Manual **025**

Alberta Energy Regulator

# Applications Under the Water Conservation Policy for Upstream Oil and Gas Operations

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Manual 025: Applications Under the Water Conservation Policy for Upstream Oil and Gas Operations

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# Contents

# 1 Introduction

The purpose of this manual is to assist operators in applying for new water licences, licence renewals, and licence amendments pursuant to the *Water Act* and under the scope of the *Water Conservation Policy for Upstream Oil and Gas Operations*. It replaces the Alberta Environment and Parks 2006 *Water Conservation and Allocation Guideline for Oilfield Injection*.

This manual only discusses the parts of the application dealing with water conservation. The process outlined in this manual supports the policy objectives by ensuring that all reasonable alternatives have been assessed for technical and economic feasibility in order to conserve high-quality nonsaline water, understanding that the use of high-quality nonsaline water is at times unavoidable.

Water conservation is only one of many aspects considered when making decisions on water licence applications. In areas of relative water abundance, greater weight will be placed on other application components. The scarcer the water, the more heavily water conservation will be considered.

This manual assumes you have read and are familiar with the terms and outcomes defined in the policy. It serves as the "guideline" mentioned in part 2 of the policy. This manual supplements existing guidance around standard *Water Act* licence applications (such as evaluating aquifer yields, maximum pumping rates, assessing impacts to other water users, impacts to the aquatic environment, recycling expectations, etc.) found in other documents, such as the following:

- The AER's webpage on *Water Act* applications: Regulating Development > Project Application > Application Legislation > Water Act
- *Alberta Environment and Protected Areas Guide to Groundwater Authorization*
- *Surface Water Allocation Directive*
- *Directive for water licensing of hydraulic fracturing projects – area of use approach*
- *Administrative guideline for transfer of water allocations (and agreements to assign water, licence amendments)*
- *Directive 081: Water Disposal Limits and Reporting Requirements for Thermal In Situ Oil Sands Schemes*

## 1.1 Applicability

This manual applies to the allocation of surface and groundwater for

- oil sands thermal in situ operations,
- enhanced oil recovery and cold bitumen enhanced recovery operation, and
- multistage hydraulic fracturing operations in horizontal wells.

Oil sands mining operations are also under the policy; however, operational water use for these operations is provided through the *Lower Athabasca Region: Surface Water Quantity Management Framework for the Lower Athabasca River* and the *Lower Athabasca Region: Tailings Management Framework for the Mineable Athabasca Oil Sands*. This manual may provide supplemental guidance when developing these applications.

Drilling and completion operations (including hydraulic fracturing) in vertical wells are *not* within the scope of the policy or this manual. Applications for *Water Act* licences for these purposes will continue to require evaluation of potential environmental impacts based on the standard application requirements of section 51 of the *Water Act*.

In alignment with the objectives of the policy, this manual should be applied to utility purposes at oil sands thermal in situ operations where there is a potential opportunity to minimize the use of high-quality nonsaline water. Considerations for applicability of this manual include the water quality requirements for the specific utility purpose, volume proposed, and integration of utility water use with steam generation.

This manual applies to new licences and licence renewals. Licence renewals should focus on whether the situation has changed with respect to the availability of new alternative water sources, technology improvements creating new alternative sources or lessening the environmental net effects of existing sources, or if the economics of the existing alternative water sources have significantly improved.

This manual only applies to licence amendments if the purpose is being changed to one that is covered under the policy. For example, if you have an existing licence to use water for dust control, and you now want to use that water for enhanced oil recovery, the licence amendment would include a change of purpose and would fall under the policy and this manual.

The manual does not apply to temporary diversion licences.

While the policy itself is mandatory, the application process described here is recommended as a best practice. Variation is allowed but will likely result in delays. Applicants should consult with AER staff in these cases.

## 1.2 How to Use This Manual

Section 2 defines the four risk tiers used to review all applications made under the policy scope, including specific application content recommendations and likely conditions that will be attached should a licence be granted. It also outlines a recommended approach to preparing applications. Section 3 discusses the various application components in more detail.

## 1.3 Important Definitions

See the policy for definitions of important terms. This section expands on those definitions.

### 1.3.1 High-Quality Nonsaline Water

The policy defines high-quality nonsaline water sources as nonsaline groundwater and surface water supplies that support instream and aquatic ecosystem needs or are usable with standard treatment technologies for drinking water supplies and livestock watering. Saline surface water is not considered an alternative source as it can provide an important ecosystem function and recreational value. For the purpose of this manual, saline surface water should be assessed in the same way as nonsaline surface water.

#### 1.3.1.1 Surface Water

Examples of high-quality surface water include water sourced from streams, rivers, lakes, springs, and wetlands as well as water sourced from anthropogenically created water bodies, such as the following:

- canals and ditches
- dugouts
- reservoirs
- borrow pits
- raw water ponds
- nonindustrial runoff (storm water) ponds
- industrial runoff ponds in water-short areas
- reclaimed water bodies and end-pit lakes
- gravel pits
- quarries

Although water sourced from anthropogenically created water bodies is still considered high quality, these sources may be preferred over natural sources if available and may still be subject to additional regulatory requirements.

#### 1.3.1.2 Groundwater

For the purpose of this manual, high-quality nonsaline groundwater is water below the surface of the ground that has total dissolved solids less than or equal to 4000 milligrams per litre and supports instream and aquatic ecosystem needs or is usable with standard treatment. The working definition is as follows:

- water sourced from shallow aquifers, where the top of the aquifer is less than 150 m depth from the surface
- water sourced from aquifers in sediments above the top of bedrock, regardless of depth
- water sourced from aquifers in water-short areas, regardless of depth
- water sourced from aquifers where there are nonindustrial users within 1.6 km and from within the same water source of the proposed diversion, regardless of depth (nonindustrial users are statutory and licensed water users for the purposes of drinking water, livestock watering, and agriculture)

### 1.3.2 Alternative Nonsaline Water

Alternative nonsaline water includes surface water and nonsaline groundwater that either is highly mineralized due to the geological setting or has already been used and adversely affected by an industrial, commercial, or municipal activity. Alternative nonsaline water often is sent to disposal wells, is stored in long-term containment ponds, or requires treatment before being returned to the environment. Alternative nonsaline groundwater includes relatively deep groundwater that does not directly support instream flow and aquatic ecosystem needs and is not being accessed by other nonindustrial users. In general, alternative nonsaline water supplies are not used for drinking water supplies, livestock watering, agriculture, or other nonindustrial purposes.

#### 1.3.2.1 Surface Water

Examples of alternative nonsaline surface water include the following:

- industrial runoff from areas that are not water short (see figure 2)
- treated, partially treated, or untreated municipal or industrial wastewater, taking return flows into consideration
- oil sands process-affected water (tailings water) from an oil sands mine
- runoff in contact with bitumen or saline groundwater from an oil sands mine
- captured/condensed steam from flue gas heat recovery systems

#### 1.3.2.2 Groundwater

For the purpose of this manual, certain waters below the surface of the ground having total dissolved solids less than or equal to 4000 milligrams per litre falls under the definition of alternative nonsaline groundwater. The criteria are as follows:

- the water is not sourced from a water-short area
- the water is not sourced from an aquifer above the top of bedrock (i.e., not in a Neogene- or Quaternary-aged aquifer)
- the top of the aquifer is equal to or deeper than 150 m
- there are no nonindustrial water wells in the same aquifer within 1.6 km

Regardless of depth, the following are also considered alternative nonsaline groundwater:

- Nonsaline groundwater in contact with bitumen deposits
- Nonsaline groundwater naturally containing hydrocarbons (excluding methane) within formations that contain both water and hydrocarbon resources
- Contaminated groundwater sourced from remediation wells

Figure 1 is a graphical summary of how to determine whether nonsaline groundwater is considered "high quality" or "alternative."

