

2020 NASCIO Award Nomination — Data Management, Analytics & Visualization

Water Quality Assessment at Ecology

Realizing efficiencies in assessing Washington State's waters

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Sponsor:

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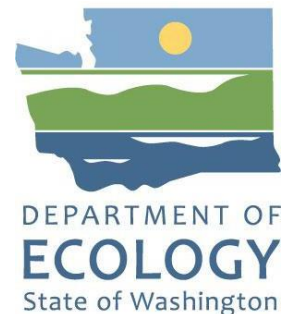
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Executive Summary

Automating the Water Quality Assessment process

The Washington state Department of Ecology (Ecology) is a regulatory agency with the mission to protect, preserve, and restore land, air and water for current and future generations. Ecology relies on science and high-quality data to drive decision making.

Ecology is required by federal law to perform a statewide assessment of all readily available environmental data related to surface water quality every two years. The information is used to determine whether Washington's waters are supporting their designated uses such as protecting aquatic species habitat or safe waters to recreate in.

The assessment, referred to as an "Integrated Report," has three sections:

- The status of all assessed waters.
- A list of impaired waters and the causes of impairment
- The status of actions being taken to restore impaired waters.

The Washington State Integrated Report forms the foundation for scientific-based monitoring and clean-up efforts. In addition, it is a determining factor in cleanup-related grant funding for municipalities and local governments.

The data assessment was previously done manually and required a growing amount of time and resources to complete. After a scoping effort, Ecology chose to build a custom tool (in-house) automating large portions of the assessment effort, making it possible to significantly reduce the amount of staff resources needed to produce a high-quality Integrated Report.

Benefiting from the efforts of the [National Water Quality Monitoring Council](#) and in cooperation with the [Center for Integrated Data Analytics \(CIDA\)](#), Ecology created a system that:

- Pulls environmental results from state and federal data repositories.
- Maintains location information (Assessment Units) to assess data within.
- Allows for robust data quality assurance.
- Automates large portions of the assessment process.
- Provides an output that integrates with EPA's "ATTAINS" data structure.

The Water Quality Assessment system streamlines the assessment of Washington State's waters. In addition to improving the quality of the data and subsequent analysis, the automated system is expected to free up staff to spend more time on other important environmental issues including ocean acidification, micro plastics and climate change. This is a great example of how technology can improve our ability to help protect the environment.

Concept

One of the many ways in which Ecology pursues its mission of protecting, preserving, and enhancing Washington state’s environment for current and future generations is with the creation of the [Clean Water Act](#) Integrated Report, in collaboration with the Federal Environmental Protection Agency (EPA). This Integrated Report is a biennial assessment of Washington State’s fresh and marine surface waters. These assessments are submitted to the EPA and become foundational pieces of information driving many regulatory and cleanup initiatives to protect Washington’s environment.

The Task

The Washington State Water Quality Assessment, or Integrated Report, is mandated by the Clean Water Act to meet sections 303(d) and 305(b) of the Act. Our agency assesses water quality data from sample locations grouped by waterbody segments. These segments are assigned one of five categories ranging from Category 1 “Meets tested standards” to Category 5, the 303(d) “list of polluted waters.”

Water Quality Assessment Categories

- Category 1** – Meets tested standards-considered clean for that parameter.
- Category 2** – Water of concern-some data indicates concern.
- Category 3** – Insufficient data available to make a category determination.
- Category 4** – Pollution problems exist but are actively being cleaned up.
- Category 5** – 303(d) list of polluted waters.

Figure 1 water quality assessment categories.

The Issue

The federal Clean Water Act requires an Integrated Report every two years, and, historically, our state’s Water Quality Assessments have been overdue by several years because most of the work had to be done manually. If Washington does not produce a timely Assessment and 303(d) list, the EPA must produce one on behalf of the state. The state’s discretion on how waters are placed on the 303(d) list would be forfeited, were this to happen, leading to inefficiencies and potential errors.

Many regulatory and environmental clean-up decisions within Washington state are based on the latest Integrated Report. Stakeholders need high quality information in a timely manner to make informed decisions.

