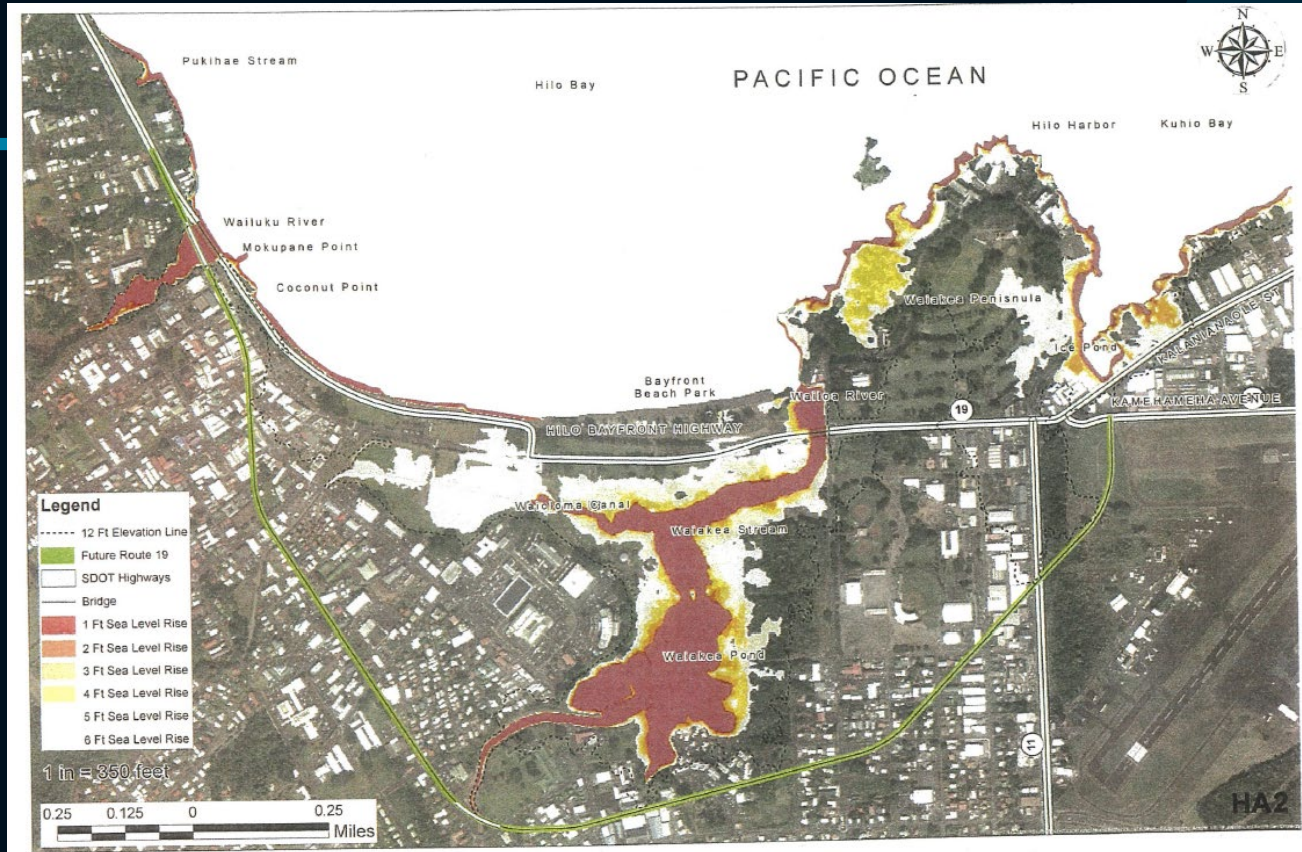




Climate Change & Hawaii Roads

Shoreline protection, rockfall hazards, and the way forward.

Assumptions: Coastal Roads & SLR



- Hawaii will have to contend with the impacts of climate change on our coastal roads.
- The Hawaii Climate Change and Adaptation Commission forecasts 3.2 feet/1 m sea level rise by 2100.
- 10-15% of the state's highway system would be affected.