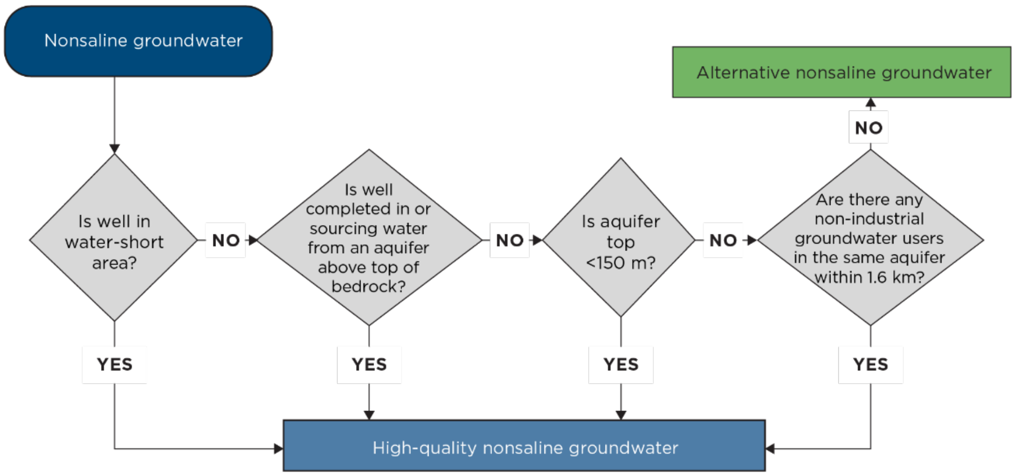


**Figure 1. Decision tree for determining if nonsaline groundwater should be treated as "high-quality" or "alternative"**

### 1.3.3 Other Alternatives

Any surface or groundwater that does not meet the above definitions is considered "other alternatives" to nonsaline water; examples include the following:

- saline groundwater
- increased recycling of produced water or flowback water
- produced water or flowback water from external projects
- water that is currently being sent to disposal wells (i.e., landfill leachate and various types of wastewater)
- non-water technologies

Efforts to use new or overlooked alternatives or non-water options are encouraged, recognizing that the regulatory oversight for these approvals falls under other statutes, including the *Oil and Gas Conservation Act* and *Environmental Protection and Enhancement Act*.

### 1.3.4 Locally Constrained Areas

The terms "water short" and "potentially water short" are defined in pages 23–25 of the policy. The term "locally constrained" is specific to this manual and is enabled through the policy provision on page 15 that "additional requirements or more stringent restrictions may apply on a regional or site-specific basis." Locally constrained areas are relatively small areas that are neither water short nor potentially water short but are showing an indication that sufficient water may not always be available to satisfy environmental needs and human or licensed demands. Locally constrained areas are determined at the hydrological unit code 8 (HUC 8) level.[1] The province has four HUCs, from coarsest to finest level: HUC 2, 4, 6 and 8.

For surface water, an area is considered locally constrained if the volume of water allocated from the main flowing water body is 3% or more of the median annual flow. The analysis takes into consideration water allocation across all sectors, including those under Alberta Environment and Protected Areas (AEPA) jurisdiction and allocations from temporary diversion licences. The 3% level takes into account seasonal variation of the water supply and represents a volume generally fully protective of the environment and other water users. Additional detail on how this assessment is done and its relation to the *Surface Water Allocation Directive* can be found in appendix 2.

For groundwater, an area is considered locally constrained if the volume of water allocated from high-quality nonsaline groundwater sources is greater than 10% of the estimated volume of groundwater available. Water allocation is established for each HUC 8, taking in consideration all groundwater licences from all sectors, including those under AEPA jurisdiction and allocations from temporary diversion licences. The 10% level represents a volume that is considered to provide a high level of protection to surface water systems. Additional detail on how this assessment is done can be found in appendix 2.

Figure 2 is a combination of the water-short and potentially water-short areas found in figure 2 of the policy and the areas designated as locally constrained *at the time of release of this manual*. A high-resolution, interactive, and up-to-date version of the map is available at https://extmapviewer.aer.ca/wcp/index.html.

The applicant can undertake their own analysis to show that a particular water source is not locally constrained and provide this to the AER with the water licence application (e.g., borrow pits that collect surface runoff and do not contribute to the main stem during winter low flow period; a withdrawal from this source would not normally affect winter flows). A more detailed assessment considering the other water users from the particular aquifer, the impacts to the overlying aquifers, and effect on surface water would be required for groundwater withdrawals where the source is previously determined to be locally constrained. The information should be submitted with the application for the AER's consideration.

[1] A classification based on a system developed by the United States Geological Survey (USGS) that divides an area into smaller and smaller hydrologic units.