Delays in getting the Assessment out means the Integrated Report is potentially years out of date the moment it is finalized. Many stakeholders, who rely on the Integrated Report to have up-to-date and accurate information, have expressed frustration.

The Problems

Many factors contributed to the Washington State Water Quality Assessment process being a slow and arduous effort:

- **Increased data volume:** The last manual assessment was performed in 2012. Approximately 10 million environmental results were available for that assessment period. With the increased reliance on continuous (time-series) data, the 2018 automated assessment will have approximately 110 million environmental results available for the most recent assessment period.
- **Inconsistency in valid values across data sources:** Ecology's primary data source for the assessment is the Environmental Information Management (EIM) system. EIM is the agency's repository for environmental results and is contributed to by both internal and external data submitters. Previously and on an ad-hoc basis, Ecology would pull data from various external data sources and accepted data submittals (outside of EIM), specifically for Assessment purposes. Part of our mandate is to assess "all readily available data." Unfortunately, that mandate presents challenges with the variety of data formats needing to be managed. Cross-walking multiple data sources to ensure consistency in data for assessment is time-consuming.
- **Data quality and review:** Before we can use environmental results within the Water Quality Assessment, data needs to meet minimum credible requirements. Ecology reviews the water quality data to ensure they were collected using sound scientific methods. All sampling and analysis must have been conducted under a documented quality-assurance project plan or other quality-assurance procedures. The quality of data from all "readily available" sources varies greatly. This quality assurance represents a substantial workload.
- **Assessment Units, Designated Uses, Standards, and criteria:** Waterbody segments and areas, called assessment units; designated uses; water quality standards; and water quality criteria must be associated and assessed against to help protect water in Washington State by setting pollution limits. Water quality standards are the backbone of our regulations and describe the water quality necessary to protect lakes, rivers, and marine waters for "designated uses," such as protecting the health of people and other species and to control pollution.

Managing all of those dynamic and distinct datasets (Assessment Units, Designated Uses, Standards, and Criteria), as well as creating relationships between them, was historically a largely manual process.

The Solution

Ecology's Information Technology (IT) and subject-matter-expert team set out to develop a solution for scientists and policy managers to perform consistent, timely, and high-quality Assessments.

A business analysis effort collected and documented requirements and identified areas for improvement. The solution would need to:

- Pull all environmental results in a consistent manner.
- Associate Assessment Units, Designated Uses, and water quality criteria spatially.
- Review data quality and flag data not meeting standards.
- Automate assessment logic.
- Report results formatted for EPA's ATTAINS data repository.

The same subject-matter experts responsible for producing the a new Integrated Report for the EPA were also responsible for developing the new, automated system at the same time. Their hard work paid off in December 2019, with the release of the Water Quality Assessment (WQ Assessment) application.

The Impact

With the click of a button, the new application automatically pulls information from Ecology's EIM database and the federally sponsored Water Quality Portal (WQP), standardizing disparate data structures, and applying all defined data quality assurance rules.

Further, these reliable data repositories have been determined to meet the Clean Water Act requirements to assess "all readily available data."

For the current assessment, the WQ Assessment application pulled more than 110 million records and made them ready for subject-matter-expert review. The application provides a data review interface that allows manual quality-assurance determinations. These will be retained and used to increase dataset quality for subsequent assessment cycles.

Our team developed an integration application that automatically maintains the relationships between Assessment Units, Designated Uses, and both numeric and narrative water quality criteria using ESRI's ArcGIS for Developers drawing from multiple maintainable spatial datasets. This combined spatial dataset is pulled into the WQ Assessment application,

allowing appropriate statewide Designated Uses, standards, and criteria to be related and applied to the assessable environmental results collected from EIM and WQP.



Figure 2 spatial representation of assessed surface waters and their assigned categories

Assessment logic for various pollutants is automated in a consistent and defensible manner, on demand. Results are made readily available, viewable with standard office software, and are easily submitted to the EPA ATTAINS system after review.

The development of the WQ Assessment application was a challenging effort, but the efficiencies gained have us energized. Ecology is looking forward to presenting these assessment results to various stakeholders every two years, with an on-time Integrated Report. We are confident that we will comprehensively and efficiently meet our Clean Water Act requirements in the future, and that this will benefit Washington State’s environment for years to come.