

RECONNAISSANCE REPORT ON SHORE PROTECTION FOR  
ASQUIROGA, GUAM

May 30, 1980



DEPARTMENT OF THE ARMY  
PACIFIC OCEAN DIVISION, CORPS OF ENGINEERS  
BUILDING 230  
FT. SHAFTER, HAWAII 96958

PODED-PH

30 May 1980

SUBJECT: Section 14 Reconnaissance Report on Shore Protection for  
Asquiroga, Guam

HQDA (DAEN-CWP-W)  
WASH DC 20001

1. AUTHORITY.

This report is submitted under the authority of Section 14 of the Flood Control Act of 1946, as amended, and was prepared in accordance with the policies and procedures prescribed by the Chief of Engineers in ER 1105-2-50 "Continuing Authorities." The report is in response to a request dated 29 October 1979 from the Governor of Guam for federal assistance in protecting the shoreline and highway at Asquiroga Bay from erosion damage.

2. DESCRIPTION.

a. Guam lies approximately 3300 nautical miles west of Hawaii, and is the largest of the Mariana Islands. The island is 209 square miles in area, approximately 30 miles in length, and about 8.5 miles at its widest point. Volcanic in origin, the island is characterized by two distinct geologic and topographic areas: the northern permeable limestone plateau which is underlain by a freshwater lens, and the southern volcanic mountains where more than 40 rivers and their tributaries are located.

b. Asquiroga Bay is located on the southeastern shore of the island, just north of Talofofo Bay (Fig 1) (Incl 1). A two-lane highway (Route 4) is situated at the base of mountainous cliffs directly adjacent to the shoreline. This scenic highway is the main thoroughfare serving the southeastern coast of the island.

3. PROBLEMS AND DESIRED IMPROVEMENTS.

a. The area is subjected to severe wave attack during storms and typhoons which periodically ravage the island. The highway, a major transportation link through the area, has suffered repeated damage, and the Government of Guam has had only limited success in protecting the highway from erosion damage. Approximately \$62,000 is spent annually

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by the Government of Guam on maintenance and repair of the highway, the most recent repair completed as a result of Typhoon Tip which struck the island on October 1979. However, continuing erosion is threatening the integrity of the highway.

b. The Government of Guam desires that emergency shore protection be constructed to protect the highway against erosion damage. The Government of Guam's attempts to halt the erosion by dumping rocks have had only limited success.

#### 4. NATURAL FORCES.

a. Winds. The dominant winds on Guam are the tradewinds which blow from the easterly direction. Winds from the east-northeast clockwise to the east-southeast occur about 63% of the time (Fig 2) (Incl 2). The easterly trades prevail from November to June with windspeeds of 15 to 25 miles per hour during January through April. Wind directions are variable with frequent calms during the main typhoon season from July to December. The project site is directly exposed to the predominant tradewinds.

b. Waves. Deepwater wave data for the Guam area were obtained from the U.S. Naval Weather Service Summary of Synoptic Meteorological Observations (SSMO) tables published in 1971. The dominant wave pattern is that caused by the easterly trades (Fig 3) (Incl 3). The waves have predominantly short periods (9 seconds or less 89% of the time) and are 7 feet or less about 84% of the time.

c. Storms and Typhoons. Tropical cyclones are a family of atmospheric circulations which originate over the tropical oceans, and are categorized in terms of their intensities or sustained windspeeds as follows: Tropical Depression (less than 34 knots), Tropical Storm (34 to 63 knots), Typhoon (greater than or equal to 64 knots). Guam is located in a typhoon belt which extends west of 180 degrees longitude to mainland China, and from the equator to approximately 25 degrees north latitude. An average of at least 19 typhoons are spawned annually within this belt, and several of these, in various stages of development, threaten Guam each year. During a 28 year record (1948-1975) 70 typhoons have developed or tracked within 180 nautical miles of Guam with at least tropical storm strength. This is an average of 2.5 storms per year or 14% of the mean annual count for the western North Pacific Ocean. Twenty-six of these storms were of typhoon strength at their closest point of approach to Guam. Although the mean would indicate the occurrence of one typhoon passing within 180 nautical miles (nm) of Guam each year, the character of typhoon frequency has been quite irregular. Approximately 40% (11 years) of

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the 28 year period has been devoid of typhoons. Conversely, seven years have produced 18 typhoons or 69% of the total count for the 28 year period. Two of the most destructive typhoons were Karen (1962) and Pamela (1976), both of which passed directly over Guam. A maximum sustained windspeed of 125 knots was recorded for Karen, with wind gusts estimated to have reached 160-180 knots over sections of the island. A minimum sea level pressure of 932 millibars (mb) was recorded at the Naval Air Station. Approximately 9000 persons were left homeless, 100 injured, and 9 dead. Approximately \$250 million in damages were sustained. The slow progression of Pamela across the island (eye passage - 3 hours compared to 20 minutes for Karen) rendered Pamela more destructive than Karen. Winds for Pamela in excess of 100 knots were observed for 6 hours, typhoon force winds for 18 hours, and winds in excess of 50 knots for 30 hours. Damage to both civilian and military facilities was estimated near \$500 million, however, only one death was recorded.

d. Tide. The tidal data shown in Table 1 were obtained from the U.S. Coast and Geodetic Survey for Apra Harbor and are referenced to mean lower low water (MLLW). Two high and two low tides occur daily.

Table 1. Tide Data

|                         | <u>feet</u> |
|-------------------------|-------------|
| Highest tide (observed) | 3.31        |
| Mean higher high water  | 2.40        |
| Mean high water         | 2.30        |
| Mean tide level         | 1.45        |
| Mean sea level          | 1.41        |
| Mean low water          | 0.60        |
| Mean lower low water    | 0.00        |
| Lowest tide (observed)  | -1.89       |

## 5. ANALYSIS OF THE PROBLEM.

The project site is located within a small bay and is somewhat sheltered from direct wave attack by the rocky headlands on either side and the shallow fringing reef across the mouth of the bay. However, the bay faces towards the easterly direction, and is subjected to the prevailing tradewinds and waves and to typhoons which normally approach from the southeasterly direction. During periods of large waves and high water levels, wave energy reaching the shore causes severe erosion damage. When the area is under the influence of a storm or typhoon, the water elevation is high, permitting large waves to reach the shore and cause considerable damage by reduction of the storm.

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## 6. PROPOSED PLAN OF IMPROVEMENT.

The proposed plan of improvement consists of protecting the shoreline and highway with about 250 feet of rock revetment (Fig 4) (Incl 4). The revetment would be constructed of two layers of 2,000 to 4,000 pound armor stone over a 4-foot thick underlayer of 1/4-inch spalls to 400 pound stone. The side slope would be 1 vertical to 1.5 horizontal and the crest elevation would be +14 feet MLLW. The north end of the revetment will be tied back into high ground about 20 feet, while the south end will terminate against the existing rock outcrop. All depths and elevations in this report refer to a Mean Lower Low Water (MLLW) datum.

