# *Reconstructing Hydrology How-To*

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Location:
U:\Projects\Colorado_River\Windy_Gap_FishMovementStudy\Data\Hydrology\ReconstructingUpperCHydrology

This document is intended as guidance to replicate and add onto reconstructed hydrology of the Upper Colorado, including the Fraser River and Upper Colorado above the confluence.

## Workflow

1. Collect data sources
2. Run R script to combine data sources and extrapolate for missing data points
3. Copy outputs back to U drive

## Data Inputs

### Manually Updated

The script currently takes 4 csvs from external data sources. When updating the script, these data will have to be manually updated to the best abilities.

- fall2025nearGranbyGageNWISInstant
    - provisional 15 min discharge data from Fall 2025 at the “near Granby” gage
    - tab separated data manually made to a csv in excel from https://waterdata.usgs.gov/nwis/uv?site_no=09019500&legacy=1
    - Having trouble recreating it, data may have disappeared to be more in accordance with their new site. Worth checking back sometimes to see if there’s new data but site might be deprecated in 2026, might not be possible to update.
    - Used to get more info on Granby flows especially in times we don’t have data in winter/fall
- moreFraserFlows_CDSS
    - Fraser flows from Northern water accessed at https://dwr.state.co.us/Tools/Stations/FRAGRACO
    - Good through April 2025, used as correct Fraser data and for help to extrapolate missing values
- WGFP_Hydrology_Qdaily_2020_to_2022
    - "U:\Projects\Colorado_River\Windy_Gap_FishMovementStudy\Data\Hydrology\WGFP_Hydrology_Qdaily_2020_to_2022.xlsx"
    - Data directly from Northern Water, including the Fraser River data from 2020 – 2022.
    - Used as a gage of correct Fraser data and used to help extrapolate for missing values.
    - Doesn’t need to be updated upon new script run
- WindyGapPumpingRecord

    - Exported CSV from https://dwr.state.co.us/Tools/Stations/WGPPMPCO
    - Record of cfs being pumped from Windy Gap reservoir, represents flow that doesn't make it below the reservoir

### Automatically Updated

The script gathers daily data from 4 USGS gages using the "DataRetrieval" package in R starting on 2020-08-06. Upon script re-run, the data will automatically update to the current date for available data. The gages used are:

- Colorado River at Hitching Post/Chimney Rock (09034250)
- Colorado River below Lake Granby (09019000)
- Colorado River Near Granby (09019500)
- Willow Creek below Willow Creek Reservoir (09021000)

## Output

- reconstructedWGFPDailyFlow.xlsx
    - Metadata sheet: variable descriptions for "Actual and Assumed Flows" sheet and information on how each was calculated
    - Actual and Assumed Flows: Reconstructed hydrology of daily flows for Upper Colorado, Fraser, and Colorado below Windy Gap Reservoir for each day of the study
    - AllData: contains all input data and various calculations used to recreate the hydrology. Basically a workbook

## Running the R script

### Setup

Once csv inputs are manually updated (check each to make sure column names are the same as the old files), run each bit of code one by one (cntrl+enter) or run the whole script at once by clicking the "source" button. The script is well commented and you should be able to follow along. Generally, the flow of the script is as follows:

- Libraries are imported, fall2025nearGranbyGageNWISInstant.csv and WindyGapPumpingRecord.csv are imported and reformatted to be able to work with easier.
- getDailyand15MinUSGSData() is defined and applied to USGS gages outlined above
- Fraser River data is imported and reformatted
- Data is joined together to get all daily flows for each data source

### Calculations

- Difference (by percent and total) between "Near Granby" USGS gage and "Below Lake Granby" gage is calculated. The percentage change is later used as a correction to the "Near Granby" gage to help assume flow when the "Near Granby" gage isn't on but the "Below Lake Granby" gage is
- "Actual/Assumed UpperC Above WillowCreek Flow" is calculated
    - If data is available for the "Near Granby" gage, then that data is used
    - If data is not available for "Near Granby" gage, then flows from fall2025nearGranbyGageNWISInstant.csv are used

    - If data isn't available for neither "Near Granby" gage nor fall2025nearGranbyGageNWISInstant.csv, then apply the correction factor to "Below Lake Granby" gage to get assumed flow
    - If none of the above are true, put NA
- "Assumed/Actual UpperC Flow" is calculated as "Actual/Assumed UpperC Above WillowCreek Flow
- "Assumed Fraser Flow" is calculated as 'CR Below WG Flow (USGS gage at Hitching Post)' + 'Windy Gap Pumping flow (WindyGapPumpingRecord)' - `Assumed/Actual UpperC Flow'
- Difference by percent and actual are calculated between Assumed Fraser Flow and the Actual Flows that we have data for
- `Assumed/Actual Fraser Flow` is calculated, using actual Fraser Flow if available (WGFP_Hydrology_Qdaily_2020_to_2022 and moreFraserFlows_CDSS) and using 'Assumed Fraser Flow' if not

Metadata is added, 'CR Below WG Flow', 'Assumed/Actual UpperC Flow', and 'Assumed/Actual Fraser Flow' are selected for the Actual and Assumed Flows sheet, and all data is saved to the output file.

If you are working off the U drive, this file should automatically get saved to U:\Projects\Colorado_River\Windy_Gap_FishMovementStudy\Data\Hydrology\ReconstructingUpperCHydrology\Outputs\reconstructedWGFPDailyFlow.xlsx