BC Oil & Gas COMMISSION

Northeast Water Tool

User Guide

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Preface

About

The Northeast Water Tool (NEWT) was developed for the BC Oil and Gas Commission (Commission) by Foundry Spatial Ltd. NEWT is a modular application that provides access to water-related data and knowledge in support of sustainable resource management. Users can generate reports describing the hydrology of over 400,000 watersheds in the region. These reports also include information on existing water users in the watershed and other watershed characteristics such as hydrological variability, land cover, climate, and predicted future climate change. This tool is intended to provide information in support of water allocation decisions. It is split up into three modules, which are outlined in the "Overview of Modules" section and are elaborated on in the "Reporting" section of this document. These modules are intended to support water management decisions and should not be the sole source of information considered. Additional information and data are used in the decision-making process. The information gathered using these tools (and other sources) requires careful interpretation by trained professionals, such as environmental consultants, hydrologists or water managers. Within each module, footnotes are used in the generated reports to provide references for data sources and further information.

Overview of Modules

1. *Watershed Module*

The Watershed module allows you to select a specific stream or lake and generate a detailed report based on the corresponding upstream watershed. The report summarizes the supply and demand on the chosen stream or lake and provides other physical watershed characteristics such as hydrological variability, elevation, land cover, climate, and predicted future climate change. This tool also allows you to locate existing water rights through easily identifiable markers that provide more details once clicked.

2. *Groundwater Review Assistant (GWRA) Module*

The Groundwater Review Assistant (GWRA) module allows you to define an area of interest and generate a custom report. The report will provide a comprehensive summary of groundwater knowledge for the user-defined area from multiple sources of information.

3. *Cumulative Diversion Analysis (CDA) Module*

The Cumulative Diversion Analysis (CDA) module allows you to locate, click, and generate an analysis for the desired stream or river location. The analysis will evaluate a new proposed diversion of surface water (using user-supplied information about the timing and volume of water desired) in the context of natural variability and existing senior water rights.

Module Features

The modules have similarities and differences that are distinguished by a wide range of features. Each module has a tour that, once selected, will guide the user through the functions and features outlined below:

Feature Similarities

The CDA module and Watershed module both have similar features in which all of the following coexist:

I. Sidebar

The sidebar, also commonly referred to as the navigation bar, allows you to navigate between the three modules the tool offers.

II. Map style switcher

The map style switcher allows you to switch between the default base map and the satellite map.

III. Zoom controls

The zoom controls allow you to zoom in (“+”) and out (“-”) of the map.

IV. Filters

The filters feature allows you to adjust which allocations are visible on the map. Three main kinds of filters can be applied to the map:

A. Surface and Groundwater

This filter allows you to toggle the visibility of surface water and groundwater allocations.

B. Other options

This option allows you to filter based on type, purpose, agency, and status. All these categories have subcategories with which you can specify your search.

C. Reset filters

This filter allows you to reset all filters that are applied and show all the allocations again.

V. Help button

The help button is located in the bottom left corner and once clicked, will provide a tour of how to navigate the tool features.