## 7. DESIGN CRITERIA.

a. The revetment design was calculated using available data and the design procedures contained in the Shore Protection Manual (CERC, 1977). The design water level and wave height were calculated based on the following parameters from typhoon Pamela (May 1976):

Maximum sustained wind speed = 120 knots

Minimum sea level pressure = 930 mb

Radius of maximum wind = 20 nm

Radial distance from storm center to site at closest point  
of approach = 0 (assume 1 nm)

b. Design Water Depth: The estimated design water depth,  $d_s$ , is 7.8 feet as shown below:

$$S_A + S_S + S_P + S_W + d = 7.8 \text{ feet}$$

in which:

|       |                                                                       |
|-------|-----------------------------------------------------------------------|
| $S_A$ | = astronomical tide = 2.4 feet ✓                                      |
| $S_S$ | = storm surge = 1.1 feet ✓                                            |
| $S_P$ | = water level rise due to atmospheric pressure reduction = 2.8 feet ✓ |
| $S_W$ | = wave setup = 0.5 feet                                               |
| $d$   | = water depth on the reef flat = 1.0 feet ✓                           |

c. Design Wave Height. The design wave height,  $H_b$ , was determined using breaking depth criteria and assuming a flat bottom on the reef flat:

$$H_b = 0.78 d_s = 6.1 \text{ feet}$$

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d. Revetment Design. The armor stone size was calculated using Hudson's stability formula:

$$W = \frac{W_r H^3}{K_D (S_r - 1)^3 \cot \theta} = 3060 \text{ pounds}$$

in which:  $W_r$  = unit weight of armor unit = 145 lbs per cubic foot  
 $H$  = design wave height = 6.1 ft  
 $K_D$  = stability coefficient = 3.5  
 $S_r$  = specific gravity of armor unit relative to seawater = 2.27  
 $\cot \theta$  = cotangent of the angle of structure slope = 1.5

The computed armor stone size is 3,060 lbs with an allowable variation of 25 percent. An acceptable range of armor stone is 2,000 to 4,000 lbs. The underlayer stone would consist of a 4-foot thick layer of 1/4-inch spalls to 400 pound stone. The crest elevation of the structure would be +14 feet, which is the approximate elevation of the existing ground. The structure would sustain only minor overtopping under design storm conditions.

8. ESTIMATE OF PROJECT FIRST COST. The estimated first cost for the proposed shore protection is \$320,000. This cost is based on March 1980 price levels in the project area and includes contingency, engineering and design, and supervision and administrative costs. A breakdown of the estimated first cost is shown in Table 2.

Table 2. Estimate of Project First Cost

| <u>Description</u>               | <u>Unit</u> | <u>Quantity</u> | <u>Unit Cost</u> | <u>Total Cost</u> |
|----------------------------------|-------------|-----------------|------------------|-------------------|
| Mob and Demob                    | Job         | --              | --               | \$13,000          |
| Excavate and Backfill            | Cy          | 1950            | 5.80             | 12,000            |
| 2,000 to 4,000 Pound Armor Stone | Cy          | 2570            | 42.80            | 110,000           |
| 1/4" to 400 Pound Bedding Stone  | Cy          | 2380            | 39.00            | 93,000            |
| Contingency (20%+)               |             |                 |                  | <u>46,000</u>     |
| Subtotal                         |             |                 |                  | 274,000           |
| Engineering and Design           |             |                 |                  | 26,000            |
| Supervision and Administration   |             |                 |                  | <u>20,000</u>     |
| Total Estimated Cost             |             |                 |                  | \$320,000         |

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9. ANNUAL COST. The average annual costs for the proposed plan are \$23,600 for interest and amortization and \$1,100 for maintenance costs. The average annual maintenance cost is based on 1% of the armor-layer cost. Interest and amortization costs were computed at an interest rate of 7-1/8 percent for an economic life of 50 years.

10. ANNUAL BENEFITS.

a. Benefits accruing to the project result from elimination of costly annual maintenance necessitated by storm damage, reduction of hazardous conditions and traffic problems during and immediately following storms, and employment of otherwise unemployed or under-employed labor during project construction (EDA benefits).

b. Maintenance Reduction. Major storm damage occurs at the site due to wave attack on an average of once every year. The Guam Department of Public Works (GDPW) spends an average of \$62,000 per year (i.e., per storm occurrence) on shoreline and highway repairs at the site. Data acquired from the GDPW shows that repair costs for 1978 and 1979 were \$40,000 and \$85,000, respectively. According to the GDPW, the average of these two amounts approximates the representative annual maintenance cost at this site due to storm wave damage. With the project, this maintenance will no longer be required, and the \$62,000 annual savings represents a project benefit.

c. Reduction of Traffic Problems and Hazardous Conditions. Wave overtopping during storms render the highway impassable due to water and debris. The project would allow traffic flow during storms since the revetment will significantly reduce wave overtopping. Repair of road damages usually takes about a week to complete and reduces traffic flow to one lane during this time. Since this highway (Route 4) is the primary route for traffic going to Agana and to Anderson Air Force Base, delays are experienced until the road is repaired. Delays are due to either the slowdown along the one-lane section of Route 4, or to the extra 2 miles of travel along an alternate by-pass (Route 17) through Talofofo town. Route 17 is a secondary road and not an equivalent alternative route, but can be used to approximate the delay cost. Based on an assessment of the area's population, local and tourist traffic through the project site amounts to an estimated 1,000 trips per day. The estimated cost of traffic delay is \$5,400/year, based on an average cost of \$0.25/mile, on individual's trip delay time valued at the average wage of \$4.00/hour, and an average of one week per year during which the delays occur.

d. EDA Benefits. Guam is an Economic Development Administration (EDA) qualified area. EDA benefits are based on the employment of

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otherwise under-or unemployed labor, and were computed to be \$800 as shown in Table 3.

Table 3. EDA Benefits

| <u>Wages Paid for Construction</u> |          | <u>Percent Applicable<br/>as EDA Benefits</u> | <u>EDA Benefits</u>      |                           |
|------------------------------------|----------|-----------------------------------------------|--------------------------|---------------------------|
|                                    |          |                                               | <u>Present<br/>Worth</u> | <u>Average<br/>Annual</u> |
| Skilled                            | \$10,800 | 43                                            | \$4,600                  | \$350                     |
| Unskilled                          | 10,400   | 58                                            | 6,000                    | 450                       |
| Total                              | \$21,200 |                                               | \$10,600                 | \$800                     |

e. Benefit Summary. Total average annual benefits are estimated to be \$68,200 as shown in Table 4.

Table 4. Total Average Annual Benefits

| <u>Benefit</u>            | <u>Average Annual Amount</u> |
|---------------------------|------------------------------|
| Maintenance Reduction     | \$62,000                     |
| Traffic Problem Reduction | 5,400                        |
| EDA Benefits              | 800                          |
| Total                     | \$68,200                     |

#### 11. ECONOMIC JUSTIFICATION.

Based on the estimates and findings of this study, the average annual benefits that would accrue from the proposed improvement are \$68,200 and the average annual costs are \$24,700. The net average annual benefits are \$43,500 and the benefit-cost ratio is 2.8.

#### 12. APPORTIONMENT OF COST.

The Section 14 authority states that the Federal share of the total first cost of the proposed project is limited to not more than \$250,000; the balance of the first cost, presently estimated at \$70,000, would be a non-federal cost to be borne by the Government of Guam. The estimated annual maintenance cost of \$1,100 would also be a local responsibility.

