

June 16, 2018

Construction Access and Bridge Design Alternatives Analysis Executive Summary

A record amount of rainfall between April 13 and April 16, 2018 caused mudslides, rockfalls, roadway and slope failures along Kūhiō Highway (Route 56 and 560), closing the highway in several places. Emergency and disaster proclamations were issued by Governor Ige, Mayor Carvalho, and President Trump. This alternatives analysis has been prepared to communicate the project's evaluation of options to address construction access to the repair sites.

Background

On 4/16/18, an initial site survey was conducted by HDOT and the design team to assess necessary repairs to address the lack of access and dangerous conditions throughout the Hanalei and Wainiha corridor. During the site visit, numerous sites were identified that required immediate work to remove imminent dangers to the public. There have been many follow-up visits to further assess areas previously covered up by debris. In all, approximately 32 sites were identified, classified, and prioritized. They are as follows:

1. Priority 1 clean up and removal of debris and a re-establishment of access through the corridor
2. Priority 2 repair damages to DOT assets and provide plans for re-establishing safe facilities
3. Priority 3 repairs that could be delayed or addressed in due time because the 'after flood' condition was deemed safe for the public without immediate remediation

In this site assessment, it was also observed that Wai'oli, Waikoko, and Waipā (3 W bridges) had suffered scour related damages to the footing and abutment areas. The work to restore the footings to the pre-flood condition was determined to be Priority 3.

The site assessment identified the two roadway repair sites, commonly referred to as Sites 1 and 2 at milepost (MP) 1.5 and MP 6.5 on Route 560. Re-establishment of the two roadway repair areas are the highest priority due to the danger they present to the remaining facilities and the high likelihood that further roadway destabilization could occur, ultimately rendering the corridor impassable for an indeterminate length of time. Design solutions for the roadway repair areas would stabilize the slopes with a soil nail wall and protection at the base where the slope repair extends down into the coastline. The added protection of boulders at the base is needed to secure the slopes from the ocean tides during certain times of year, storm events, and other potential threats to undermining. The large boulders needed to stabilize the slope, large backhoe, in the 35-ton range, and a crane in the

80 to 120-ton range would be needed to reach 40 to 70 foot slope faces and complete the repairs. Necessary equipment and materials can be broken down into smaller loads and re-assembled on-site, but would still exceed the 8-ton limit of Wai'oli, Waipā, and Waikoko Bridges.

Purpose and Need

Emergency repairs are needed to preserve, restore, and stabilize Kūhiō Highway such that full operations can be resumed. Repairs are critical as Kūhiō is the only roadway access to Northern Kaua'i.

Secondary needs were identified in the course of evaluating the emergency response. One such need includes enabling heavy machinery and equipment to reach construction sites. As described in the previous section, Wai'oli, Waipā, and Waikoko Bridges are unable to bear heavy loads needed to complete the repairs.

As the only public route that provides transportation to and through the Kaua'i's North shore, safe access is essential for general ingress and egress, including emergency vehicles and all traffic in the event of emergency evacuations. Wainiha's history of tsunami and flooding includes documented events dating back to 1946, 1957, with more recent events in 2004, 2007, 2012, and the current 2018 event. The increased frequency and intensity of the landslides and flooding provide concern that the region remains vulnerable to storm events. Due to the steep slopes adjacent to Kūhiō Highway along much of the northern coast, landslide and rockfall issues have potential to continue to occur in the future. Appropriate solutions must consider the likelihood of future events and allow for more consistent response when addressing emergency needs.

This northern section of Kūhiō Highway, known as Kaua'i Belt Road, was listed in the Hawai'i Register of Historic Places in 2003 and the National Register of Historic Places (NRHP) in 2004 for its significance in engineering, transportation, and social history. The emergency repair activities are also needed to restore and preserve this historic roadway. Given that Wai'oli, Waipā, and Waikoko Bridges are contributing features to Kaua'i and may be individually eligible for the NRHP, historic preservation best practices are necessary aspect of an appropriate solution.

Identified Alternatives

Various construction access alternatives were evaluated. The alternatives generally fall within the categories to include:

- Avoidance Alternatives; and
- Build Alternatives including Preservation, Restoration, Rehabilitation and Reconstruction.

Note that a No Build alternative is one that would eliminate the need for construction materials and equipment access. This option is discussed with the Avoidance Alternatives.

