OREGON WATER RESOURCES DEPARTMENT

Surface Water Information Modeling System

Technical Advisory Group

Meeting #3 – Acknowledging Feedback

Purpose

This document summarizes feedback from members of the SWIMS Technical Advisory Group during meeting #3 on April 7, 2026, and describes how feedback will be considered during development.

Meeting procedure

The meeting began by following up on items that were discussed at the previous meeting and any additional work that was performed to address feedback. Then, overviews of four separate assessments and analyses were presented to briefly introduce background information, methods, results, and outcomes that were covered in detailed reports that were shared with TAG members prior to the meeting to prepare for discussion. Presentations were given during the first half of the meeting, then during the discussion portion TAG members provided feedback regarding the approaches taken to analyze and assess information, interpret results, and suggest modifications or further investigation that may improve or bolster results. SWIMS project team members engaged in discussion for clarification, but the focus was on obtaining feedback from TAG members.

Meeting theme

The theme of SWIMS TAG meeting #3 was to share and discuss assessments and analysis to evaluate various products and techniques for establishing the modeling framework for SWIMS, including decisions related to the geospatial framework, data selection, modeling approaches, and how climate trends influence water availability. These topics are important for establishing foundational pieces of SWIMS and influence the usability of model output in decision making.

Feedback Summaries and Acknowledgement

Follow-up

Topics:

The following topics were revisited from the previous TAG meeting to discuss additional work that was done to address feedback from the previous meeting. See meeting materials from TAG meeting #2 for more detail:

- Hydrologic disturbance index to assess factors influencing gaged streamflow records.
    - Incorporated metric to quantify groundwater use in gaged watersheds.
- Stationarity analysis to assess the presence of trends in streamflow over time.

    - Assessed trends in streamflow and climate data in relation to different climatic oscillation variables to evaluate strength of results from initial analysis.
- Gap tolerance analysis to determine data requirements for modeling streamflow.
    - Performed analysis to identify shorter, climate-normal windows within the base period to expand available pool of gages providing flow data.
    - Conducted analysis to characterize typical patterns of missingness in real gage data.
- The project team shared a decision to not pursue the use of third-party streamflow data that has not been reviewed or published by Oregon Water Resources Department or the US Geological Survey.

Additional discussion questions:

The project team also proposed additional questions that arose between TAG meetings and were related to the theme of the previous meeting (i.e., streamflow data):

- What must be considered when evaluating naturalized mean daily flow records from other studies for use in model development?

Feedback summary:

There were no additional comments on any of the additional work that was done on topics from the previous meeting. There was interest in learning whether the decision to not use third-party streamflow records impacts the use of any other naturalized streamflow data set that was produced via another study. At least one TAG member encouraged the use of alternative naturalized flow data sets as long as the project team felt comfortable with development methods and that the information is representative of similar conditions described in the agency's definition of natural streamflow in the context of water availability.

Acknowledgement:

Regarding other naturalized flow data sets, the decision to utilize them would at least partially depend on whether the observed streamflow data that the naturalized data is based upon was reviewed and published by OWRD or USGS. The water availability modeling framework is anticipated to incorporate some degree of flow naturalization for some gaged streamflow records by accounting for factors like water use and storage to establish reference conditions for streamflow absent water management decisions (e.g., regulation). It is assumed that other studies are incorporating similar practices for similar reasons, meaning that the applicability of other natural flow records would depend on what reference conditions of other studies represent.

Geospatial framework

Topic:

An evaluation of several available data sets that provide information for establishing the geospatial framework of SWIMS. The geospatial framework is a critical element of the overall modeling system because it defines the digital stream network and watershed boundaries that are important for defining the coverage and resolution of the model. The project team is proposing the use of the National Hydrography Dataset Plus Version 2 (NHDPlus V2).

Discussion question:

- How does data availability constrain the ability to model at various scales?
- What are the differences in modeling at the catchment scale compared to the watershed scale?
- Do any products provide more stability in terms of their technical support or consistency with other hydrologic modeling efforts?

