GIS, GPS, and Lasers: Field Crews Assess the State of Northwestern Watersheds

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Mark Isley, AREMP Data Manager

↓ Field crews use a laser and prism setup from Laser Technology, Inc., to capture precise measurements of river and stream morphology, which are fed directly into a GIS.

Human activity such as logging and road building inevitably transform our environment, but federal agencies are collaborating to evaluate, protect, and restore some of the most vital and sensitive areas. Riparian zones—from the Latin word *ripa*, meaning riverbank—refer to rivers, streams, and surrounding land. They serve as habitats for diverse flora and fauna and have far-reaching influence on soil and groundwater conditions. When outside influences turn a lush, shaded, slow-moving stream into a barren chute, for example, the entire watershed can be impacted, and invasive species can take over.

The Northwest Forest Plan helps ensure that scenarios like that are avoided—and even reversed. The plan's policies and guidelines empower agencies to work together toward more sustainable management of federally owned lands that span from Northern California to the Canadian border. In the crucial area of watershed conservation, their efforts are informed by comprehensive reports prepared through the Aquatic and Riparian Effectiveness Monitoring Plan (AREMP).

The AREMP team surveys over 250 riparian sites and analyzes hundreds of environmental and human factors in GIS to assess ecosystem conditions, identify areas of concern, and measure the effectiveness of restoration projects. From offices in Portland and Corvallis, Oregon, employees of the US Forest Service and US Bureau of Land Management work with adventurous seasonal field crews to get the job done.

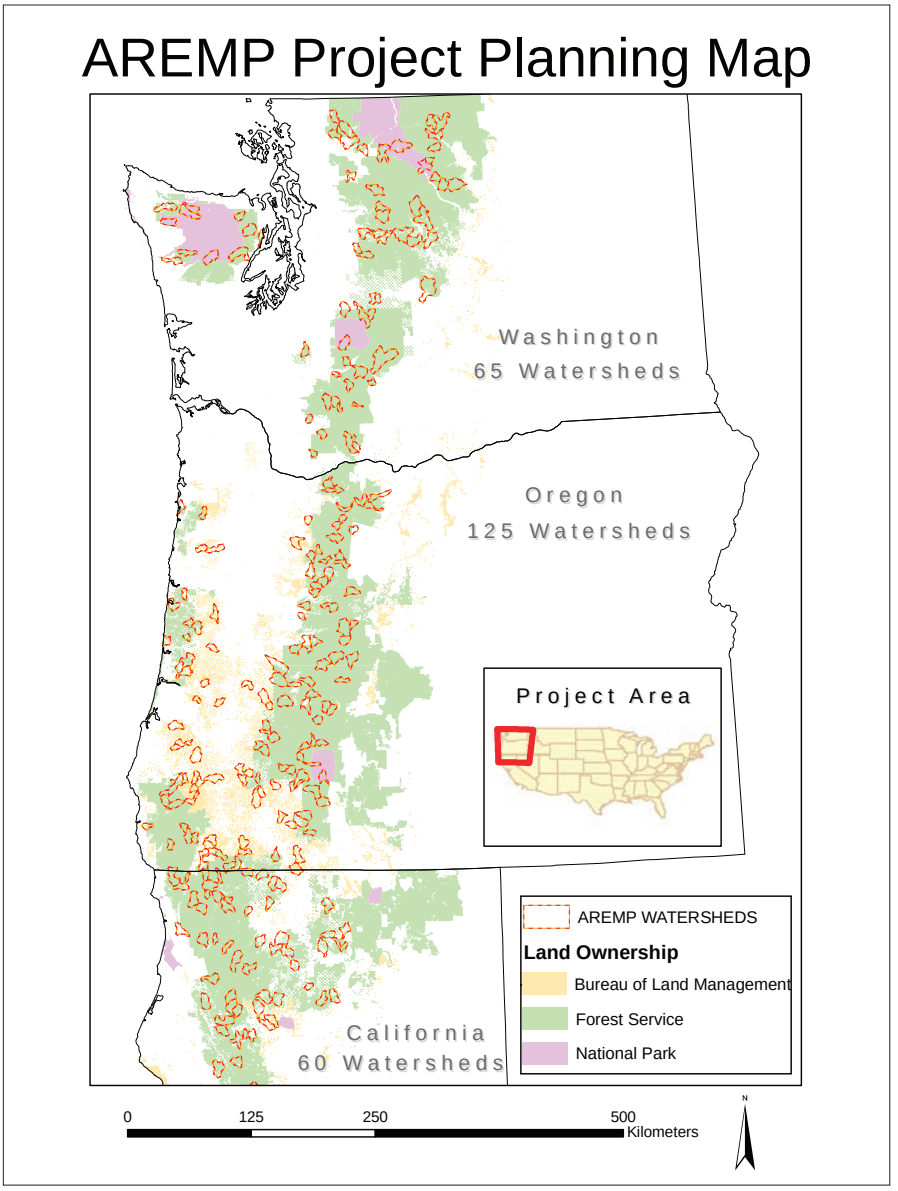
Each summer, four to six crews of three to six members set out to sample 25 watersheds on a 10-year rotation. They measure a variety of attributes, including vegetation, road networks, the shapes and sizes of streams and rivers, and biological factors such as the types of fish and amphibians present. The result is an overall score for each watershed that reveals its health and enables comparisons with previous conditions and surrounding areas.