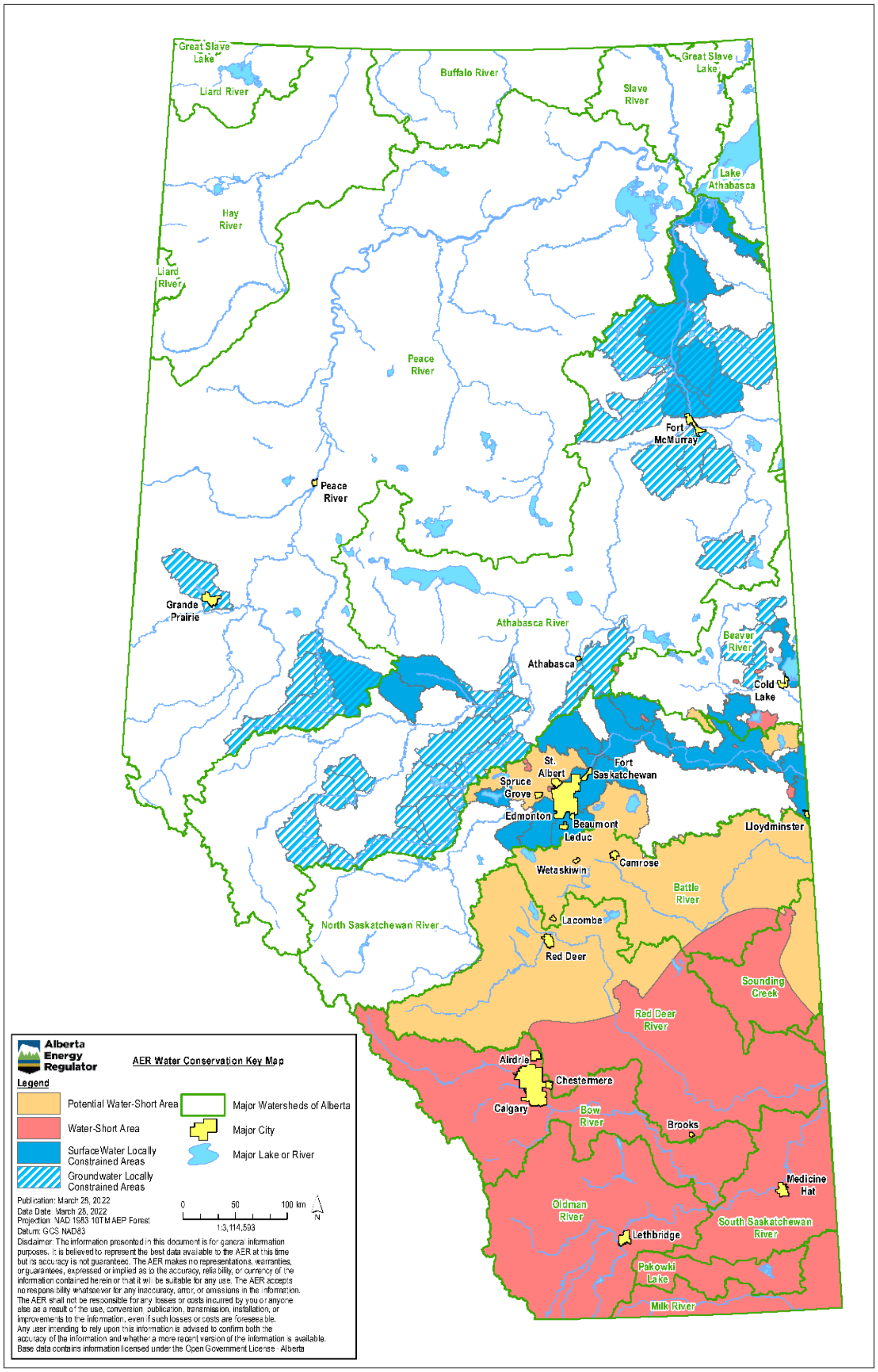


**Figure 2. Map showing water-short, potentially water-short, and locally constrained areas. Locally constrained areas are updated annually. A high-resolution, interactive version of this map is available on the AER website at https://extmapviewer.aer.ca/wcp/index.html.**

# 2 Applying for a Water Licence

## 2.1 Risk-Based Assessment

All applications submitted under the policy are assessed based on four risk tiers. The tiers are based on three criteria: water source, project scale, and whether the application falls within a water-short area.

***Water Source:*** applications for high-quality nonsaline water (see section 1.3.1) will be assessed under a higher risk tier than applications using alternative nonsaline water.

***Project Scale:*** small-scale projects represent a different degree of conservation expectation compared to large. Larger projects are more able to implement water conservation and are expected to undertake greater evaluation regarding conservation.

Project scale is the total volume of the annual allocations authorized by all term licences to a site. The total annual allocation is projected to a daily volume, though the instantaneous maximum rate may be higher depending on the project needs and specific licence conditions. For the purpose of this manual, the total volume of high-quality nonsaline water licensed for that site includes term licences where the water infrastructure for diversion or use is interconnected. This does not include projects that are adjacent to one another that do not share common water infrastructure or separate licensees on separate projects accessing a water source through a common intake or well. Processing trains within the same site but not sharing water infrastructure should be considered as separate projects.

For groundwater applications, the threshold volume for small- and large-scale projects is based on the total allocation volume of all high-quality nonsaline water needed for the entire project. Groundwater licence applications are considered small scale if the total project water allocation (all previous existing groundwater licences plus the allocations being applied for) is less than 1370 $m^3$/day.

The project scale for surface water is defined by both the total allocation volume of all high-quality nonsaline water needed for the entire project (similar to groundwater) and also the relative portion of water available in the source. Small-scale surface water projects are those that have a total project water allocation (all previous existing surface water licences plus the allocations being applied for) less than 2700 $m^3$/day *and* the application represents less than 0.7% of the median annual runoff contributing to the source water body. This includes outflows from lakes and reservoirs, as well as flowing water bodies. Otherwise it is considered large scale.

***Water-Short Designation:*** the water diversion may fall within areas that are water short or potentially water short. This criterion applies at the point of diversion from the water source and considers the degree of existing and potential stress on the available water supply in relation to human demand, while considering how this stress affects the aquatic environment and cultural use. Applications that involve such areas will be assessed under a higher risk tier.

Table 1 outlines how each tier is defined, any application content recommendations, and conditions specific to water conservation that would be included should a licence be granted. Detailed descriptions of the recommended application content are given in section 3.

**Table 1. Risk assessment tiers with associated application content recommendations and typical conditions related to water conservation**

| Tier | Criteria | Application content recommendations | Typical licence conditions |
|---|---|---|---|
| 1 | • Alternative nonsaline water use requested | • Confirmation-level environmental net effects assessment on the preferred source | • 10-year term on new licences<br>• 10-year term on renewals<br>• Monthly monitoring<br>• Annual reporting |
| 2 | • High-quality nonsaline water use requested<br>• Small-scale project<br>• Located in an area that is neither water short nor potentially water short (white, blue, and hatched blue areas depicted in figure 2) | • Confirmation-level alternative source assessment with a 5 km radius<br>• Qualitative environmental net effects assessment<br>• Screening-level economic evaluation<br>• A plan to address winter flows in locally constrained areas for surface water diversion<br>• A plan to monitor and address impacts to overlying aquifers in locally constrained areas for groundwater diversion | • 5-year term on new licences<br>• 10-year term on renewals<br>• Monitoring and reporting determined on case-by-case basis<br>• Drawdown in the production aquifer is limited to 50 per cent of the available head at a distance of 150 m from the production well over the life of the project for groundwater licences in locally constrained areas |
| 3 | • High-quality nonsaline water use requested<br>One of the following:<br>• Potentially water-short areas (yellow areas depicted in figure 2), or<br>• Large-scale project in any location other than a water short area (red areas depicted in figure 2) | • Screening-level alternative source assessment with a 10 km radius<br>• Screening-level environmental net effects assessment<br>• Screening-level economic evaluation<br>• Cumulative effects evaluation for large-scale projects<br>• A plan to address winter flows in locally constrained areas for surface water diversion<br>• A plan to monitor and address impacts to overlying aquifers in locally constrained areas for groundwater diversion | • 5-year term on new licences<br>• 10-year term on renewals<br>• Drawdown in the production aquifer is limited to 50 per cent of the available head at a distance of 150 m from the production well over the life of the project for groundwater licences<br>• Plan for combined use (for large-scale projects)<br>• Monitoring and reporting determined on a case-by-case basis |

| Tier | Criteria | Application content recommendations | Typical licence conditions |
|---|---|---|---|
| 4 | • High-quality nonsaline water use requested<br>• Water-short area (red areas depicted in figure 2) | • Detailed-level alternative source assessment with 20 km radius<br>• Detailed-level environmental net effects assessment<br>• Detailed-level economic evaluation<br>• Cumulative effects evaluation<br>• Assess potential for combined use of alternatives<br>• A plan for water conservation and efficiency improvement | • 5-year term on new licences<br>• 5-year term on renewals<br>• Drawdown in the production aquifer is limited to 50 per cent of the available head at a distance of 150 m from the production well over the life of the project for groundwater licences<br>• Monitoring and reporting determined on a case-by-case basis<br>• Conservation and efficiency conditions |

## 2.2 Combined Water Use

In situations where alternative water sources may not meet the full project needs or are available in variable volumes or on an infrequent or irregular basis, they should not be discounted as potential contributors to the project water supply. Rather, those sources should be considered as potential supplements to high-quality nonsaline water that are incorporated into the project when available, thereby reducing the overall use (and increasing conservation) of high-quality nonsaline water. While water source certainty may necessitate the need for a licence for high-quality nonsaline water to meet the full project need, submitting a plan for combined use of high-quality nonsaline and alternative nonsaline water sources with the application can lead to improved transparency and demonstrated conservation effort.