Statewide Highway Shoreline Protection Study

Updates 2003 study with new methodology.

2019 Study finalized/released - June 2019.

Study identifies and prioritize state roads in need of immediate and short-term erosion control/shoreline remediation measures, as well as sites that should be monitored.

Oahu mobilization anticipated Summer 2019. Immediate mitigations complete within one calendar year.

Methodology

- Sites are evaluated using Coastal Road Erosion Susceptibility Index (CRESI)
- CRESI uses 11 different variables (Beach Geomorphology, Coast Geomorphology, Erodeable Volume, Slope, Coast ground cover & structures, Road base/subgrade, Armoring, Relative sea level change rate, Shoreline accretion/erosion rate, Mean tidal change, and Significant wave height).
- Expected traffic impacts (of the use of the roadway being effected by coastal erosion) and surrounding land use of the site will be added to final calculations.

Priority Level/Tier Rankings

Tier 1 Immediate.

- Repairs recommended within 12 months.

Tier 2 Short-term.

- Repairs recommended within 1-5 years.

Tier 3 Long-term management.

- 5 – 10 years
- Monitor existing shoreline improvements and consider additional evaluation.

Tier 4 Periodic monitoring.

- Beyond 10 years
- Site will remain on inventory with periodic monitoring.

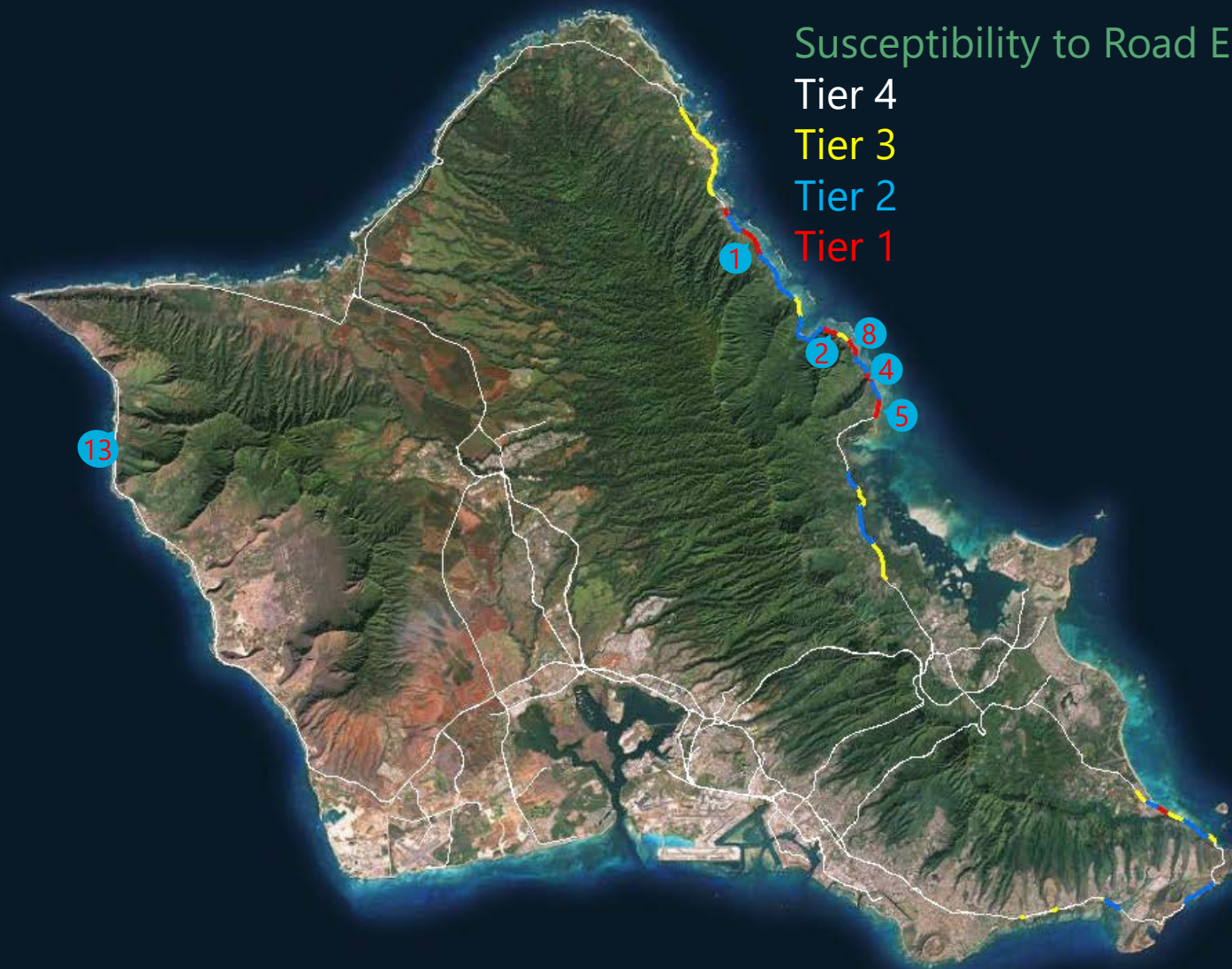
Susceptibility to Road Erosion

Tier 4

Tier 3

Tier 2

Tier 1



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Preliminary Ranking of Tier 1 Sites

1. Oahu #7 (Kamehameha Highway in Hauula at Pokiwai Road)
2. Oahu #6 (Kamehameha Highway in Kaaawa at Crouching Lion)
3. Maui #4
4. Oahu #4 (Kamehameha Highway in Kaaawa at Puakenikeni Road)
5. Oahu #3 (Kamehameha Highway in Kaaawa vicinity of Kalaeoio Beach Park)
6. Molokai #2
7. Molokai #3
8. Oahu #5 (Kamehameha Highway in Kaaawa vicinity of Makaua Village)
9. Kauai #2
10. Molokai #4
11. Molokai #7
12. Molokai #8
13. Oahu #12 (Farrington Highway in Makua at Keaau Stream Bridge)



Route 83 (Hauula/Pokiwai Road)

Before (KITV Photo)



After (HDOT Photo)