The AREMP team's findings help inform a variety of National Forest Plan efforts. Near Roseburg, Oregon, for example, before riparian zones were protected, logging activity resulted in decreased amounts of woody debris, altering the streams and making them less hospitable to the salmon that once thrived there. In cases like that, federal or regional government organizations sometimes place trees and branches in riparian zones to help build up substrate levels to create better fish habitats. Upon returning to the sites like the ones in Roseburg, field crews find that the restoration work did in fact result in increased numbers of fish and better overall scores.

The AREMP team also helps alleviate problems with invasive species. When team members come across nonnative species as they collect samples, the appropriate government organizations are informed so they can take immediate action before the problem worsens.

After visiting 4 to 10 sites within a watershed, the crew moves on to the next. To get to remote sites in places like Olympic National Park in Washington, which has some of the highest watershed scores due to limited human activity, crews must hike 10 or more miles. In some

→ Each decade, 250 sites are surveyed between Northern California and the Canadian border. The data collected is combined with other spatial datasets and remotely sensed imagery and analyzed in a GIS to better understand the conditions of northwestern watersheds.



cases, horses are used to help transport surveying gear to especially rugged sites. They work from May through September, with some special monitoring projects extending into October.

A key piece of the fieldwork that lays the groundwork for the surveys is measuring river or stream morphology: the width, depth, and path of the water and how it changes over time. To take accurate measurements, two crew members work together using a laser and prism setup from Laser Technology, Inc., called the Impulse Laser, which is waterproof and can be mounted for extra stability on rough terrain. Measurements are immediately displayed on a backlit LCD display to ensure accurate readings in shady environments like riparian zones.

A built-in serial port brings the laser data directly into surveying software running on Esri's ArcPad platform on rugged handheld devices, which also record the location via a GPS sensor in the device. These measurements create a map within the surveying software, providing context for each site study. In the meantime, other crew members measure shade levels; sample for amphibians, invasive species, and small invertebrates like snails, worms, and crayfish; and collect other data that is input once the site map is established.

Future enhancements to the system may include customized data input forms that automatically appear when a laser measurement is taken. These forms would be specific to AREMP work and would include fields for common riparian features such as sandbars.

"The laser works together with everything else to give a lean interface and streamlined workflows," says AREMP data manager Mark Isley. "Sometimes we'll be measuring channel widths that are a meter or meter and a half wide with a depth of 10 to 15 centimeters, so that kind of highly accurate information in terms of the laser offsets is important to us."

To determine monitoring site locations, the AREMP GIS team starts with USGS watershed data to define the full project areas and then brings in stream and river data from the national hydrologic dataset. The resultant map is matched up with the EPA's nationwide layer of randomly selected points suggested for environmental analysis, and points that lie along riparian areas are identified as potential sites for the crews to assess. The options are then refined to only the watersheds with at least 25 percent of their stream channels lying within federal land and further refined to 250 watersheds that contain at least four accessible sites for the field crews to sample.

Selecting from the EPA's suggested points helps ensure that AREMP monitoring locations represent a truly random selection of the Northwest Forest Plan area. Because other agencies and organizations also use this criterion to select study sites, AREMP findings contribute to richer overall intelligence about the sample areas and can help inform other environmental efforts.

Along with the data collected in the field, the GIS team brings in additional datasets—including remotely sensed imagery—to analyze key riparian factors across full watersheds, such as upslope, miles of road within riparian areas, and the frequency of roads crossing streams. All this information results in a comprehensive picture of the health of northwestern watersheds.

The AREMP team's hard work has not gone unnoticed. It's received a Riparian Challenge Award from the American Fisheries Society and a National Interagency Service First Award for its collaborative, multiagency projects that support the success of the Northwest Forest Plan.