Avoidance Alternatives

Avoidance alternatives include any alternative that would avoid involvement of the Wai'oli, Waipā, or Waikoko Bridges.

Access via Ocean or Landing Craft

Delivery of equipment and materials was similarly evaluated in Central Federal Land's (CFL's) Replacement of the Temporary Wainiha Bridges and Rehabilitation of Kaua'i Belt Road (Wainiha Bridges EA). Landing craft owned by the Robinson Family or the Navy could be utilized to bring in the necessary heavy machinery and materials, and remove spoils. When previously studied by CFL, it was deemed not feasible due to environmental impacts caused by the landing craft. Since there are no piers on the North shore beyond the three bridges where the equipment and supplies could be offloaded, it was assumed that construction of a new jetty would be needed. This would have severe impacts on recreation resources as well as severe impacts on aquatic species, monk seal critical habitat, and essential fish habitat as it would involve placement of fill in an open marine environment.

Community input high-lights that recent emergency responses have demonstrated that construction equipment can be off-loaded without need for a jetty. While the continuous loading and off-loading present concerns for impacts on recreation resources, aquatic species, monk seal habitat, endangered species, critical habitat and challenges with Clean Water Act permitting, these impacts and challenges are far less severe than that associated with constructing a jetty, which was originally assumed in CFL's Wainiha Bridges EA.

Further investigation of Naval landing craft, indicate that these ships are designed to withstand a variety of sea and landing conditions as well as transport very large payloads directly to shore. However, the limitations are not fully known and have certain known threats to their stability. Potential hazards include, sea conditions, unknown surf height limits; concern for ability to maintain control in surf zones on approach to beach and potential for capsizing due to wave action; concern for loss of propulsion power during transit in open water and surf zones; and concern for securing the vessel when loading, unloading, and positioning in variable draughts. These areas have been identified as potential hazards for further research to determine landing craft stability standards and limits.

A precautionary risk management approach would assume conservative limits to control for the unknown payload concerns. However, given the level and variety of risk involved with surf and sea conditions, which are uncontrollable risk factors, as well as the need for dependability in moving heavy construction equipment, this alternative was eliminated from further consideration.

Notably, this alternative does not address the secondary need to provide consistent response in emergency situations.

Modification of the Design

Modifying the design to no longer require heavy equipment or materials was evaluated. Benching the slope to create shorter reaches for equipment has already been incorporated into the repairs sites to allow for smaller equipment to initiate repairs at the sites. However, the large revetment materials are still needed to stabilize the base. Additionally, benching is not practical for upland slope faces where there is no access from the top of the slope.

Temporary Acrow Bridges

Installation of temporary Acrow bridges was initially considered the preferred alternative. Although this alternative does not fully avoid impacts to the Waikoko Bridge, it may be considered a quasi-avoidance alternative. At the onset of the emergency, the Design team contacted CFL, who had been working on a plan that would allow for larger equipment and materials to be brought into the site for the planned replacement of Wai'oli, Waipā, and Waikoko Bridges. CFL provided the 95% plans and the Acrow bridges were ordered and shipped to Kauai. The plan at the time was to install the bridges to allow equipment and materials to be brought in for road repair Sites 1 and 2, and also to allow for the temporary bridges to remain in place for the 3 Wainiha Bridges Project.

During the design stage, numerous issues were identified that would cause the State to re-think the temporary bridge plan and then to ultimately abandon the plan. The issues identified were as follows:

1. The Acrow designs would need to fill in large areas of wetlands that would ultimately need to be repaired (see attached CFL Plans). Although this impact was identified in the CFL Wainiha Bridge EA, the duration in which the Acrow bridge would need to remain in place would be much longer than originally anticipated in the EA. Anticipated timeframes are described in Issue 5 below.
2. The Acrow design required large previously undisturbed areas to be destroyed.
3. For the Waikoko Bridge, the entire bridge deck would need to be raised by a minimum of 3 feet. This raised deck would cause sight distances to be drastically reduced. Furthermore, this could not be accomplished without avoiding the Waikoko Bridge parapets. In initial meetings with SHPD for emergency repairs, SHPD opined that modifications to the parapet would be considered an adverse effect, even if the sub-structure remained.

