

# NAPILI 4/5

# CULVERT REPLACEMENT



**BEFORE:** Old, deteriorated drainage structure. 16-foot drop from culverts resulted in flooding on roadway above.



**AFTER:** New drainage way, featuring lowered precast drainage box culverts.



**BEFORE:** Narrow, 22-foot roadway crossing.



**AFTER:** 36-foot roadway crossing with sidewalk & widened shoulder.

## PROJECT TEAM

Agency/Owner:	County of Maui Department of Public Works
Contractor:	Maui Kupono Builders, LLC
Construction Manager:	Bowers + Kubota
Civil Engineer/ Land Surveyor:	Fukumoto Engineering, Inc.
Structural Engineer:	Gholkar & Associates, Inc.
Geotechnical Engineer:	Hawaii Geotechnical Consulting
Archaeologist:	Scientific Consultant Services, Inc.
Permit Consulting/ Public Outreach:	Munekiyo Hiraga
Naturalist:	Robert W. Hobdy, Environmental Consultant
Wetland Scientist:	AECOS, Inc.

## PROJECT SUMMARY

The County of Maui, Department of Public Works implemented a drainage replacement project in Napili to address the erosion and deterioration of two (2) existing 7.5-foot by 3.5-foot box culverts located under Lower Honoapiilani Road between Napili Place and Hui Drive.

The project involved removal of the existing box culverts and replacement with two (2) new 8-foot by 5-foot precast drainage box culverts. The proposed work also included installation of associated inlet and outlet structures; Armor Flex articulated, open-cell concrete mat within the mauka drainageway; ungrouted riprap on the makai side of the drainageway; and a retaining wall along the adjacent property to the west of the drainageway.

The existing channel was regraded to reduce erosion and improve water quality downstream of the proposed replacement culvert. Native planting material was incorporated into the vegetated portions of the project.

The project incorporated sidewalk and roadway improvements, including widening Lower Honoapiilani Road in the project area from 22 feet to 36 feet. Additionally, the project entailed removal and replacement of a Department of Water Supply water line and Department of Environmental Management sewer force mains.

## PUBLIC BENEFIT

- **Public involved early in the process.** Coordinated with Napili Bay and Beach Foundation and held public meeting for input and direction to ensure community was satisfied with final design.
- **Construction time minimized.** Used precast block retaining walls and precast box culvert rather than cast-in-place concrete structures to reduce construction time.
- **Replaced deteriorated structure.** Old structure was being undermined from erosion. Provided trusted road crossing over drainageway.
- **Widened road to provide safe access.** Improved pedestrian and bike access across drainageway; fall protection railing heights set for pedestrians and cyclists. Widened mauka shoulder. Previous roadway was 22-foot wide, now is over 36-foot wide.
- **Reduced flooding.** Culvert inlet elevation lowered to allow adequate height of roadway above stormwater. This prevents water from overtopping the roadway surface.

