

Surface Water Supply Index (SWSI) Generator for DNR

Scope of Work

August 2013

1. INTRODUCTION

The Water Availability Task Force (WATF), chaired by the Colorado Department of Natural Resources (DNR) - Colorado Water Conservation Board (CWCB) and the Colorado Division of Water Resources (DWR) is contracting with the Open Water Foundation (OWF) to migrate Natural Resources Conservation Service (NRCS)-developed surface water supply index (SWSI) from the current Microsoft macro-enabled Excel technology to technologies that can be scaled to statewide implementation, are consistent with NRCS technologies, and allow migration to a web based tool ("Web-SWSI") in the future. The software will use data stored in NRCS databases via web services and the NRCS calculations for Colorado 8 digit Hydrologic Unit Codes (HUCs).

Ultimately, the Web-SWSI will be used by the WATF, State Drought Plan Impact Task Forces, and other stakeholders as input when making water management decisions. The SWSI Generator is an intermediate step that will allow DNR staff, or other interested stakeholders, to generate the SWSI using TSTool software installed on a PC, command files for each HUC, and a master command file that will run the calculations for each HUC and generate the output table. The TSTool software and command files will be built upon in the future to develop the Web-SWSI.

2. PROJECT DESCRIPTION

The eventual goal of this project is to develop a web-enabled display of (1) Colorado's SWSIs by HUC on a map and (2) display of the hydrologic data comprising each HUC's SWSI and a chart of the historic SWSI (back to 1980) for that HUC. Web-SWSI ultimately should be capable of being housed on the NRCS website. The tool should be developed in a manner so that potential future enhancements can be incorporated without significant redesign of the underlying tool or selection of new technologies. This should be accomplished by utilizing NRCS web services and using technologies consistent with NRCS standards.

State of CO and NRCS funding and other resources to achieve these goals is limited and may be made available in phases. Technology issues must be considered in a systematic way, so as to ensure that the final system meets requirements and integrates into operational systems, but also allows for incremental progress required by incremental funding. Consequently, it is recommended that the following phased approach be taken:

Phase 1 - Migrate the existing NRCS Excel-based SWSI calculation tool to a SWSI Generator that:

- is consistent with NRCS technologies (see Appendix A) and can be utilized by DNR staff
- can be implemented with incremental DNR funding while coordinating with NRCS at an appropriate level to facilitate future integration of work products
- allow DNR to run to SWSI analysis on desktop computers, both to generate results used in business processes and verify input and calculations
- allow migration to Web-SWSI in future phases (see next items below)

Phase 2 - Migrate the software from Phase 1 above to a web server environment to allow SWSI products to be provided over the web, including implementing a web application that:

- coordinate technology use with NRCS
- provides a map interface for SWSI Hydrologic Unit Code basins
- allows users to select and view SWSI products

Phase 3 - Integrate initial DNR-supported efforts into NRCS production environment:

- Coordinate migration of early phase efforts into NRCS production systems
- Enhance tools and processes as required

In addition to the above sequential phases (which may overlap to some degree), it will be necessary to provide support for SWSI tools and ideally encourage continued collaboration to respond to feedback from DNR, the WATF, and other users.

3. SCOPE OF WORK FOR SWSI GENERATOR

This project focuses on Phase 1 – SWSI Generator from the Project Description from above, which includes migrating the Excel-based SWSI tool to software that is consistent with NRCS technologies (see Appendix A). The approach described below will allow the Phase 1 work to be used in the short term by DNR in support of the WATF and be leveraged in later phases.

The NRCS utilizes Java technologies for its web servers and is interested in an open source software solution. The TSTool software developed for Colorado's Decision Support Systems (CDSS) is a mature Java application that provides extensive capabilities for time series processing, and has been selected for the SWSI Generator.