From a design perspective, once emergency repairs were complete, the temporary Acrow bridge could not be removed without replacing the Waikoko Bridge. After factoring in the cost considerations described in Issue 4, a temporary Acrow bridge for Waikoko was eliminated as a viable option.

4. The estimated costs for the temporary Acrow bridges (\$10 Million) would be close to the estimated costs to build new bridges (\$12 million)

5. Bridge inspection reports note that Wai'oli, Waipā, and Waikoko are structurally deficient and have ratings that dictate replacement (see attached inspection reports). A discussion of individual bridge eligibility for replacement and/or rehabilitation is provided in the Rehabilitation alternatives section.
6. Wai'oli, Waipā, and Waikoko bridge replacement projects are planned for a few years from now since it has been clearly established that the current bridges will not last long. A discussion of individual bridge eligibility for replacement and/or rehabilitation is provided in the Rehabilitation alternatives section.
7. The estimated cost to install the temporary bridges, re-build the bridges and then to remove the temporary bridges is estimated at about \$26 million, more than double the cost to re-build the bridges now.
8. The Acrow bridges would need to remain in place until - a. the emergency repairs were completed; b. the Wainiha Bridges were constructed; and c. the Wai'oli, and Waipā replacement or rehabilitation projects were constructed. In Hawai'i's climate for planning and development, this means that the Acrow bridges may need to be in place 10 to 15 years or more.

HDOT could remove the Acrow bridges between the three individual projects, and re-install when the projects are ready to construct. However, this would add the cost of removing and re-installing the Acrow Bridge two additional times at Wai'oli and Waipā. Assuming it costs \$3 million dollars for installation and take down of both bridges, this would add \$6 million dollars to the over-all approach. This also means that the community would endure impacts of bridge closures and bridge work two additional times at Wai'oli and Waipā. Wetlands would also be repeatedly affected.

Lastly, in the event of another emergency, the Acrow bridges would need to be reinstalled to accommodate heavy equipment should it become needed.

Given that there is a pre-existing need to address the structural deficiencies at the Wai'oli, Waipā, and Waikoko Bridges, which could be addressed with less impact to the surrounding community and adjacent resources, at nearly identical costs as the temporary Acrow bridges, the temporary Acrow bridges alternative was dismissed,

Alternatives to rehabilitate and replace the Wai'oli, Waipā, and Waikoko Bridges are described in the next section.

Build Alternatives

The Secretary of Interior (SOI) has developed four treatment standards - Preservation; Rehabilitation; Restoration; and Reconstruction. These treatment standards guide best practices for protecting historic properties. For this reason, any discussion of a Build Alternative should be within the SOI framework.

Preservation

The Secretary of Interior's (SOI's) Preservation standard was deemed inappropriate because these treatments are characterized as preliminary non-invasive maintenance and repair measures (www.nps.gov, accessed 6/21/18). New exterior additions, such as those typically used in addressing the structural deficiencies of bridges, are beyond the scope of this treatment standard.

Restoration

The SOI's Restoration standard seeks to restore the form, feature, and character of a historic property back to a specific time period, which would also include removal of features from other periods as well as restoring those from a particular period (www.nps.gov, accessed 6/21/18). This standard also typically limits the functional and system upgrades for the property in favor of promoting characteristic or defining features of the period. When the bridges were first constructed in the early 1900s, it is believed that they would've been capable of carrying the loads needed for the repairs. Therefore, in evaluating the appropriateness of this standard, it would be appropriate to consider the 1912 design. All three bridges have undergone modifications of varying degrees over time to maintain their use, sometimes in response to a changing environment. Lack of as-built plans or consistency between what is observed at the bridges and what is shown on the plans make the bridges poor candidates for restoration. Furthermore, an understanding of the construction method originally used in securing timber piles to the coral substrate is lacking.

Bridge Rehabilitation

The SOI's Rehabilitation standard allows for repairs or alterations to a historic property to allow for compatible uses of the property while preserving the historic features. Bridge rehabilitation was considered for Wai'oli, Waipā, and Waikoko as part of the project evaluation to provide access to the construction repair sites. Rehabilitation would involve repairing the structural deficiencies of the bridges to bring them back to their original design specifications and to increase the load capacity enough to meet the project needs without affecting the character defining features of the bridges.