Feature Differences

I. Watershed Module

A. Search bar

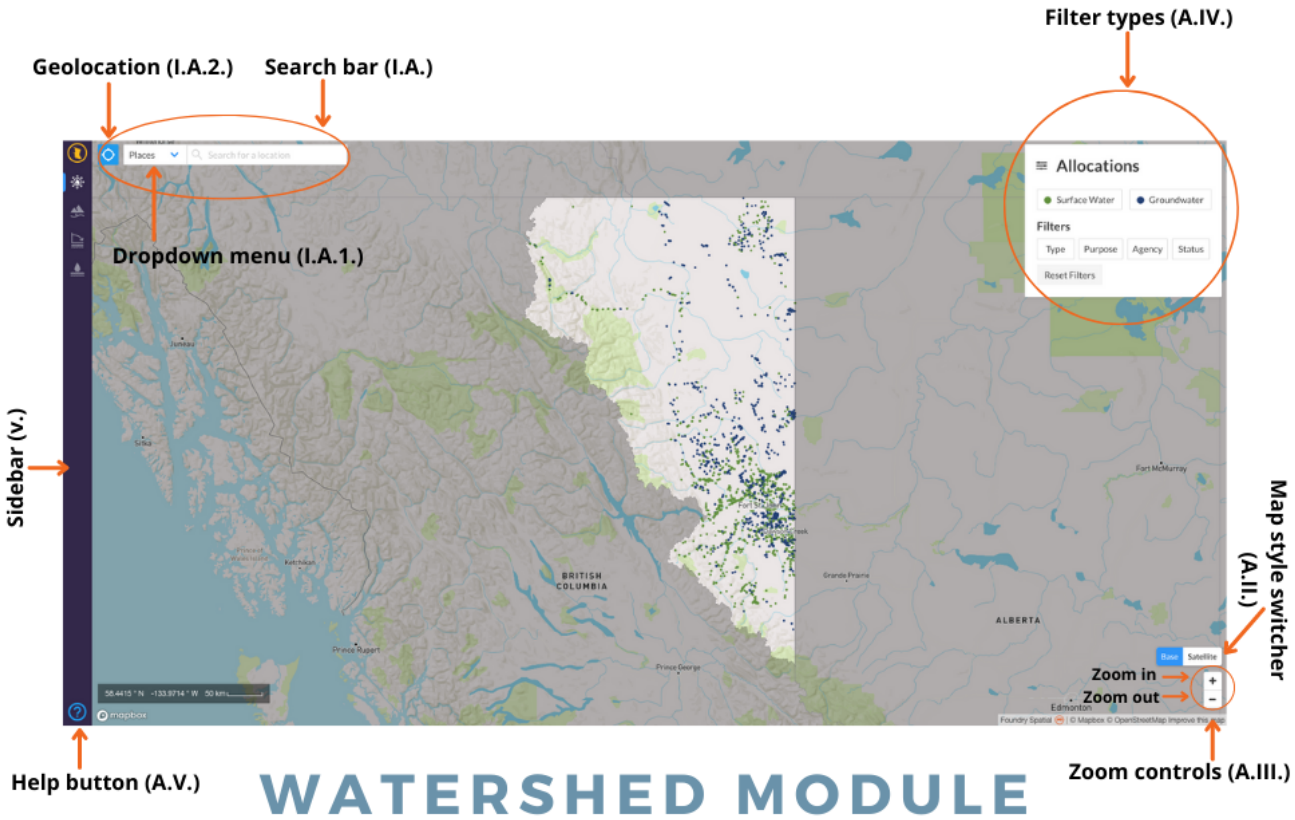
The “Search” box in the upper left allows you to search for your area of interest or named features (lakes, rivers, water licences and short-term water use licences, approval numbers, approval holders, and many others). There are two types of search bar buttons:

1. Dropdown menu

   This button allows you to choose a preferred search method, including by place name, latitude/longitude coordinates, Universal Transverse Mercator (UTM) coordinates, or Watershed Feature Id (WFI).

2. Geolocation

   This button requires you to allow your browser access to your location when prompted so that you can center the map at your given location.



II. GWRA Module

A. Search bar

1. Dropdown menu

This button allows you to choose a preferred search method, including by place name, latitude and longitude coordinates, UTM coordinates, Dominion Land Survey (DLS) grid IDs, or National Topographic System (NTS) grid IDs.

2. Geolocation

This button requires you to allow your browser access to your location when prompted so that you can center the map at your given location.

B. Selection tools

This tool allows you to select an area on the map for which you'd like to create a report. There are five kinds of selection tools from which you can choose:

1. Geometry upload tool

The upload tool allows you to upload a geometry file of the area in which you are interested. Supported file formats include Shapefile and KML.

2. Line tool

The line tool lets you draw a line along a path in which you are interested. A buffer zone will be applied around the line.

3. Polygon tool

The polygon tool lets you define the area you are interested in by drawing a shape on the map.

4. Point tool

The point tool lets you select a point location. A buffer zone will be applied around the point.

