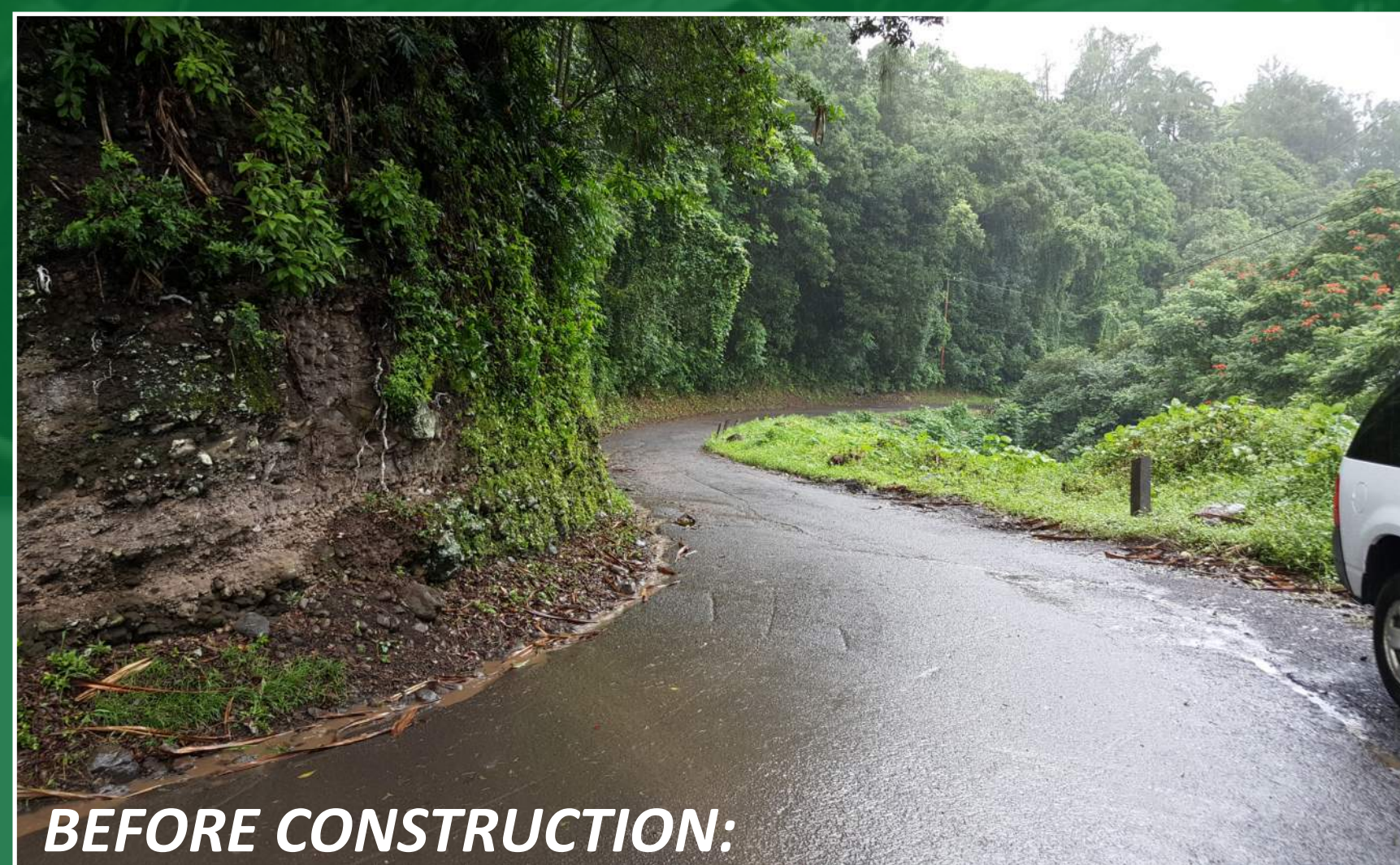


Ke'anae Road provides the only access to historic Ke'anae Peninsula. The mile-long road off Hāna Highway also receives significant tourist traffic important to the community's financial well-being. A 100-foot-high slope along an 800-foot roadway section had a history of significant rockfall incidents, endangering residents and tourists alike.

