

R.A.F.T.E.R.

(River Analogues and Fulcrum Transport Estimates Repository)

Software for the Geological Analysis of River Stream Data

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Introduction

Dr. John Holbrook is a professor in the TCU Geology Department. Dr. Holbrook's current research emphasis revolves around the Fulcrum Theory, a set of calculations that determine sediment discharge of a stream. This measure allows one to estimate and more accurately quantify fluvial sand reservoir rock, which can contain oil and natural gas deposits. Prior to the conception of this project, in order to utilize the Fulcrum Theory, a scientist would need to reach out to Dr. Holbrook who would send an Excel document containing the equations necessary to evaluate the data. This was cumbersome and time consuming. To this end, our research, in collaboration with the Geology Department, focused on creating an user friendly application that would make the Fulcrum Theory more accessible across the world.

Problem Overview

- There is no pre-existing application that easily performs the calculations of the Fulcrum Theory, since it is a newly theorized research method
- The Fulcrum Theory calculations are currently reliant on a default value for the yearly averaged bankfull flow duration (t_{bd}), a measure of the average number of days a year the river flows at full capacity
- There is no readily available consolidation of river stream data from across the world which is necessary to produce a calculated t_{bd} value based on specific rivers' attributes

Goals

- Provide a user with the option to choose from three different modules, including Fulcrum Transport Estimate, Stream Specific Bankfull Duration (t_{bd}) Calculation, and River Analogues Search
- Input data into the Fulcrum Theory calculations and return values concerning sediment discharge of a stream
- Determine and return a calculated yearly averaged bankfull flow duration value (t_{bd}) binned on a combination of river stream attributes which can then also be implemented in the Fulcrum Theory calculations
- Display stream data that contributed to the calculated yearly averaged bankfull flow duration value (t_{bd}) to give a user confidence in the calculations
- Enable the user to look for specific analogue streams binned on a combination of river stream attributes