## 2.3 Water Conservation Incentives

If a renewal application demonstrates extra efforts to conserve water, the application may be evaluated on the submission requirements of one risk tier lower, recognizing that tier 1 is the lowest possible and that the standard application requirements will still need to be submitted for all risk tiers.

Examples of such efforts include the following:

- Significant allocation reduction. This includes cancellation or amalgamation of licences on the project site which results in a reduction of high-quality nonsaline water allocation.
- Significant improvement in resource productivity and efficiency (i.e., water use intensity).
- An application that demonstrates significant combined use of alternatives.

For example, a large-scale project using high-quality nonsaline water will normally be assessed as a tier 3. If the applicant proposes to significantly lower their allocation in the renewal application, the proponent may submit the application based on a tier 2 level. If no further gains are made over the balance of the project life, future licence renewals will again be based on application risk tier 3 requirements (depending on the future project scale volume).

Historic water conservation efforts (i.e., those that occurred before the renewal term and before this manual was published) may be considered when determining the application risk tier. In addition, short-term pilots and projects in the final years of operation (i.e., when water use is expected to stop within the renewal timeframe) may qualify for reduced assessment and application submission requirements.

Applicants should have a preapplication consultation meeting with the AER to determine if the project potentially qualifies for a lower tier assessment. The specific application requirements will be determined on a case-by-case basis.

## 2.4 Preparing an Application

It is recommended that applicants follow this seven-step process when preparing an application that falls under the policy.

***Step 1 – Water Need Identified***

- Applicant identifies the need for water and any water-related design constraints such as chemical or physical compatibility, average and instantaneous flow rates, duration of use, etc. We use this information to understand the annual volumetric need and to confirm that the requested amount of water is justifiable for the intended purpose.

***Step 2 – Preliminary Assessment***

- Applicant undertakes a preliminary assessment to identify sources of water, which should include
  - the potential points of diversion,
  - the points of use,
  - the water-short designation (see figure 2),
  - the water type (i.e., high-quality nonsaline, alternative nonsaline, other alternatives), and
  - impacts to municipal and Indigenous communities (applicants are encouraged to engage proactively with any potentially affected communities).
- The regulatory process for water licensing is simplified and expedited if the project uses alternative nonsaline water or if there are no water licensing requirements for other alternatives. A list of water types and corresponding regulatory framework is provided in appendix 1.
- The applicant should consider water availability and conservation as early as possible in the overall project planning. The applicant may apply to the AER for a water licence when sufficient information

is available to submit a complete application to address impacts to other water users, the aquatic environment, water management, as well as water conservation considerations.

***Step 3 – Identify Application Risk Tier***

- Identify the application risk tier based on the water type, project scale, and whether the application falls within a water-short or potentially-water-short area. All applications will be reviewed by the AER to ensure that the appropriate risk tier has been identified and that the assessment and submission requirements are appropriate.
- Water type can be determined using figure 1.

***Step 4 – Identify and Assess Alternative Sources***

- The project proponent should identify and assess according to table 1 the technical feasibility of alternative nonsaline water sources. This should include assessing water conservation options and the potential for combined water use.
- The economic viability of the options should be included for at least two options where the application is for high-quality nonsaline water, recognizing that an economic evaluation is not required where no practical alternative water sources have been identified.

***Step 5 – Reassess Preferred Water Source***

- Based on the evaluation of alternative sources, the project proponent should reassess the preferred water source. Consideration should be given to all practical and economically viable alternatives.
- This reassessment includes a rationalization of why the preferred water source is the best option, particularly where the preferred water source is high-quality nonsaline water.
- In water-short areas and where no feasible alternatives exist, consideration should be given to delaying the project until new technology or alternative water sources become available. In situations such as these, one of the options evaluated should include not proceeding with the project.

***Step 6 – Standard Application Assessment***

- Include all the other information required under applicable legislation and guidance documents. Applications should be prepared using, at a minimum, the *Alberta Environment and Protected Areas Guide to Groundwater Authorization* and the *Surface Water Allocation Directive*, as appropriate, as points of reference.
- The application submission requirements include an assessment of the availability of the nonsaline water and the potential impacts of the proposed water use.
- The application should include an evaluation of impacts on the aquatic environment, local existing water supplies, other water users, and water management.

- The Aboriginal Consultation Office (ACO) assesses consultation on specified enactments, including the *Water Act*. Contact the ACO to obtain a preconsultation assessment for land or natural resource management decisions that may have the potential to adversely impact First Nations' treaty rights or traditional uses or may adversely impact Métis settlement members' harvesting or traditional use activities.

***Step 7 – Water Act Licence Application Submission***

- An application for a *Water Act* licence is to be submitted where nonsaline water sources are requested and a licence is required. (Not all alternative nonsaline water sources require a *Water Act* licence. Appendix 1 identifies which water sources require licences.)
- A licence application is required for both new and renewal applications of a term licence as well as amendments for a change of purpose for water use that is covered under the scope of this manual (see section 1.1).
- The application should include the following:
  - An application form with project and licensee information.
  - A description of the project and water use anticipated throughout the project life. This should include the anticipated high-quality nonsaline water use intensity compared to the relevant aggregated industry performance as shown in the Water Use Performance report. Renewal applications should also compare the actual high-quality nonsaline water use intensity compared to the relevant aggregated industry performance.
  - Based on the application risk tier, a technical assessment of the feasibility of alternative nonsaline water and alternatives to nonsaline water.
  - Based on the application risk tier, a review of alternate water source availability and progress towards reduction of the use of high-quality nonsaline water.
  - Based on the application risk tier, an economic assessment identifying the economic viability of the options.
  - Based on the application risk tier, the environmental net effects assessment of the alternative water source options to compare the potential environmental impacts of the options compared to that of using high-quality nonsaline water.
  - As per step 6, a report describing the proposed nonsaline water source, the natural variability and supply constraints of the source. This report should also include an evaluation of impacts to other users and the aquatic environment.
  - Based on the application risk tier, an evaluation of the cumulative effects of the high-quality nonsaline water diversion and mitigation plans consistent with the scale of the project.

The complete application should be submitted to EPEA.WA.Applications@aer.ca.

# 3 Application Content

This section describes in greater detail the application content requested in table 1.

## 3.1 Alternative Source Assessments

Applicants are expected to identify and assess alternative water sources and non-water technologies. Information related to these alternatives should be included in each application for a water licence using a high-quality nonsaline water source. In addition to providing the minimum amount of application information outlined below, all projects should evaluate water source options and maximize water recycling/reuse opportunities and minimize water disposal whenever practical.

### 3.1.1 Confirmation Level

At a minimum, the applicant should do the following:

- Identify potential alternative water sources within the minimum search radius of the appropriate risk tier (see table 1). Identification of potential water sources may include a review of published or otherwise pre-existing information. For alternative water sources, the radius is centred from the point of use or the approximate centre of the area of use.
- Assess the operational suitability of these alternative water sources, considering at least the following:
  - water availability (e.g., quantity, rate)
  - reliability (e.g., seasonality, off-stream storage need)
  - accessibility (e.g., permissions needed for access, transfer between major river basins [see section 47 of the *Water Act*], logistics, conveyance, new or existing infrastructure, potential for increasing/decreasing water need over the duration of the project)
- The assessment does not need to be included in the application, but the applicant should assert that other alternative nonsaline water sources were assessed. The assessment may be requested as part of the licence application review.

Alternative sources should not be discounted solely on the basis that they may not provide the entire water needs of the project; instead, applicants should consider supplemental water sources or combined use.

