

# User Guide

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## Colorado Watershed Rapid Assessment Program



**One Water Solutions Institute**

Colorado State University

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## EXECUTIVE MESSAGE

Catena Analytics offers powerful platforms for building accessible and scalable analytical tools and simulation models that can be accessed via desktop or mobile devices. Our team has spent that last decade developing the Environmental Resource Assessment and Management System (eRAMS), an open-source technology that provides cloud-based geospatially-enabled software solutions as online services and a platform for collaboration, development, and deployment of online tools. Our services are used to assist with strategic and tactical decision making for sustainable management of land, water and energy resources. Thank you for choosing Catena Analytics and the eRAMS platform to meet your data, modeling, analysis and geospatial needs.

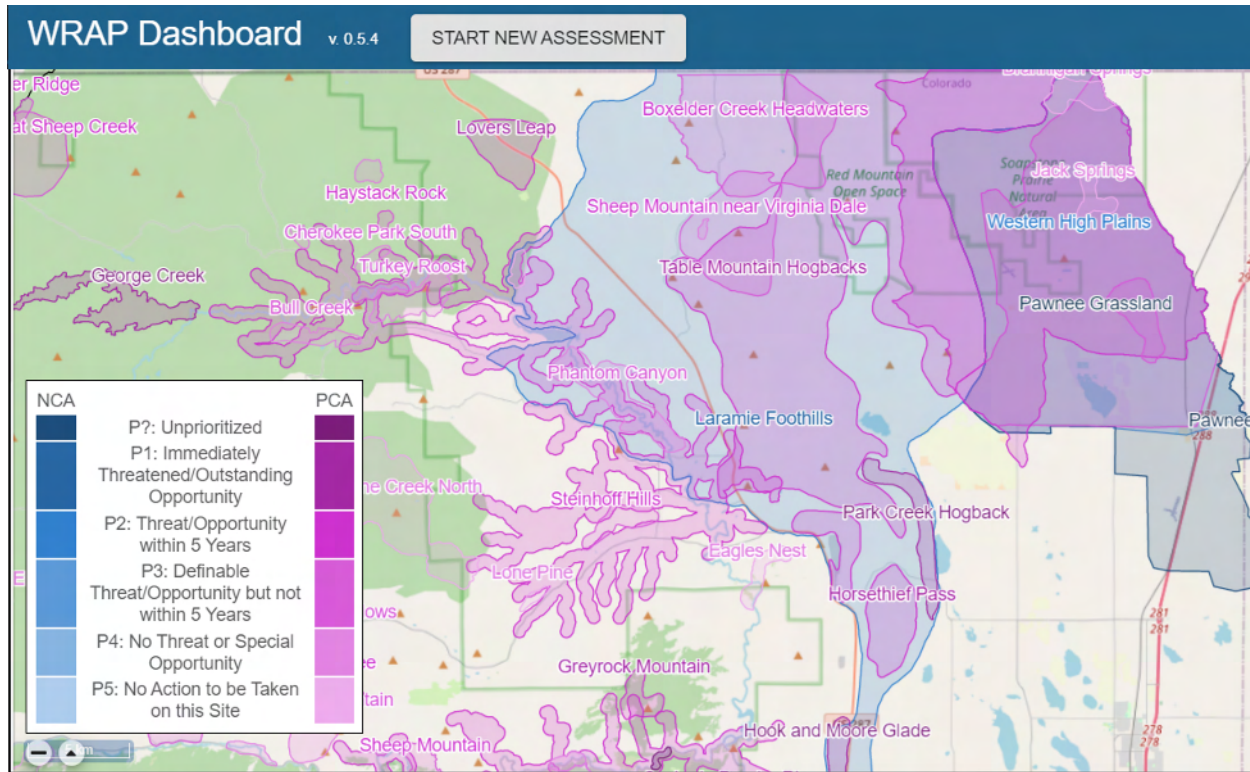
### WHO SHOULD USE THIS GUIDE

This guide is a tutorial to get you started using eRAMS and the [Watershed Rapid Assessment Program](#). The guide provides instructions for commonly performed tasks and uses of the tool. This tool is intended for use by urban planners and water managers, academic groups, regulatory officials, consultants as well as state, local and federal agencies planning for the future of water resources.

### NEED HELP?

After reviewing the guide if you need additional assistance we are here to help! This guide is designed to provide instruction on commonly performed operations and answers to many frequently asked questions. If you find any aspect of the tool challenging or missing information from this guide, please engage an eRAMS expert to guide you through any hurdles. Contact us at: [eramsinfo@gmail.com](mailto:eramsinfo@gmail.com)

# INTRODUCTION



## PURPOSE

The Colorado WRAP is intended to facilitate comparison of different state watersheds and allows users to conduct a variety of analyses ranging from simple watershed summaries to more complex analyses such as TMDL planning and implementation.

## DESCRIPTION

Watershed protection programs aim to maintain or restore the physical, chemical, and biological integrity of waterbodies. The development and implementation of these watershed plans require analysis of watershed conditions which are both spatially and temporally variable. Therefore, assessment of current and historic data and information is vital for continuously updating management plans in response to changing land use, climate, and watershed conditions.

The [Watershed Rapid Assessment Program \(WRAP\)](#) is a summary tool that extracts, organizes, and analyzes data and information at various watershed scales, including HUC 12, HUC 10, and HUC8 levels. Utilizing the extracted data, the WRAP tool calculates a number of watershed health indicators to create an overall summary of the watershed condition.

This tool summarizes readily available geospatial characteristics including land use, land cover, soils, climate, stream discharge, and water quality from various data resources including:

- [Multivariate Adaptive Constructed Analogs \(MACA\) Statistical Downscaling Method](#)
- [National Oceanic and Atmospheric Administration \(NOAA\) Daily Global Historical Climatology Network \(GHCN-Daily\)](#)
- [Snow Telemetry \(SNOTEL\)](#)
- [Parameter-elevation Regressions on Independent Slopes Model \(PRISM\)](#)
- [USGS National Water Information System \(NWIS\)](#)
- [US. EPA WQX \(formerly STORET\)](#)
- [US. EPA 303d](#)
- [US. EPA 305b](#)
- [US. Census Bureau](#)
- [USDA National Agricultural Statistical Service \(NASS\)](#)
- [USGS National Land Cover Dataset and impervious cover \(NLCD\)](#)
- [USDA SSURGO Soils](#)
- [FEMA National Flood Hazard Layer](#)
- [Geology](#)
- [National Atmospheric Deposition Program \(NADP\)](#)
- [U.S. EPA Wastewater Treatment Permit Locations \(NPDES\)](#)
- Colorado-specific data for:
  - [Stream Segmentation](#)
  - [Water Quality Standards](#)
  - [Water Rights](#)
  - Confined Animal Feeding Operations
  - [Wastewater Treatment Monitoring](#)
  - [Wetlands & Riparian Zones \(CNHP\)](#)
  - [Irrigated Agriculture](#)
  - [Abandoned Mine Lands](#)

The tool summarizes various time series and spatial data in a consistent format to facilitate watershed comparisons. The information is summarized in multiple graphs displaying time series data such as precipitation, temperature, snowpack, stream flow, water quality, and more. Additionally, interactive maps produced by the WRAP tool allow users to examine spatial data including land use, aquifer extent, soil drainage classification, impervious surface, and more. The raw data (time series, raster maps) are also available for download.