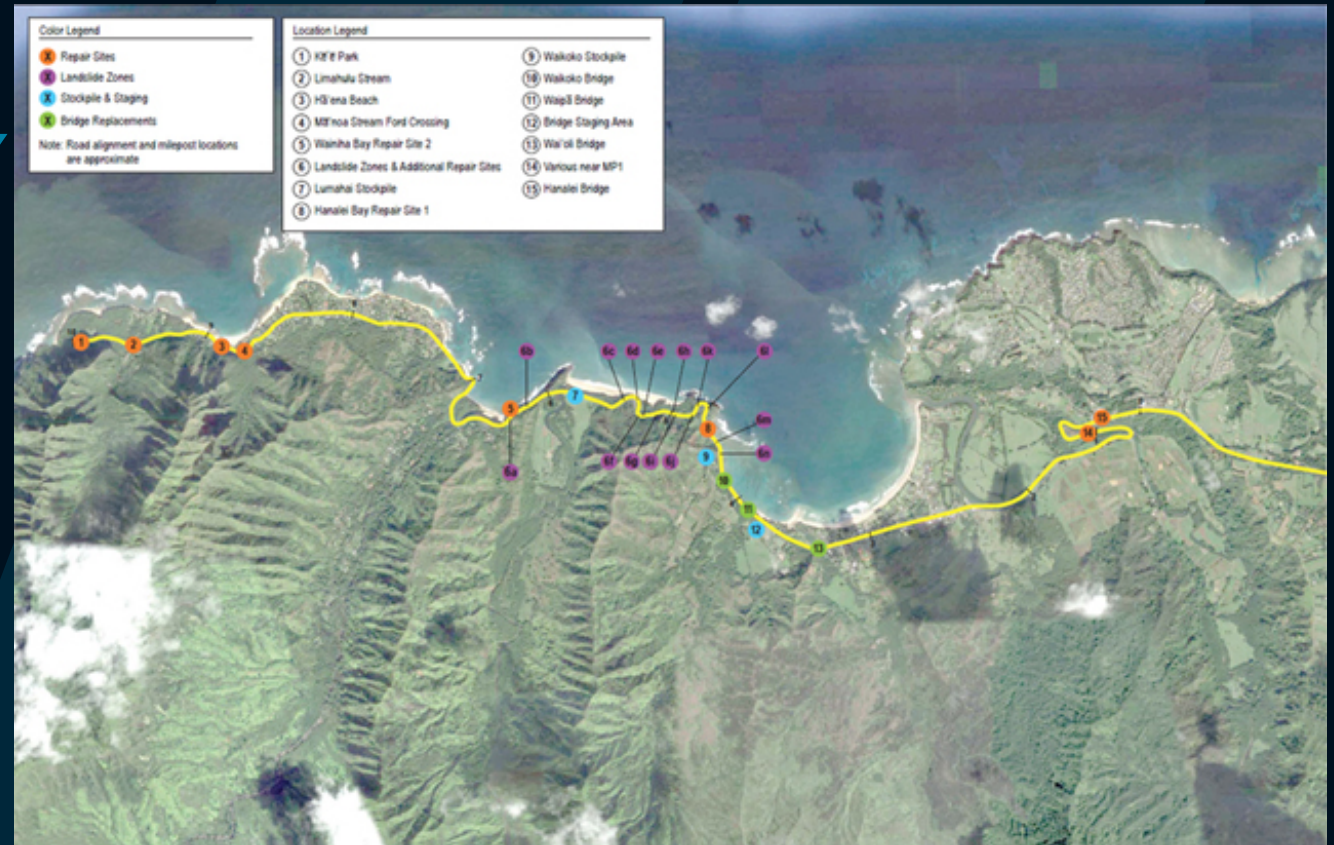




OTHER HAZARDS

April Flood

- Historic flooding April 14 & 15 caused multiple landslides and washed out portions of Route 560 on Kauai.
- Route 560 is the only way in and out for approximately 600 people.
- Landslides and rockfalls were also seen in East Oahu, but were cleared on April 14.



Pali Highway

Approximate
Location of Tunnel

Approximate
Location of Tunnel

Nuʻuanu Pali Lookout

Pali Puka Trail Head

Nuʻuanu Pali
State Wayside

impact location on Pali Highway

impact location on Old Pali Highway

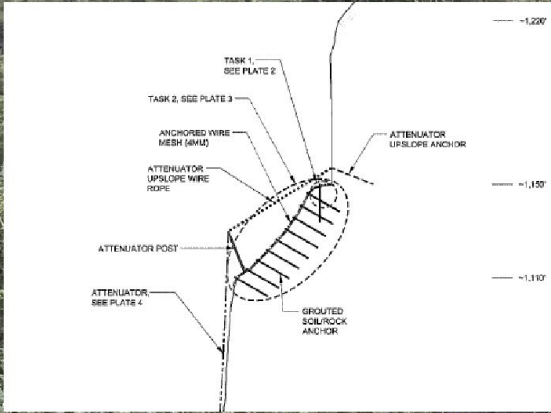
rock slide origin

mud slide location

Pali Notches

Nuuanu Pali Dr

Nuuanu Pali Dr



3 Reinforce slope under Old Pali Road through installation of soil nail, shot-crete, and mesh attenuators to catch loose material.