5. Delete button

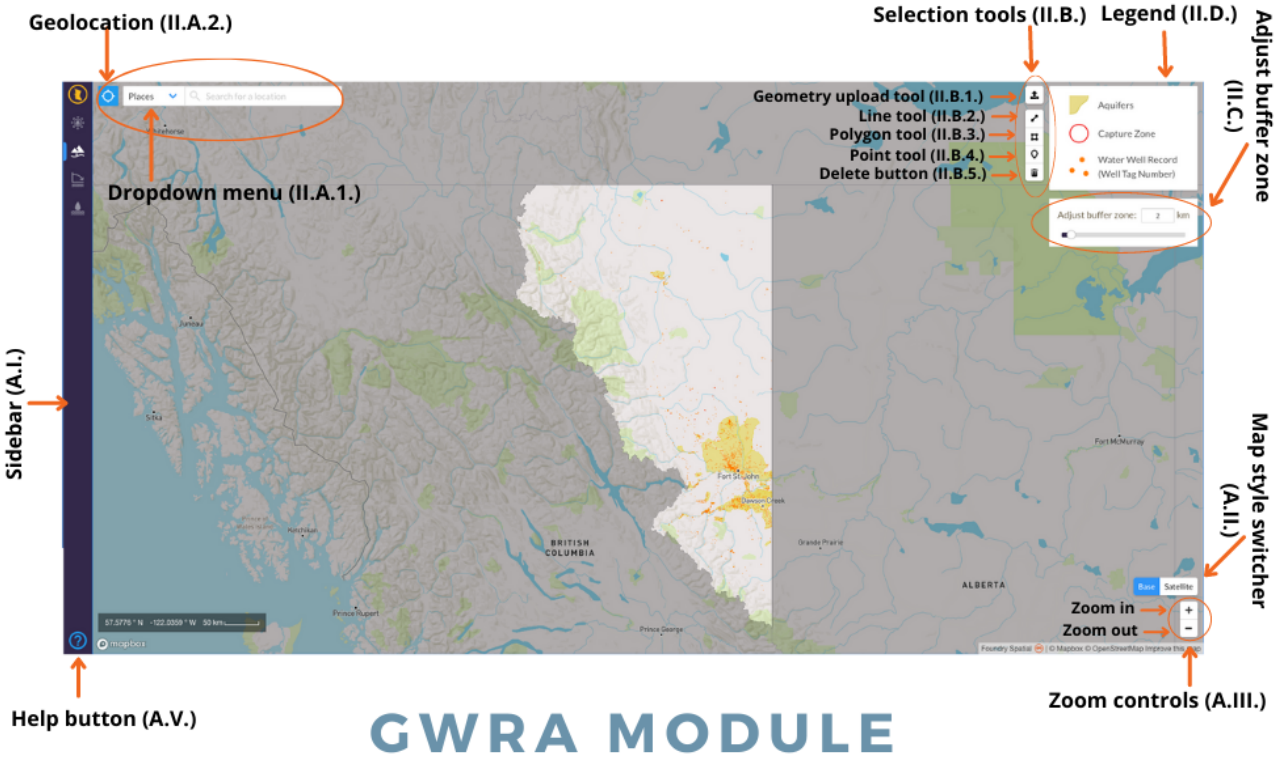
The delete button will close the current report and remove your current selected area from the map.

C. Adjust Buffer Zone

You can adjust the buffer zone that exists around point and line selections. Users can move the slider or input a numerical value to change the buffer. The buffer difference represents the radius around a point or the distance between the line and the nearest edge of the buffer. The area defined by the buffer will be used to create the report.

D. Legend

This feature allows you to identify and understand what each map symbol means.



III. CDA Module

A. Search bar

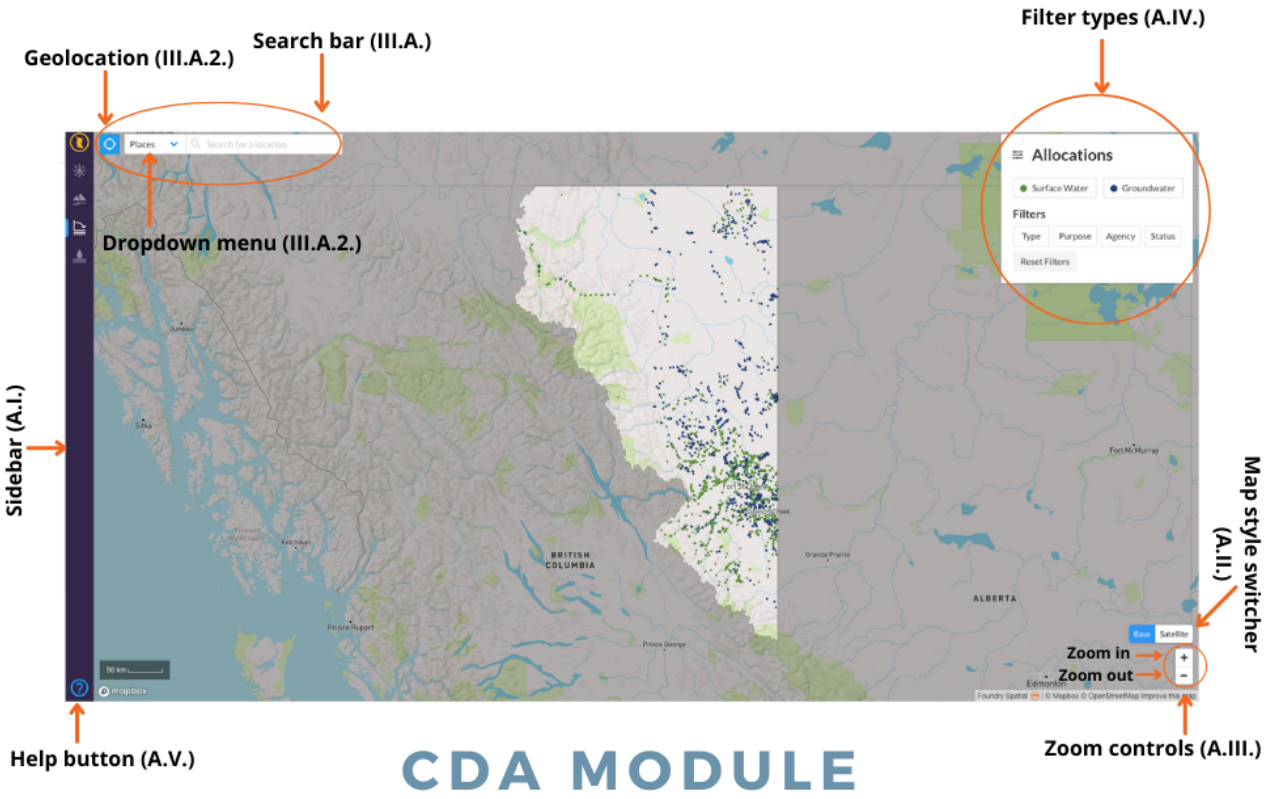
The search box in the upper left corner allows you to search for your area of interest or named features (lakes, rivers, water licences and short-term water use licences, approval numbers, approval holders, and many others). There are two types of search bar buttons:

1. Dropdown menu

   This button allows you to choose a preferred search method, including by place name, latitude/longitude coordinates, UTM coordinates, or Freshwater Atlas Fundamental WFI.

2. Geolocation

   This button requires you to allow your browser access to your location when prompted so that you can center the map at your given location.



Reporting

Generating a Report

To generate a NEWT report, you either zoom into a location using your mouse, the "+" and "-" buttons, or choose your preferred method of searching (places, UTM, WFI, or latitude and longitude coordinates) by clicking the dropdown menu on the search bar. Once at the area of interest, click on the river or lake. The selected watershed will be highlighted on the map, and the "Results" box will appear:

The "Results" box displays the following:

- Name of the body of water (if it is a named waterbody).
- The WFI of the point you selected.
- A button that reads "Show Report".
- To close the results box and make the orange watershed disappear, use the clear watershed (x) symbol located in the upper right corner of the results box.

I. Watershed Module Report

Report Content

1.1 Cover Page

Depicts a map of the watershed area upstream of the point of diversion you selected. In addition, the header box displays the following:

- The name of the water body (if it is a named water body).
- The UTM coordinates for the point you selected.
- The upstream watershed drainage area (km^2).
- The minimum, median and maximum elevations in the watershed (metres above mean sea level).
- The drainage hierarchy for the point you selected (e.g., Fontas River, Fort Nelson River, Liard River, Mackenzie River, Arctic Ocean).
- The mean annual discharge from the selected area (m^3/s).

1.2 Hydrology – Annual

The map shows the query (orange) and downstream (purple) watersheds. The table below the map provides an overview of the hydrology and existing authorized water allocations under the Water Sustainability Act within these watersheds.

1.3 Hydrology – Monthly – Query Watershed

The chart and table show information on modeled hydrology and existing allocations in the query watershed. This location is shown with an orange marker and watershed outline in the map in the section “Hydrology - Monthly”. The table includes:

- Mean Annual Discharge (MAD) and a calculation for both 20% and 10% of MAD. The discharge calculations in NEWT are based on hydrology modelling and represent a 30-year average (or “normal” discharge).
- Mean Monthly Discharge (in units of millimetres- mm, cubic metres per second - m^3/s, and cubic metres- m^3).
- % of MAD – this is monthly runoff as % of Mean Annual Discharge.
- Flow Sensitivity (based on BC Ministry of Environment *Environmental Flow Needs Policy*).
- Environmental Flow Needs (EFN) (calculated as 85%, 90%, or 95% of monthly runoff, derived from the approach in the BC Ministry of Environment *Environmental Flow Needs Policy*).
- Existing Water Licences – this is the cumulative total of all surface water long-term water licences in the watershed upstream of the query point and divided evenly over the 12 months. Licences with an irrigation water purpose were not divided equally over the 12 months, the volume was assumed to be

diverted in June (30%), July (30%), August (30%), and September (10%). Licences with a non-consumptive or 'flow-through' water purpose as well as long-term licences in an application stage were excluded from the totals.