## SOFTWARE AVAILABILITY

### Domain

<https://cdphe-wrap.erams.com/>

### Documentation URL

<https://erams.com/catena/tools/colorado-collaborative/watershed-assessment/>

### Publication/Citation

Arabi, M, T. Wible, and M. Smith. 2015. Watershed Rapid Assessment Program (WRAP) Presentation. 2015 Colorado Watershed Assembly Conference.

## AUTHORIZED USE PERMISSION

The information contained in the Watershed Rapid Assessment Program (the "Service") is for general information purposes only. Colorado State University's One Water Solutions Institute ("CSU-OWSI") assumes no responsibility for errors or omissions in the contents of the Service. In the Service ([www.erams.com/wrap](http://www.erams.com/wrap)), you agree to hold neither the creators of the software platform nor CSU-OWSI liable for any action resulting from use or misuse of the Service. In no event shall CSU-OWSI be liable for any special, direct, indirect, consequential, or incidental damages or any damages whatsoever, whether in an action of contract, negligence or other sort, arising out of or in connection with the use of the Service or the contents of the Service. CSU-OWSI reserves the right to make additions, deletions, or modification to the contents of the Service at any time without prior notice.

# GETTING STARTED

## QUICK START

WRAP is intended to facilitate comparison of different watersheds. WRAP allows users to conduct a variety of analyses ranging from simple watershed summaries to more complex analyses such as TMDL planning and implementation.

Follow the simple workflow below to get started:

1. [Define Area of Interest](#)
2. [Extract Data](#)
3. [Generate Watershed Management Plan](#)

## SYSTEM REQUIREMENTS

A modern web-browser is required to connect and run the WRAP. Browser options include: Google Chrome v.69, Mozilla Firefox v.62, Safari v.11.1, and Microsoft Edge v.17.



# USING THE TOOL

## STEP 1 – DEFINE AREA OF INTEREST

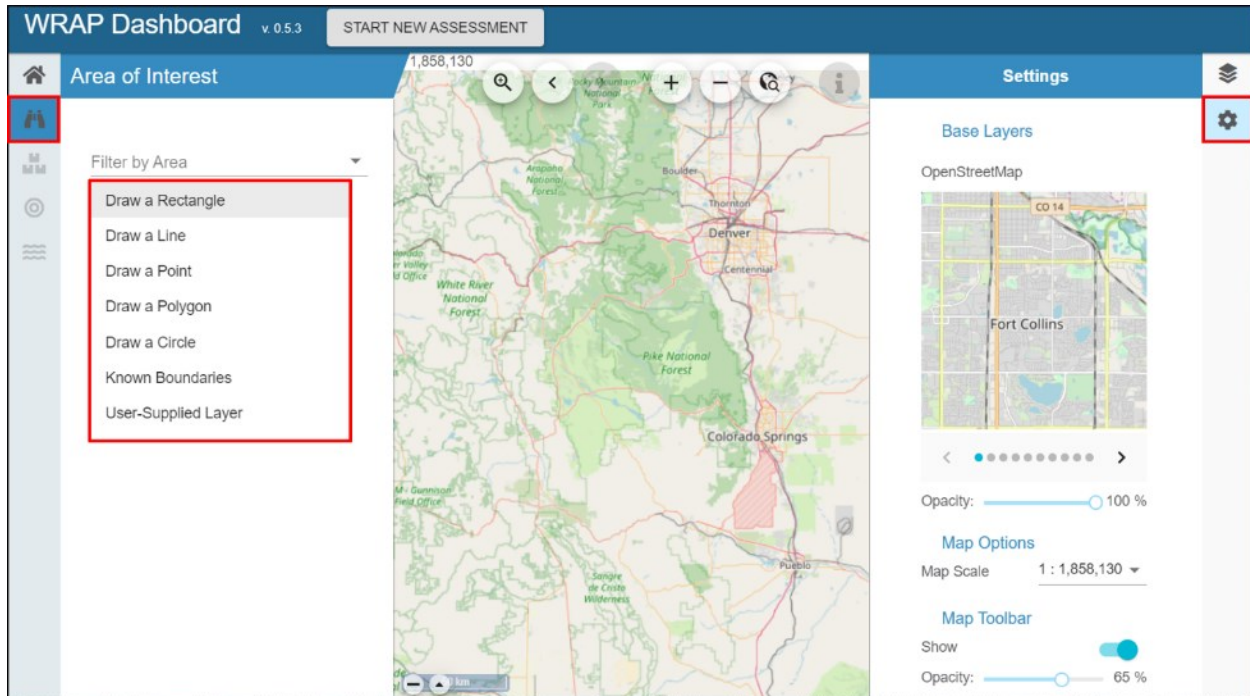


Figure 1 Define area of interest and modify base map (optional).

### Select Base Layer (optional)

With the WRAP interface open, click the “Settings” tab located on the right dashboard

1. Select the desired base layer and modify map settings including opacity and scale.
  - Base layer options include: OpenStreets, USGS National Maps, Google, None.

### Define Watershed Boundary

With the WRAP interface open, click the “Select Area of Interest” (binoculars) tab from the left dashboard. Define your watershed boundary by performing one of the following operations:

#### Draw Boundary

The options for manual selection of the geographic region of interest include the area within a desired radius of a point (point buffer); area within a buffer of a line; area within a rectangle; or area within a free-hand polygon.

1. Select boundary type
  - Enter desired buffer radius (point or line)
2. Place point(s) on desired map location



3. Name the watershed

*Select Known Boundary*

Users can select a region from known boundaries such as states, counties, or hydrological unit codes (HUCs).

1. Select "Known Boundary"
2. Select predefined boundary from drop down list (states, counties, cities, HUC-8, HUC-10 or HUC-12 watersheds).

*Upload Boundary Layer*

Users can upload a layer (shapefile) by performing the following operations:

1. Select "Upload a Boundary"
2. Select a shapefile for upload from your device
  - All files associated with a shapefile can be zipped into a ZIP archive (\*.zip) then uploaded, or multiple files can be uploaded at the same time outside of a ZIP archive
  - Depending on the size of your file(s), it may take a few minutes to process

## Upload Layers

Users can upload files (Figure 2) and add their own information under the "Layers" tab located on the right dashboard:

1. Upload geospatial user layers
2. Import data from public sources such as U.S. Geo Data, U.S. Hydro Data and U.S. Environmental Protection Agency water data.

