Souris River Python Code Project
Final Report

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1 Project Scope

Traditionally, Environment and Climate Change Canada (ECCC) has been responsible for the development, computation, and delivery of the apportionment calculations between the Canadian province of Saskatchewan (SK) and the United States state of North Dakota (ND). ECCC has begun working on transitioning to the programming language, Python, from Excel Workbooks for the apportionment calculations. The apportionment code described in this report is an extension of the ECCC work that was conducted by the United States Geological Survey (USGS).

The python version of the Souris River Apportionment will cover the following:

- The code must be able to calculate the apportionment accurately and reliably between Saskatchewan and North Dakota in accordance with the approved procedures and in compliance with the Interim Measures as Modified in 2000.
- The code and its outputs must be clear, transparent, and reproducible.

2 DELIVERABLES

2.1 CODE

The apportionment code was built on python 3.10 using the Poetry dependency management tool. Modern tooling such as linters and auto formatters were employed in addition to following "pythonic" coding conventions.

The code is available and tracked at:

- https://github.com/IJCCMI/Souris_Apportionment_Code
- Access is by request only and is controlled by IJC IT personnel.

2.2 MANUAL

A program manual was developed concurrently with the code to detail to users how to install, configure, run, develop, and maintain the code base.

3 INPUT DATA

The code can download time-series data from multiple sources including:

- USGS Water Data for the Nation
- Water Level and Flow - Environment Canada (ec.gc.ca)
- https://climate.weather.gc.ca/
- ECCC Aquarius (ECCC internal or credentialed access only)

The user can configure if data is to be sourced from ECCC Aquarius or from real-time sources.

3.1 METEOROLOGICAL DATA LIMITATIONS

A major limitation of the program is the necessary access to the Roughbark (05NB016) and Handsworth (05NCM01) meteorological data that is currently only accessible on the ECCC Aquarius system. If the user does not have ECCC Aquarius access, they must request the data and use the override functionality of the program documented in the user manual.

3.2 LONG CREEK AND SHERWOOD DATA

Data from two USGS operated stations: Long Creek at Eastern Crossing (05113600) and Souris River near Sherwood (05114000), used to be acquired from the North Dakota WSC directly but is now downloaded from NWIS without user input.

3.3 USER INPUTS

User settings such as reported flows are input by the user in the user_settings.env file.

3.4 OVERRIDE DATA

If a user chooses, they may override station data or fill in data gaps by following the program manual.

4 OUTPUT REPORT

The apportionment code outputs a final report as an Excel Workbook with a familiar Natural Flow Summary sheet. The Workbook output also includes sheets that contain:

- Reported flows
- Input daily data
- Records missing daily data
- Records “overridden” data
- Records user configuration
- Records program logs
- Helpful station information

Each time the program runs, a separate report is generated in the *reports* folder.

5 REPORT VALIDATION

The program was tested against official 2022 apportionment data and computed final values were within a 1% margin of error. Calculation differences largely came down to two changes in how the program runs: 1) Rounding of intermediary values and 2) Reservoir stage-area-capacity calculations.

5.1 ROUNDING

Both the first Excel-based iteration of the apportionment program and the follow up python-based version created by ECCC rounded intermediary calculation values frequently. After experimenting with rounding in different parts of the program, it was found that rounding values did not significantly alter output results and to simplify the program. Intermediary values are no longer rounded unless necessary for specific calculations that expect a certain number of significant figures.

This investigation mimicked a more in-depth study of rounding for the St. Mary and Milk River apportionment calculations where it was found rounding did not significantly alter results.

5.2 RESERVOIR STAGE-AREA-CAPACITY CALCULATIONS

The first Excel-based apportionment program used a pre-calculated table of stage-area-capacity values for calculations. The follow up ECCC python program instead interpolated these values which did cause a significant difference in reservoir calculations and differences between the interpolated versus the table method were found to be around 5-10%. After experimentation with both methods, it was determined that while the calculations produced different stage-area-capacity values, the influence on the final reported values was not significant.

Because the Excel version of the program was historically used for apportionments, the final calculated values were not influenced significantly, and the table method was simpler to implement and understand in python. The interpolation method was abandoned, and the current python version now calculates stage-area-capacity values using the original Excel table.