#### 13. PROPOSED LOCAL COOPERATION.

Federal participation in the project would be subject to the condition that local interests would:

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a. Provide without cost to the United States all necessary lands, easements, rights-of-way, and relocations required for construction of the project.

b. Hold and save the United States free from claims for damages which may result from construction and subsequent maintenance of the project, except damages due to the fault or negligence of the United States or its contractors.

c. Assure continued conditions of public ownership and use of the shore upon which the amount of Federal participation is based during the economic life of the project.

d. Assure maintenance and repair during the economic life of the project as required to serve the intended purposes.

e. Provide and maintain necessary access roads, open and available to all on equal terms.

f. Comply with the provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 (Public Law 91-646).

g. Comply with Title VI of the Civil Rights Act of 1964 (PL 88-352).

h. Assume full responsibility for all project costs in excess of the federal cost limitation of \$250,000.

#### 14. ENVIRONMENTAL CONSIDERATIONS.

a. None of the following exist within the project site: sites listed on the National Register of Historic Places, monuments or landmarks, valuable natural scenic or recreational areas, critical habitats for listed endangered species, wildlife or marine sanctuaries or refuges, prime agricultural lands, important commercial or recreational fishing.

b. An evaluation of fill activities, based upon EPA guidelines for the discharge of dredged or fill material under Section 404(b) of the Federal Clean Water Act of 1977, indicates that the material is suitable for discharge at the project site. A public notice has been issued requesting public comment on the proposed activities.

c. The project may result in a temporary increase in water turbidity. No human residences will be relocated or displaced. The

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project does not change the social structure, cohesion, or social well-being of the community. No modification of existing land use plans will occur. No new permanent noise, air, or water pollution sources will be created by the project. A consistency determination, prepared in accordance with the Federal Coastal Zone Management Act of 1972, indicates that the proposed project is consistent with the approved local coastal management program.

d. A terrestrial and marine environment survey has been completed by the U.S. Fish and Wildlife Service and the 2(b) report indicated no significant impact. A water quality certification was obtained and historic/archeological resources were coordinated with the Government of Guam. An evaluation report, prepared in compliance with Presidential Executive Order 11988 on Floodplain Management, indicates that the project has no adverse impact on the base floodplain.

e. Based on the above considerations an environmental assessment was prepared and is on file at the Pacific Ocean Division office. A Finding of No Significant Impact (FONSI) was determined for the subject project.

#### 15. FINDINGS.

Investigations made during the preparation of this report determined that the shoreline fronting Route 4 at Asquiroga Bay is susceptible to erosion damage which presents a serious hazard to continued access through the area. Periodic storm wave damage results in costly maintenance and repair work, hazardous conditions and traffic problems during and immediately following storms. Annual benefits resulting from shore protection improvements exceed the annual cost associated with the construction and maintenance of the protective work.

#### 16. CONCLUSIONS AND RECOMMENDATIONS.

a. Based on the findings of this report, the Division Engineer concludes that the plan proposed herein is an effective method for protection of the highway at Asquiroga Bay, Guam, from damage by shoreline erosion and recommends federal authorization of the project. The Governor of Guam, by letter dated 20 May 1980 (Incl 5), has provided assurance that the Government of Guam will comply with the requirements of local cooperation as stipulated in paragraph 13 of this report.

b. A work allowance, allotment, and apportionment under Appropriation Construction, General, 96X3122, are requested in the

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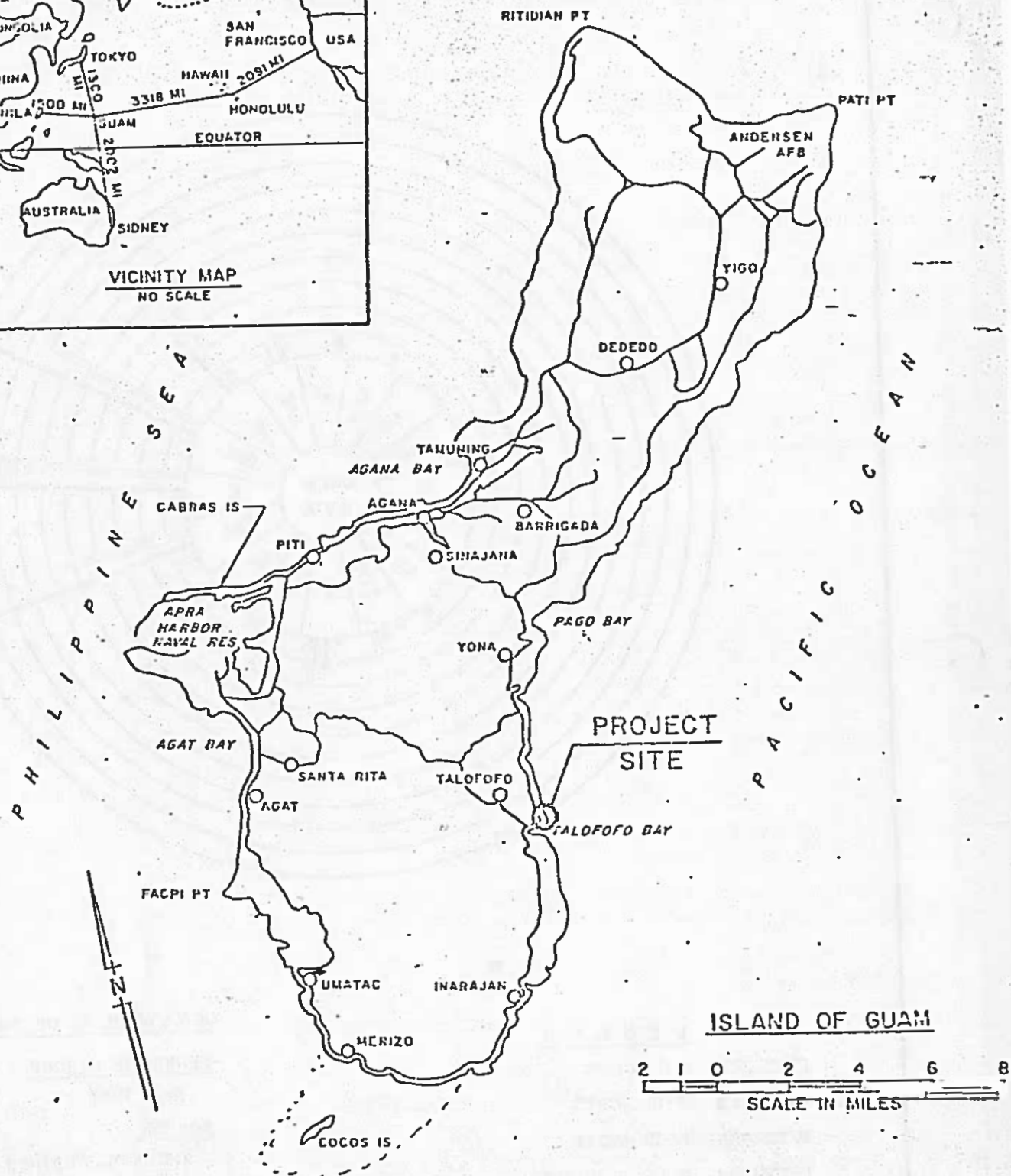
SUBJECT: Section 14 Reconnaissance Report on Shore Protection for  
Asquiroga, Guam

amount of \$9,000 to reimburse the cost of preparation of this report,  
and \$10,000 to initiate plans and specifications for construction of  
the emergency shore protection work.