Map Features

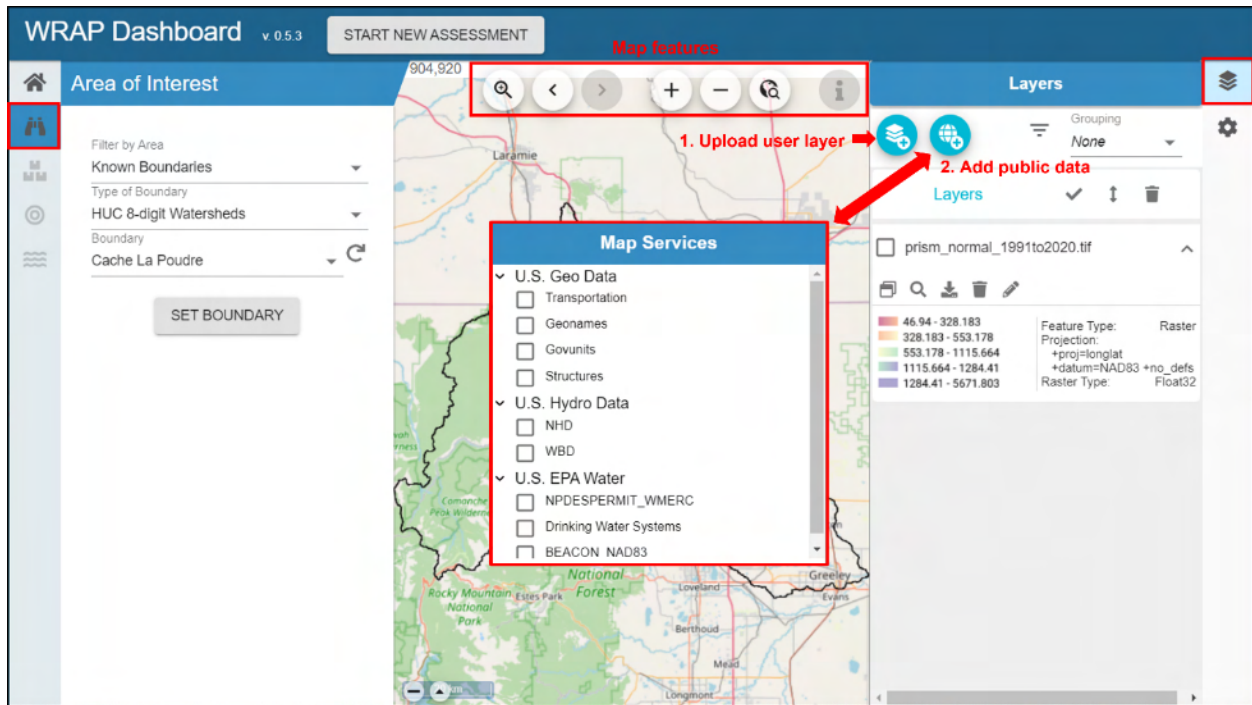


Figure 2 Add user layers, import public data, and navigate map features.

The dashboard also allows users to navigate basic mapping features from the toolbar located on top of the map canvas (search location, zoom in/out/to specific place, enter location, layer attributes).

## STEP 2 – EXTRACT DATA

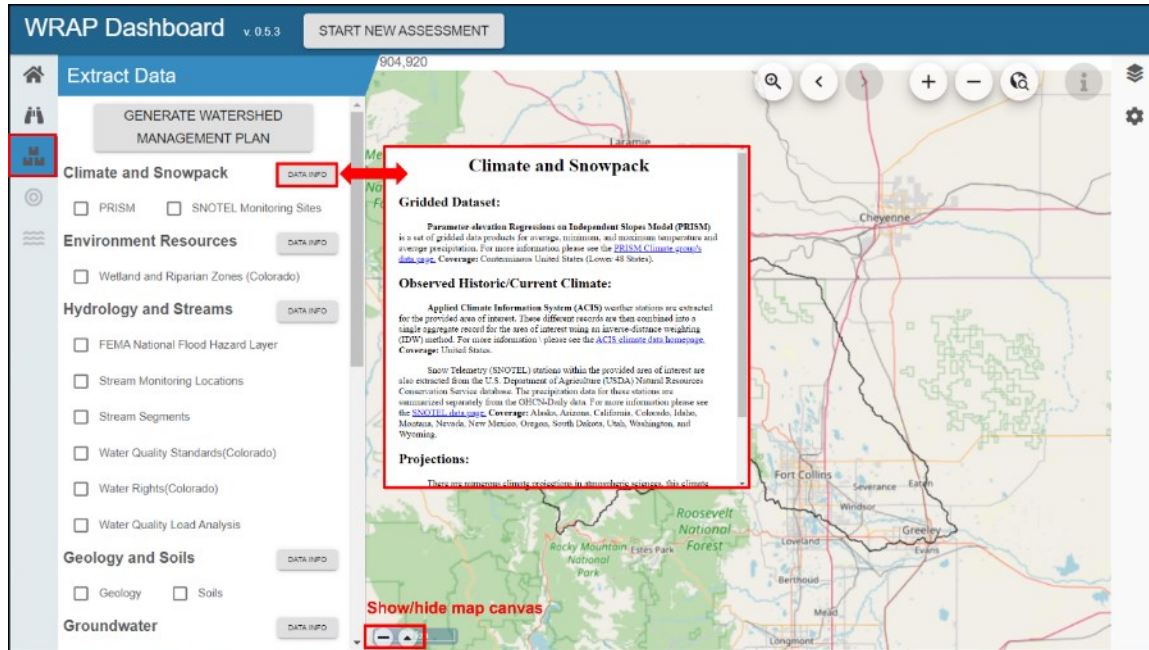


Figure 3 Select and extract desired data, help text available.

### Select Datasets

The eRAMS platform retrieves live data for the prepopulated categories described in further detail below. Therefore, the processing time may take a few minutes after you have selected the desired dataset(s) to complete the extraction. Inline help and links to the data sources are available in the WRAP interface by clicking the “DATA INFO” button next to each data category (Figure 3) which are also described below. The direct link, source and/or citation information for each dataset is included in the generated report ([Step 3](#)).

#### Climate and Snowpack Data

##### Gridded Datasets

**Parameter-elevation Regressions on Independent Slopes Model (PRISM)** is a set of gridded data products for average, minimum, and maximum temperature and average precipitation. For more information please see the [PRISM Climate group's data page](#). **Coverage:** Conterminous United States (Lower 48 States).

##### Observed Historic/Current Climate

**Applied Climate Information System (ACIS)** weather stations are extracted for the provided area of interest. These different records are then combined into a single aggregate record for the area of interest using an inverse-distance weighting (IDW) method. For more information please see the [ACIS climate data home page](#). **Coverage:** United States.

**Snow Telemetry (SNOTEL)** stations within the provided area of interest are also extracted from the U.S. Department of Agriculture (USDA) Natural Resources Conservation Service

database. The precipitation data for these stations are summarized separately from the GHCN-Daily data. For more information please see the [SNOTEL data page](#). **Coverage:** Alaska, Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, South Dakota, Utah, Washington, and Wyoming.

### Projections

There are numerous climate projections in atmospheric sciences, this climate projection data is from the **Multivariate Adaptive Constructed Analogs (MACA) Statistical Downscaling Method**. For more information please see the [MACA Data home page](#). **Coverage:** United States.

### *Environmental Resources Data*

#### Wetlands and Riparian Zones

**Colorado Natural Heritage Program (CNHP)** has performed a state-level wetlands assessment including potential conservation areas and networks of conservation areas. For more information please see the [CNHP data page](#). **Coverage:** Colorado.