- Existing Short-Term Approvals - this is the cumulative total of all short-term approvals in the watershed upstream of the query point and divided equally over the 12 months. Approvals with a dugout water purpose were not divided equally over the 12 months, the volume was assumed to be diverted in May (35%), June (35%), July (15%) and August (15%).
- Potential Allocation – calculated as the Potential Maximum Allocation (monthly runoff subtracting the EFN) subtracting the Existing Short- and Long-Term Allocations.
    - ➔ Notes – This will show if a water source is "winter flow limited", or if it's a lake source. Where a query point is on a lake or is from a stream that is winter flow limited, the "Remaining Potential Allocation" is depicted as "/". When a lake source is selected, it is OGC policy that cumulative winter withdrawal for December- March is limited to a maximum of 10 cm water depth related to the lake's surface area. The detail on the water availability for the winter period is shown below the table.

1.a Model Performance

The hydrology estimates are produced from a hydrology model which included 55 long-term hydrometric stations in Northeast BC, NWT, and AB. Model uncertainty is calculated using a leave-one-out cross-validation with calculated results of mean error = 5.5%, median error = 3.7%, mean absolute error = 16.1%, and modeled annual runoff within ± 20% for 77.8% of the calibration watersheds.

1.4 Hydrology – Monthly – Downstream Watershed

Same information as on query watershed monthly hydrology sections, except for the downstream watershed. The downstream watershed is defined at the mouth of the queried stream. If that downstream watershed's area is within 15% of the queried drainage area, then the watershed at the mouth of the next downstream stream is chosen as the downstream watershed.

- For the Existing Short-Term Approvals, the same rules as the query watershed apply to the downstream watershed with one addition; for non-consumptive water use licences that are in the downstream watershed but not in the query watershed, the quantities are included in the allocation estimates (whereas normally they are excluded).

1.5 Allocations by Industry

A table depicting the existing and active water allocations, regulated under the Water Sustainability Act, are summarized by water source (surface or groundwater), the term (long or short term), and type (industry grouping categories). Below the chart is a

definition of the water use purposes that make up each industry grouping category, ensuring a clear understanding of each industry is available.

1.6 Allocations

The existing allocations and active water licence applications, managed under the Water Sustainability Act, within the query basin are summarized in a table that shows the licence name, number, POD, start and end date, quantity, flag, type (surface water or groundwater, long or short term), and status. In the web report, the allocations can be filtered by source, term, and purpose. In the exported PDF report, which is not interactive, all allocations are listed, grouped in separate headings by term, type and status:

- Water Licences (Surface Water),
- Water Licences (Groundwater),
- Short Term Use Approvals (Surface Water),
- Short Term Use Approvals (Groundwater),
- Water Licence Applications (Surface Water),
- Water Licence Applications (Groundwater).

1.7 Hydrologic Variability

This section contains a map showing gauged watersheds (different colored area outlines) that are most similar to the query watershed (orange locator and area), referred to as candidate watersheds. Candidate watersheds are chosen via a generated similarity score based on a comparison of physical and environmental characteristics of gauged watersheds with hydrometric monitoring records. Below the map is a table that shows some key characteristics used in the comparison, including location coordinates, area, elevation, precipitation, precipitation as snow, and temperature. Below the table is a graph that displays the statistical distribution of flows from the top three candidate watersheds applied to the estimated mean monthly flow of the query watershed (black bar).

1.8 Land Cover and Topography

This page presents characteristics of land cover and topography for the query watershed.

1.9 Climate

This page presents historic “climate normal” conditions and predicted future changes in temperature and precipitation for the query watershed. The climate normal data represent the historical period and is based on modeling by the Climate WNA project team (UBC, University of Alberta, BC MFLNRO). The future climate data represent estimates for the 2041-2070 period. Three future climate scenarios were selected to provide a range of generally hot/dry, warm/very wet, and moderately warm/wet conditions for scenarios A, B, and C respectively.

II. Groundwater Review Assistant (GWRA) Module Report

What Is It?

Foundry Spatial developed the GWRA water tool at the request of the Commission to facilitate the retrieval of groundwater-related data in Northeast BC. The information presented is retrieved from Provincial data sources that are directly available through the BC Geographic Warehouse. In addition, the user is encouraged to research all potential sources of geological, hydrogeological, land use, or other information potentially relevant to a hydrogeological question. Hydrological expertise is recommended with respect to the interpretation of the data retrieved by this tool.

What is Presented?

In this report, you will find a summary of data that can help inform a range of potential groundwater questions. Naturally, the information is contextual and based on the area that you defined. The report describes:

- Presence and location of mapped aquifers and registered groundwater wells.
- Oil and gas wells and associated activities.
- Land use-related information.
- Other sources of data that may be relevant to groundwater management.

Both maps and tables are used to report the retrieved data. Functionality within the live report includes live links to additional information, the ability to zoom in or out of maps, and the ability to sort/filter tables. Reports can also be downloaded in PDF version which includes live links for further information. A table (CSV file format) version can also be generated for selected tables.

