with the regulation governing well completion at the time of the replacement
- have a drawdown cone similar to that of the original well

An application for an amendment to the existing licence must be submitted, along with the drilling report for the replacement well and the reclamation report for the original well. The original well must be reclaimed in accordance with the Wells Directive to prevent contamination of the aquifer (Figure 6).

FIGURE 6: EXAMPLE OF PLUGGED HOLES IN AN OLD WELL



A replacement water well must be constructed to replace an existing well.

4.2 Supplementary water well

A supplementary well is a well that is drilled when the productivity of the original well declines over time and additional well(s) will be needed to maintain the original water volume authorized by a licence. An application under the *Water Act* to amend the existing licence is required. The cumulative diversion rate from all of the wells cannot exceed the original diversion authorized on the existing licence.

For the new well to qualify as a supplementary well, it must be completed in the same aquifer as the existing well **and** completed in accordance with the regulation at the time of the construction.

Note: The effects of well interference must be assessed as the addition of a new well has the potential to create overlapping cones of depression.

Note: A new application must be submitted for any additional volume of water required over the original authorized amount in an existing licence. Additional testing may be required.

5.0 Water well complaints

Complaints related to water wells should be reported to the EPA hotline at 1-800-222-6514. Visit the Energy and Environmental Response Line for useful information needed when filing a complaint.

EPA, in partnership with other agencies, has developed the Working Well program, which provides well owners with information on well management, including tips on proper operation, maintenance and repair. Access to this information may be found at https://www.alberta.ca/working-well.aspx.

6.0 Activities with specific authorization requirements

6.1 Oilfield injection

EPA's objective is to enhance the conservation and protection of Alberta's water and to reduce or eliminate the use of non-saline water resources for oilfield injection purposes on a case-by-case basis. To achieve this objective, specific requirements are set out in the Applications Under the Water Conservation Policy for Upstream Oil and Gas Operations, which applicants must follow to obtain a licence for oilfield injection purposes. The Water Conservation Policy for Upstream Oil and Gas Operations can be found at https://open.alberta.ca/publications/water-conservation-policy-for-upstream-oil-and-gas-operations.

6.2 Groundwater diversion for geothermal purposes

Open-loop systems use the geothermal properties of groundwater for heating or cooling purposes. This is achieved by diverting groundwater from a well, circulating the water through a heat transfer system, and returning the water to the sub-surface through another well. Where there is no loss of water as part of the system, and where the withdrawal and the return points are within the same water body, the installation and operation of an open-loop system is an "activity" as defined by the *Water Act*; therefore, an approval is required. If the withdrawal and the return points of an open-loop system are within different water bodies and/or there are water losses in the geothermal system, a licence under the *Water Act* is required.

Information supporting the application must include, but is not limited to, an assessment of the potential and cumulative effects, including **all** of the following:

- capability of the aquifer to circulate the required quantities of groundwater
- effects of the geothermal system on groundwater quantity, temperature and quality
- effects of the geothermal system on household users, traditional agricultural users, approval holders or licensees

A qualified groundwater practitioner who is a member of APEGA must prepare a technical report supporting the application. The submitted report must be prepared in accordance with the criteria identified in this guide.

Canadian Standards Association (CSA) C448-13, Design and Installation of Earth Energy Systems, may be referenced for heat pump system installation standards. Where discrepancies arise between the CSA standards and the *Water Act* and Water (Ministerial) Regulation or this Guide, the *Water Act* and Water (Ministerial) Regulation and this Guide will prevail in terms of authorization process, well construction and the evaluation and reporting requirements.

The applicant is required to ensure that the water wells are drilled by a certified journeyman water well driller who has a valid approval to drill water wells and all work must be done in accordance with the Wells Directive.

The groundwater used in the geothermal system for heating/cooling purposes must not be used for another purpose without prior authorization of the director.

The director must authorize temporary discharges or withdrawals of water from all geothermal systems.

Note: The owner of a horizontal, closed-loop system is not required to obtain a *Water Act* approval, as long as the system is installed above the water table. However, if a vertical closed-loop system is being installed, the person doing the drilling of the boreholes and the installation of the earth loops must be a certified journeyman earth loop technician who has a valid approval to drill and all work must be done in accordance with the Wells Directive.

6.3 Remediation

Remediation is the process by which contaminated groundwater is removed for treatment or disposal. If a project already holds an EPEA approval, including groundwater remediation programs, an additional application under the *Water Act* is not required in order to disturb water for remediation purposes. For projects that do not hold any EPEA approval or registration, the diversion of small quantities (< 1250 m^3/year) of contaminated groundwater do not require an authorization under the *Water Act*. For additional information on groundwater remediation, go to: https://www.alberta.ca/contaminated-site-remediation.aspx.