Because TSTool is a desktop application that is able to access NRCS, USGS, NCDC web services, it can be used to implement and test SWSI calculations by defining a command workflow. OWF will enhance the TSTool software as needed to implement SWSI calculations and will define command workflow templates. DNR resources can help validate SWSI implementation and integrate with its business processes, such as support of the WATF. Specifically, the following activities will be performed by DNR staff, with input from NRCS as appropriate:

- Provide to OWF test data sets
- Provide list of HUCs, with reservoirs and streamflow locations for SWSI calculations
- Attend scheduled meetings meeting
- Install and test delivered software
- Manipulate tabular output files to generate any charts, graphs, or maps desired.

The following tasks will be completed by OWF to complete this project.

3.1 Proof of Concept – Automate SWSI using TSTool for St. Vrain HUC (1019005)

- 3.1.1 If not already available, implement data access features in TSTool for inputs to SWSI calculations, using web services. It is assumed that any limitations in data access at the NRCS will be overcome with support from NRCS technical staff.
- 3.1.2 Develop command file to generate St. Vrain HUC SWSI using stations listed in Appendix B for October 1979 through present.
- 3.1.3 Confirm values match with NRCS historic calculations (October 2010 through May 2013) (listed in Appendix B).
- 3.1.4 Generate output file based on template included in Appendix B.
- 3.1.5 Demonstrate software performance and output to DNR either in person or via conferencing software.
- 3.1.6 OWF will not proceed further in SOW without approval from DNR.

3.2 All HUCS SWSI Generator

- 3.2.1 Calculate historical monthly SWSIs for October 1979 to present using the list of stations (streamflow forecast, actual streamflow, and reservoir storage) for each Colorado HUC based on the documented NRCS methodology in “Transition from State Engineer SWSI to NRCS SWSI”, dated July 9, 2013” (in both nonexceedance probability and -4 to +4 scale), by accessing NRCS web services. The period of analysis is not limited by TSTool functionality but by the data limitations and level of effort to study and overcome such limitations. Output format will be tabular time series matching the template included in Appendix B (e.g. CSV file or Excel).
- 3.2.2 Implement automated tests to compare TSTool-generated SWSIs to those previously generated by the NRCS Excel spreadsheets to ensure they match (oldest Colorado SWSI calculations are November 2009). TSTool includes a test framework that is used to perform such tests to validate software prior to software release. TSTool can read from Excel and consequently it will be possible to automate the comparison using the existing Excel SWSI workbooks, although some changes may be needed to facilitate data access in the workbooks.
- 3.2.3 Develop TSTool command files and master command file (to run each HUC command file for Colorado in sequence) to automatically generate future monthly SWSIs using the NRCS methodology.
- 3.2.4 Document how DNR can perform the SWSI analysis with TSTool and extend the period of the analysis on a monthly basis as needed.
- 3.2.5 Develop a mechanism for substituting data (such as a monthly average) when data are not available from NRCS and flagging the substitution on the display, consistent with NRCS SWSI calculation methodology. TSTool includes features to flag data values during processing and there are commands for estimating and filling data. Flagged values can be displayed on graphs and in tabular data products. The TSTool data flagging and substitution will be implemented in template command files.
- 3.2.6 Develop mechanism where the list of stations in a particular HUC SWSI calculation can be modified by DNR staff by modifying a text file or spreadsheet, rather than by

manipulating code. TSTool is able to read lists of locations and time series from Excel files, delimited files such as CSV, and database tables. OWF will discuss with DNR the appropriate data formats to use for station lists and will implement in the SWSI command file templates.

3.2.7 The following deliverables will be provided to DNR:

- TSTool software to perform SWSI calculations, including updated software and documentation.
- Command files for each HUC SWSI calculation and master command file for HUCs where input data have been provided by DNR
- Data files for automated tests.
- Documentation explaining how the command files work and how DNR staff can run TSTool to perform the SWSI calculations.
- Table of historic SWSIs back to water year 1980.

3.2.8 Based on the above deliverables, OWF will respond to DNR feedback to adjust the deliverables to meet the intent of the SOW.