Feedback summary:

There were several comments related to the selection of a geospatial framework. One question was about whether misalignment between the current water availability basin framework incorporated into WARS and any alternate framework would create any issues regarding implementation of SWIMS and its effects on interested parties. Two other comments were related to the operability of NHDPlus V2. The first mentioned the development of an updated flowline network led by the Oregon Department of Forestry. The second was a suggestion to use the flow routing mechanism for NHD flowlines as opposed to that used by the associated watershed boundary dataset (WBD).

Acknowledgement:

The project team recognizes the need to evaluate impacts of a modified geospatial framework in terms of how it affects business needs of agencies who rely on water availability information and will engage with affected users (i.e., Oregon Department of Fish and Wildlife and Oregon Department of Environmental Quality). The project team initially recognized an issue with the routing mechanism in the NHDPlus V2 and will evaluate the use of the flowline routing mechanism to appropriately track the movement of water.

Environmental data

Topic:

This assessment evaluated datasets for potential inclusion in SWIMS to support natural streamflow prediction. These characteristics included climate variables, morphologic characteristics, soil and geology characteristics, land cover characteristics, hydrologic network characteristics, and fire-related variables.

Discussion question:

- Are there any data sets the TAG recommends?
- Are there any considerations we should be aware of with proposed datasets?
- Are there any variables or derived variables that you recommend?
- Do you have any suggestions for approaches on identifying key predictor variables?

Feedback summary:

Several TAG members mentioned or provided links to other datasets in the meeting chat. There was a particular mention of the usefulness of geologic characteristics when attempting to model streamflow in different hydrogeologic regions. For instance, when evaluating multi-model ensembles for streamflow prediction, certain systems were difficult to model until incorporating underlying geologic characteristics, such as percent composition of soils or geology. Classification and regression trees (CART) were suggested as a good approach for identifying key predictor variables, and the use of principal components analysis (PCA) was also mentioned as a reasonable method for combining variables and making the model more parsimonious.

Acknowledgement:

The project team was specifically interested in learning how to appropriately aggregate environmental data that represents geologic characteristics and will consider the material provided by one TAG member regarding the particular use of geologic characteristics when modeling streams in the Great Basin. CART will be evaluated as an approach for classification to distinguish between particular modeling categories or 'regions' and identify key predictor variables that are significant to each 'region'. The project team will also evaluate datasets mentioned by the TAG (Table 1).

Data Type	Host	Dataset	URL
SWE	University of Arizona	SnowView	https://snowview.arizona.edu/
Soil	California Soil Resource Lab	Soil properties	https://gee-community-catalog.org/projects/soilprop/
Soil	US Department of Agriculture	Soil landscapes	https://developers.google.com/earth-engine/datasets/catalog/USDA_SOLUS100_V0#description
ET	USGS ScienceBase	Historical evapotranspiration	https://doi.org/10.1029/2022WR034012 https://github.com/samapriya/awesome-gee-community-datasets/issues/419
ET (comparison)		Multiple	https://nwi-usgs.projects.earthengine.app/view/aet-explorer

Flow (ML example)	Headwaters Hydrology Project	Machine-learning streamflow estimates	https://doi.org/10.5281/zenodo.15021802
Flow (ensemble example)	NCAR	Daily hydrology and meteorology	https://doi.org/10.1038/s41597-026-06865-5 https://gdex.ucar.edu/datasets/d010014/

Modeling approach

Topic:

This assessment provided an overview of model-related choices to be made when developing the natural streamflow model, including model needs, statistical modeling approaches, regional stratification, feature selection, model performance criteria, and model selection procedures.

Discussion questions:

- Do any model approaches offer significant advantages over others?
- Are there other approaches that should be considered?
- What types of model selection criteria should be applied?
- How should regionalization be factored into the modeling approach?
- What methods do you recommend for selecting predictor variables?

Feedback summary:

TAG members mentioned several considerations to assist with strategizing the modeling approach, including mentions of machine learning, multi-model ensembles, model testing and evaluation, and extrapolation. While machine-learning methods are appealing, there are some limitations and trade-offs related to accessibility, interpretability, and reliability of results. Machine learning models are difficult to interpret in terms of how their mechanics influence results, more so than simple statistical approaches (e.g., regression), making them inaccessible (i.e., difficult to understand) for many interested parties. The TAG also mentioned cases where machine learning models 'hallucinate' or produce unrealistic results and have difficulty extrapolating beyond training data.

