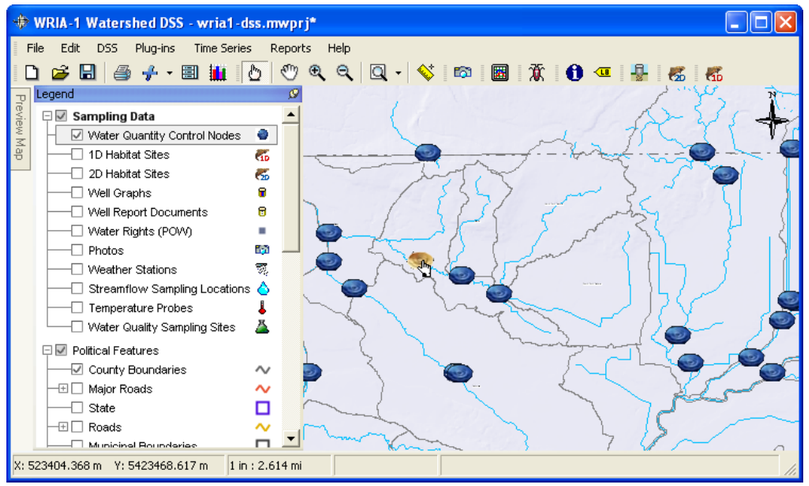
is part of this plug-in that lets the DSS user plot one parameter at multiple sites or multiple parameters at a single site. As with the Scenario Builder, the options selected by a DSS user for data plotting and analysis in a drainage can be saved and exported for future use or consideration in decision-making or community meetings.

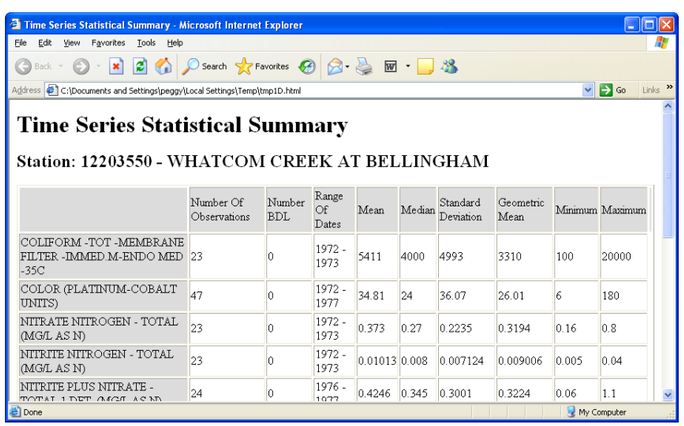


✱ *1D and 2D Habitat Viewer*

There are two separate DSS plug-ins that allow the person operating the DSS to view and query information on the effects of different stream flow regimes to fish habitat. Whether you select the 1D or 2D Habitat Viewer depends on if you are interested in information associated with a rapid or intensive sampling site, both of which were part of the technical field work completed during Phase II. This tool is similar to the Time Series Analyst in that it provides multiple options for plotting and displaying technical data. The type of data that can be viewed in the Habitat Viewer includes predicted stream flows, species to species comparison for habitat suitability, fish distribution, and stream discharge information.

✱ *Other DSS Viewers*

The DSS includes additional plug-ins for viewing information. These viewers include a Well Log Data Viewer, Macroinvertebrates Data Viewer, Periodicity Viewer, and Photo Viewer. These plug-in viewers are accessed through the DSS toolbar, and provide the user with the ability to view well log documents, type and distribution of macroinvertebrates sampled during the Phase II technical studies, information about the presence of fish at different times of the year, and digital photographs taken at locations throughout the watershed.