6.4 Hydrocarbon wells producing non-saline water

Prior to any oil and gas well being drilled, an operator must receive appropriate regulatory approval from the AER. Part of the information gathered initially helps assess the likelihood that an oil or gas well will produce non-saline groundwater. If an oil or gas well will produce non-saline groundwater, a *Water Act* authorization may be required through the AER.

7.0 Groundwater diversion in restricted water basins

Water management plans have been developed for various river basins in Alberta. All proposed groundwater diversions located in these water basins must be consistent with the appropriate water management plans which can be found at https://www.alberta.ca/water-management-plans.aspx.

In closed basins (e.g., SSRB) licensing of groundwater may not be permitted if an aquifer source is proven to have a groundwater-surface water connection.

8.0 Water diversion from sands and gravels adjacent to surface water and water diversion from springs

All water diversion projects from sand and gravel deposits **adjacent to a surface water body (river, stream, lake, etc.)** will be evaluated according to surface water licensing procedures.

If the applicant can prove no hydraulic connection between the sand and gravel deposit and a surface water body, the applicant will need to make an application for a groundwater diversion licence and the project will be evaluated according to groundwater licensing procedures. Evaluation of the project should be done in accordance with this guide, including addressing the impacts, if any, that the proposed groundwater diversion will have on local groundwater users.

All applications for diversion **from springs** will be evaluated according to surface water licensing procedures unless the development will increase the flow rate of the spring. In that case, the water from the spring will be considered groundwater and the applicant must make an application for a groundwater diversion licence.

Note: In a closed basin, such as the SSRB, new water licences for springs may not be permitted.

9.0 References

Maathuis, H. and van der Kamp G., 2006. The Q_{20} concept: Sustainable well yield and sustainable aquifer yield. Saskatchewan Research Council, Environment and Forestry Division, National Water Research Institute, Saskatoon: SRC Publication No. 10417-4E06, 110 pp.

APPENDIX 1: Example of field-verified survey form

Parameters	Water Source #1	Water Source #2	Water Source #3	Water Source #4
Owner/lessee name				
Legal land location, lat/long, GPS coordinates				
Surface elevation				
Type of water source				
Water source/well status				
Well depth				
Original non-pumping level and date level recorded				
Current non-pumping water level and date level recorded				
Well completion details (open hole, perforated, or screened) and completion interval				
Depth to top of aquifer and amount of available head				
Maximum pumping rate				
Current estimated water requirements (daily/annual)				
Purpose of use (household, livestock, industrial, etc.)				
Distance from proposed water diversion or drainage site				
Summary of historical chemical analyses				

APPENDIX 2: Minimum recommended length of aquifer test and information required for the maximum water diversion/drainage

Daily pumping rate	Number of days	Maximum yearly water requirement	Length of pumping and recovery period at anticipated maximum pumping rate	Observation/ monitoring well(s)	Information required under section 2 of this guide
up to 10 m^3/day (2200 Igpd) (1.5 Igpm)	365	3650 m^3 (803,000 Ig)	2 + 2 hours* (or longer) and at least 90% recovery	0	2.1 2.2.3 2.2.6 2.2.10
> 10 to 35 m^3/day (2200 to 7700 Igpd) (1.5 to 5.3 Igpm)	applicant to enter	applicant to enter	24 + 24 hours (or longer) and at least 90% recovery	0–1	All of Section 2
> 35 to 65 m^3/day (7700 to 14,300 Igpd) (5.3 to 10.0 Igpm)	applicant to enter	applicant to enter	24 + 24 hours (or longer) and at least 90% recovery	1	All of Section 2
> 65 to 265 m^3/day 14,300 to 60,500 Igpd) (10.0 to 40.0 Igpm)	applicant to enter	applicant to enter	48 + 48 hours (or longer) and at least 90% recovery	1–2	All of Section 2
> 265 m^3/day	applicant to enter	applicant to enter	72 + 72 hours (or longer) and at least 90% recovery	1–2	All of Section 2

*In some cases, more information or longer aquifer tests may be required.

LEGEND

g = gallons

m^3 = cubic metre = 220 Imperial gallons

Ig = Imperial gallons

Igpd = Imperial gallons per day

Igpm = Imperial gallons per minute

APPENDIX 3: Additional Resources

Legislation:

Environmental Protection and Enhancement Act: https://open.alberta.ca/publications/e12

Potable Water Regulation: https://open.alberta.ca/publications/2003_277

Responsible Energy Development Act: https://open.alberta.ca/publications/r17p3

Water Act: https://open.alberta.ca/publications/w03

Water (Ministerial) Regulation: https://open.alberta.ca/publications/1998_205

Summary of links in this Guide:

AER *Water Act* Application Information: https:/www.aer.ca/regulating-development/project-application/application-legislation/water-act

Alberta Tier 1 Soil and Groundwater Remediation Guidelines: https://open.alberta.ca/publications/1926-6243