### *Hydrology and Streams Data*

#### FEMA Flood Plain Maps

**Federal Emergency Agency (FEMA) National Flood Hazard Layer (NFHL)** dataset (S\_Fld\_Haz\_Ar) are used by FEMA to designate the Special Flood Hazard Area (SFHA) and for insurance rating purposes. These data are the regulatory flood zones designated by FEMA. For more information, please see the FEMA page for their [Flood Insurance Rate MAP \(FIRM\) Database Technical Reference](#). **Coverage:** United States.

#### Historical/Current Stream Discharge

**The U.S. Geological Survey (USGS) National Water Information System (NWIS)** database of stream monitoring locations (average daily discharge) within the provided area of interest will be extracted. For more information please see the [USGS NWIS home page](#). **Coverage:** United States.

**The U.S. EPA STORET database** of stream monitoring locations (average daily discharge) within the provided area of interest will be extracted. For more information please see the [STORET Central Warehouse data page](#). **Coverage:** United States.

**The Colorado Division of Water Resources (CDWR) database** of stream monitoring locations (average daily discharge) within the provided area of interest will be extracted. For more information please see the [Colorado DWR data page](#). **Coverage:** Colorado.

**The Colorado Data Sharing Network (CDSN)** database of stream monitoring locations (average daily discharge) within the provided area of interest will be extracted. For more information please see the [Colorado Data Sharing Network home page](#). **Coverage:** Colorado.

#### Historical/Current Water Quality

**The U.S. Geological Survey (USGS) National Water Information System (NWIS)** database of stream monitoring locations (water quality) within the provided area of interest will be extracted. For more information please see the [USGS NWIS home page](#). **Coverage:** United States.

**The U.S. EPA STORET** database of stream monitoring locations (water quality) within the provided area of interest will be extracted. For more information please see the [STORET Central Warehouse data page](#). **Coverage:** United States.

**The Colorado Data Sharing Network (CDSN)** database of stream monitoring locations (water quality) within the provided area of interest will be extracted. For more information please see the [Colorado Data Sharing Network home page](#). **Coverage:** Colorado.

#### Hydrography

**The U.S. Geological Survey (USGS) National Map Viewer's Hydrography** Database of watershed boundaries (hydrologic unit codes, HUCs), flow lines, waterbodies, and more are provided in an interactive map (based on zoom level). For more information please see the [USGS National Map Viewer help page](#). **Coverage:** United States.

#### Impaired and Use-Limited Waterbodies (EPA 303d)

**The U.S. Environmental Protect Agency (EPA) Impaired and Use-Limited Waterbodies (2014)** within the provided area of interest will be extracted and summarized. For more information please see the [U.S. EPA Impaired Waters and TMDL home page](#). **Coverage:** United States.

**Colorado Department of Public Health and Environment (CDPHE) Impaired and Use-Limited Waterbodies (2016)** for areas in Colorado only will be extracted and summarized instead of the U.S. EPA data. For more information please see the [CDPHE GIS Maps page](#). **Coverage:** Colorado.

#### Waterbody Classification (EPA 305b)

**The U.S. Environmental Protect Agency (EPA) National Water Quality Inventory Report (2012)** of streams and waterbodies and their designated uses within the provided area of interest will be extracted and summarized. For more information please see the [U.S. EPA 305b home page](#). **Coverage:** United States.

**Colorado Department of Public Health and Environment (CDPHE) Waterbodies (2016)** for areas in Colorado only will be extracted and summarized instead of the U.S. EPA data. For more information please see the [CDPHE GIS Maps page](#). **Coverage:** Colorado.

#### Water Quality Standards

Colorado Department of Public Health and Environment (CDPHE) **stream standards** are derived from Regulation 31, there are site specific standards but Regulation 31 and corresponding basin-specific Regulations 32 through 39 provide a full summary of stream water

quality standards. For more information please see the [CDPHE Regulations page](#).

**Coverage:** Colorado.

#### Water Rights

**The Colorado Decision Support Systems (CDSS) HydroBase** database of diversion structures and water rights are extracted and summarized for the provided area of interest. For more information please see the [Colorado Decision Support Systems HydroBase data page](#). **Coverage:** Colorado.

#### *Geology and Soils*

Soil type and other attributes are extracted from the **Soil Survey Geographic (SSURGO)** database from the U.S. Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS). For more information please see the [USDA-NRCS Soil Data home page](#). **Coverage:** United States.

#### *Groundwater Data*

##### Principal Aquifer Extent

**The U.S. Geological Survey (USGS) Groundwater Atlas** of principal aquifer extent. For more information please see the [USGS Aquifer home page](#). **Coverage:** United States.

##### Historical/Current Groundwater

**The U.S. Geological Survey (USGS) National Water Information System (NWIS)** database of groundwater monitoring locations (water table elevation) within the provided area of interest will be extracted. For more information please see the [USGS NWIS home page](#). **Coverage:** United States.

#### *Land Surface Data*

##### Agriculture

**Dry-land Irrigated Agriculture** The dry-land agricultural field layer shown was developed by combining multi-year NLCD cultivated cropland data and intersecting it with public land survey units (PLSS), erasing out irrigated field coverage from the [Colorado Decision Support System \(CDSS\) website](#). **Coverage:** Colorado.

**Irrigated Agriculture** is a set of irrigated field boundaries for the state of Colorado available from the [Colorado Decision Support System \(CDSS\) website](#). **Coverage:** Colorado.

##### Land Use

**The National Land Cover Database (NLCD) of Percent Developed Imperviousness** is an impervious surface summary by the U.S. Geological Survey (USGS). These assessments began in 2001 nationwide. For more information please see the [USGS NLCD home page](#). **Coverage:** Conterminous United States (Lower 48 States).



**The National Agricultural Statistical Service (NASS)** is a land use summary by the U.S. Department of Agriculture (USDA) with an emphasis on crop type. These assessments began in 1997 at the state level with nationwide coverage by 2008. For more information please see the [USDA NASS home page](#). **Coverage:** Conterminous United States (Lower 48 States).

**The National Land Cover Database (NLCD)** is a land use summary by the U.S. Geological Survey (USGS). These assessments began in 1992 nationwide. For more information please see the [USGS NLCD home page](#). **Coverage:** Conterminous United States (Lower 48 States).

The land use trends analysis extracts a subset of land use cover layers from either NASS (2014, 2012, 2010, 2008) and NLCD (2011, 2006, 2001, 1992) and then displays them side by side for comparison. **Coverage:** Conterminous United States (Lower 48 States).

#### Population

**Decennial U.S. Census (2010 and 2000)** population for blocks or block groups (depending on the size of the area of interest) extracted and analyzed. **Coverage:** United States.

**American Community Survey** population for counties are extracted and analyzed. **Coverage:** United States.

#### Topography

30-meter Digital Elevation Maps (DEMs) of topography are extracted from the **National Hydrography Dataset (NHDPlus Version 2)**. For more information please see the [NHDPlus Version 2 home page](#). **Coverage:** Conterminous United States (Lower 48 States).

#### Wildfire Extent

**U.S. Forest Service Wildfire Hazard Potential (WHP)** (270-m grid) dataset by the U.S. Department of Agriculture (USDA) will extract and summarize wildfire risk in the provided area of interest. There are two datasets, a continuous risk value and a categorized risk value. A dataset with categorized risk value was used for WHP. For more information, please see the Forest Service page for their [continuous](#) and [categorized](#) datasets. **Coverage:** Conterminous United States (Lower 48 States).