## ENVIRONMENTAL CONSIDERATIONS

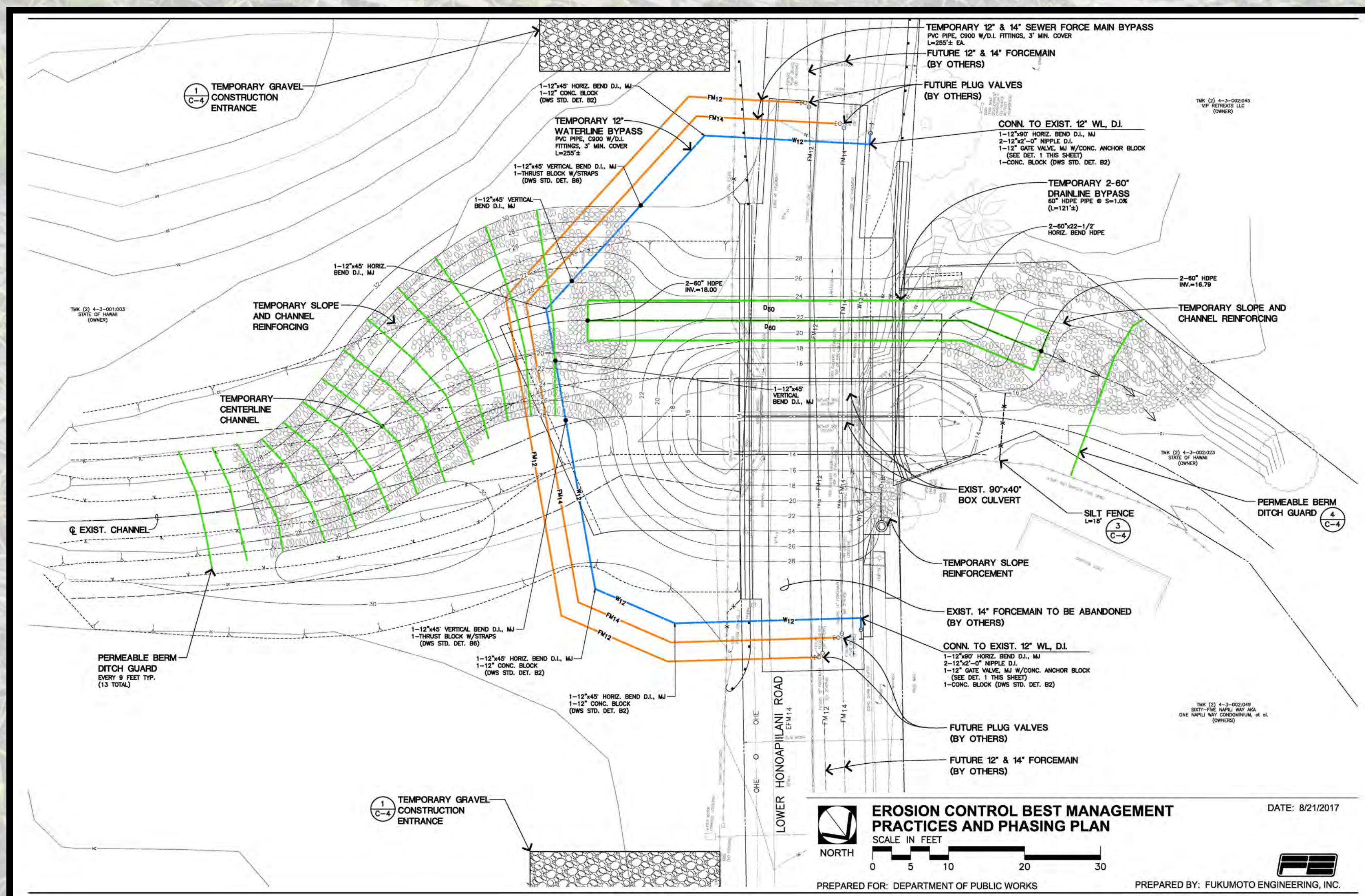
- **Improved water quality in stream.** Height of existing culvert outlet caused severe erosion that added sediment to the runoff. The new culvert was widened and lowered to reduce the energy of stormwater flow leaving the culvert, thus reducing suspended sediment washing out into Napili Bay.
- **Native grass planted throughout stream.** Solid hardened surface not used in stream allowing for nutrient uptake from water flow by vegetation. Grass will be left uncut to filter debris from water.

## ENGINEERING DIFFICULTY

- **Develop options for elevation difference.** Stormwater from drainage culvert outlet dropped 16 feet to drainageway below. Various options were developed. Option selected for construction included lowering culvert to outlet elevation and regrading mauka drainageway.
- **High flow velocity.** Multiple vegetated channel lining options were required, but few options were available. Composite turf reinforcement mat was used in the gentler sloped channel. Articulated open block mats were used on the steeper sloped channel.
- **Utility bypass.** Existing waterlines and sewerlines crossed the drainageway. With new culvert excavation extending 20-feet below the road grade, temporary by-pass lines were designed to allow construction to occur in phases with uninterrupted utility services.
- **Permitting.** Because of environmental sensitivity of working in the stream, a large project team spent over 40 months to secure 9 different permits including Department of Army Nationwide Permit, Section 401 Water Quality Certification, and Stream Channel Alteration Permit.