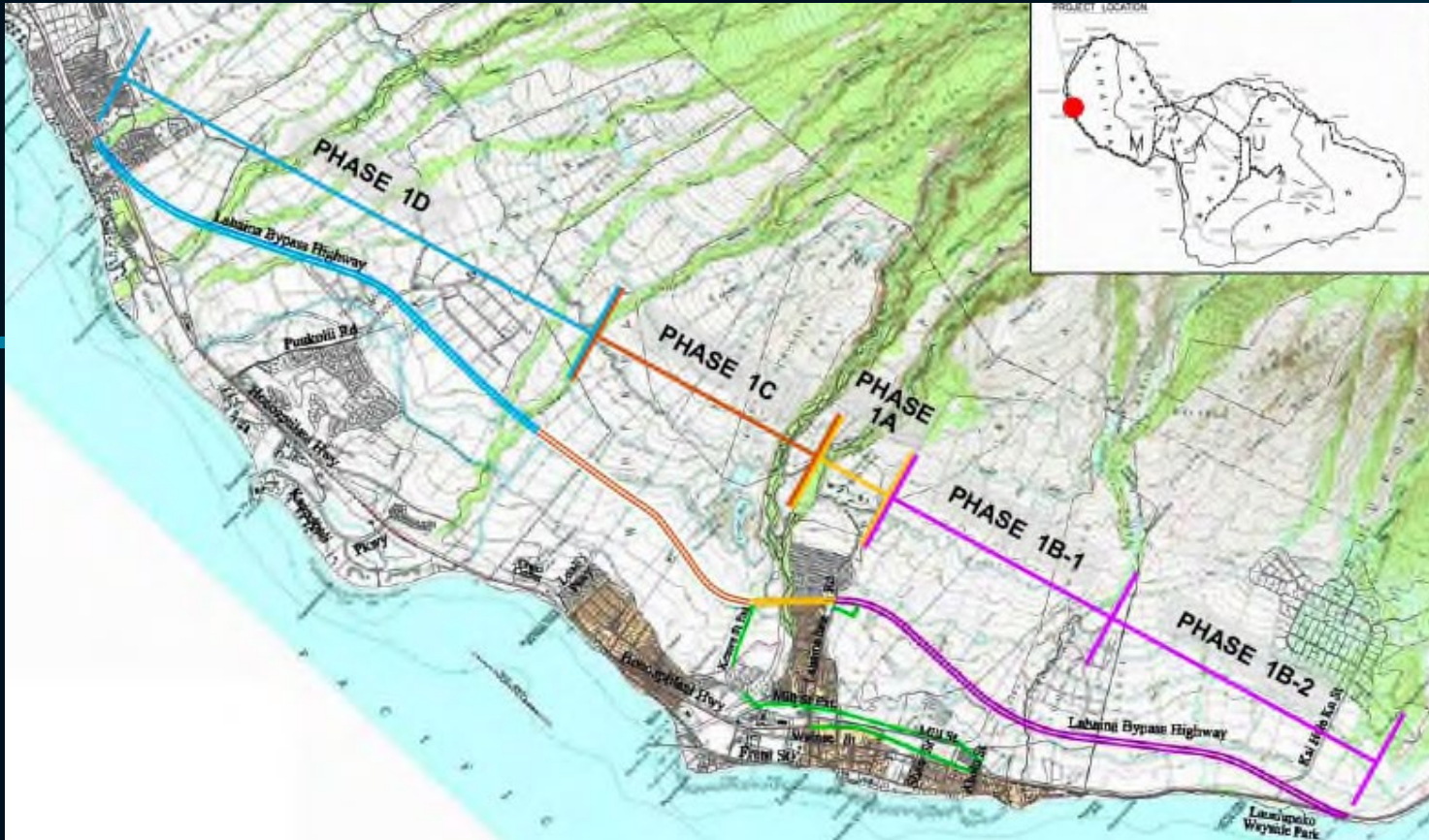


Secure rockface above existing tunnel with soil nail and mesh. (Example shown from Kuhio Highway Emergency Work).



4 Extend Pali Tunnel #2 IB to provide rockfall protection for the Honolulu bound roadway between tunnels.





Realignment cost example

Costs to date for completed phases of the Honoapiilani Highway Realignment (Lahaina Bypass)

- Phase 1A - \$80 M
- Phase 1B-1 - \$35 M
- Phase 1B-2 - \$45 M

Total estimate including design, construction and R/W: \$450 M

What can we do?

- Work with experts to prioritize sites and design mitigation measures.
- Speak with the community on what the future of Hawaii's roads might look like.
- Work with stakeholders on land use, access, and other considerations.
- Future decisions for roads, more than just DOT. Need alignment with State, County and Fed agencies and community.





Mahalo

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