#### *Other Data*

##### Abandoned Mine Lands (Colorado)

**Colorado Abandoned Mine Land** features from [numerous agencies](#) will be extracted and summarized. For more information please see the [Colorado Abandoned Mine Lands Metadata page](#). **Coverage:** Colorado.

##### Atmospheric Deposition

**National Atmospheric Deposition Program (NADP)** National Trends Network atmospheric deposition monitoring stations are also extracted for the provided area of interest. Data for these stations are summarized separately from the GHCN-Daily data. For more information please see the [NADP data page](#). **Coverage:** United States.



### Canals and Ditches

**Canals and Ditches** from USGS National Map Viewer's Hydrography database of flow lines are provided for the area of interest. For more information please see the [USGS National Map Viewer help page](#). **Coverage:** United States.

### Confined Animal Feeding Operations (CAFOs):

A summary of the total number of animal units, by type of animal, is included for watersheds larger than 20 square miles. **Coverage:** Colorado.

### CDPHE Regulation Boundaries

Colorado Department of Public Health and Environment (CDPHE) **regulation boundaries** are important areas to keep in mind with watershed assessment. These include Control Regulation areas, TMDL areas, and areas with Watershed Plans. **Coverage:** Colorado.

### Roadways

**Roadways** from USGS National Map Viewer's Geo Data database of national transportation datasets are provided for the area of interest. For more information please see the [USGS National Map Viewer help page](#). **Coverage:** United States. This is missing from inline text

### Colorado Transbasin Diversions

**Colorado transbasin (transmountain) diversions** are important alterations to natural hydrography. Ditch and tunnel structures along with associated monitoring gages within the provided area of interest will be extracted and summarized. **Coverage:** Colorado.

### Wastewater Treatment Plants

**Colorado Department of Public Health and Environment (CDPHE) Regulation 85** nutrient management data for wastewater treatment plants within the provided area of interest will be extracted and summarized. For more information please see the CDPHE Regulation 85 nutrient home page. **Coverage:** Colorado.

**National Pollution Discharge Elimination System (NPDES)** The NPDES permit program addresses water pollution by regulating point sources that discharge pollutants to waters of the United States [NPDES home page](#). **Coverage:** United States.

### STEP 3 – GENERATE WATERSHED MANAGEMENT PLAN

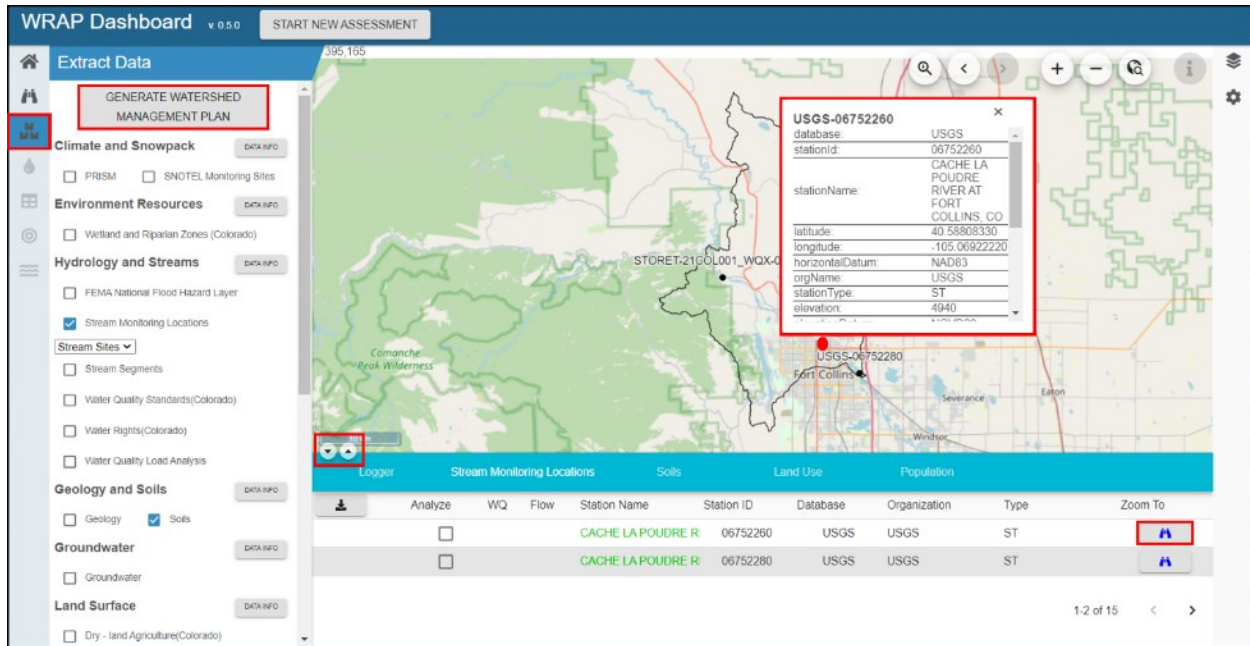


Figure 4 Complete analysis for desired data to be included in the report template

Once the desired data has been selected, new tab(s) will process and summarize the selected watershed data analysis summary for the area of interest and the information will be summarized underneath the map canvas (teal table below map).

Users can toggle the map on/off by selecting the arrows at the bottom of the map (Figure 4). Stream monitoring locations can be zoomed to from the results tab or by clicking the pin at the specific location to display additional information (Figure 4).

- **Note:** *Popups must be enabled to que the report for download (i.e., not just for a specific website as this tool generates unique tokens, therefore any browser application used to block pop-ups must be completely disabled).*