The County of Maui engaged the design team to assess whether the rockfall hazard could be mitigated or the road should be relocated. The project included significant community outreach and coordination since construction would require road closures.

Rockfall mitigation included a combination of rock scaling, netting, rock fencing, and concrete barriers to address different risks at different positions along the roadway. Roadway improvements, including regrading and widening the pavement from 14 feet to 20 feet where possible and installing guard rails, were incorporated into the project to improve roadway safety.



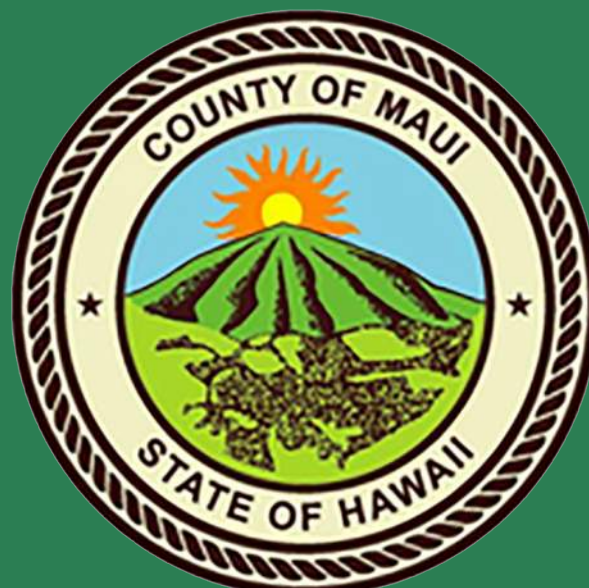
BEFORE CONSTRUCTION:

The narrow roadway down to Ke'anae, with the steep cliff to the left and dropoffs to the right, was a hazard to residents and tourists alike.



AFTER CONSTRUCTION:

The cliff to the left has been scaled back and protected with rockfall netting and a rockfall fence. The road has been widened where possible and guardrail added.



Ke'anae Road Safety Improvements



Project Team

Owner:	<i>County of Maui, Department of Public Works</i>
Geotechnical Engineer:	<i>Hart Crowser, a division of Haley & Aldrich</i>
Civil Engineer & Land Surveyor:	<i>Fukumoto Engineering, Inc.</i>
Archaeologist:	<i>Scientific Consulting Services, Inc.</i>
Permit Consulting/Public Outreach:	<i>Munekiyo Hiraga</i>
Naturalist:	<i>Robert W. Hobdy, Environmental Consultant</i>
Contractor:	<i>Prometheus Construction</i>
Construction Manager:	<i>Bowers + Kubota</i>