Selected Area of Interest

There are four different methods from which users can pick to generate a report for an area of interest: upload polygon shapefile, line with buffer, draw polygon, and point with buffer. This area selection functionality is described previously in the GWRA Module component of this document in the subsection called “Selection tools.”

Report Content

2.1 Overview and Introduction

This first section of the report includes a map of the selected area of interest. The header box displays the following:

- The selection method (“Search Type”);
- The area in km^2 (“Search Area”); and
- The minimum, mean, and maximum elevation (meters above sea level) for the area.

The introduction section provides an overview of the GWRA module and report, including a link to this guide.

2.2 Groundwater Information

2.a Aquifers

The aquifers in the selected area of interest are listed in a table, along with general information regarding their geology, productivity, vulnerability, demand, and the number of registered water wells. Only Provincially mapped aquifers will be listed, and links are provided in the table to access additional aquifer mapping information that the Province has developed. The absence of mapped aquifers in a selected area does not imply that no aquifers exist as many aquifers in BC are not mapped.

2.b Water Well Records

The registered groundwater wells in the selected area of interest are listed by their well tag number (WTN) in a table, along with information including the location coordinates and ground elevation. In addition, well information from the Provincial Groundwater Wells Database, where available, is included for: well depth, bedrock depth, depth to water, estimated yield, and lithology - clicking on the WTN links to the Provincial Groundwater Wells and Aquifers webpage for additional information.

If a water well record is for a regulated Drinking Water Supply System well or designated as a Provincial Observation Well, it is indicated in the table, with links to additional Provincial information, where available.

2.c Capture Zones

Water well capture zones may be defined for Drinking Water Supply System wells. Any mapped capture zones available from spatial data from the BC Geographic Warehouse (BCGW) that are within the selected area of interest are listed in a table (by WTN) along with the determination methodology and links to the capture zone or source area determination report, where available on the Provincial Ecological Reports Catalogue (Ecocat). As with the list of water supply wells, the WTN (i.e., for the water well associated with the mapped capture zone) links to the Provincial water well record information.

2.d Estimated Water Table Elevations

Elevations of surface water features and reported elevation of water levels from groundwater wells are interpolated within the selected area of interest to create a 2-dimensional gridded raster representation of estimated water table elevations. This approach is based on assumptions about topographically driven groundwater flow and surface water – groundwater connectivity and uniform geology. The interpretation may provide insights regarding the potential groundwater flow regime. Uncertainty in the raster generated is also related to the number of water wells with groundwater elevations and the accuracy of the water wells database.

2.e Water Allocations

Map: A map presents locations of all Water Sustainability Act water licences and short-term use approvals for groundwater and surface water within the selected area of interest. Both issued authorizations and applications are shown.

2.f Table of Water Licences and Short-Term Approvals

This table lists Water Sustainability Act water licences, short-term use approvals, and water authorization applications within the selected area of interest (i.e., those identified on the map above). Some information is summarized in the table, including the authorization number, point of diversion number, quantity, authorization type, and status. The retrieved information can be sorted and filtered on the web version of the table. Additional Provincial water licence information can be reviewed by clicking the "licence details link" for individual authorizations.

2.3 Geological Information

This section of the report summarizes geological mapping information, where it is available, for karst, sand and gravel deposits based on mapped tenure, and mapped bedrock geology. Where data is available, results are provided in tables with some specific attributes. In addition, other geological mapping information not retrieved by this tool may be available.

2.4 Land Use Information

2.g ALR and Parks

A map is generated showing areas within the selected area of interest designated as Agricultural Land Reserves (ALR) or parks and protected areas in the BCGW. The percentage of the area coverage for each category is calculated within the selected area of interest.

2.h Oil and Gas Activities

This section identifies permitted oil and gas wells and facilities, as well as some specific attribute information. A map shows the locations of the listed wells and facilities within the indicated selected area of interest. Tables provide some additional attribute information for the activities that are identified on the map. For example, the Oil and Gas Wells table within the selected area includes the Well Authorization Number for the location coordinates and elevation, well authorization grant date, and well status. Oil and gas facilities are listed by facility ID number, and the table includes facility type, facility name, and status.

III. The Cumulative Diversion Analysis (CDA) Module Report

What Is It?

The CDA tool is designed to let users understand how the variability of stream flows can impact the reliability of a given water source. In addition, this tool evaluates the potential impact of water diversions for user-selected locations.

What is Presented?

The information presented on the generated reports can be used to ensure that new water diversions and changes to current allocations (water right licences) will not affect the instream flows. Unfortunately, most streams are either poorly gauged or not gauged at all, making it difficult to manage this valuable resource effectively. Therefore, the volumetric analysis part of this tool estimates how much water is available at any given location. This volumetric analysis coupled with existing allocations can make it easier to quantify the risks associated with any water diversions proposed by potential users.