## Visualization & Graphing

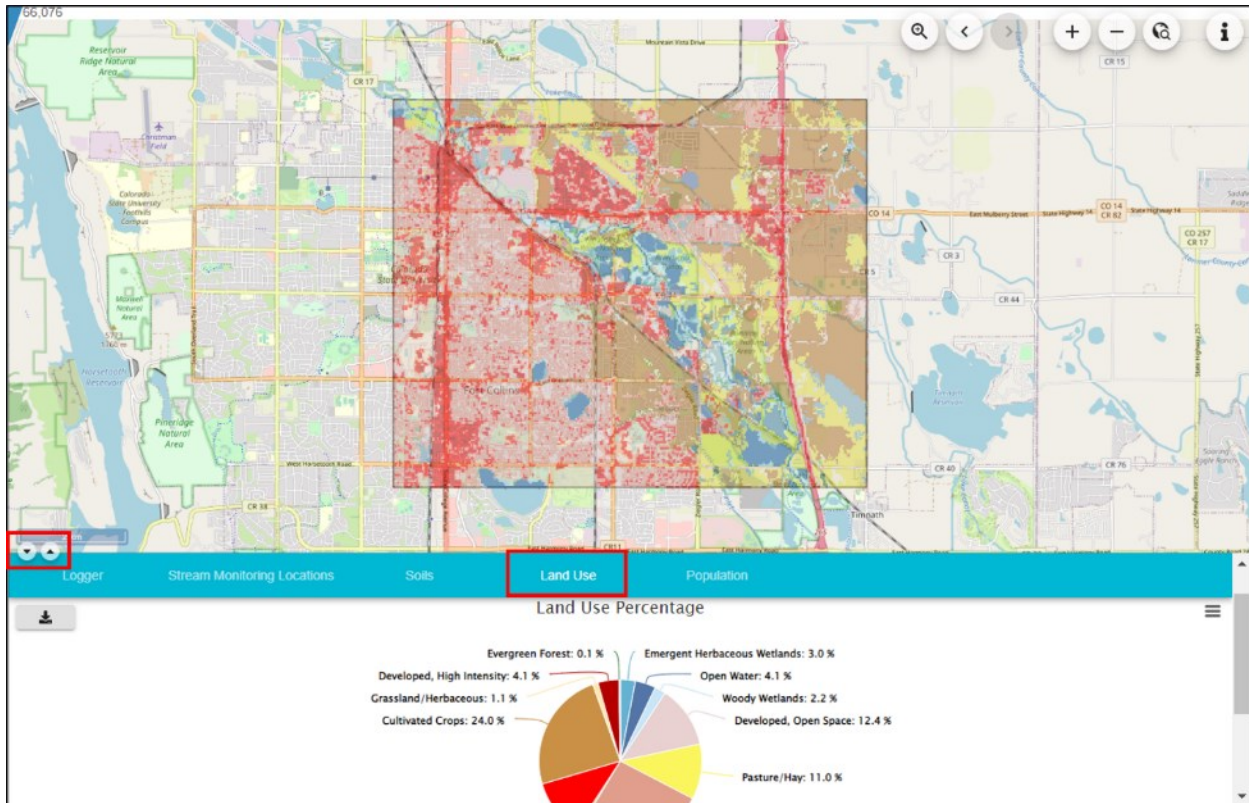


Figure 5 Analysis results example (land use) on map canvas and results table

The WRAP tool is intended to facilitate comparison of different watersheds. The tool summarizes various time series and spatial data in a consistent format to facilitate these comparisons.

Each data category is summarized using interactive maps and graphs which are accessible from the results tab(s) that automatically populate under the map canvas (Figure 5). The results tabs can be maximized or minimized and the map canvas can be hidden by clicking the arrows at the bottom left corner of the map canvas (Figure 5).

The graphs (png, jpeg, pdf, svg) as well as the raw data including time series (xls, csv) and raster maps can be downloaded from the dashboard (Figures 6-8). These figures are interactive and hovering your mouse over any section will reveal additional information.

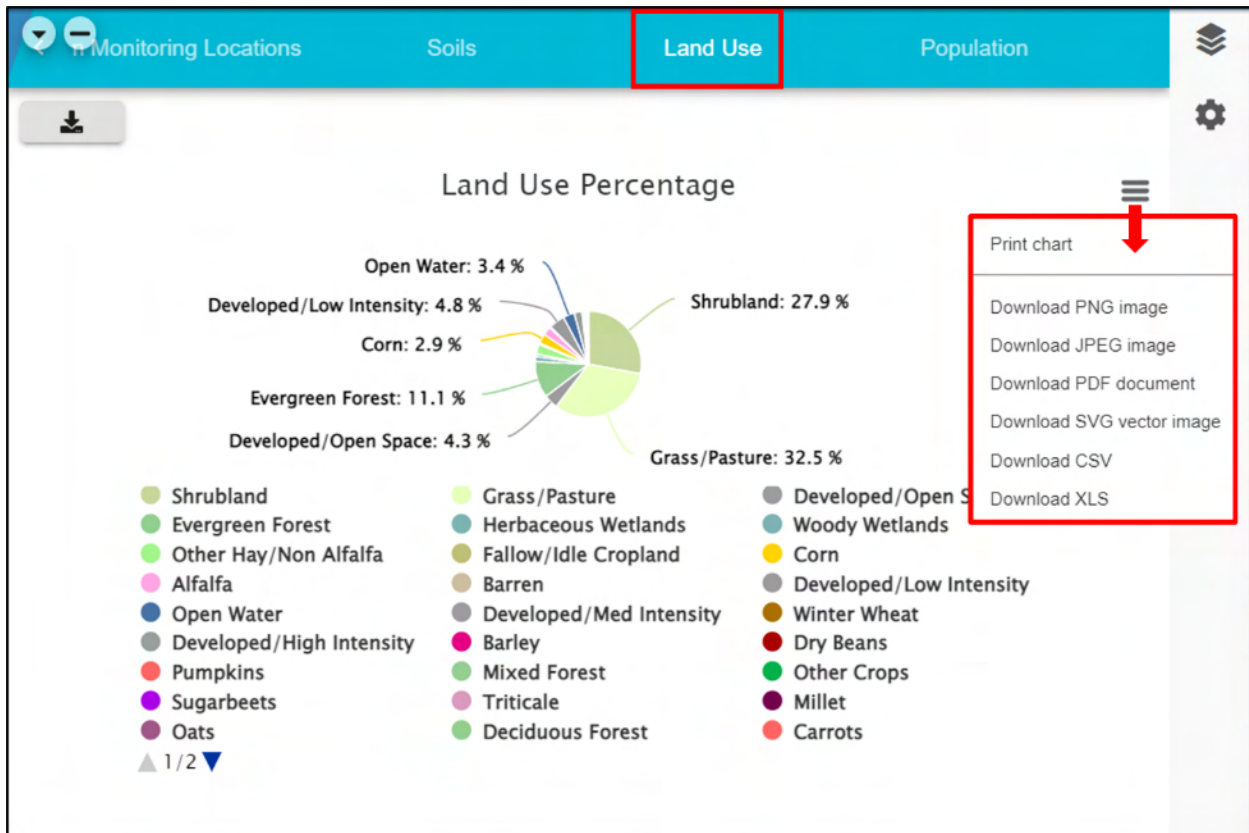


Figure 6 Example of land use analysis results and download features.



Figure 7 Example of population results and download features.



## Water Quality Data

Once a user has selected one or more stream monitoring locations that also include water quality data (check “analyze” button) within the default period of record ([Extract Data](#) section, green check), additional data summary sections for water quality (bullseye icon on left dashboard) is enabled (Figure 9).