Waikoko

Rehabilitation for Waikoko is not an option due to the severity of the failures that have occurred in the past. Half of the bridge remains buried in the sand. One of the abutments has completely failed, while the other shows extensive rust and concrete damage. The corrosion of the reinforcing steel is so severe that it is causing the concrete to crack and spall. Therefore, Reconstruction has been deemed the more appropriate standard for treatment.

Waipā

Rehabilitation for Waipā was considered, but severe scour issues with the piers and abutments as well as the small openings for drainage do not allow for encapsulating the existing structure without affecting the free passage of water through the structure. A review of the available inspection reports from past years confirmed the field inspections that were done to evaluate rehabilitation. Waipā Bridge is actually two bridges built at different times to address scour and erosion issues that have occurred. Based on the deteriorated condition of the bridge, Reconstruction has been deemed the more appropriate standard for treatment.

Wai'oli

Wai'oli Bridge was considered the best candidate for rehabilitation and is in better shape than both Waipā and Waikoko. But scour issues, reinforcing corrosion and lack of as-built drawings or even plans showing the existing reinforcing is minimal. The plan for reinforcing and ultimately rehabilitating the existing bridge would be to remove the existing concrete, replace the reinforcing to meet the current requirements and replace any deteriorated steel or to encapsulate the existing structure to meet the code requirements. Encapsulating the structure would result in added weight that would require significant improvements to the foundation and piers. The cost to rehabilitate would be almost twice as much to replace the bridge itself. Rehabilitation would also require the installation of a bypass or temporary bridge making the entire costs for rehabilitation three times the cost of a new bridge. Even after rehabilitation, the bridge would not be able to retain its present form or shape. Given that one of the standards for rehabilitation requires minimal change to its distinctive materials, Wai'oli Bridge may be more appropriately considered under the standards for Reconstruction.

Reconstruction

SOI standards define Reconstruction as the act of depicting the form, features or detailing of a non-surviving structure through new construction for the purpose of replicating its appearance.

The Kūhiō Highway (Route 560) Historic Roadway Corridor Plan, developed in partnership with the Hanalei Roads Committee and other members of a Community Advisory Committee, provides guidelines for the replacement of historic bridges within the district. Section VIII.b of the Plan describes the design guidelines for bridges:

1. Any preservation, rehabilitation, restoration, or reconstruction work on the bridges should be consistent, as much as practical, with the original historic design, scale, and color of the structure, the National Historic

Preservation Act (1966, as amended), and the SOI's Standards for the Treatment of Historic Properties.

2. Replacement of any of Route 560's one-lane bridges should:
 - a) be reconstructed, as much as practical, with a bridge similar in design,
 - b) have a single 12'-wide travel lane and 2'-wide shoulders (see Figure 7),
 - c) have parapets or rails that are designed in character with Route 560's
 - d) existing one-lane bridges,
 - e) accommodate pedestrian/bicycle access within or outside of the bridge,
 - f) have a posted load of 15 tons and be capable of accommodating 18-ton
 - g) fire trucks and other public utility or service vehicles, and
 - h) incorporate AASHTO guidance or crash-tested features.
3. The hydraulic capacity of the one-lane bridges' historic design will require special consideration and/or adjustments under current design standards.
4. Adequate sight distance shall be provided at all approaches to one-lane bridges. When such adequate sight distance is inconsistent with the historic or scenic element of the Plan, the speed limit on the approach should be reduced.
5. Concrete slabs, fords, and other similar crossings with no parapets or rails should incorporate safety features for pedestrian crossings, such as separate pedestrian crossings, warning signs, alternative routes, etc.

The proposed designs for Wai'oli, Waipā, and Waikoko seek to meet the guidelines for replacement or reconstruction identified in the Historic Roadway Corridor Plan and have been developed in coordination with Section 106 consulting parties. As described in the preceding portions of this analysis, Preservation, Restoration, and Rehabilitation standards were considered, but were not the best fit due to existing deterioration, and the methods needed to achieve carrying capacity.

Environmental damages would be significantly reduced as the bridges and the roadway could remain in its current location and alignment. The new bridges would be built on top of the old bridges and then the old bridges would be removed.

Sight distances for the proposed single lane bridges would be affected but only slightly as the new bridge riding surface would be about a foot higher than the current riding surface

The cost to reconstruct the bridges now are less than half the cost to build it a few years from now. Rebuilding the bridges in place would limit interruptions to traffic and access.