FOR THE DIVISION ENGINEER:

5 Incl  
as

*B. R. Schlapak*  
B. R. SCHLAPAK  
Colonel, Corps of Engineer  
Deputy Division Engineer



# **LEGEND**

- MUNICIPAL VILLAGE CENTER
- MAJOR ROADS

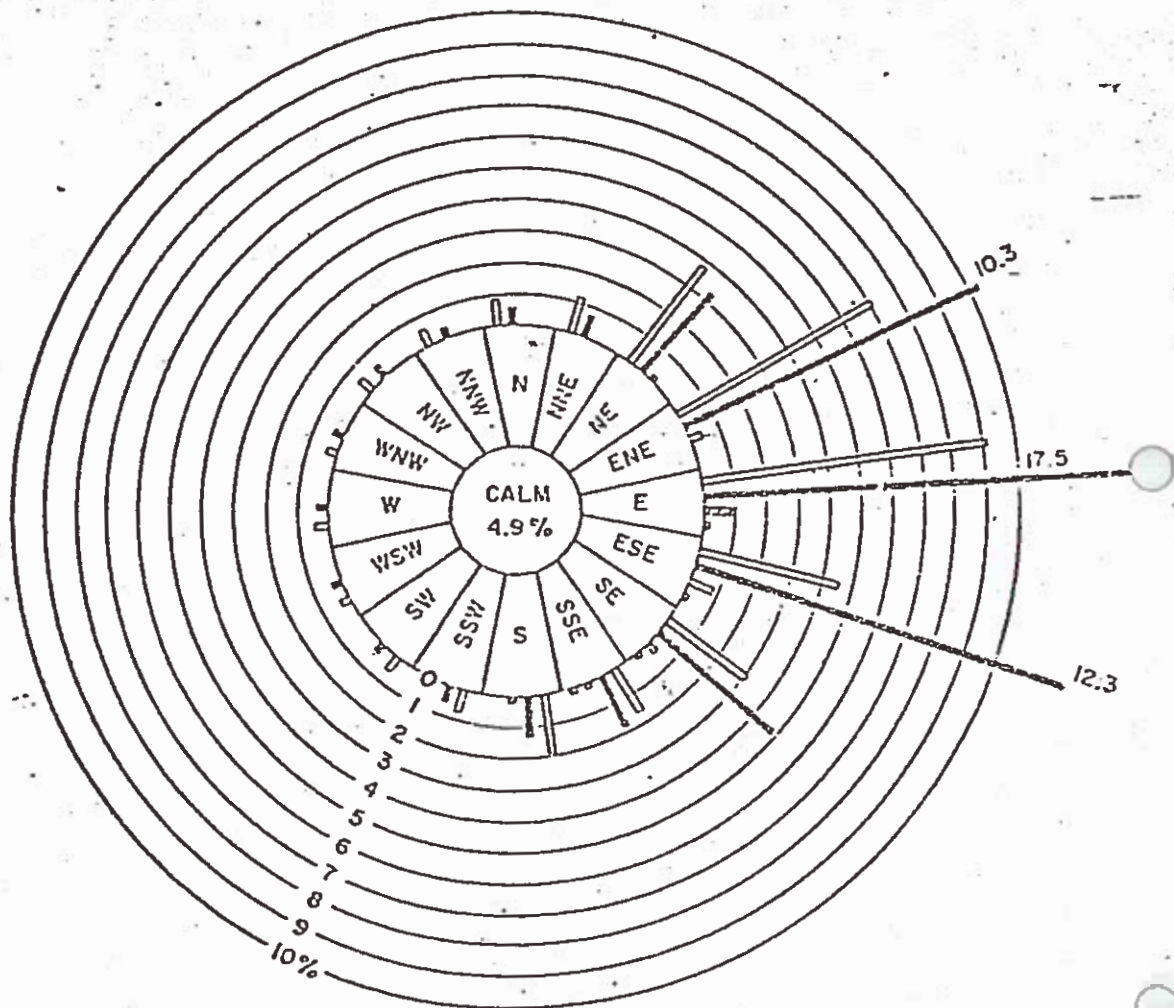
ASKIROGA BAY

GUA

## **LOCATION MAP**

U.S. ARMY ENGINEER DISTRICT, HONOLULU

SURFACE WIND DIAGRAM  
AGANA FIELD FLEET WEATHER CENTRAL  
GUAM, MARIANA ISLANDS



LEGEND

-  1-6 KNOTS
-  7-16 KNOTS
-  17-21 KNOTS
-  OVER 21 KNOTS

CONVERSION: 1 KNOT = 1.1516 MPH

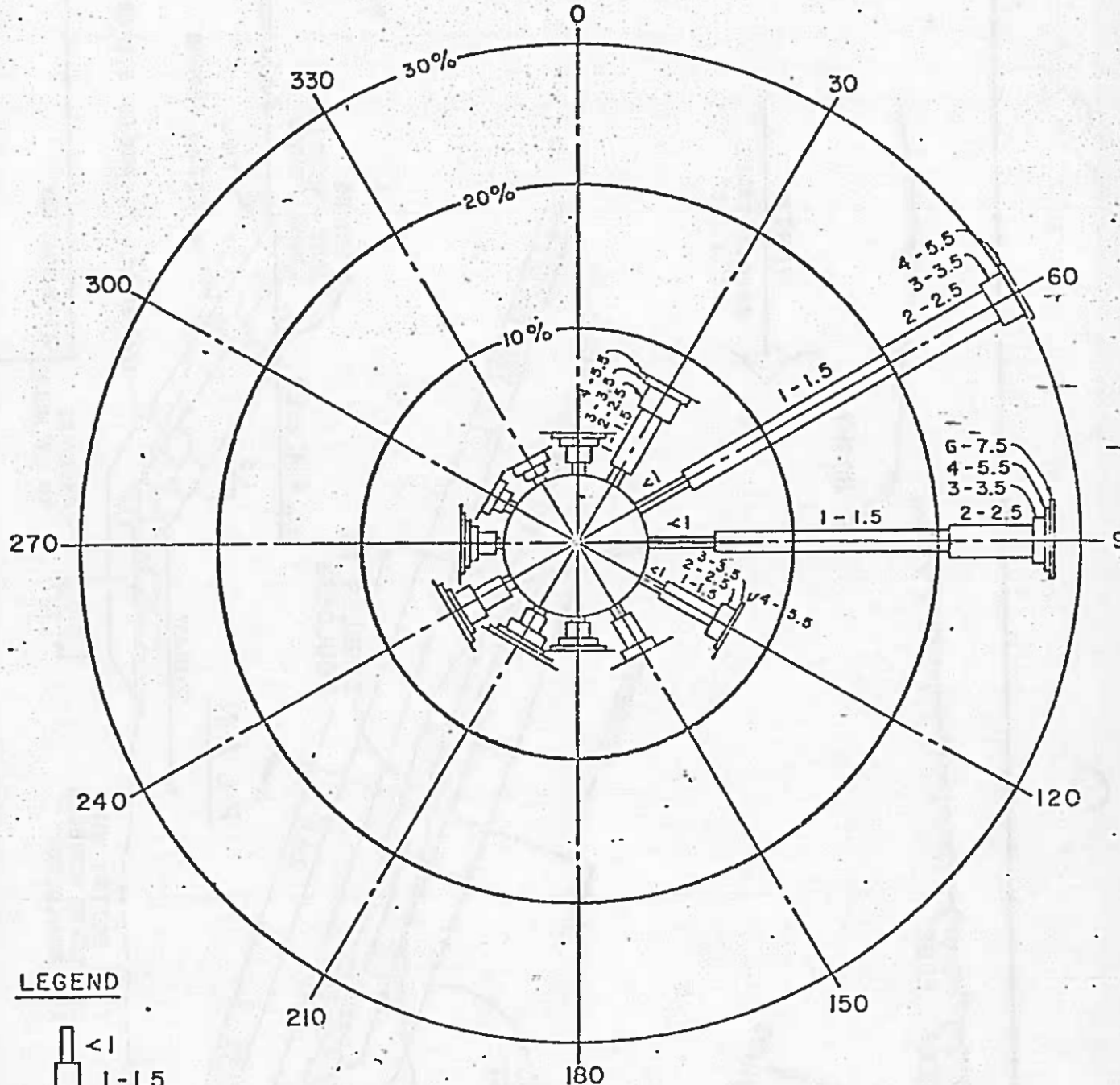
10% TOTAL % OF THE YEAR

PERIOD OF RECORD

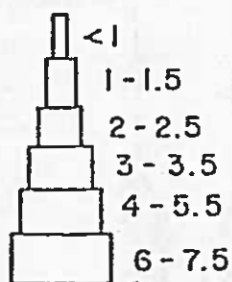
1945-1967

SOURCE

NATIONAL WEATHER SERVICE  
HONOLULU, HAWAII  
DATA COMPILED BY U.S. AIR FORCE  
ENVIRONMENTAL TECHNICAL  
APPLICATION CENTER,  
ASHEVILLE, N.C.



# LEGEND

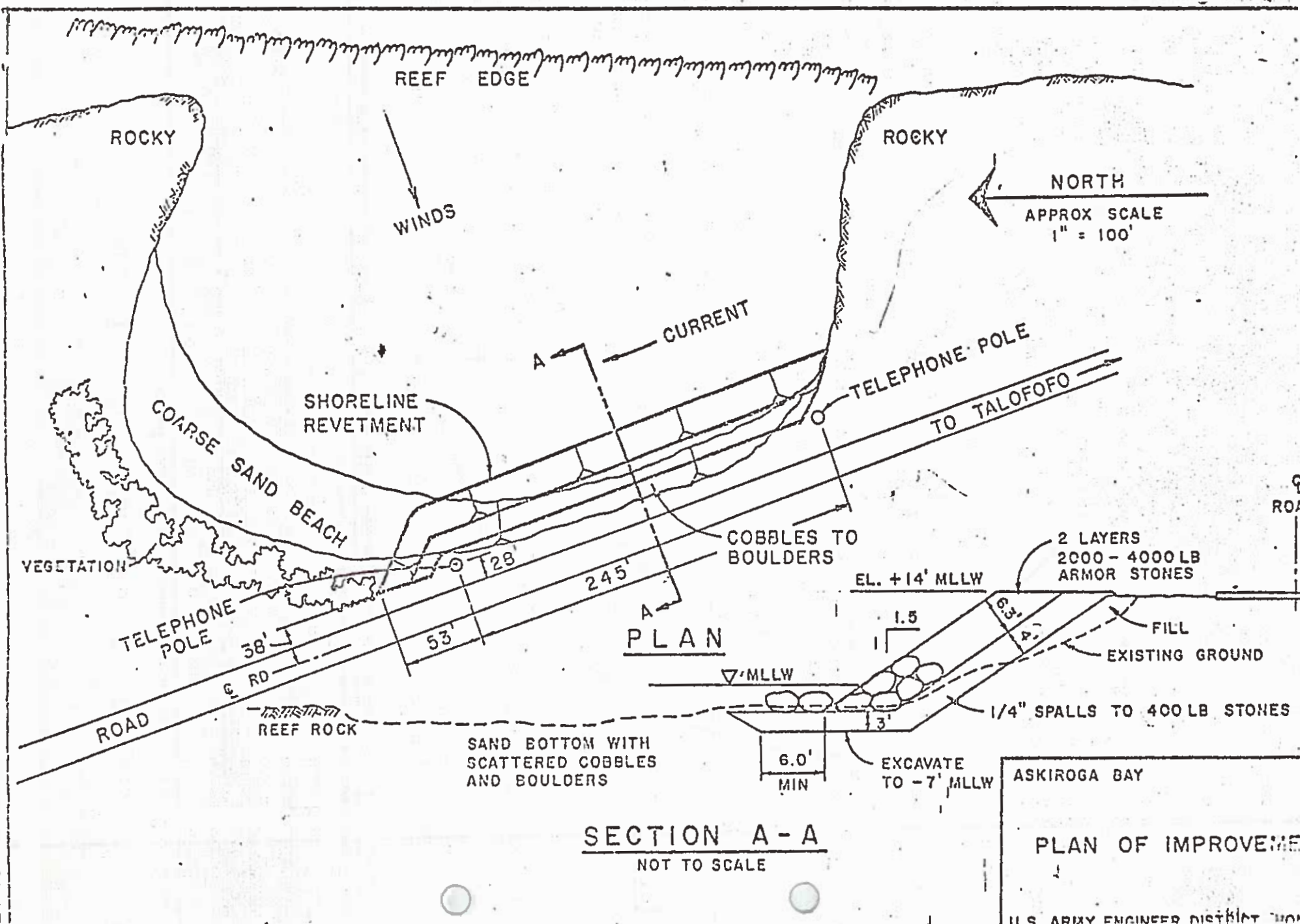


## ALL SEASON WAVE ROSE (H. IN METERS)

SOURCE: U.S. NAVAL WEATHER SERVICE, SUMMARY OF SYNOPTIC METEOROLOGICAL OBSERVATIONS. (SSMO)

PERIOD OF RECORD: 1963 TO 1970

DATA COMPILED BY NATIONAL CLIMATIC CENTER.





PAUL M. CALVO  
GOVERNOR

# *Territory of Guam*

OFFICE OF THE GOVERNOR  
AGANA, GUAM 96910  
U.S.A.

74770

20 MAY 1980

B. R. Schlapak  
Colonel, Corps of Engineers  
District Engineer  
Department of the Army  
U. S. Army Engineer District, Honolulu  
Building 230  
Ft. Shafer, Hawaii 96858

Dear Colonel Schlapak:

I have received your letter of May 6, 1980, and my staff and the Department of Public Works have reviewed the reconnaissance study of the Askiroga Bay erosion problem. We concur with your analysis of the problem, and support the proposed plan of improvement.

As requested in your letter, I am committing the Government of Guam to:

- a. Provide without cost to the United States all necessary lands, easements, rights-of-way, and relocations required for construction of the project.
- b. Hold and save the United States free from claims for damages which may result from construction and subsequent maintenance of the project, except damages due to the fault or negligence of the United States or its contractors.
- c. Assure continued conditions of public ownership and use of the shore upon which the amount of Federal participation is based during the economic life of the project.
- d. Assure maintenance and repair during the economic life of the project as required to serve the intended purposes.
- e. Provide and maintain necessary access roads, open and available to all on equal terms.
- f. Comply with the provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 (Public Law 91-646).