### 3.1.2 Screening Level

At a minimum, the applicant should do the following, in addition to everything listed in a confirmation-level assessment:

- The assessment should be more thorough, including the review of well logs for potential groundwater sources.
- Include in the application information on at least two of the most operationally feasible alternatives identified. This information should identify the sources, how each one was assessed, and provide the rationale for why those alternatives were discounted in favour of the preferred source.

Note that the economic feasibility of a project (see section 3.4) is not a factor in determining the technical feasibility of the water source.

### 3.1.3 Detailed Level

At a minimum, the applicant should do the following, in addition to everything listed in a screening-level assessment:

- Include in the application information on *all* operationally feasible alternatives identified.
- Describe the broader project-level water management plan, including at least the following:
  - how you will try to reduce reliance on high-quality nonsaline water, including combined use
  - how the high-quality nonsaline water use intensity of the project can be improved over time
  - how you will collaborate with other water users in efforts to reduce overall reliance on high-quality nonsaline water
  - potential impacts of deferring the project until alternative nonsaline water sources, lower-water-intensity technology, or off-stream water storage become available or overall pressure on the local water system is alleviated

The *Water Act* licence, if issued, may include a condition to submit an annual report of any changes to productivity, efficiency, or replacement of high-quality nonsaline water with alternative nonsaline, other alternatives to nonsaline, or non-water-based technology. A plan for water conservation and efficiency improvement should include the following:

- a description of how the licensee will reduce reliance on high-quality nonsaline water over the term of their licence by
  - improving water use efficiency or productivity,
  - combining use with alternative nonsaline or alternative water sources, or
  - other identified water conservation and efficiency measures

- water conservation and efficiency targets for the licence, including quantitative performance measures to evaluate performance and success
- a schedule for implementing the plan

## 3.2 Environmental Net Effects Assessment

A main objective of the policy is to reduce the use of high-quality nonsaline water use while recognizing that water is needed for energy development. Conservation in areas where water is relatively abundant should not come at the cost of unacceptable environmental impacts. The potential environmental impacts of alternatives on integrated water, land, air, and biodiversity outcomes, and local and regional water conservation outcomes need to be considered and weighed against potential impacts of nonsaline water use (both high quality and alternative). The environmental net effects assessment allows the applicant and the AER to assess that balance. Where the alternative source assessment demonstrates that an alternative water source is not practically feasible, no environmental net effects assessment is required.

An environmental net effects assessment includes answers to the following questions. Additional quantitative data may be required depending on the assessment level. Even if not included in the application (see section 3.2.1), the assessment and corresponding data and rationale should be documented and retained. The assessment may be requested during application review, and retention may be required by licence conditions, if granted.

- Will the use of alternative water sources/technology result in a greater environmental impact?
- Will the use of alternatives result in additional energy expenditure?
- Will there be additional emissions (e.g., $NO_2$, $SO_2$, PM2.5, $H_2S$)?
- Will there be additional greenhouse gas emissions (e.g., $CO_2e$)?
- Will there be additional waste disposal requiring landfill capacity?
- Will there be additional liquid waste requiring disposal well capacity?
- Will the project require additional land clearing of agricultural, wetlands, forested areas?
- Will there be additional habitat disturbance?
- Will there be a disturbance to any sensitive species?
- Will there be disturbance of cultural or historical resources?
- Is the alternative water hazardous (e.g., $H_2S$, corrosive)?
- Will the alternative create additional concerns (e.g., traffic, noise, dust) on area users, local residents, and Indigenous communities?

- Have you identified social or cultural impacts that are informed through engagement with Indigenous peoples, including information gained through the sharing of Indigenous knowledge?
- Will using alternative water supply increase the probability of a hazardous spill to the environment?
- Will using alternative water increase the amount of pollutants emitted per unit of product produced?
- Is there an increase in long-term environmental risk or liabilities (e.g., increased tailings pond salinity, long-term leaching from landfills)?
- How will the use of alternatives affect overall project efficiency and productivity?

### 3.2.1 Confirmation Level

The applicant should do the following:

- Assess the net effects of the selected alternative nonsaline source, as described above.
- The assessment does not need to be included in the application, but the applicant should confirm in that application that the assessment was performed. The assessment may be requested as part of the licence application review or, if a *Water Act* licence is issued, the applicant will be required to maintain records of their assessment for the duration of the licence and provide those records to the AER upon request.

### 3.2.2 Qualitative Level

The applicant should do the following, in addition to everything listed in a confirmation-level assessment:

- Include in the application the assessment of the selected source and those alternatives evaluated in the corresponding alternative source assessment. This should include a table with yes/no answers for each question. Quantitative data is not required.
- Provide a clear rationale for choosing the preferred source.

### 3.2.3 Screening Level

The applicant should do the following, in addition to everything listed in a qualitative-level assessment:

- The assessment should include quantitative data supporting the yes/no answers, including any assumptions and relative comparisons (e.g., 2× or 10× $CO_2$ equivalent emissions, 2× waste created, etc.).
- Identify any variables that make a material difference in the assessment.

### 3.2.4 Detailed Level

The applicant should do the following, in addition to everything listed in a screening-level assessment:

- As part of the broader project-level water management plan (see section 3.1.3), describe the following:
  - how effectiveness of the selected source will be assessed and reported for actual (realized) benefit and minimization of impact compared to the submitted assessment (e.g., air, nuisance, complaints, number of trucks)
  - how the assessment of potential alternative sources and technologies will continue to be evaluated and updated on an ongoing basis in comparison to the selected source (possibly leading to moving away from high-quality nonsaline water as the project proceeds)

The *Water Act* licence, if issued, may include a condition to submit an annual report of any changes to productivity, efficiency, or replacement of high-quality nonsaline water with alternative nonsaline or other alternatives to nonsaline, or non-water-based technology.

## 3.3 Cumulative Effects

This manual focuses on the impacts of only surface water and groundwater diversions on the aquatic environment and other water users. The term “cumulative effects” here refers to the combined effects of the proposed high-quality nonsaline water use and the water use from all current and anticipated future diversions. This includes household use, Indigenous community use, municipal use, agriculture use, and the ecological needs of the aquatic environment. This evaluation should consider groundwater–surface water interactions, seasonal and interannual variation, and all water users and diversion types including reasonably anticipated future industrial and non-industrial water use. This information may be obtained from publicly available sources and through engagement with municipal and Indigenous communities.

The evaluation should determine the cumulative effects within the geographical area where the water diversion is proposed. The exact area depends on the scale of the diversion, other current and future water diversions in the area, and groundwater–surface water interactions of that and the other project diversions in the area. The analysis can conservatively assume that all groundwater sources share connection and actively contribute to the relevant subwatershed unless they have been determined (based on sound hydrogeology principles) not to be significant contributors to surface water or the aquatic environment.

The cumulative effects assessment should include at least the following:

- The rationale for the geographic area being assessed and timeframe considered.
- A description of the water sources within the geographic area for flowing and nonflowing water bodies, groundwater, and wetlands.

- A description of the hydrologic conditions and restrictions, including historic flows and variability, seasonal flow variation, instream flow needs, and water conservation objectives.
- A listing of the different uses, including licensed, statutory, and nonlicensed, including recreational (e.g., boating), habitat (e.g., wetlands), and the water source potentially impacted by the proposed diversion and use trends.
- A quantitative evaluation and description of the impacts resulting from or caused by the proposed diversion and cumulative impacts caused by the proposed diversion, other existing diversions, pre-existing conditions, and future proposed projects as known.
- Identify mitigation options where the resource is currently stressed (e.g., the point of diversion is in a water-short or potentially water-short area) and the proposed diversion increases the impact on the aquatic environment or high-quality nonsaline water resources. All relevant reasonable mitigation measures should be identified, including monitoring of the aquatic environment and engaging Indigenous communities and other users to identify water supply issues or limitations.