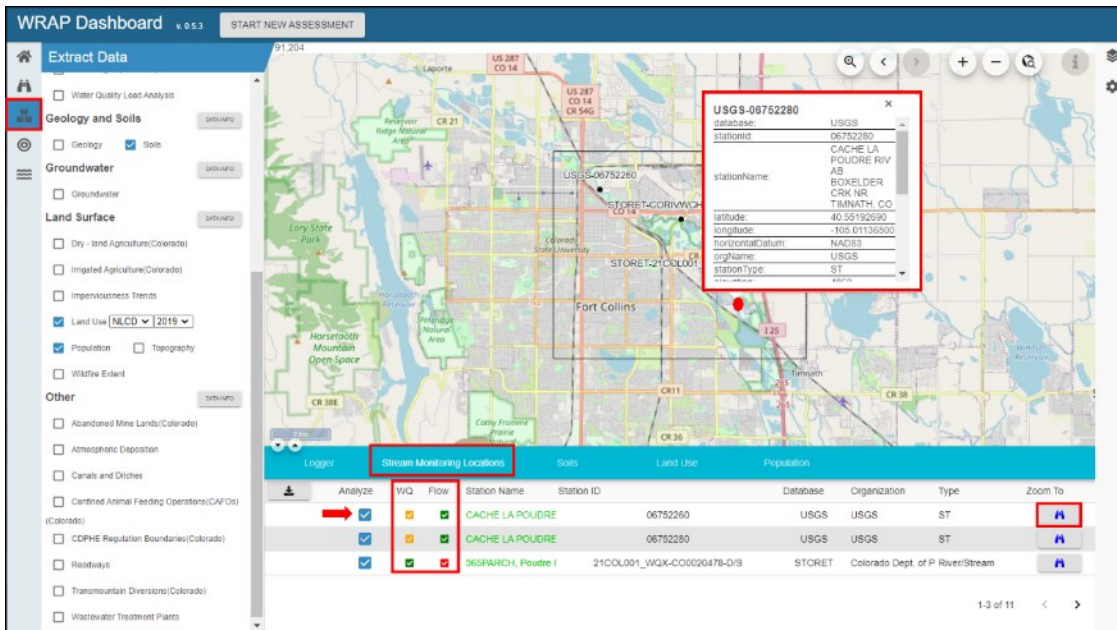


Figure 8 Example Stream Monitoring Location selection

The Water Quality Data (bullseye icon) section begins with the Parameter Summary tab containing a count of available data by parameter and station as well as a download data option (Figure 9).

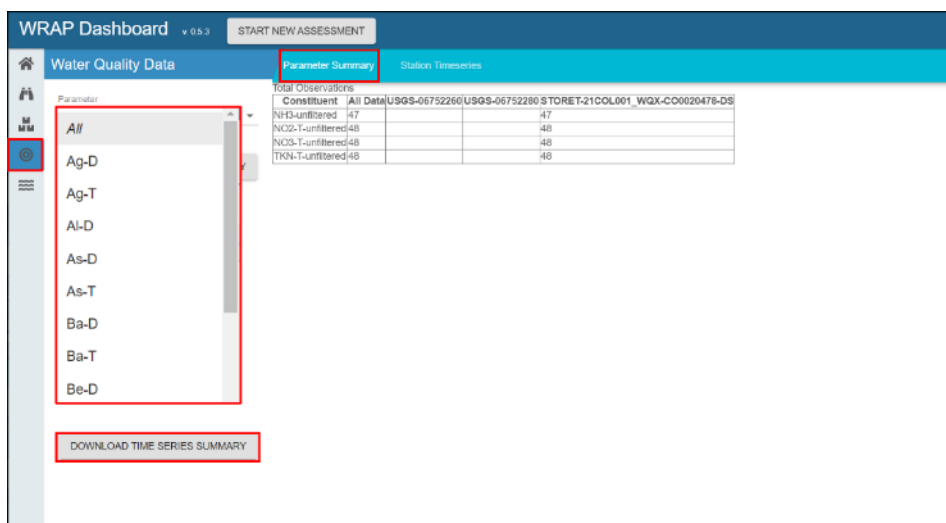


Figure 9 Example water quality parameter summary tab

A Station Summary tab will appear when a specific parameter is selected from the water quality data parameter drop-down menu. This summary provides a statistical overview of the station data for each monitoring location and the combined total dataset, including boxplot (Figure 10).

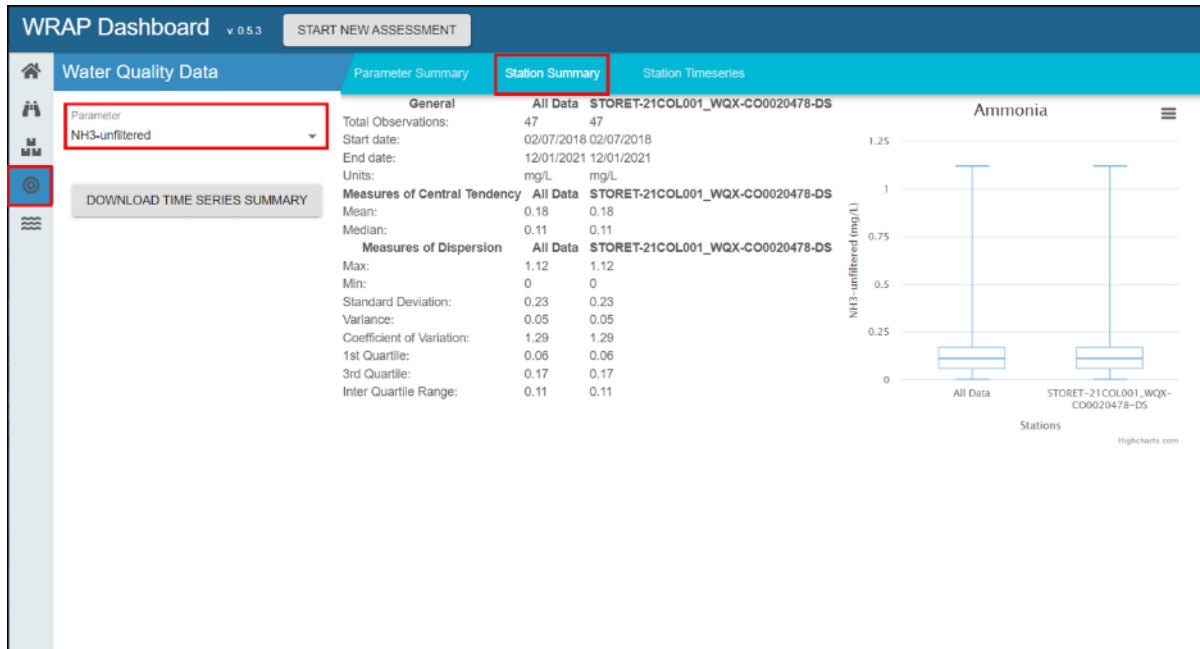


Figure 10 Example water quality station summary tab

The Station Timeseries tab contains a graphical summary of the raw data as well as a table of the available data for the selected parameter, its date-time stamp, any detection limits or other relevant water quality data flags, and units (Figure 11).

