

## Comprehensive Watershed Improvements in Laolao Bay, Saipan, Commonwealth of the Northern Mariana Islands

### The Challenge

The island of Saipan is the most populated island in the Commonwealth of the Northern Mariana Islands (CNMI) with just over 48,000 people. On the eastern side of Saipan, Laolao Bay is a popular fishing and diving site among residents and tourists alike. Unfortunately, the coral reefs and the rest of the marine ecosystems in the bay, including sea turtle habitat, are suffering from extremely degraded water quality due to a variety of point source and non-point source pollution. Ecological monitoring studies from the development of a golf course in 1991 provided baseline data for the bay, and in combination with more current monitoring, results show negative changes to the coral reef assemblages and fisheries over the last 20 years.



Location of Laolao Bay, Saipan, CNMI

The upland area of the watershed is a mix of residential lots (many of which have septic systems), a golf course, and agricultural and other private land uses. As a result, the bay is subject to erosion and runoff pollution from unpaved roads, unpermitted development, land clearing, and agricultural practices. Heavy rain events exacerbate the problem as stormwater carries soil and pollutants into the bay. Land-based pollution from upland watersheds has resulted in excess nutrients and macroalgae in Laolao Bay.

### Actions Taken

In order to improve water quality and coral reef health, which in turn can enhance tourism and the local economy, the CNMI Division of Environmental Quality (DEQ) embarked on a multi-year, multi-million dollar engineering, road construction, re-vegetation and outreach project at Laolao Bay. A National Oceanic and Atmospheric Administration (NOAA) grant was awarded to DEQ through the American Recovery and Reinvestment Act (ARRA) for road and drainage improvements and revegetation. The following actions were taken to reduce erosion and sediment transfer into Laolao Bay:



Sedimentation stream outfalls prior to restoration project (2004) © Tim Lang

#### *Road Improvements*

The two access roads to Laolao Bay are Laolao Bay Drive and Gaggap Road. About a half a mile of Laolao Bay Drive was paved and storm water runoff controls were installed to redirect water into a series of sediment chambers at the bottom of the road. The unpaved portions of Laolao Bay Drive and Gaggap Road (which leads to a popular dive site from the village of Kagman) have been regraded to improve drainage. Plans were created to realign Gaggap Road to follow the natural curve of the land, decreasing erosion and sedimentation into the bay, although they have not yet been implemented.

### *Hardening Stream Crossings*

The unpaved portion of the road was hardened at six stream crossings to prevent chronic erosion.

### *Revegetation*

1600 seedlings of 12 native or naturalized species have been planted over a 14 acre area in the upper badlands of the watershed that had been damaged by land clearing and fires.

### *Community Outreach*

Signs have been posted at beach access points to educate people about littering and sea turtles. Brochures were distributed to schools to teach children about revegetation efforts, and project slides were shown at the local movie theatres. Volunteers have been involved with raising awareness about the project and the threats to the natural resources in the bay. A social marketing campaign was launched in 2012 called “OurLaolao”, encouraging visitors to take pride in the resources of the bay and clean up litter along the beaches.

### *Biological and Water Quality Monitoring*

The DEQ and Coastal Resource Management Office (CRM) Marine Monitoring Team partnered with the Pacific Marine Resources Institute to conduct ecological monitoring of benthic substrate, coral communities, algal diversity, invertebrate densities and fish communities. Data from this assessment were compared to a similar study done in the fall of 1991 and the spring of 1992, before the construction of the Laolao Bay Golf Resort. The Division of Fish and Wildlife (DFW) Sea Turtle monitoring program surveys the beaches for turtle nesting sites. Fishing pressure and catch-per-unit effort are also monitored by DFW.

For the duration of the ARRA funded project, water quality was monitored at the reef flat on a monthly basis for temperature, pH, salinity, total suspended sediments, turbidity, and nutrients. During rain events, stormwater at ten locations where stormwater crosses the access road, some of which have been improved with ARRA funds, was sampled.

### **How Successful Has it Been?**

The paving of 0.4 miles of Laolao Bay Drive was completed in April 2012. The new drainage system includes a curb and catch basin system, subgrade drain pipe, concrete sediment chamber, and a gabion sediment chamber. A total of 1.9 miles of unpaved parts of Laolao Bay Drive and Gagap Road were regraded utilizing techniques learned from workshop training. Six stream crossings were constructed of reinforced concrete fords and included rip-rap slope protection.



Section of road grading work completed by DPW © Tim Lang

DEQ partnered with the Department of Land and Natural Resources, DFW, CRM and the U.S. Department of Agriculture’s Natural Resources Conservation Service (NRCS) on the reforestation of the watershed. More than 1,600 plants representing 12 native species and 5,000+ linear feet of Vetiver grass were planted in 2010 and 2011 across the 14-acre deforested upland site above Laolao Bay. Monitoring is ongoing, but within the first year, a 67% survival rate had been observed.

