



NONPOINT SOURCE SUCCESS STORY

Hawaii

Holistic Approach to Watershed Management Enhances Water Quality and Aquatic Habitat in the Waipā Stream

Waterbody Improved

Dense stands of unmanaged hau bush had grown into a segment of Waipā Stream on the north shore of Kauaʻi, Hawaiʻi. Trapped sediment and plant litter in the stream channel degraded important spawning habitats and created substantial obstacles for migrating native fish. Soil erosion in upland areas also contributed to increased levels of sediment in the lower stream reaches. As a result, state water quality standards for turbidity were exceeded, and the entire stream network was added to the state's 2006 Clean Water Act (CWA) Section 303(d) List of Impaired Waters. The estuary was also listed for enterococcus and nutrients (ammonia and total phosphorus) in 2014. After years of restoration efforts and a holistic approach to watershed management, measurable improvements to water quality resulted in a delisting for turbidity and nutrients within the stream and its estuary, respectively.

Problem

As in many areas throughout Hawaiʻi, Waipā's native forests on the north shore of Kauaʻi (Figure 1) were historically altered by human and feral ungulate activities. Over about 200 years, deforestation by the sandalwood trade, intensive agricultural activity (rice cultivation and cattle ranching), and forest fires changed the native landscape, allowing non-native grasses, shrubs and trees to invade. These invasive species disrupted the natural water cycle and reduced the forest's ability to absorb and retain water, leading to increased runoff and acceleration of the natural soil erosion process. Rooting, soil compaction, and wallowing behaviors of feral pigs also degraded Waipā's native forests and worsened runoff and soil erosion conditions.

Sediment-laden runoff was thus easily transported from the steep mountain slopes in the upper watershed to the lower-elevation floodplains, where slow-draining soils impeded water infiltration. The lower stream reaches then became clogged and flooded when invasive hau bushes trapped excess sediment and plant litter in the stream channel, as seen along a segment of the Waipā Stream. These conditions degraded important spawning habitat and created substantial obstacles for migrating native 'o'opu (Hawaiian gobies) that pass through this section of the stream at least twice during their life cycle.

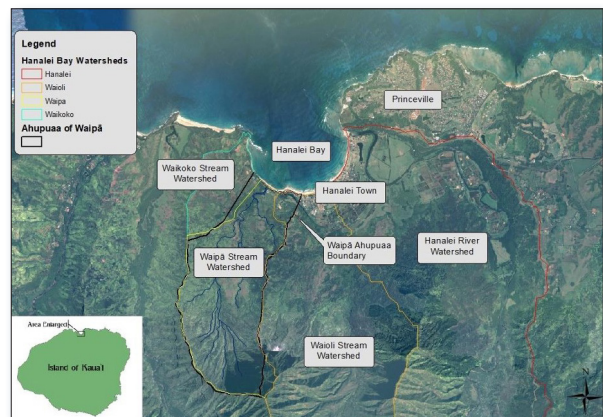


Figure 1. The Waipā Stream project area is on the north side of the island of Kauaʻi.

In response, a total maximum daily load (TMDL) for total suspended solids as a surrogate for turbidity was developed and approved in 2008. Informative TMDLs for enterococcus and nutrient concentrations were also developed where water quality standards were being met but were close to falling below acceptable levels. A watershed management plan for the Hanalei Bay Watershed was later developed based on these TMDLs and established a framework for improving and protecting water quality in the Hanalei Bay Watershed.

Story Highlights

In 2016, the Waipā Foundation was subawarded CWA Section 319 funds for the Waipā Stream Restoration Project. The project addressed nonpoint source pollution holistically by implementing a suite of management measures at various locations throughout the watershed. These management measures aimed to limit nonpoint source pollution using both structural and nonstructural best management practices that built on previous efforts to minimize water pollution.

By 2023, the Waipā Foundation completed the project and accomplished several milestones in the long-term management of the watershed, including removing hau bush and restoring 3 acres of stream and riparian areas, removing at least 100 feral pigs from the upper watershed, developing and implementing best management practices to minimize turbid water conditions resulting from work in the lo'i kalo, installing a constructed wetland to filter turbid waters from the lo'i, revegetating erosion hot spots in several small (< 1 acre) upland areas, installing 1,000 feet of fencing to exclude livestock from waterways, and replacing a total of 12 cesspools within Waipā and the neighboring watersheds of Waioli and Waikoko.

A robust monitoring program was deployed to provide data that allowed the evaluation of the project's impact on pollution reduction in Waipā's waterbodies. Community education, outreach, and public engagement activities with community members, volunteers and students directly contributed to the project's implementation and helped to spread awareness of the work in the watershed (Figure 2).

Results

Monitoring results, including the data collected before and after a large stream-flushing event in 2018, showed measurable improvements in water quality and aquatic habitat for native species in Waipā Stream. The stream's dissolved oxygen levels increased dramatically, and native fish populations returned to levels two to four times as much as when the project began. Fish passage to important spawning habitat was restored. There was also a 62% decrease in average turbidity levels, which was enough to delist the freshwater portion of Waipā Stream for turbidity.



Figure 2. Community volunteers restore the riparian area and plant native species after removing the invasive hau bush (see inset photo).

In the Waipā Stream Estuary, turbidity trended steadily downward over the project period, and fecal indicator bacteria (FIB) levels declined. Enterococcus average values at the Waipā Stream mouth have declined by more than 50% since 2005, and the average values for *Clostridium Perfringens*, a secondary FIB organism, have declined by more than 50% since 2013. Monitoring data also showed total nitrogen and total phosphorus values well under the applicable water quality standards despite slight increases over the project period, while nitrate + nitrite values improved to levels below the water quality standard. Consequently, the Waipā Stream Estuary was delisted for nutrients.

While these results are very encouraging, the freshwater portion of the stream remains listed for enterococcus, and the estuary is still listed for turbidity and enterococcus. More work is needed to reassess critical pollutant sources and address the remaining impairments. Investment and commitment to the area ensures work can continue beyond the life of the project. For more details, see the [Waipā Stream Restoration Project story map](#).

Partners and Funding

Partners include the Hawaii Department of Land and Natural Resources, the Hawaii Department of Health, the Hanalei Initiative, the Waipā Foundation, the National Tropical Botanical Gardens, the Limahuli Gardens, The Nature Conservancy, the University of Hawaii's Department of Natural Resources and Environmental Management and the University of Hawaii's Stream Research Center. Funding for the restoration efforts included \$737,289 in CWA Section 319 funds from the U.S. Environmental Protection Agency.



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