This manual does not prescribe a precise methodology for determining the scope and extent of a cumulative effects analysis. The applicant should determine the methods and analysis required based on the size and specifics of the proposed diversion, the water type, the location of the proposed diversion, whether it is currently identified as being water-short or potentially water-short, and its potential to affect water resources, other water users, and the aquatic environment.

For proposed projects that require an environmental impact assessment (Part 2, Division 1, of the *Environmental Protection and Enhancement Act*), a decision on issuing the *Water Act* licence will not be made if the AER believes that the environmental assessment process is applicable and has not been completed. The process of evaluating environmental impact assessments is separate from the process described in this manual.

## 3.4 Economic Evaluation

The policy requires the applicant to identify whether an alternative water source is economically feasible for their project. It is not a cost comparison between options, as surface water is often the lowest cost, but provides an assessment of whether the proponent can use an alternative source and still have an economically viable project. The economic evaluation should be sufficiently detailed, defensible, and auditable and completed by a member of APEGA familiar with economic analysis or by an accredited accounting professional. Where the alternative source assessment demonstrates that an alternative water source is not practically feasible, no economic evaluation is required.

### 3.4.1 Screening Level

The screening-level evaluation should enable a general comparison of capital and operating costs and water conservation for the alternatives considered. It should be completed on at least two feasible water alternatives and include at least the following:

- evaluation and exploration costs (including field testing, surveys, and conveyance)
- capital costs
- annual operation and maintenance costs

Capital, operation, and maintenance costs should be based on a “Class 5” cost estimate (see *AACE International Recommended Practice No. 18R-97: Cost Estimate Classification System – As Applied in Engineering, Procurement, and Construction for the Process Industries*). It is not required that the standard be used as the basis for developing the cost estimate provided that the accuracy and assumptions are specified. Other similar cost estimation methodologies are also acceptable. It should also include an assessment of the incremental resource productivity as a result of the water use. The productivity assessment should include at least the following:

- overall water volume needed throughout the project life by category (i.e., high-quality nonsaline, alternative nonsaline, alternative to nonsaline)
- overall hydrocarbon reserves (proven and probable) and the incremental production resulting from the project
- duration of water use
- estimation of the nonsaline water use intensity (i.e., ratio of high-quality nonsaline water use to hydrocarbon production, see the Water Use Performance report for details)

The evaluation should begin with a summary table following the template given in table 2.

**Table 2. Economic evaluation summary table template**

| Technical Alternative | Economic Information | | Environmental Information |
|---|---|---|---|
| | Capital Costs | Annual Operating Expense | |
| Alternative 1 | $XXXX | $YYYY | ABC |
| Alternative 2 | $XXXX | $YYYY | ABC |
| Alternative 3 | $XXXX | $YYYY | ABC |

### 3.4.2 Detailed Level

A detailed-level evaluation should include everything listed in a screening-level evaluation plus the following:

- an evaluation of the pre-tax net present value (NPV)
- commodity price forecast

- information to support calculation of the remaining reserves and to establish the production forecasts
- detailed breakdown of capital and annual operation and maintenance costs for each alternative at a “Class 3” level (also known as the preliminary cost estimate or budget level cost estimate)
- long-term inflation rate used
- discount rate used
- incremental revenue, minus royalties, for oil and gas that would otherwise not be recovered if the high-quality nonsaline water source was not used
- the net present value of the proposed energy project over its life for each feasible alternative

The evaluation of the costs for each alternative should include the cost of water conservation, contingencies, and combined water use (for alternative nonsaline water and other alternatives to nonsaline).

The economic evaluation as a whole should demonstrate the balance between the economic costs and the benefits of water conservation. The proponent should do everything feasible to demonstrate that the applied-for option is the “best” option overall, which does necessarily mean the lowest cost option. “Best” refers to the optimum balance between water conservation, costs, and environmental net effects given that the water diversion does not have significant impacts to existing water users, the environment or water management.

Under section 15(4) of the *Water (Ministerial) Regulation*, an applicant may request that certain information be kept confidential. Matters of confidentiality and disclosure should be determined and addressed *before* submitting the application. Please contact the AER if a request for confidentiality will be made.

# Appendix 1 Water Types and AER Regulatory Authorization Frameworks

Not all water types or alternatives require a water licence under the *Water Act*, although other regulatory processes may exist. A listing of the potential water sources is included in table 3.

**Table 3. Water types and associated regulatory regime**

| Water type | WCP category | *Water Act* licence required? | Other regulatory process | Additional guidance |
|---|---|---|---|---|
| Non-water options | Non-water | No | Experimental or commercial scheme approval applications under the *OGCA* or *OSCA* | |
| Produced water or flowback water from another project | Other | No | | Contact the AER |
| Saline groundwater | Other | No | *Directive 056* | |
| Landfill Leachate | Other | No | | Contact the AER |
| Other wastewater sent to disposal wells | Other | No | | Contact the AER |
| Municipal or industrial wastewater returned to environment | ANS* | No | *EPEA* authorization, letter of authorization from water supplier and receiver | *Interim Guidance to Authorize Reuse of Municipal and Industrial Wastewater* |
| Oil sands process-affected (tailings) water from a mine | ANS | No | *EPEA* authorization, letter of authorization from water supplier and receiver | *Interim Guidance to Authorize Reuse of Municipal and Industrial Wastewater* |
| Industrial runoff from non-water-short area | ANS | Yes† | | |
| Runoff in contact with bitumen from an oil sands mine | ANS | Yes | | |
| Nonsaline groundwater in contact with bitumen | ANS | Yes | *Directive 056* | *Alberta Environment and Protected Areas Guide to Groundwater Authorization* |
| Nonsaline groundwater naturally containing hydrocarbons (excluding methane) | ANS | Yes | *Directive 056*, if zone bears hydrocarbons | *Alberta Environment and Protected Areas Guide to Groundwater Authorization* |
| Contaminated groundwater | ANS | Yes | | *Alberta Environment and Protected Areas Guide to Groundwater Authorization* |
| Other alternative nonsaline groundwater | ANS | Yes | *Directive 056* | *Alberta Environment and Protected Areas Guide to Groundwater Authorization* |
| High-quality surface water from natural water bodies | HQNS | Yes | | *Surface Water Allocation Directive* |

| Water type | WCP category | *Water Act* licence required? | Other regulatory process | Additional guidance |
|---|---|---|---|---|
| High-quality surface water from anthropogenic water bodies | HQNS | Yes† | | *Surface Water Allocation Directive* |
| High-quality nonsaline groundwater | HQNS | Yes | *Directive 056*, if depth >150 m | *Alberta Environment and Protected Areas Guide to Groundwater Authorization* |

* ANS = alternative nonsaline; HQNS = high-quality nonsaline

† As per the *Water (Ministerial) Regulation*, stormwater diversions of less than 6250 cubic metres per year may be exempt from requiring a *Water Act* licence.

# Appendix 2 Assessment of Locally Constrained Watersheds

The terms "water short" and "locally constrained" define parts of Alberta where water availability is a crucial factor in the evaluation of applications to use high-quality nonsaline water. Areas that are identified as being water-short or locally constrained have increased application submission requirements and higher expectations for conservation.