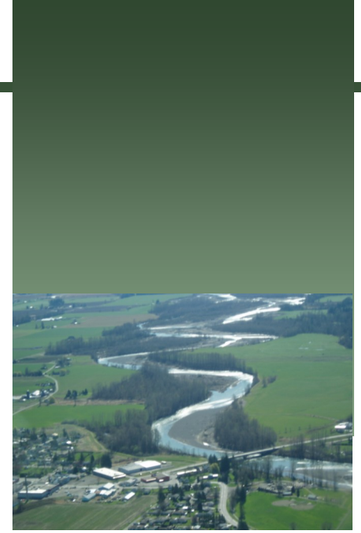


	Number Of Observations	Number BDL	Range Of Dates	Mean	Median	Standard Deviation	Geometric Mean	Minimum	Maximum
COLIFORM -TOT -MEMBRANE FILTER -IMMED M-ENDO MED -35C	23	0	1972 - 1973	5411	4000	4993	3310	100	20000
COLOR (PLATINUM-COBALT UNITS)	47	0	1972 - 1977	34.81	24	36.07	26.01	6	180
NITRATE NITROGEN - TOTAL (MG/L AS N)	23	0	1972 - 1973	0.373	0.27	0.2235	0.3194	0.16	0.8
NITRITE NITROGEN - TOTAL (MG/L AS N)	23	0	1972 - 1973	0.01013	0.008	0.007124	0.009006	0.005	0.04
NITRITE PLUS NITRATE - TOTAL 1 DET (MG/L AS N)	24	0	1976 - 1977	0.4246	0.345	0.3001	0.3224	0.06	1.1

The Reading Room: Recent Releases

In addition to the beta version of the WRIA 1 Decision Support System, the recent delivery of technical work products from Utah State University included several technical reports and memorandums. The reports include documentation of the model development and calibration, user manuals for the DSS, technical documentation describing data sets and fields for the models, and other relevant information. These documents are preliminary drafts, and can be reviewed at Whatcom County Public Works, Water Resource Library, 322 N. Commercial, Bellingham, WA. For more information on the WRIA 1 DSS contact Terry Holland at Whatcom County Public Works, 676-6876. For information about the technical reports, contact Peter Gill, Whatcom County Planning & Development Services, 676-6907 ext. 50263.

http://wria1project.whatcomcounty.org



WRIA 1 Decision Support System

A Model-Based Tool to Inform Water Management Decisions

A major element of the WRIA 1 Watershed Management Project Phase III technical work contracted to Utah State University is the construction of a spatially based modeling tool called a Decision Support System (DSS). The Decision Support System, or DSS, is essentially a library of computer programs and databases that work together to manage and report information about water quality, stream flows, and fish habitat. Planners, decision-makers, professionals, and the community can use the information to identify and compare different options for managing water resources.

At the heart of the DSS are three large models- surface water quality, surface water quantity, and instream flow/fish habitat- and a series of custom “plug-ins” that work together to perform a variety of functions. The face of the DSS is a user-friendly interface called MapWindow GIS, which includes typical GIS applications and access to the plug-ins that analyze water quality and quantity data, display data, and create scenarios.

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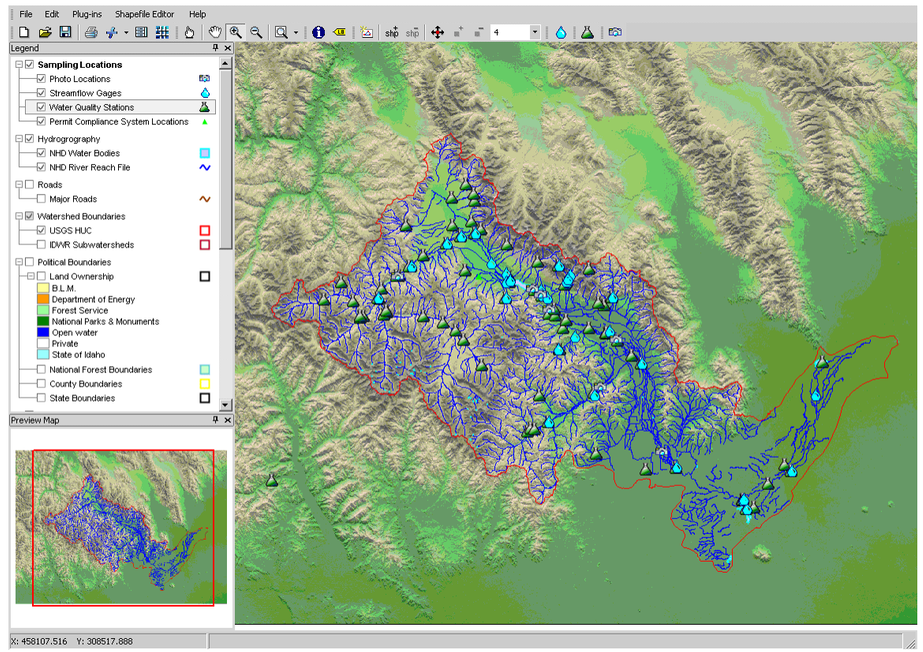