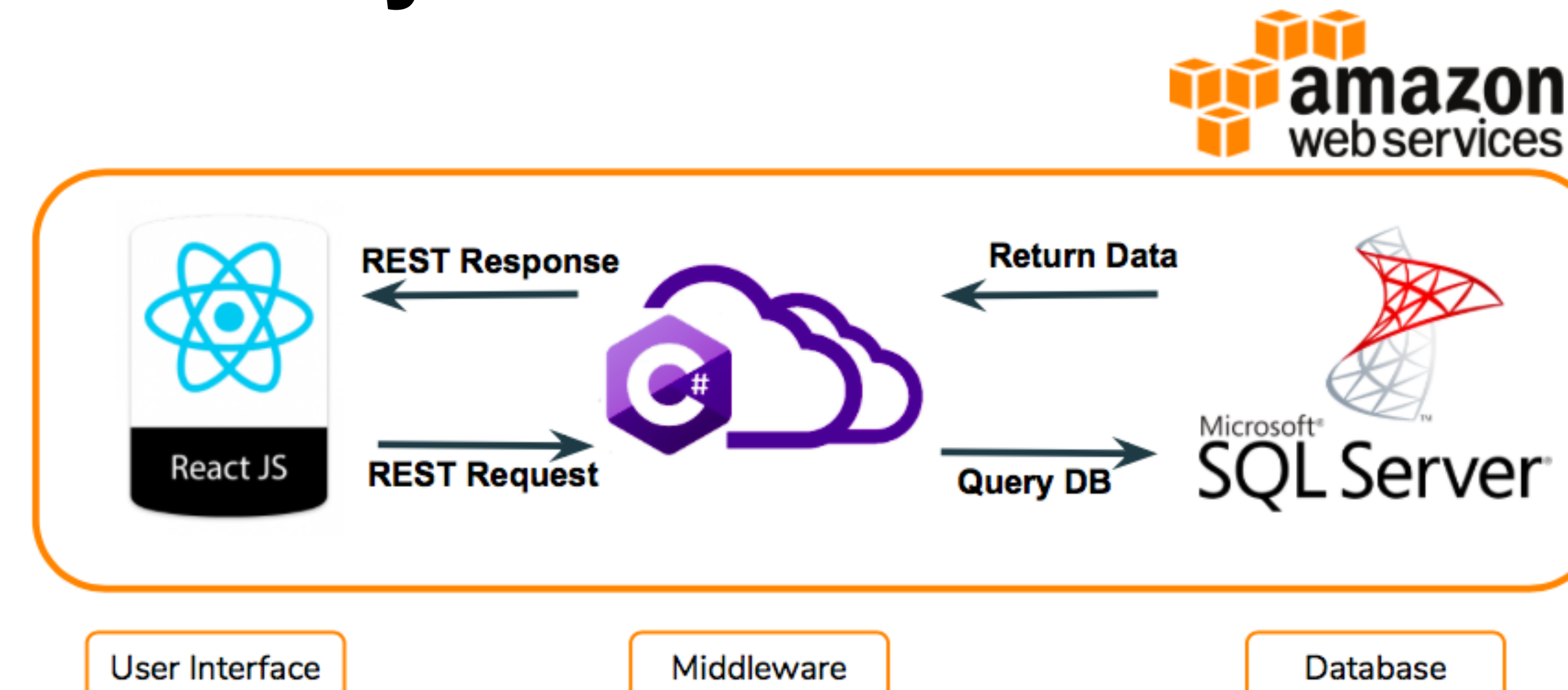
Solution Design

A web-based application supported by a database containing consolidated geological stream data enabling easy access and intuitive design for users

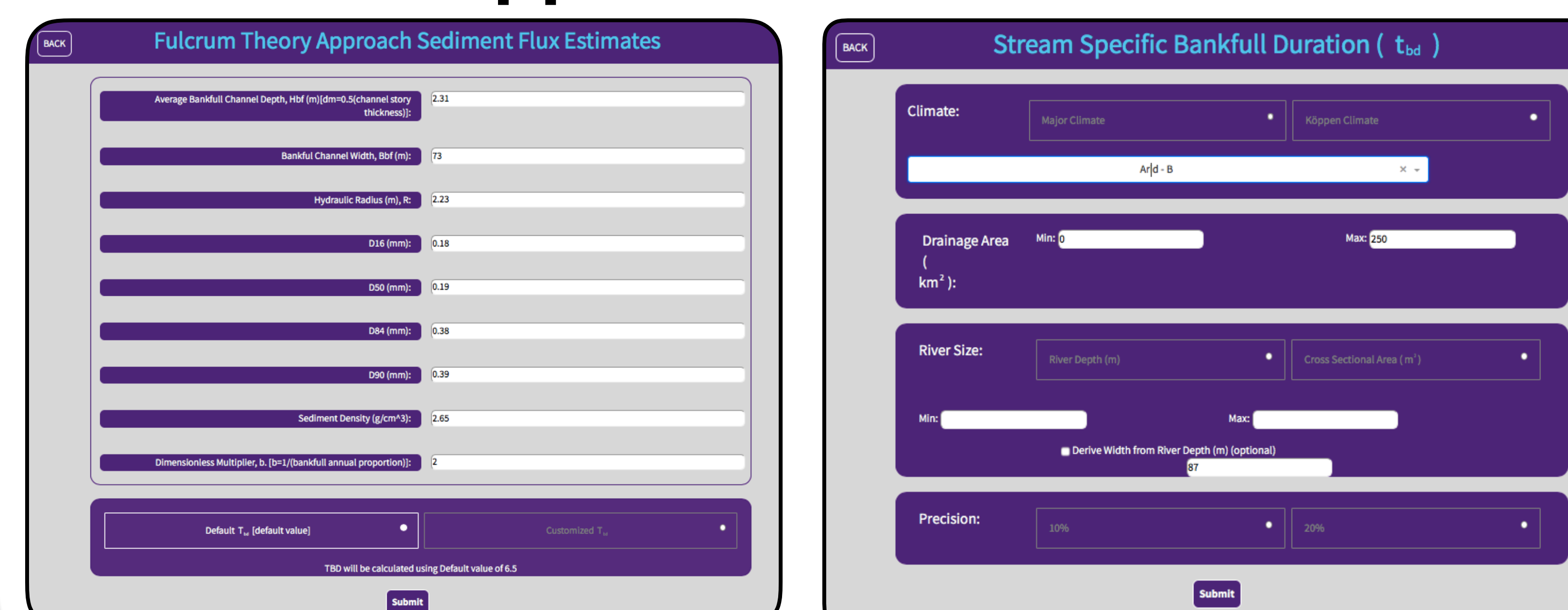
The three main components:

- Front end: An intuitive User Interface where users can input geological data and receive calculated values and streams used in the calculations
- Middleware: The bridge between the User Interface and the database performing calculations and facilitating the passing of information between the other two components
- Back end: The database with all relevant stream data loaded and a schema allowing for straightforward queries

System Architecture

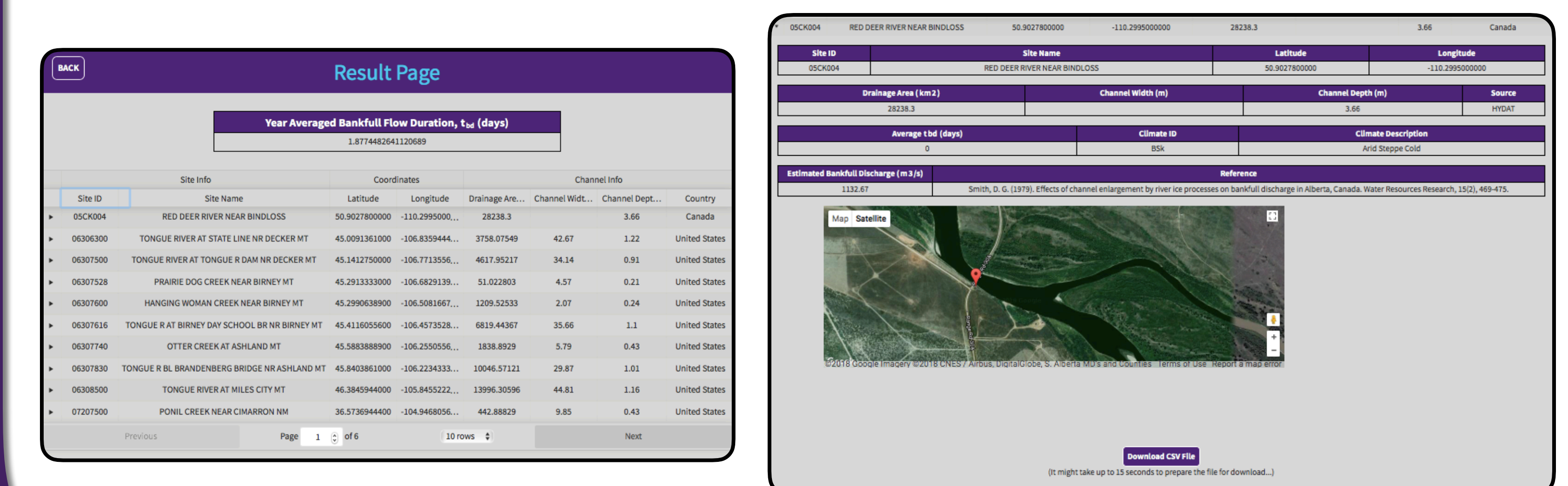


Application Modules



Results and Conclusions

- Created a full-stack web application supported by a database, currently being extensively tested
- Calculated a stream specific t_{bd} value, increasing the accuracy of the returned values from the Fulcrum Theory by an order of magnitude
- Created an intuitive User Interface enabling geologists to quickly and efficiently input data and receive results
- Allowed users to download a CSV file of all discharge data for a specific stream
- Included functionality to view analogue streams used in stream specific t_{bd} value calculations



Acknowledgments

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References

- Holbrook, John, and Hamdalla Wanas. "A Fulcrum approach to assessing source-to-sink mass balance using channel paleohydrologic parameters derivable from common fluvial data sets with an example from the Cretaceous of Egypt." *Journal of Sedimentary Research* 84.5 (2014): 349-372.
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