User Input Form

To interact with this tool, users need to fill in diversion information:

- Location name.
- Location identification number.
- Proposed diversion start and end time.
    - Must be within 365 days of each other.
    - This is requested in order to provide an estimate of the frequency of total flow or water supply in the given location.
- The total volume of proposed demand in cubic meters.
- Instantaneous demand in cubic meters per second.
    - This is requested in order to check against low flows during the inquired period.

Report Content

3.1 Cover Page

The header box displays the following:

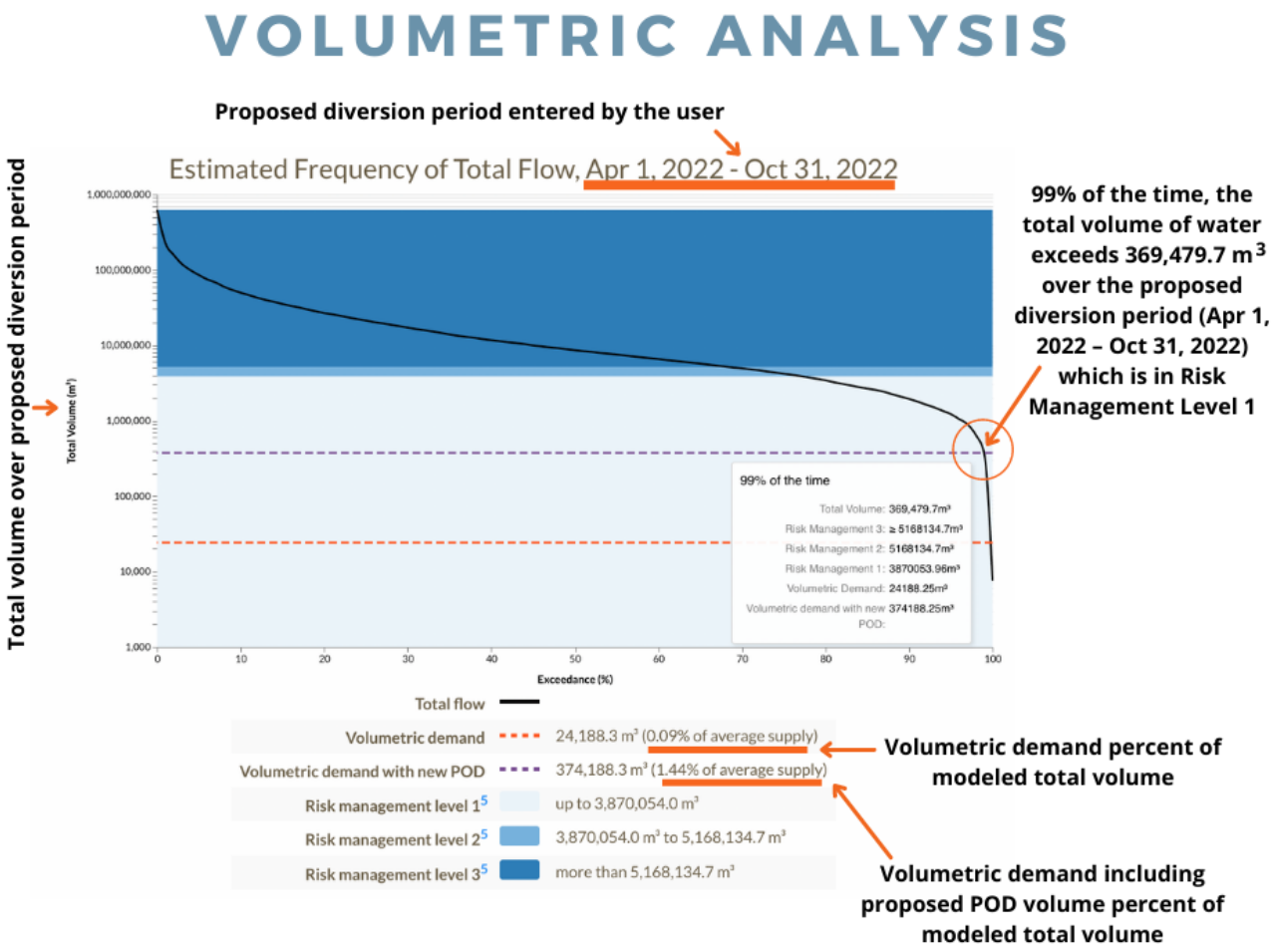
- The name of the watershed area (if it has a name).
- The location ID.
- The watershed WFI number.
- The proposed withdrawal scenario that includes the inputted diversion information.