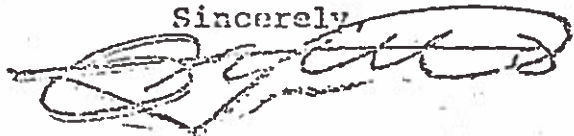
g. Comply with Title VI of the Civil Rights Act of 1964 (PL 88-352).

h. Assume full responsibility for all project costs in excess of the federal cost limitation of \$250,000.

In making this commitment, I recognize that the total project cost may approach \$320,000; \$70,000 of which would be a non-federal cost to be borne by the Government of Guam.

I appreciate your continuing cooperation in addressing Guam's shoreline erosion problems, and look forward to working with you on the Askiroga project and other erosion projects along southern coast.

Sincerely,

A handwritten signature in dark ink, appearing to read 'Paul M. Calvo', written over a horizontal line.

Paul M. Calvo  
Governor of Guam



# United States Department of the Interior

## FISH AND WILDLIFE SERVICE

300 ALA MOANA BOULEVARD  
P O BOX 50167  
HONOLULU, HAWAII 96850

IN REPLY REFER TO:

ES  
Room 6307

May 5, 1980

Colonel B. R. Schlapak  
U.S. Army Corps of Engineers  
Building 230  
Fort Shafter, Hawaii 96858

Re: 2(b) Report  
Askiroga Bay Shore  
Protection Project, Guam

Dear Colonel Schlapak:

Enclosed are three copies of our final detailed report on the effects the proposed Askiroga Bay Shore Protection Project, Guam, would have on fish and wildlife resources.

Sincerely yours,

Maurice H. Taylor  
Field Supervisor  
Division of Ecological Services

Enclosures-3

cc: OEC, Washington, D.C. (2)  
ARD-E, Portland, (2)  
Public Affairs Office, Portland  
ES Field Offices, Region 1  
Boise  
Olympia  
Laguna-Niguel  
Sacramento  
EPA, San Francisco  
National Marine Fisheries Service, Hawaii  
Div. of Aquatic & Wildlife Resources, Guam  
Endangered Species, FWS, Honolulu



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# United States Department of the Interior

## FISH AND WILDLIFE SERVICE

300 ALA MOANA BOULEVARD  
P O BOX 50167  
HONOLULU, HAWAII 96850

IN REPLY REFER TO

ES  
Room 6307

May 5, 1980

Colonel B. R. Schlapak  
U.S. Army Engineer District Honolulu  
Building 230  
Fort Shafter, Hawaii 96858

Re: 2(b) Report  
Askiroga Bay Shore  
Protection Project, Guam

Dear Colonel Schlapak:

This is the report of the U.S. Fish and Wildlife Service on the U.S. Army Corps of Engineers Askiroga Bay Shore Protection Project, Guam. This document constitutes the report of the Secretary of the Interior on the project within the meaning of Section 2(b) of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. et seq.).

The project is being conducted under the authority of Section 14 of the Flood Control Act of 1946, as amended.

This document has been prepared using materials provided by the Corps of Engineers, data collected during the Service's site inspection, and other pertinent information. The major published source of local biological information is Randall (1974)\*, whose work centered on the Talofofo Bay area, approximately one-half mile south of the project site. The proposed project located on Guam's southeast shore (Enclosure 1). Its purpose is to halt shoreline erosion along approximately 250 feet of highway. Implementation of existing plans will result in the construction of approximately 300 feet of ungrouted riprap embankment as shown in Enclosure 2.

Weather conditions at the time of the Service's survey (February 27 and March 3) precluded meaningful offshore aquatic work due to high surf and turbidity. As a result, the investigation was limited to sampling organisms along the intertidal and supratidal portions of the project site (Enclosure 3)

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\*Randall, R. H. 1974. Talofofo Bay Coastal Survey. University of Guam Marine Laboratory Technical Report No. 13. Submitted to U.S. Army Corps of Engineers. Contract No. DACW 84-72-C-0015.



*Save Energy and You Serve America!*

Fifty random casts of a 1/2 meter-square quadrat revealed that dominant organisms on the coarse sandy beach were hermit crabs (Paqurus guttatus, Cancellus sp., Aniculus sp.), and ghost crab (Ocypode sp.). Densities of ghost crab burrows and hermit crabs (three species) were found to be 0.40 and 1.28 per square meter, respectively.

Infaunal examination was limited to screening four samples of sand along the water's edge above the limestone strip. Samples were dug to the limestone layer three to four inches below the sand surface. The only organisms found were a single unidentified polychaete and two hemichordates, the densities of which were 3.50 and 7.00 per square meter, respectively.

A strip of Mariana Limestone Formation, probably Agana Argillaceous Member (Randall 1974) was exposed along the water's edge. This substrate was irregularly pocketed with small holes which frequently formed interconnecting tunnel systems. Within these tunnels were found a variety of organisms including, snails, crabs, and gobies. As a result, samples of epifaunal organisms are highly inaccurate and do not represent true densities of organisms in this habitat type. Accurate sampling required destruction of the limestone, served no purpose, and was not conducted. Thirty random casts of the quadrat revealed a density of 8.8 organisms per square meter, comprised of mussels (Brachidontes sp. -  $0.67/m^2$ ), hermit crabs ( $5.6/m^2$ ), grapsid crabs ( $0.53/m^2$ ), and snails (Mitra litterata, Strombus sp., Nerita plicata, and Pythia scarabaeus  $1.73/m^2$ ), clams (Tellina sp. -  $0.13/m^2$ ), and xanthid crabs ( $0.13/m^2$ ).

During a search of the boulders along the southwest margin of the bay, only grapsid crabs were seen, but not sampled quantitatively.

At the time of the Service investigation there was a line of drift debris along the shore. This material was composed primarily of palm fronds and fruits, and pieces of bamboo culms. Within the debris were abundant populations of amphipods.

Terrestrial resources in the project site (i.e. east of the road) are limited. Vegetation is distributed as shown on Enclosure 3. Birds actually seen in the area were limited to one black drongo (Dicrurus macrocercus harterti, (S. Baker) and two reef herons (Egretta sacra sacra (Gmelin)) which flew past. Charadriiformes probably feed along the shoreline, however, the area is not significant bird habitat (Enclosures 4 and 5).

Due to the nature of existing resources, probably caused in part by erosion at the site, and the limited effect of the proposed Corps' project thereon, the U.S. Fish and Wildlife Service does not expect any significant resource losses due to project construction or maintenance. No endangered species will be affected at the site of the revetment. In fact, the Service believes that the revetment will provide a stable rocky intertidal habitat resulting in an increase in epifaunal populations.

At this time the only resource related problem we envision is that the north end of the revetment, by angling sharply into the shore, could result in an unknown amount of erosion along the remaining unprotected beach. Also quarrying activities associated with acquisition of armor stone could produce environmental effects, the nature of which are unknown at this time.

