Connecting Hydrologic Research and Management in American Samoa through Collaboration and Capacity Building

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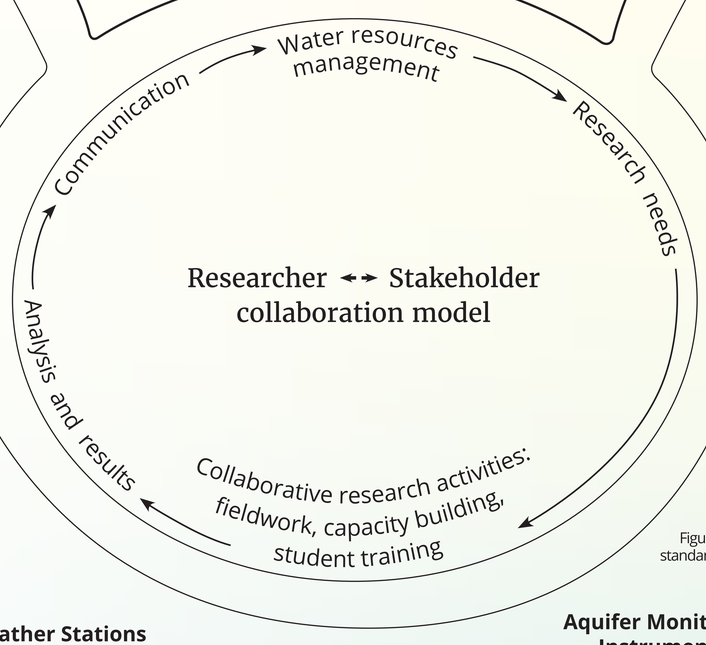
Introduction

Small island developing communities such as the U.S. Territory of American Samoa, are often faced with critical challenges in water storage and management. In American Samoa these challenges include: salt-water-intrusion, surface water contamination of drinking water, and a lack of information about human water quality impacts on fragile coastal ecosystems. The remoteness and small scale of the Territory encourages a collaborative approach between scientists and local stakeholders, where water resource managers benefit from timely locally driven science, and stakeholder input helps researchers target topics that address high-priority needs.

This poster presents three case studies that exemplify how our research group has implemented a collaboration-focused water science program in American Samoa. We do not see research as a one sided activity; instead we seek opportunities to build local capacity, develop relationships with key on-island stakeholders, and involve local community members whenever possible.



Case study

Research driven management for coral reefs

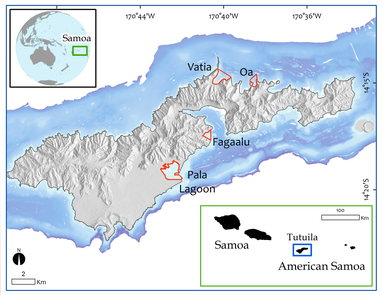


Figure 1: Map of Tutuila Island and specific locations where we quantified SGD and the effects of human land-use on coastal water quality.

Need - Vulnerable coastal ecosystems may be impacted by nutrients or sediments from human activities. While riverine inputs are monitored by resource managers, inputs via submarine groundwater discharge (SGD) remain unconstrained.

Activities – We are working to quantify SGD nutrient flux and groundwater-stream interactions in multiple watersheds (Fig. 1). Additionally, we are collaborating with the American Samoa EPA on a Ridge-to-Reef water quality assessment project.

Results – In coastal watersheds, we have observed SGD to be an important nutrient delivery mechanism (Fig. 2). The Ridge-to-Reef project is continuing to assess the potential for applying local water quality standards to SGD.

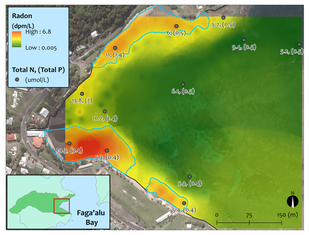


Figure 2: Concentrations of nutrients and distribution of dissolved ^{222}Rn, a natural groundwater tracer, in Fagaalu Bay. We use this method in multiple watersheds to quantify SGD rate and associated nutrient loading.

Case study

Hydrologic monitoring for research and resources management

Need - In 2008 the USGS stopped hydrologic monitoring operations in American Samoa. Yet climactic, surface water, and aquifer condition data is still needed by researchers, water managers, and other agencies.

Activities – UH-WRRC and American Samoa Power Authority (ASPA) initiated a cooperative agreement in 2015 for installation and long-term maintenance of an island-wide hydrologic monitoring network (Fig. 4). We currently use data to develop water budget and groundwater models.

Results – Weather data from 7 stations is available online at (http://www.aspower.com/Water-ASPA-weather-station-data.html). Stream gauges produce hydrographs at 15 minute intervals (data available upon request). We are currently testing systems for telemetered aquifer monitoring at production and observation wells.