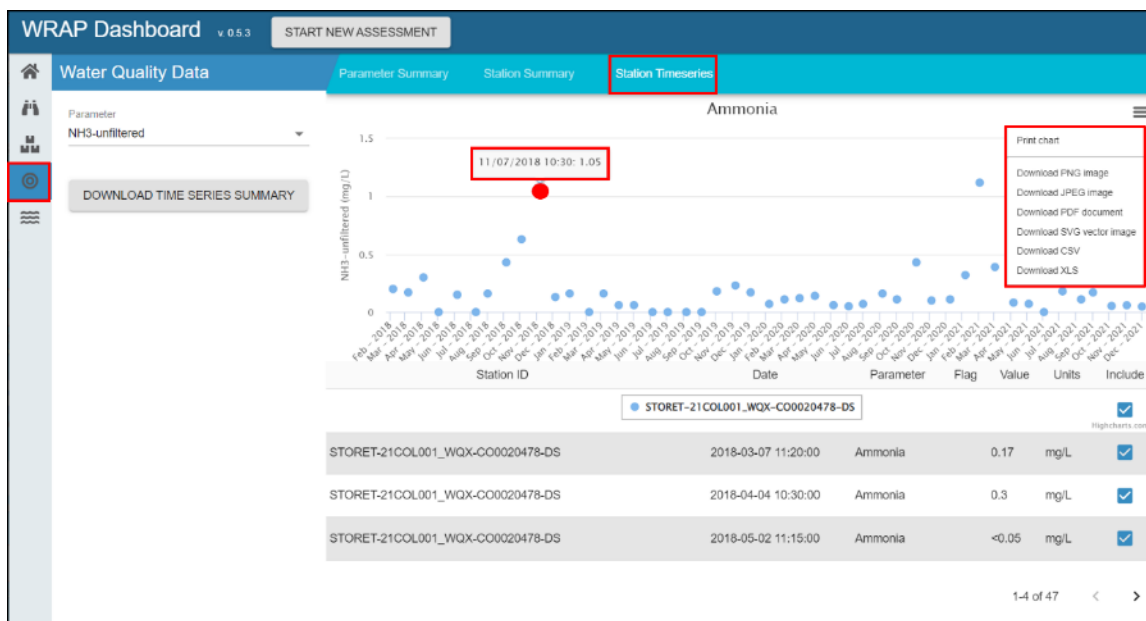


Figure 11 Example water quality station timeseries tab

## Flow Data Analysis

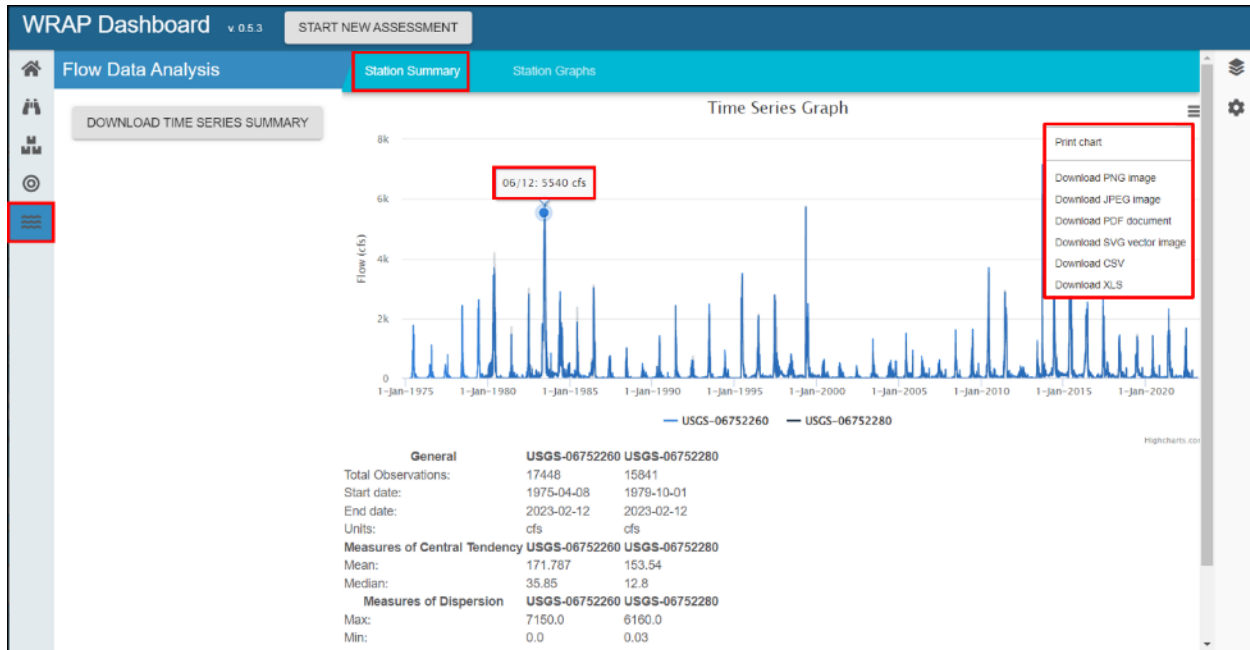


Figure 12 Example Flow Data Station Summary Tab

Similar to the [Water Quality Data](#) section, once a user has selected one or more stream monitoring locations with related flow data (green check Figure 8), additional Flow Data (water line icon) summary sections are enabled (Figure 12).

## Generate Watershed Management Report

Once all desired analyses have been completed, the WRAP tool will generate a zip file that includes maps, data, and MS word template with prompts for completing a Watershed Management Report.

All highlighted text within the word template are intended to be updated by the user. Although the document is yours to edit, it is best to keep as much of the recommended content (highlighted text and sections) as possible to ensure the plan is approvable by CDPHE.

**Note:** *Popups must be enabled to que the report for download*

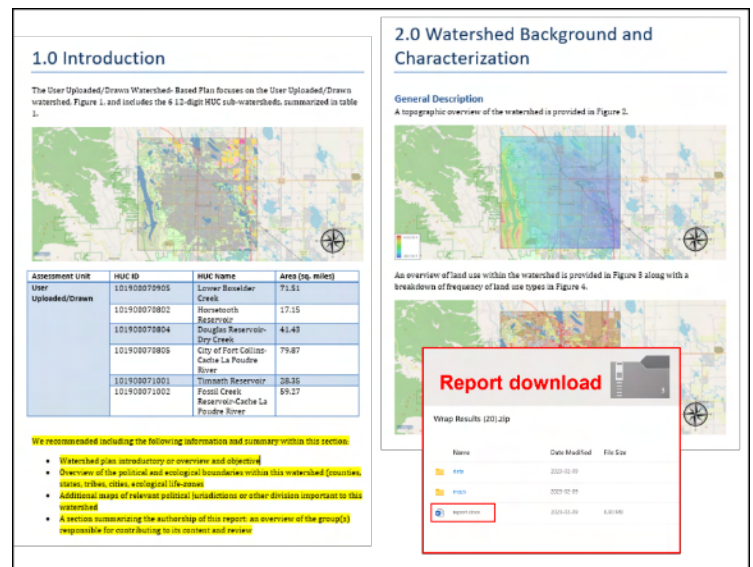


Figure 13 Example report files that are generated by WRAP



## REFERENCES

### STAKEHOLDER PRESENTATIONS

Arabi, M, T. Wible, and M. Smith. 2015. Watershed Rapid Assessment Program (WRAP) Presentation. 2015 Colorado Watershed Assembly Conference.

Wible, T. and T. Renniger. 2018. Promoting Data Literacy Through Data Visualization Storyboards. Sustaining Colorado Watersheds Conference Workshop.

Wible, T. and M. Arabi. 2018. A Web-Based Healthy Watersheds Assessment Framework. International Environmental Modeling and Software Society (iEMSs) Conference Proceedings.

Wible, T, T. Connor, and M. Arabi. 2016. Let's WRAP! One Water Solutions Institute at CSU has created WRAP – Watershed Rapid Assessment Program. Sustaining Colorado Watersheds Conference Proceedings.

### DATA SOURCES

See [Section 2 – Extract Data](#) or inline help text within the WRAP tool.