3.2 Setting

The map shows the upstream (orange) and downstream (purple) watersheds. Specifically, the orange shaded area is the user-defined location, and the purple shaded area is the next confluence. The table below the map provides an overview of the Proposed Point of Diversion (POD) location and existing authorized water licences within these watershed flow paths.

3.3 Volumetric Analysis

This analysis provides an estimate of how much water is available within the proposed duration. It is coupled with existing allocations and the proposed new volume of diversion to help understand how these amounts relate to the frequency of the total supply. The presented chart shows the estimated frequency distribution of total volumetric flows within the specified time period, helping link existing and proposed cumulative demand, risk management levels, and frequency of estimated total discharge together.



The Province of BC *Environmental Flow Needs Policy* provides a workflow for calculating risk management levels based on mean monthly and mean annual discharge. The colored areas on the chart represent the total volume of water available to be

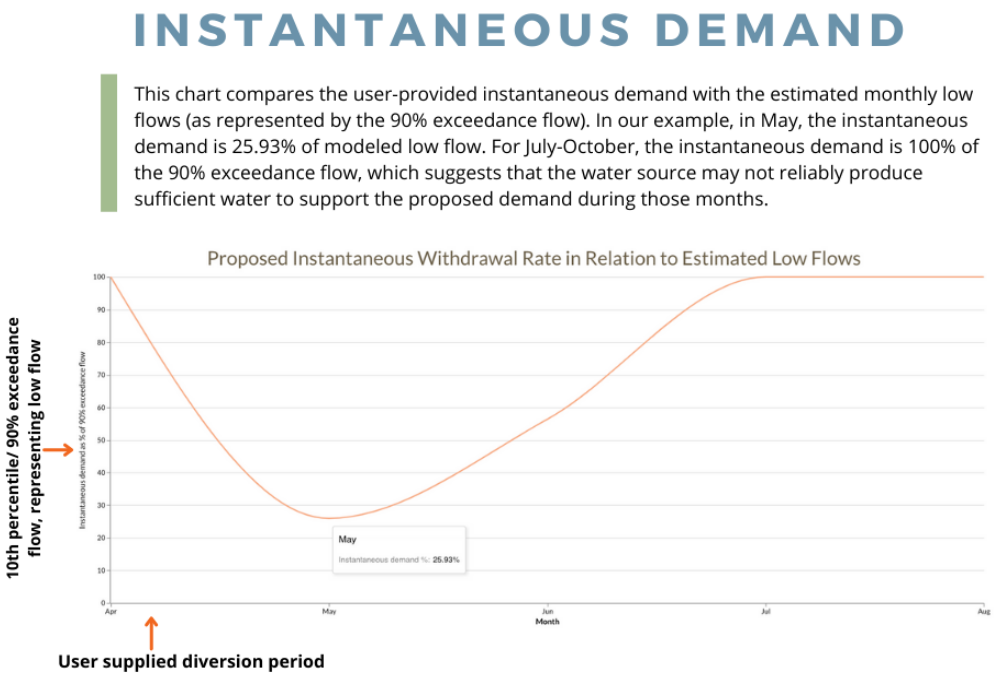
allocated under the policy, as written. Overlain in dashed lines are the existing cumulative demand for water (orange), and the potential cumulative demand with the new proposed diversion (purple). The black, curved line on the chart shows the frequency of **total** flows. These values all describe the same time period, which is the proposed diversion period entered by the user.

This chart can be used to help understand how reliable a water supply is. If the volumetric demand with the new POD crosses the total flow curve, the corresponding exceedance percentage is the probability that the water source will produce that volume of water in the defined time period - and no more. In this scenario, a water user should expect to not have access to water continuously within the defined period, due to the need to maintain environmental flows, and natural limitations of supply.

3.4 Instantaneous Demand

The relationship between instantaneous demand for water at the proposed POD and the frequency of instantaneous flows in the waterbody at the proposed POD location is considered. The chart displays the proposed instantaneous withdrawal rate in relation to estimated low flows.

When the instantaneous demand is a substantial portion of the estimated low flows, this indicates that the stream may not provide a reliable source of water in a given month. This chart can be used in conjunction with the volumetric analysis chart to understand how the reliability of supply may vary within the proposed withdrawal period. The raw data may require additional data analysis, field measurements, an investigation into existing licensed demand and/or aquatic/riparian ecosystem needs to determine the reliability and other considerations related to the use of a water source.



3.5 Downstream Flow Path Water Licences

A list of downstream flow path water licences is available for the selected watershed location.

Contact Information

1. *For further information about NEWT, contact:*

Suzan Lapp, *Ph.D., PGeo, Hydrologist*
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