Figure 3: Chris Shuler (UH-WRRC) and Katrina Mariner (ASPA hydrogeologist) installing a weather station in 2015.

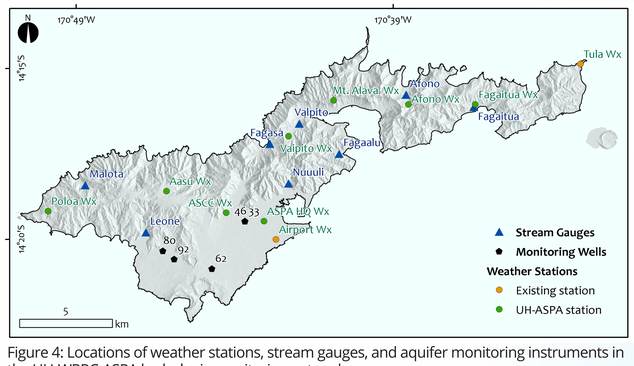


Figure 4: Locations of weather stations, stream gauges, and aquifer monitoring instruments in the UH-WRRC-ASPA hydrologic monitoring network.

Weather Stations

We are testing three types of weather stations for their long-term durability in American Samoa. All stations in the network measure rainfall, temperature, relative humidity, wind, and solar radiation.

Figure 5: Matt Erickson (ASPA technician) downloading a weather station.

Stream Gauges

We installed eight continuous-measurement stream gauges throughout the island to measure stream discharge. These currently are the only operational stream gauges on the island.

Figure 6: Developing rating curves for a stream gauge in Afono watershed.

Aquifer Monitoring Instruments

We are field testing instruments to monitor water levels and conductivity (a proxy for Cl^- levels) in both production wells and observation wells. Ultimately the instruments will be connected via telemetry to an ASPA SCADA system.

Figure 7: Joe Fackrell (UH-WRRC) deploying a monitoring well instrument.

Case study

Student help in solving priority drinking water issues

Need – Parts of Tutuila have been under a boil-water advisory since 2009 due to surface water contamination in wells. Determining the contamination mechanism (Fig. 13) may assist with management of the problem.

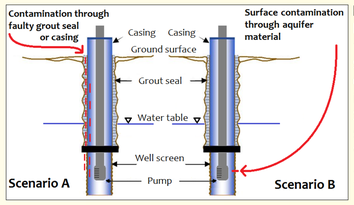


Figure 13: Possible mechanisms for surface water contamination in wells. Scenario (A) shows surface water (*red lines*) traveling through a poorly sealed grout or well casing, while Scenario (B) shows how surface water may reach a properly sealed well through highly-permeable aquifer matrix.

Activities – We used environmental tracers to assess recharge timing. These included microbial samples taken with the assistance of local community college (ASCC) and high school student interns (Figs. 14 & 15), and turbidity data provided by AS-EPA (Fig. 12).

Results – Available data suggest contamination travels through the aquifer matrix. We continually communicate results to the island's water utility.

Figure 14: ASCC student intern Jennet Chang analyzing microbial samples with Dr. Randy DeWees.

Figure 15: ASCC student intern Rocco Tinitali taking well samples with assistance from ASPA staff.

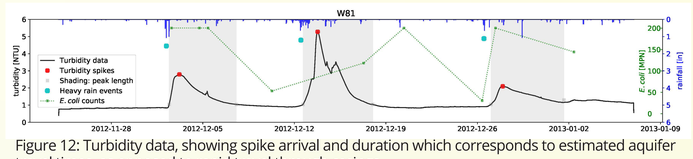


Figure 12: Turbidity data, showing spike arrival and duration which corresponds to estimated aquifer travel times, as opposed to rapid travel through casings.

ASPA standard rain-gauge replacement

Figure 8: Original ASPA standard style rain gauge.

Prior to the cooperative agreement initiated in 2015, ASPA was monitoring daily rainfall totals at 11 sites (Fig. 10) with standard style rain gauges (Fig. 8). We are now assisting ASPA in replacing these gauges with automated tipping bucket rain gauges (Fig. 11) to increase data quality and resolution.

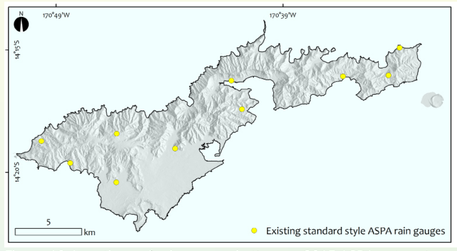


Figure 10: Locations of rain gauges in the pre-2015 ASPA network.

Figure 9: Assisting ASPA staff with learning new data collection software.

Figure 11: ASPA technicians replacing standard gauges with tipping bucket rain gages at existing monitoring sites.

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