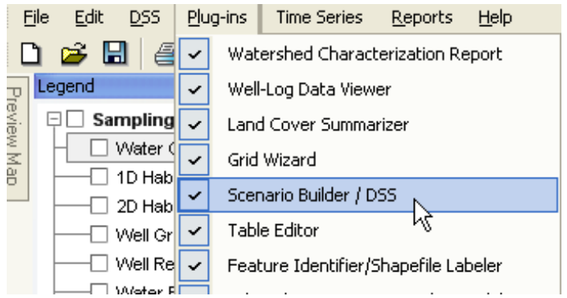
Behind the Curtain: the WRIA 1 DSS

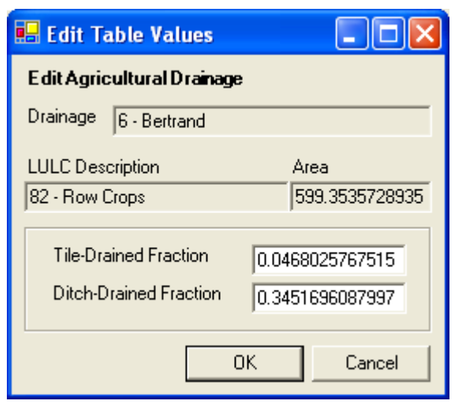
While the user of the WRIA 1 Decision Support System (DSS) sees a user-friendly screen when operating the DSS, there is a complex software system grinding away in the background doing mathematical computations to simulate and predict conditions to inform decision-making. The different elements of the system that make up the DSS include the following:

- *GIS Viewer and Editor*
- *Database Manager*
- *Scenario Builder*
- *Land Cover Change Scenario Element*
- *Water Quantity Model Interface*
- *Lake Whatcom Water Quality Model Interface*
- *WRIA-Wide Water Quality Model Interface*
- *Periodicity Viewer Plug-In*
- *Habitat Time Series Model Interface*
- *Temperature and Dissolved Oxygen Flags Model Interface*
- *Time Series Data Analyst Plug-In*
- *Photo Viewer Plug-In*
- *1D Habitat Viewer Plug-In*
- *2D Habitat Viewer Plug-In*
- *Macroinvertebrate Data Viewer*
- *Well Log Data Viewer Plug-in*
- *Watershed Characterization Report Generator*

While the DSS is a powerful tool, it does have some limitations. The scale and resolution of the underlying models influences the models' results. For example, the surface water quality model for streams is a coarse resolution model that provides information at the outlet of a stream rather than at any point along a stream's reach. This means that if the user of the DSS is interested in comparing two different options to reduce bacteria entering a tributary to see which one option has a greater benefit to water quality, the comparison will be made at a scale that includes the entire drainage rather than the specific location where the practice is put in place.

Another limitation of the DSS and underlying models is the availability of existing data. Since the models rely on data to predict results or simulate different conditions, the certainty associated with the DSS will vary depending on the data available in a given area. If the drainage area selected has an extensive data set, there will be greater certainty with those results than an area with very little data. The certainty can improve over time, however, since the database that is part of the DSS is constructed in ways that allow the DSS administrators to update it as new data becomes available.





The WRIA 1 Decision Support System Tools

The WRIA 1 DSS includes several different tools that can be used to inform decision-making and community discussion of options for managing water. Two of the primary tools are the Watershed Characterization Report and the Scenario Builder. While the Watershed Characterization Report Generator provides "static" information about selected watersheds, the Scenario Builder allows users of the DSS to build scenarios to answer "what if" questions around managing water resources. A number of viewers are incorporated in the DSS that are useful in displaying technical information. The intent of this brochure is to provide a brief description of the WRIA 1 DSS tools and viewers.