In view of the above, the U.S. Fish and Wildlife Service recommends that:

1. The north end of the revetment gradually blend into the existing beach.
2. All construction activities within and adjacent to the water be done so as to minimize turbidity and control erosion.
3. Unless the existing commerical quarry site is used for the acquisition of armor stone, the Service will be contacted when the quarry site is selected to determine the degree of effect, if any, of quarrying activities on endangered species.
4. All quarrying activities will be conducted such that they do not affect waters of the United States.

We appreciate the opportunity to comment. Please advise us if there are any changes to project plans accompanying Mr. Cheung's letter of March 25, 1980.

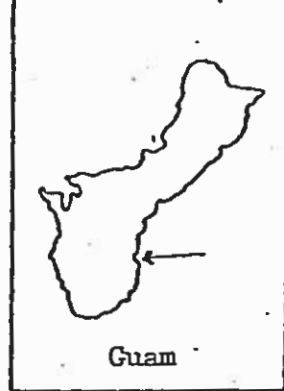
Sincerely yours,

*Maurice H. Taylor*

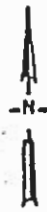
Maurice H. Taylor  
Field Supervisor  
Division of Ecological Services

Enclosures

cc: OEC, Washington, D.C. (2)  
ARD-E, Portland, (2)  
Public Affairs Office, Portland  
ES Field Offices, Region 1  
Boise  
Olympia  
Sacramento  
Laguna-Niguel  
EPA, San Francisco  
National Marine Fisheries Service, Honolulu  
Div. of Aquatic & Wildlife Resources, Guam  
Endangered Species, Honolulu