Alberta Water Well Information Database: https://www.alberta.ca/alberta-water-well-information-database-overview.aspx

Applications Under the Water Conservation Policy for Upstream Oil and Gas Operations: https://static.aer.ca/prd/documents/manuals/Manual025.pdf

Canadian Standards Association (CSA) C448-13, Design and Installation of Earth Energy Systems: https://www.csagroup.org/store/product/CAN%25100CSA-C448%20SERIES-13/

Confined Feeding Operations (CFO) Information: https://www.nrcb.ca/confined-feeding-operations

Digital Regulatory Assurance System (DRAS): https://www.alberta.ca/digital-regulatory-assurance-system.aspx

Energy and Environmental Response Line: https:/www.alberta.ca/energy-and-environmental-response-line.aspx

Groundwater remediation information: https://www.alberta.ca/contaminated-site-remediation.aspx

Guidelines for Canadian Drinking Water Quality (GCDWQ): (https://www.canada.ca/en/health-canada/services/environmental-workplace-health/reports-publications/water-quality/guidelines-canadian-drinking-water-quality-summary-table.html

Standards and Guidelines for Municipal Waterworks, Wastewater and Storm Drainage Systems: https://open.alberta.ca/publications/5668185

Water Act Forms: https://www.alberta.ca/water-act-forms.aspx

Water Act: Temporary Water Diversions fact sheet: https://open.alberta.ca/publications/water-act-temporary-water-diversions

Water Conservation Policy for Upstream Oil and Gas Operations: https://open.alberta.ca/publications/water-conservation-policy-for-upstream-oil-and-gas-operations

Water Management Plans: https://www.alberta.ca/water-management-plans.aspx

Water Use Reporting System: https://www.alberta.ca/water-use-reporting-system.aspx

Water Wells and Ground Source Heat Exchange Systems Directive (Wells Directive): https://open.alberta.ca/publications/9781460141588

Working Well: https://www.alberta.ca/working-well.aspx

Additional Resources:

Detail Site Plan: https://www.alberta.ca/system/files/custom_downloaded_images/ep-water-well-detail-site-plan.pdf

Detail Site Plan example: https://www.alberta.ca/system/files/custom_downloaded_images/ep-water-well-detail-site-plan-example.pdf

Guidelines for Licensing Water Diversion Projects: https://open.alberta.ca/publications/guidelines-for-licensing-water-diversion-projects

Livestock Water Requirements: https://open.alberta.ca/publications/3124615

Livestock Water Requirement Worksheet: https://www.alberta.ca/system/files/custom_downloaded_images/ep-livestock-water-requirement-worksheet.doc

Livestock Water Requirement Online Calculator: https://www.agric.gov.ab.ca/app19/calc/livestock/waterreq_dataentry1.jsp

Livestock Water Source Calculation Sheet: https://www.alberta.ca/system/files/custom_downloaded_images/ep-livestock-water-source-calculation-chart.doc

Quarter-Section Plan Related to Detail Site Plan: https://www.alberta.ca/system/files/custom_downloaded_images/ep-water-well-quarter-section-plan-related-to-detail-site-plan.pdf

Quarter-Section Plan Related to Detail Site Plan example: https://www.alberta.ca/system/files/custom_downloaded_images/ep-water-well-quarter-section-plan-related-to-detail-site-plan-example.pdf

Water Well Inventory Form: https://www.alberta.ca/system/files/custom_downloaded_images/ep-water-well-inventory-list.doc

APPENDIX 4: Map of Alberta Environment and Protected Areas District Offices

For more information, contact the appropriate office:

NORTH REGION
Boreal District
Grande Prairie Provincial Building
Main Floor, 10320 99 Street
Grande Prairie, AB T8V 6J4
Phone: 780-538-5260
aep.waborealregion@gov.ab.ca

Capital District
Twin Atria Building
4999 98 Avenue NW
Edmonton, AB T6B 2X3
Phone: 780-427-1044
aep.wacapitalregion@gov.ab.ca

Capital District
Telus Building
Suite 1, 250 Diamond Avenue (T7X 4C7)
PO Box 4240 (T7X 3B4)
Spruce Grove, AB
Phone: 780-960-8600
aep.wacapitalregion@gov.ab.ca

SOUTH REGION
Red Deer District
Red Deer Provincial Building
Suite 304, 4920 51 Street
Red Deer, AB T4N 6K8
Phone: 403-340-7052
WaterApprovals.RedDeer@gov.ab.ca

Calgary District
Deerfoot Square Building
2938 11 Street NE
Calgary, AB T2E 7L7
Phone: 403-297-7602
aep.waapprovcal@gov.ab.ca

Lethbridge District
Lethbridge Provincial Building
200 – 5 Avenue S
Lethbridge, AB T1J 4L1
Phone: 403-381-5322
WaterApprovals.Lethbridge@gov.ab.ca