(Continued on page 3)

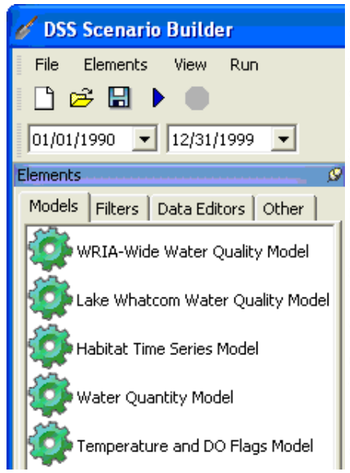
Funding to prepare and print the WRIA 1 Decision Support System summary document provided through Washington Department of Ecology, Grant No. GO6OO298 Phase IV Watershed Implementation grant.

- *Watershed Characterization Report Generator*

  The Watershed Characterization tool lets the DSS user select a watershed or a series of watersheds, and generate a variety of summary reports and maps. The reports generated can be saved as a PDF, Word document, or Excel spreadsheet. The items, or characteristics, that the user wants to display are selected from a menu and includes information about land cover, zoning, climate and weather, and fish use and habitat. The amount of information displayed will depend on whether that information is in the DSS databases. Since the underlying database for this DSS plug-in is updatable without changing the software system that connects the DSS underlying models, watershed information can continue to be added to improve the function of this plug-in.

- *Scenario Builder*

  This tool is for building "what if" scenarios. The person operating the DSS uses the Scenario Builder to assemble and combine elements from a menu to create different scenarios. The scenarios are run through the DSS to see how conditions change based on the elements selected. The elements that can be selected and simulated as part of a scenario include land cover changes, water right changes, best management practices, population, and water storage. Included in the Scenario Builder are model interfaces for the Water Quantity, WRIA Wide Water Quality, Lake Whatcom, and Habitat Time Series Models that allow the DSS user to incorporate these models into different scenarios. An analysis modeling system that is built into the Scenario Builder takes information from the prepared scenarios and converts it to the format the model needs to simulate conditions under the "what if" scenario. Once a scenario is run it can be saved and logged. Logging the scenario will provide information about the user running the scenario, the elements selected, and details about what actions the elements took. These scenarios can help inform decisions and community conversations about options for managing water.



- *Time Series Analyst*

  The DSS includes databases for water quality, climate, streamflow, and water temperature. The Time Series Analyst is a tool that someone running the DSS can use to view and analyze data for a selected watershed. This tool allows the user to select from a variety of options for plotting data and performing statistical analyses. There is a Multiple Time Series Analyst that

(Continued on page 4)

Under the Hood of the DSS

<u>The Water Quantity Model</u>

The Water Quantity Model is one of three underlying models fundamental to the operation of the DSS. The model is an enhanced version of an existing surface water quantity model called TOPNET. The enhancements programmed by Utah State University modelers enable the model to compute additional processes including irrigation, artificial drainage, impervious areas, snowmelt and evaporation. The model provides the mechanism for simulating conditions under different management scenarios that a DSS user creates in the Scenario Builder including changes in water use, land use, augmentation of stream flows, storage facilities, and water rights enforcement.

<u>The Water Quality Model</u>

The second of the three underlying models is the Water Quality Model, which includes two components: a Lake Whatcom model and a WRIA-Wide model. Both models predict the type and amount of pollutants entering the receiving water, and the effect of the pollutants on water quality. The information is computed at the drainage level using an estimated pollutant concentration based on the predominant land cover in the drainage. Flow information generated from the water quantity model is used in the water quality model.

<u>Instream Flow/Habitat Model</u>

The focus of this last of the three underlying DSS models is on predicting the relationship between stream flow and fish habitat for different fish life stages at selected locations through out WRIA 1.The 1D and 2D Habitat Modeling provides a comparison between observed fish species and life stage habitat at the 19 rapid assessment and 22 intensive sites established during the Phase II technical field work . The instream flow/habitat modeling also includes a Temperature and Dissolved Oxygen Flag plug-in that, when selected in the DSS, will flag these water quality parameters based on what fish need. As with the other two models, the instream flow/habitat related models rely on results from the other developed models as input into the models' predictions and calculations.