Guam



ASANITE POINT

ASKIROGA BAY PROJECT  
SITE

PAVED ROAD

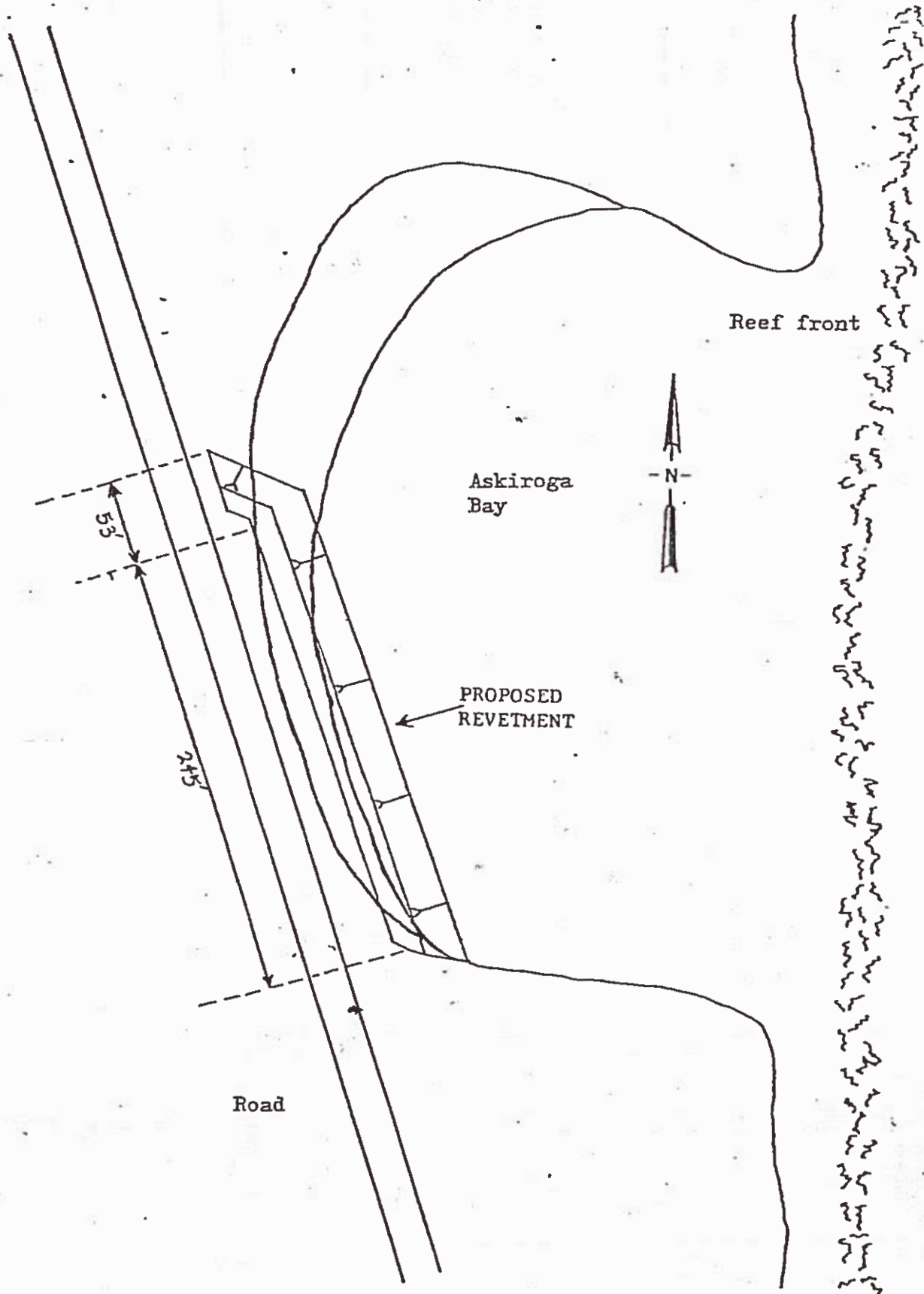
YPAN POINT

TALOFOFO BAY

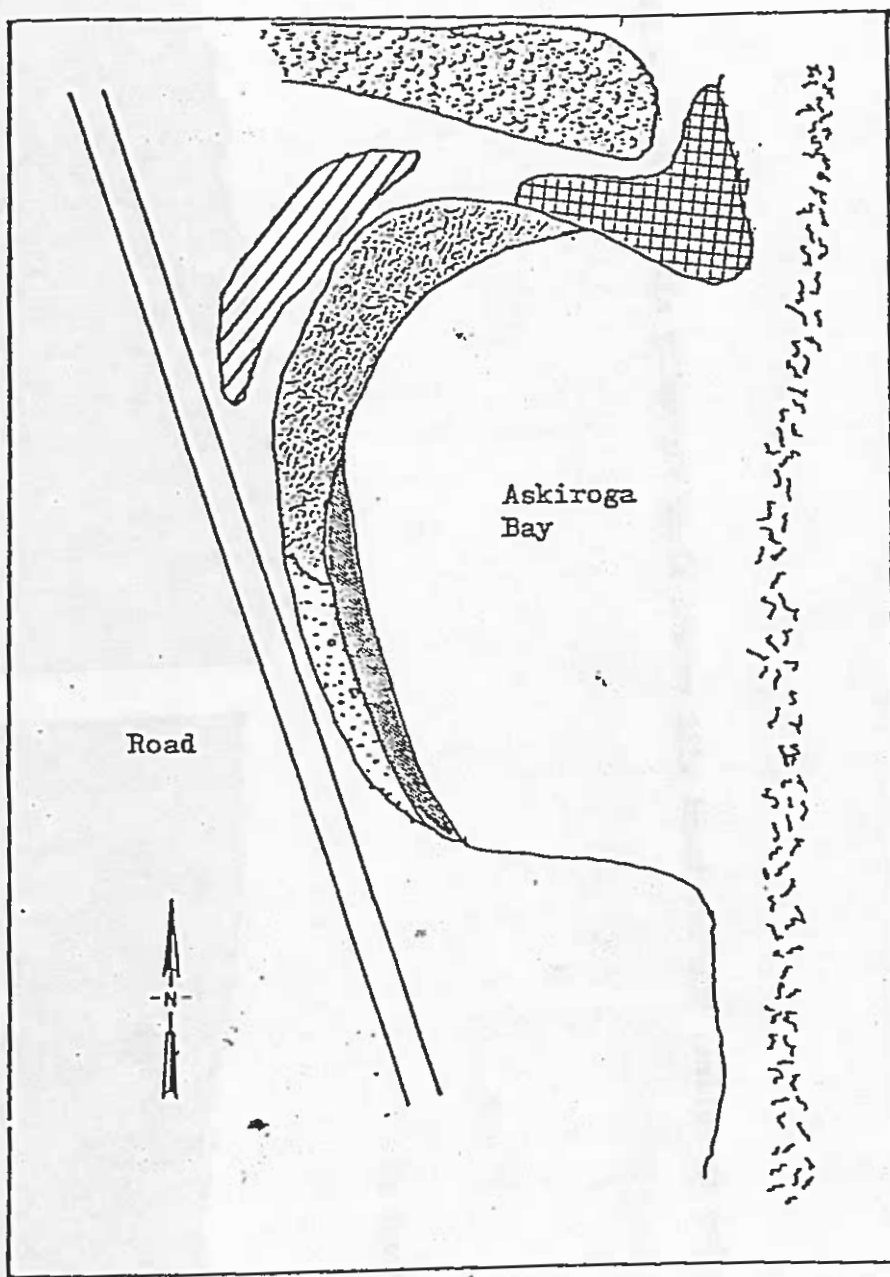
CORAL REEF



Enclosure 1: Vicinity map and project location,  
Askiroga Bay Shore Protection Project,  
Askiroga Bay, Guam



Enclosure 2: The proposed Corps of Engineers' shore protection project.  
Askiroga Bay, Guam



☒ Pemphis acidula (Forst.)

☒ Coarse sandy beach

☒ Mixed trees & shrubby vegetation

☒ Limestone

☒ BouEd rs

// Apo og na se C aprae subsp. brasiliensis (L.) (Ooststr.)

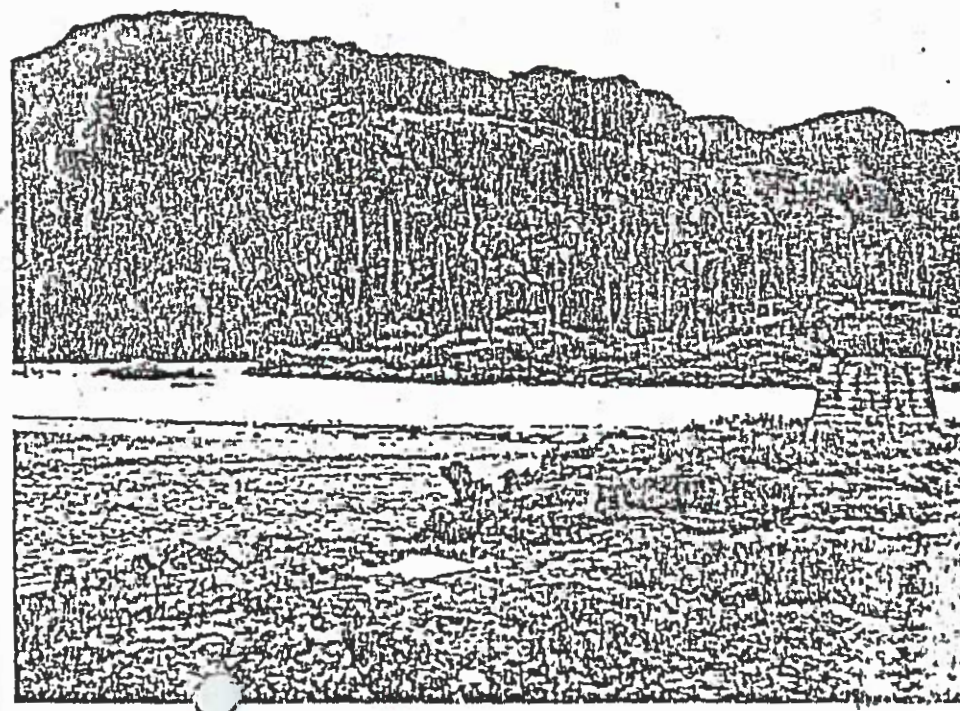
Enclosure 3: Map of Askiroga Bay, Guam, showing vegetation and substrate types

Enclosure 4: Askiroga Bay shoreline. The revetment will extend along virtually all of shoreline in Photograph #1

Photograph #1

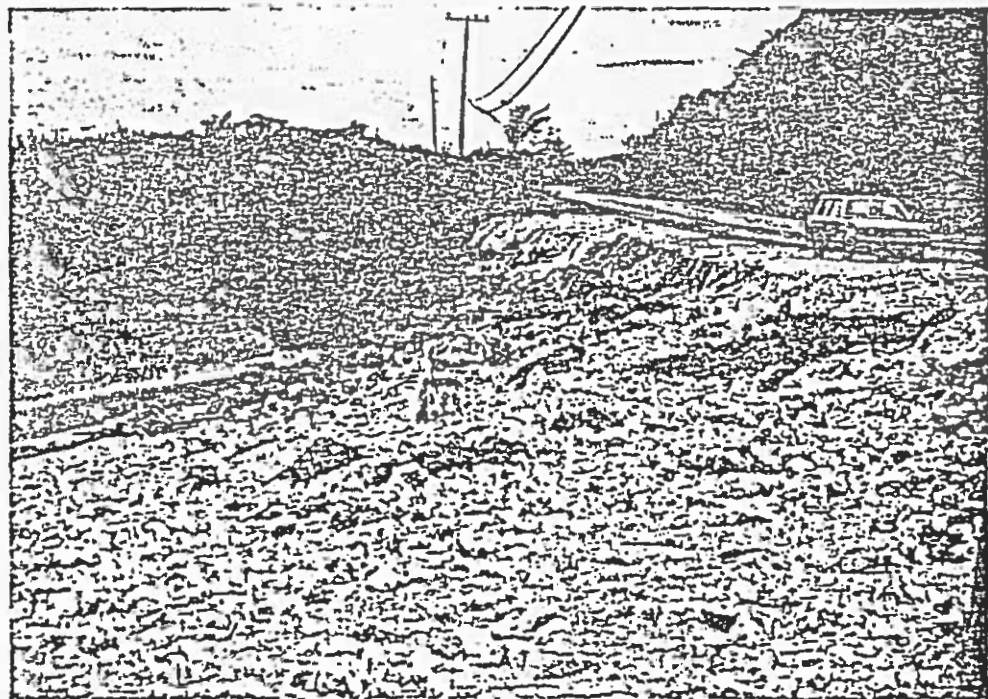


Photograph #2





Photograph 1: Coarse sandy beach and limestone substrate.  
Askinga Ba y, Guam



Photograph 2: Boulder embankment.  
Askiroga Bay, Guam