3.3 SWSI Generator Workshop

3.3.1 After completion of Task 3.2, OWF will meet with DNR staff in person to discuss the software and SWSI implementation (2 hour meeting). This meeting is intended to discuss both the implementation to date, required refinements to complete the SOW, and direction forward in future phases. Attendance may include DNR, WATF, and other persons, at DNR's discretion. OWF will provide support to install the software on other computers; however, one-on-one training will be provided only to key DNR staff, as initiated in the previous task.

3.3.2 Feedback will be recorded and discussed to determine which items can be completed within project budget and schedule.

3.4 Respond to Feedback & Support

3.4.1 OWF will update the TSTool software, SWSI calculation templates, and documentation based on feedback from the workshop and subsequent two week period, and will provide updates to DNR.

4 PROJECT ADMINISTRATION & MEETINGS

4.1 Proof of concept meeting (2 hours max) to confirm approach and SWSI understanding. Appropriate DNR and NRCS staff (Jim Marron) will be included in the discussion, using internet conferencing if necessary/possible.

4.2 SWSI Generator Workshop (2 hours max) at DNR.

4.3 The Project will be under the direction of the WATF chairs under a contract with CWCB. Monthly status calls will be scheduled with the DNR project manager to provide information about the development and to respond to feedback on deliverables.

4.4 DNR will be responsible for developing maps and other graphics using the tabular output file.

5 PROJECT SCHEDULE & PERFORMANCE OBJECTIVES

The project and all components must be completed by March 28, 2014 according to the following benchmarks:

- Contract award expected September 1, 2013
- Completion of Task 3.1 by 45 days after signed contract
- Completion of Task 3.2 within 4 months of signed contract
- Completion of all Tasks within 7 months of signed contract

Payment will be upon completion of each task, as follows:

Task 3.1 - \$7,000

Task 3.2 - \$10,000

Task 3.3 - \$2,000

Task 3.4 - \$1,000

Appendix A

NRCS technical information:

- 1) User Interface Technologies: Java Server Faces (JSF), JSP, Applets
- 2) JSF Component Libraries (open source): PrimeFaces, RichFaces
- 3) Database: SQL Server 2008
- 4) Object Relational Mapping tool (ORM): Hibernate

Standards:

- 1) Language = Java
- 2) IDE = Eclipse
- 3) Build tool = ANT
- 4) Source control = SVN
- 5) Web Server = Apache
- 6) App Server = JBoss
- 7) Web Server to App Server bridge = JKMod
- 8) Database = SQL
- 9) Database bridge = Hibernate
- 10) Component libraries = Open Source
- 11) Map server (for HUC and other map layers) = to be determined
- 12) JavaScript web mapping package = to be determined

Appendix B – Proof of Concept Information

St. Vrain HUC (1019005) Stations

RESV	GROSS RESERVOIR	6016130
RESV	MARSHALL RESERVOIR	6016220
RESV	TERRY RESERVOIR	6016290
RESV	UNION RESERVOIR	6016300
STRM	BOULDER CREEK NEAR ORODELL	6727000
STRM	SAINT VRAIN CREEK AT LYONS	6724000
STRM	SOUTH BOULDER CK NR ELDORADO SPRINGS, CO	6729500
RESV	RALPH PRICE RESERVOIR	6016260

St. Vrain Historic SWSI

Water year	oct	nov	dec	jan	feb	mar	apr	may	jun	jul	aug	sep
2012	3.70	3.41	3.52	-1.18	-1.33	-0.97	-2.84	-3.79	-3.40	-3.85	-3.75	-3.72
2013	-2.81	-2.51	-1.72	-2.22	-3.01	-3.04	-3.01	-2.20				

Output File Template

HUC	HUC_Name	Month	Year	SWSI_Palm	SWSI_Pct	ResA_Code	ResA_Name	ResA_Vol	ResA_Pct	ResB* ...	Strm1_Code	Strm1_Name	Strm1_Vol	Strm1_Pct	Strm2 *...
1019005	St. Vrain	5	2013	-2.1	25	6016130	Gross	10000	55		6727000	BOULDER CREEK NEAR ORODELL	15000	22	

* The number of reservoir and stream stations included in each HUC varies