The TAG also highlighted the benefits of multi-model ensembles. The approach is flexible to accommodating results from models with different structures and offers error-cancelling capabilities as the number of models included increases. For instance, results from statistical and physical models could be aggregated to improve upon the results from just one of those two approaches. Artificial neural networks were mentioned as an additional modeling approach.

There was mention of the importance of a rigorous testing scheme to evaluate model performance. A TAG member suggested a more advanced approach to subsetting data, because a simple 50-50 split can result in elevated performance metrics. Splitting the data temporally by withholding streamflow data from particular months or years and spatially by removing certain watersheds can create complex testing schemes that improve model performance evaluation. Data splitting can also help assess model performance in situations where it must extrapolate beyond the training data.

Finally, it was suggested that the natural streamflow model should be constructed to estimate the streamflow at various percentiles of interest directly, as opposed to modeling a time series and computing the flow at different percentiles from that. The time series approach is likely to introduce greater amounts of uncertainty or error into results.

Acknowledgement:

One of the core values of the SWIMS project is to ensure that the model is accessible and interpretable to a broad range of audiences. While machine learning approaches are appealing, here are few instances of machine learning models acting as operational models for regulatory agencies. Some aspects of machine learning, such as underlying classification and variable selection algorithms, do address some of the challenges the project team was interested in learning more about from the TAG. As mentioned above, the project team will consider integrating the CART approach into the modeling effort.

An ensemble approach to modeling is appealing, considering the relatively simple procedure to aggregate results while potentially reducing errors. While the main goal is to select a single natural streamflow model, several models will be compared via model evaluation and selection procedure. This may provide an opportunity to evaluate the ensemble approach, though it may be beyond the scope of this project.

The model testing scheme is an important consideration for the project team as it relates to understanding model errors and uncertainty. It is expected that performance will vary both spatially (i.e., by watershed) and temporally (i.e., by month) but establishing a rigorous testing scheme will help identify weaknesses in the model and guide model updates in the future.

Climate impacts

Topic:

This assessment evaluated how observed climate trends and variability influence hydrologic modeling approaches used to estimate water availability, including implications for natural streamflow and consumptive use within the SWIMS modeling framework.

Discussion questions:

- How often should data be updated and the model re-calibrated to adapt to climate trends?
- How does the availability of various data sets affect updates to the model?

Feedback summary:

While discussion was relatively limited, there were a few key considerations to be aware of in terms of how climate variability and data availability can impact modeling efforts. First, there was a word of caution about attributing changes in natural streamflow to climate variability, particularly in areas where it coincides with land and water use. Next, a TAG member suggested that latencies in data availability (e.g., annual precipitation data) are typically short enough (e.g., a year or two) that they may not significantly impact future updates to the model or simply incorporating newer climate data into model predictions. There was also a suggestion to incorporate the ability to estimate water availability under future climate scenarios.

Acknowledgement:

The project team attempted to attribute changes in streamflow to climate variability by isolating particular gages that are less impacted by water use relative to other gaging stations. Land use was less of a consideration in gage selection for climate trend analysis because the focus of modeling natural streamflow is to estimate conditions assuming the absence of water management actions. While there may be some land use and/or modification in the gaged watersheds, it is likely relatively low compared to other sites that have more water use.

The project team has proposed a tiered list of strategies to adapt to a changing climate when developing the SWIMS modeling framework. This approach suggests routine updates to incorporate recent climate data as it becomes available without a major recalibration effort. Then, every so often (e.g., 5-10 years) model performance will be tested to reassess relationships and determine whether major revisions to the model structure are necessary.

While the project team recognizes the importance of understanding how future climate scenarios will impact water availability, it is not within the scope of this project. Future climate scenarios are often best performed using physical modeling approaches to isolate the impacts of particular aspects of a changing climate (e.g., reduced snowpack, warmer temperatures, etc.). Statistical models, on the other hand, are somewhat limited in their ability to project conditions. The project team anticipates relying on a statistical modeling approach but will evaluate the potential to incorporate climate projections as possible.