Several stakeholder workshops were held in order to educate the community about the project and get feedback. Fifty-five community volunteers attended training on revegetation. Along with the two beach signs for turtles and anti-littering, theatre slide Public Service Announcements (PSAs) were shown at the local movie theatre for six months, and radio PSAs were broadcasted on three stations for six months. Informational materials such as posters and brochures were distributed to 32 schools.



Workshop participants discuss stream crossing © Tim Lang

The Laolao Bay Coral Reef & Water Quality Monitoring Plan was completed in 2010. The DEQ-CRM Marine Monitoring Team completed a baseline ecological survey of the reef flat and slope in 2011. Compared to 1991 data, results indicated a significant increase in macroalgae, mainly consisting of red algae, but also seasonal brown algae. It is anticipated that the completion of road improvements will result in improved water quality and a decrease in algal cover, thus having a positive influence on reefs in the future.

Water quality monitoring of streams, reef flats, and the outer reef have been conducted regularly for 12 months to measure nutrient levels. During rain events, turbidity measurements are taken at ten stream locations to measure the effects of the road improvements and revegetation in the area.

### **Lessons Learned and Recommendations**

- It is expected that with the completion of the road improvements and upland restoration activities that algae biomass will be reduced. However, ecological responses may take several years to realize. The biomass of herbivorous fish will play a large part in the control of algae on the reef.
- There are many societal components in Laolao Bay, such as historic sites, fishermen, and divers. A social diagram should be made to compliment the natural resource management work to make sure those social considerations are included in long-term planning.
- Private landowner conservation practices should be encouraged.
- In addition to existing natural resource targets, causes of forest habitat loss, overharvesting of Tangantangan (castor oil plant) for charcoal, soil, and birds should be considered as potential conservation targets for Laolao Bay.
- Through this project, agencies and the public have learned a great deal about how sensitive the watershed is, and the value of preventing land-based pollution. This will hopefully lead to better protected lands in the future and especially in the case when lands are being developed.
- Not every problem in the Laolao Bay watershed has been fixed. Poorly developed roads and aging individual wastewater treatment systems are continuous problems. Despite increases in the resilience of Laolao Bay in the past few years, the watershed and the coral reef continue to face threats.

### **Funding Summary**

Original Grant - \$641,273 (US) (awarded 6/26/09)

- Revegetate 14-acre upland area
- Marine Monitoring - Ecological & Water Quality

- Public Awareness Campaign - Beach Signs - Public Service Announcements - Informational Brochures & Posters

Supplemental Funding - \$492,118 (US) (awarded 8/10/10)

- Enhanced Water Quality Monitoring - Additional sampling of streams - Sampling of reef flat - Profiling beyond reef
- Low-volume Roads Engineering Training Workshops
- Design and Construction of Stream Crossings
- Regrading of Laolao Bay Drive
- Laolao Bay Drive Minor Improvements

NOAA-Funded/Managed Works - \$1,470,773 (US)

- 0.4 mile Road Paving and Drainage Laolao Bay Dr.
- Construction Management
- A/E Design for Gaggap Rd. Paving and Drainage

Total ARRA Funding: \$2,604,164 (US)

Additional Funding: \$65,926 (US) EPA grant (for stream crossings construction)

#### **Lead Organizations**

CNMI Coastal Resources Management Office

<http://www.crm.gov.mp>

CNMI Division of Environmental Quality

<http://www.deq.gov.mp>

CNMI Department of Land and Natural Resources, Division of Fish & Wildlife

<http://www.cnmi-dfw.org>

#### **Partners**

CNMI Department of Finance

CNMI Procurement & Supply

CNMI Department of Public Lands

CNMI Department of Public Works

CNMI Forestry

CNMI Historic Preservation Office

U.S. National Oceanic and Atmospheric Administration

U.S. Natural Resources Conservation Service

U.S. Office of Personnel Management

U.S. Office of the Attorney General

U.S. Office of the Governor

U.S. Office of the Lt. Governor

U.S. Office of the Public Auditor

U.S. Department of the Treasury

U.S. Army Corps of Engineers

U.S. Environmental Protection Agency US Fish & Wildlife Service

Northern Marianas College

Pacific Marine Resources Institute

The Nature Conservancy

**Resources**

Laolao Watershed Restoration Project, Coastal Resources Management Office, CNMI  
<http://www.crm.gov.mp/projects/laulau.asp>

Coral Reef Initiative, Northern Mariana Islands  
<http://cnmicoralreef.com/>

Marine Monitoring and Coral Reef Program, Division of Environmental Quality, CNMI  
<http://www.deq.gov.mp/sec.asp?secID=12>

Turning Problems into Advantages – The Marianas Islands Responds to Nonpoint Sources in the Lau Lau Bay Watershed  
<http://water.epa.gov/polwaste/nps/success319/marianas.cfm>

Laolao Bay Road and Coastal Management Improvement Project: Ecological and Water Quality Assessment

Laolao Bay Conservation Action Plan

Laolao Bay Road & Coastal Management Improvement Plan

Our Laolao  
<http://www.ourlaolao.com/>