Locally constrained areas are relatively small areas that are showing early indications that sufficient water may not always be available to satisfy the needs of the environment and other users. Locally constrained areas may experience fluctuations in water demand and are intended to be responsive to short-term (i.e., annual or biannual) changes in water allocations and are, therefore, updated regularly by the AER. The analysis takes into consideration water allocation of all sectors, including temporary diversion licences.

## Groundwater

An area is designated as locally constrained if it is neither water short nor potentially water short and the allocation of high-quality nonsaline groundwater exceeds 10% of the availability. Groundwater availability is based on the average volume of recharge for each HUC 8, which is equivalent to

- the safe yield defined in *OFR 2017-07: First-Order Groundwater Availability Assessments for Central Alberta*,
- the mean of the high and low values for maximum sustained yield defined in *OFR 2018-09: First-Order Groundwater Availability Assessment for Southern Alberta*, and
- the maximum sustained yield defined in *OFR 2019-10: First-Order Groundwater Availability Assessment for the Upper Peace Region*, *OFR 2020-05: First-Order Groundwater Availability Assessment for the Lower Athabasca Region*, and *DIG 2021-0010: Groundwater Yield Continuum for the Cold Lake–Beaver River Basin (GIS data, polygon features)*.

Where overlap occurs between the central and southern Alberta study areas, the results of *OFR 2018-09* were used.

Groundwater availability, as described above, is based on a regional water balance concept. Assuming the natural groundwater system is in a long-term equilibrium, groundwater discharge equals the amount of recharge. When groundwater is withdrawn by pumping, it must be balanced by a decrease in storage, a decrease in discharge, an increase in recharge, or a combination of these. In the simplest case of a closed basin and a long timeframe, withdrawing groundwater at the rate of recharge will eventually result in the elimination of discharge (e.g., baseflow to rivers and lakes, discharge to wetlands, and evapotranspiration by plants). Although the response of the groundwater system to pumping can be complex, comparing recharge to total groundwater withdrawals captures the relative importance of these withdrawals on the regional water balance.

Since withdrawing groundwater equal to or greater than the rate of recharge can have extreme long-term consequences, only a fraction of the available groundwater can be allocated in order to ensure that surface water sources have sufficient year-round supply to meet the needs of the environment and other users. This is called the permissive sustained yield in *OFR 2018-09*.

Gleeson and Richter (2018, doi:10.1002/rra.3185) present a presumptive standard for permissive sustained yield based on case studies that groundwater pumping reduces baseflow by no more than 10%. Therefore, in the absence of detailed groundwater-surface water modelling, we have adopted this presumptive standard across Alberta to designate a HUC 8 as locally constrained when the allocated groundwater volume reaches 10% of the recharge.

As an example, the 10% level was tested with an integrated surface water–groundwater model previously developed for an area in west-central Alberta. The model simulates overland flow, streamflow, unsaturated and saturated groundwater flow, and interactions between the groundwater and surface water (e.g., discharge of groundwater to streams as baseflow, and recharge of groundwater from streams). Groundwater pumping occurs from both licensed industrial and unlicensed domestic water wells. The calibrated model simulates hydrological conditions for 27 years under several different scenarios:

1) No groundwater pumping (base case).
2) Groundwater pumping from locations of currently active licensed water wells. Each well withdraws water according to its licensed allocation, which is a maximum value. Often these wells would be pumped less than their licensed allocated amount. The total pumped volume equals 4% of the maximum sustained yield (i.e., recharge) from *OFR 2019-10*.
3) Groundwater pumping from locations of currently active licensed water wells, with a total pumped volume equal to 10% of the maximum sustained yield from *OFR 2019-10*.
4) Groundwater pumping from locations of currently active licensed wells and a projection of future wells. The total pumped volume is equal to 10% of the maximum sustained yield from *OFR 2019-10*.
5) Groundwater withdrawals from locations of currently active licensed wells and a projection of future wells. The total pumped volume is equal to 20% of the maximum sustained yield from *OFR 2019-10*.

The model results show that over the 27-year period, groundwater pumping at rate of 20% of the maximum sustained yield (scenario 5) reduces baseflow to streams by an undesirable amount and over a large area. Baseflow is affected in higher-order streams by up to 10% and in lower-order streams by up to 25% compared to the base case with no groundwater pumping.

When groundwater pumping occurs at current licensed allocation rates (scenario 2), the model results show there are localized effects on lower-order streams during dry years or in some winters, with baseflow reductions of up to 5–10% compared to the base case.

When groundwater pumping occurs at 10% of the maximum sustained yield (scenarios 3 and 4), the model results show that while there are still some effects on lower-order streams, there is little effect on higher-order streams. The effects of pumping also stabilize within the 27-year time period.

The modelling results show that exceeding the 10% limit of Gleeson and Richter (2018) can cause widespread negative impact to surface water and is therefore a reasonable level for considering an area as locally constrained.

## Surface Water

An area is designated as locally constrained if it is neither water short nor potentially water short and the main stem net allocation is 3% or more of the median annual flow. How that 3% level was determined is the subject of this section.

The analysis considers seasonal variation of the water supply and represents a volume considered to be fully protective of the environment and other water users. The goal is to ensure that the water sources within a locally constrained HUC8 have sufficient year-round supply. In some cases, a comprehensive local or subwatershed scale analysis may indicate that the preferred high-quality nonsaline water source is not as significantly stressed as in the surrounding area, and the need to conserve may not be as high.

A determination of "locally constrained" is made at the HUC 8 scale. The determination depends on how much water is available to satisfy environmental needs and human or licensed demands. Based on the *Surface Water Allocation Directive* (*SWAD*), an annual licence demand of 12% of the mean annual discharge is considered to be an acceptable low risk. While the *SWAD* has an overall trigger or threshold of 12% it also has instantaneous cumulative limits based on the size of the stream that help to further protect the aquatic ecosystem of rivers, creeks, and lakes. The 12% upper limit identified within the *SWAD* is suitable to define a locally constrained watershed. While this is appropriate for the annual average and correct for the overall purpose of the *SWAD*, the potential use of 12% to describe a locally constrained watershed under the WCP may not be sufficient, particularly in consideration of the natural pattern of lower flows occurring in the winter. Knowing the annual upper limit of 12% based on the *SWAD*, another potential trigger was adopted to help identify a locally constrained watershed that may experience a potential impact due to allocation at any time during the year, in particular during the winter low-flow period.

The analysis uses the following data:

- Hydrometric data with natural flows to determine the per cent contribution of winter flows compared to the overall year.
- Licensed allocation data broken up by year and by purpose to try to estimate the potential licence demand during the winter period compared to the overall year.

Before analyzing the above data, an analysis based on professional judgement was conducted to provide a meaningful range of potential triggers. This analysis was completed by setting the following parameters:

- The expected winter demand as a percentage of the annual total demand. Five demand profiles of winter percentage demand were evaluated. Two of the profiles placed the winter demand higher than 50% of the overall demand, while the other two placed the winter demand lower than 50%. The last demand profile placed the winter percentage at exactly 50%. Table 4 below contains the winter demands tested with this analysis.
- Water availability during the winter period compared to the rest of the year. Table 4 contains the two different scenarios with respect to how much water is contributed to the overall annual volume during the winter period.