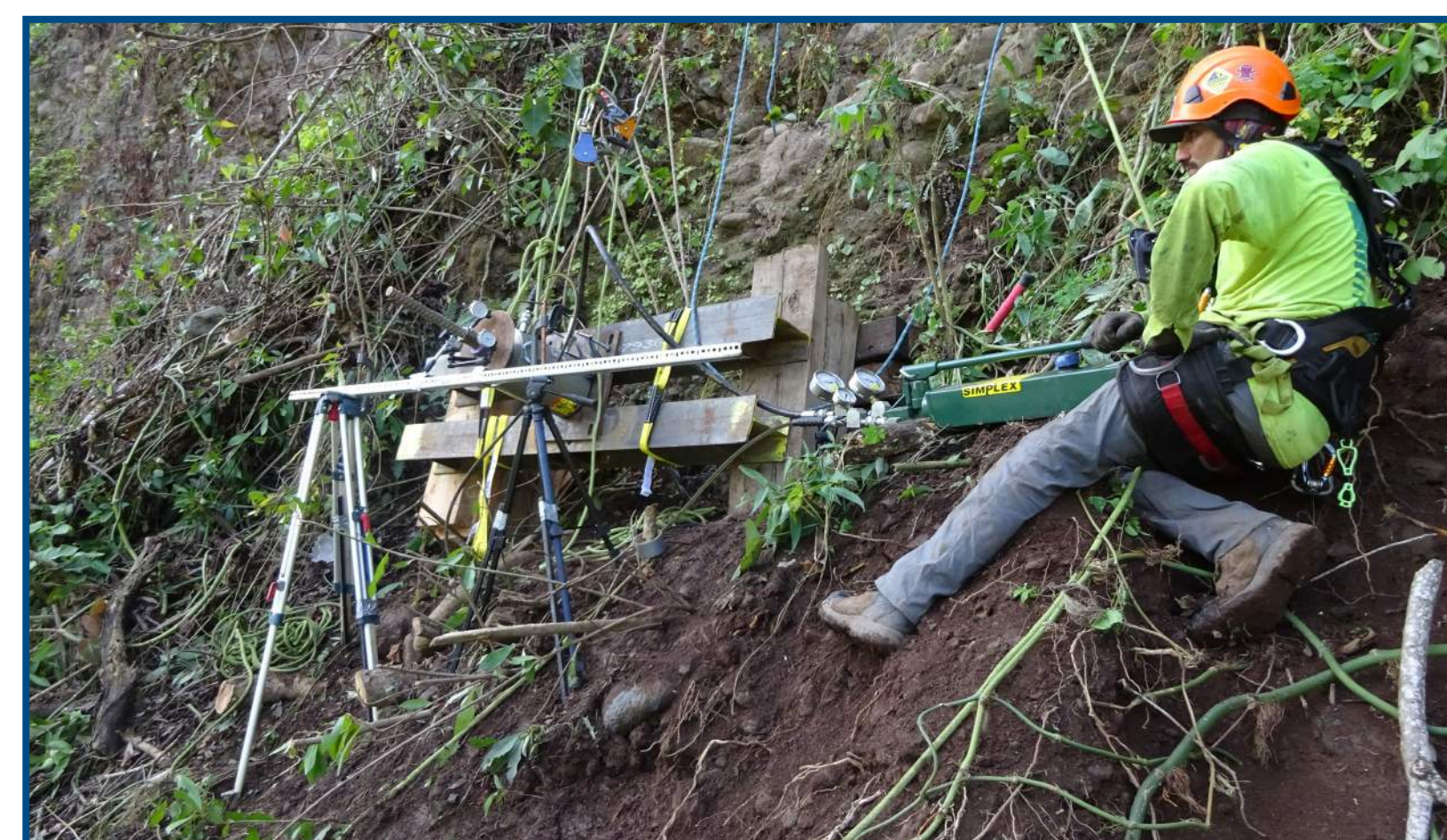
Engineering Difficulty

Community concern about rockfall hazards pushed the team to accelerate the design. Project engineering faced several challenges, from initial reconnaissance and investigation through design. The cliff was cloaked in thick vegetation, providing a challenge for the detailed assessment of rock hazards necessary for design and for estimating quantities for rock scaling and netting. Once vegetation was removed at the start of construction, additional assessment and design changes were required. Despite minor design modifications, material estimates held, and the contractor was not delayed by having to order additional materials during supply chain slow-downs due to COVID-19.



Construction Difficulty

Hart Crowser provided construction observation services, checking on the contractor's compliance with various system installation and testing requirements prescribed by the design specifications. Construction challenges included worker safety on the sheer vertical rock face and during rock removal activities, access from private landowners for heavy equipment needed to hang the netting and to allow for structural load testing, and road closures to protect users during risky activities such as removing rocks from the cliff. The team worked with the community to develop consensus on closure periods to allow for the early- to mid-morning peak tourist traffic to the peninsula.



Environmental Considerations

The project's location required care for natural and cultural resources. Archaeologists identified potential cultural sites at the top of the slope, and the design accommodated avoiding these resources by working with the contractor and rockfall netting manufacturer on alternative configurations and connections. Environmental measures such as stormwater BMPs mitigated adverse impacts to sensitive aquatic resources. Rocks removed from the cliff were provided to residents for their use, minimizing trucking impacts and promoting local beneficial re-use. Rockfall netting allows vegetation growth, minimizing the visual impact of the mitigation.



Public Benefit

The project greatly reduced the rockfall and road hazard risk to the public who travel on Ke'anae Road, providing peace of mind for residents who rely on the road for access to their homes and tourist contributions to their livelihood. Active collaboration and coordination with Ke'anae residents resulted in a project inspired and accepted by the community, while meeting the County's objectives of a cost-effective solution that would improve safety. The project construction and design teams stayed at the YMCA at the top of the cliff, providing income for that facility. Traffic control provided employment opportunities for local workers.