## CONSTRUCTION DIFFICULTY

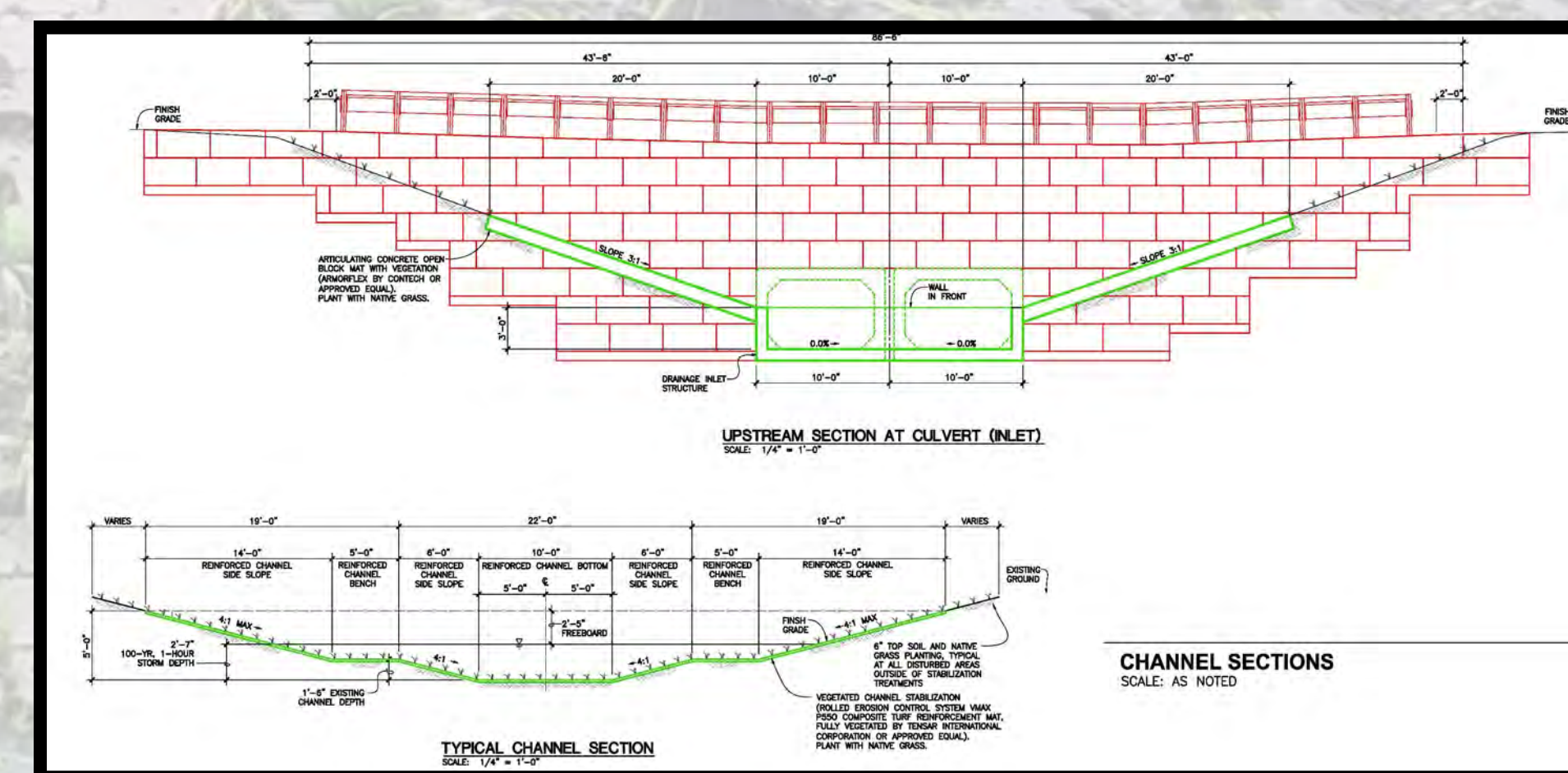
- **Installed utility bypasses in phases.** Coordination with concurrent adjacent sewer project. Installed two new sewer force mains to be connected at a later date; temporary sewer by-pass still in operation.
- **Native Grass.** Grown in Kaneohe, Oahu and shipped to Maui.
- **Unique materials.** Articulated-block mats were fabricated and shipped in 31 pieces averaging 20 feet in length. Required specific spreader bars for installation.



**DURING:** Installing articulated-block mats in the drainageway.



**AFTER:** Native grass planted in the stream & drainageway.



**EVENT:**  
2021 Project of the Year Competition

**SPONSOR:**  
Hawaii Society of Professional Engineers Maui Chapter

**DATE:** January 22, 2021

**SUBMITTED BY:**  
Fukumoto Engineering, Inc.  
1721 Wili Pa Loop, Ste. 203  
Wailuku, Hawaii 96793

**NSPE-HI MAUI CHAPTER**  
HAWAII SOCIETY OF PROFESSIONAL ENGINEERS