**Table 4. Demand and water availability percentages used in this analysis**

| **Demand Curve Scenario** | **Demand Profile 1** | **Demand Profile 2** | **Demand Profile 3** | **Demand Profile 4** | **Demand Profile 5** |
|---|---|---|---|---|---|
| Percentage Winter Demand | 30% | 40% | 50% | 60% | 75% |
| **Water Availability Scenario** | **Supply 1** | **Supply 2** | | | |
| Percentage Winter Availability | 5% | 12% | | | |

A total of ten permutations were conducted with the above data. Below is an example of the computations for a winter demand equal to 40%, combined with the two supply scenarios of 5% and 12% (see table 5). For each annual supply/demand combination, the winter percentage was computed based on the demand profile and each individual supply scenarios. The overall objective of this analysis was to determine at what percentage of the annual demand to annual supply the winter demand to winter supply reaches close to 12%.

**Table 5. Annual average flows calculation using a winter demand profile of 40%**

| **%annual demand to annual supply:** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** |
|---|---|---|---|---|---|---|---|---|---|
| winter (demand based on 40% demand profile) | 0.4 | 0.8 | 1.2 | 1.6 | 2 | 2.4 | 2.8 | 3.2 | 3.6 |
| supply 1 – %allocation – seasonal (smaller/sensitive system) | | | | | | | | | |
| Winter demand to winter supply | 8% | 16% | 24% | 32% | 40% | 48% | 56% | 64% | 72% |
| Annual demand to annual supply | 1% | 2% | 3% | 4% | 5% | 6% | 7% | 8% | 9% |
| supply 2 – % allocation – seasonal (larger/more tolerant system) | | | | | | | | | |
| Winter demand to winter supply | 3% | 7% | 10% | 13% | 17% | 20% | 23% | 27% | 30% |

| %annual demand to annual supply: | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|
| Annual demand to annual supply | 1% | 2% | 3% | 4% | 5% | 6% | 7% | 8% | 9% |

Based on the above table and when using the winter supply scenario of 5% (for what is considered a small/sensitive system), the maximum annual level that approaches 12% during the winter period is about 1% of annual allocation to annual supply. This means that the annual trigger to set a locally constrained watershed should be about 1% in order to be protective of the environment during winter low flows. This level increases accordingly for larger and more tolerant systems. Table 6 summarizes the results of this analysis.

**Table 6. Annual allocation to annual supply percentage to ensure winter demand to winter supply is about 12%**

| | Demand Profile 1 | Demand Profile 2 | Demand Profile 3 | Demand Profile 4 | Demand Profile 5 |
|---|---|---|---|---|---|
| **Supply 1 – 5% winter flow availability** | 2% | 1% | 1% | 1% | 1% |
| **Supply 2 – 12% winter flow availability** | 5% | 4% | 3% | 2% | 1% |

While this analysis provides a range between 1% to about 5%, it does not provide a definite conclusion as to what should the supply and demand difference be set at. Based on conservative environmental protection considerations. Demand profile 2 provides an average of about 2.5% based on the two supply scenarios used.

### Hydrometric Gauge Analysis for Locally Constrained Watersheds

Hydrometric gauge data was analyzed to further validate and compare appropriate levels for locally constrained areas. The following criteria were taken into consideration:

- The hydrometric gauge has to have sufficient winter flow data to allow the computation of a winter weekly median flow for each of the 52 weeks in a year.
- The winter period was set to start on week 44 to week 52 and from week 1 to week 13 or approximately from November 1 to March 31.
- The hydrometric gauge data has to contain natural or near-natural flow data, meaning there is no major regulation (e.g., a dam and reservoir) affecting the recorded data. Any gauge involving regulated flows was not included into the analysis.
- As previously mentioned, the analysis was completed on a weekly timestep, where daily hydrometric gauge data was used to compute the weekly median flow for each of the 52 weeks in the year.

The analysis of the hydrometric gauges show that the winter contribution varies between 1% to about 35%, with a median of about 11%. From the statistics, the winter contribution percentage varies between 6% to 17% within one standard deviation of the distribution. For this analysis the median winter percentage was taken as representative of the hydrometric analysis. For additional comparison, an 8% winter contribution was used. This is less than 80% of all the hydrometric stations used in the analysis.

Table 7 contains the use of the 11% and 8% winter contribution as per the hydrometric gauge analysis, together with the winter demand profiles identified in table 4.

**Table 7. Annual allocation to annual supply percentage that approaches 12% winter demand to winter supply**

| Winter availability | Winter demand | | | | |
|---|---|---|---|---|---|
| | **30%** | **40%** | **50%** | **60%** | **75%** |
| **8%** | 3.3 | 2.4 | 1.9 | 1.6 | 1.3 |
| **11%** | 4.3 | 3.3 | 2.6 | 2.2 | 1.7 |

The results in table 7 are very similar to the overall results obtained under the initial analysis based on professional judgement; this is mainly because the use of 11% for this analysis is very close to scenario 2 of 12% of winter supply (see table 4 and table 6). The use of 8% is greater than the supply scenario 1 of 5% in the initial analysis above. As a result, for the 30% winter demand, the annual trigger in table 7 is about 1.3% higher than what is shown in table 6. Overall, the results compare consistently with the range of triggers obtained in the above professional-judgement-based analysis; however, going with winter contribution of 11% and a winter demand of 50% the overall trigger is about 2.6%.

### Allocation Demand Analysis for Locally Constrained Watersheds

A third analysis focused on the allocation data, meaning all *Water Act* licences including all temporary diversion licences (TDLs) in order to further validate and refine the trigger values. The analysis used the following parameters:

- The analysis was completed on an annual basis, taking into consideration only those licences that were active during the year in question.
- Licences were categorized by whether they would or would not potentially divert water during the winter period. For example, an irrigation licence would not divert during the winter period, while a municipality might.
- For every year the winter period was set from November 1 to March 31.
- Once the licence was determined if it had the potential to divert in the winter, the number of days that it would divert during the winter period was calculated. This was based on the calendar year in question and the number of days the licence was active in the year.
- For each licence, the gross and net allocation were computed. The net allocation was computed by subtracting the expected daily return (if any) from the daily allocation.
- The overall allocation was first computed in a daily form: dividing the allocation by the number of days the licence was active during the calendar year in question. The daily allocation was then

multiplied by the number of days in the winter period or the overall number of days during the calendar year.

- Each licence was tagged by a HUC8 code based on the geospatial location of the licence.
- The analysis was conducted for licences that were active in 2014, 2015, 2016, 2017, 2018, and 2019.

Table 8 contains overall results of the licence allocation analysis together with a series of water supply scenarios. The results in table 8 are similar to those presented in table 6 and table 7 of the previous two analyses.

**Table 8. Annual demand to annual supply percentage that results in a winter demand to winter supply of about 12%**

| Winter availability as percentage of annual total | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 |
|---|---|---|---|---|---|---|
| **5** | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 |
| **8** | 1.9 | 1.9 | 1.9 | 1.9 | 1.9 | 1.9 |
| **11** | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.7 |
| **15** | 3.5 | 3.5 | 3.5 | 3.6 | 3.6 | 3.7 |
| **20** | 4.6 | 4.7 | 4.7 | 4.8 | 4.8 | 4.9 |

Year after year the change in percentage is minimal; for example, at 20% winter availability, the change in percentage between 2014 to 2019 is only about 0.3 percentage points. The overall range of triggers of this analysis are in consistent placing an overall trigger between 1 to 5% depending on the water supply scenario. Therefore, using the results from the hydrometric gauge analysis, which showed that the median winter availability is about 11%, the overall annual trigger should be about 2.7%.

Based on the above analysis, a 3% annual allocation level was selected as a reasonable way to protect winter low flows. The 3% level is aligned with the *SWAD.*