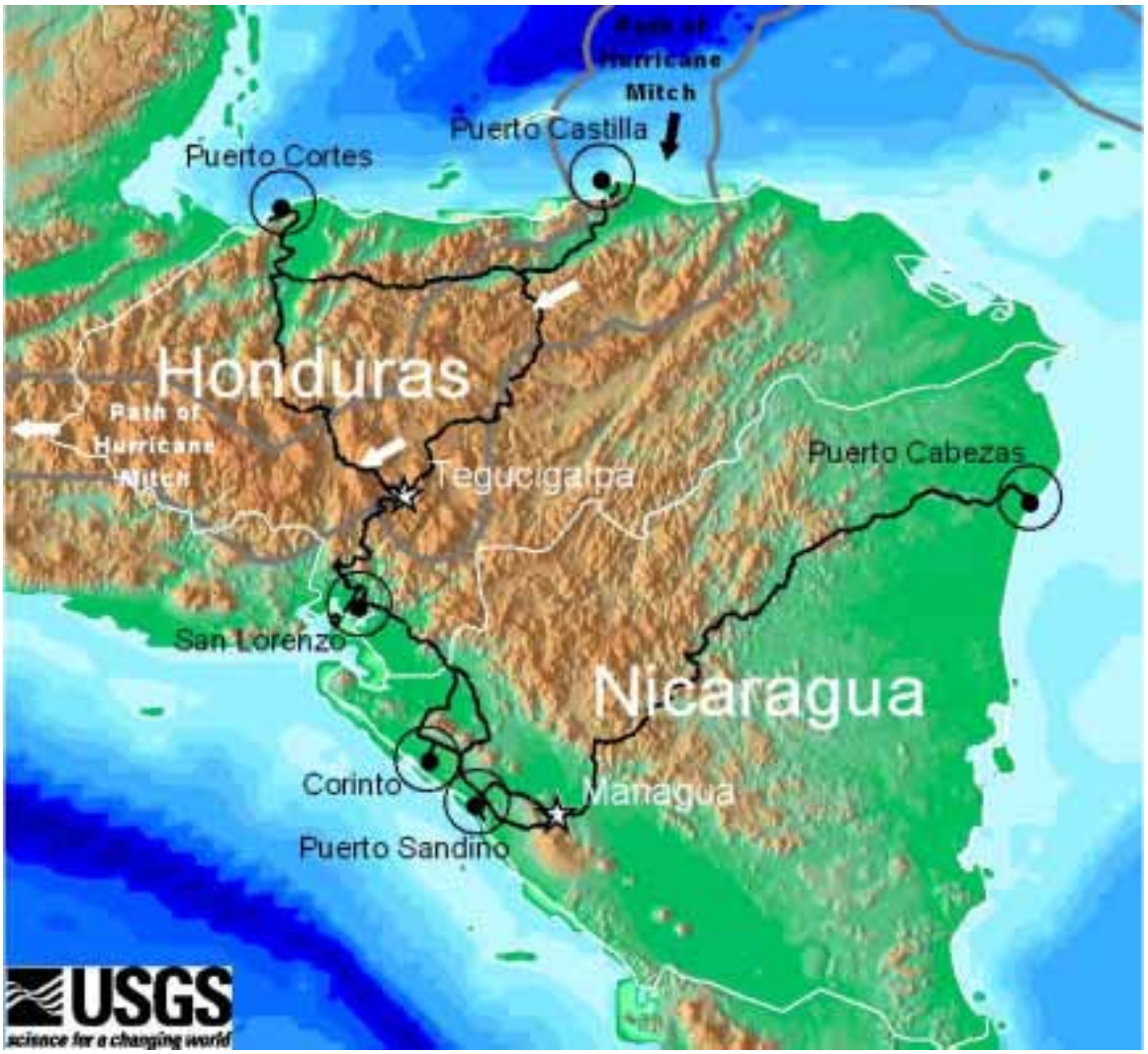
U. S. Department
of Transportation
Maritime
Administration

Port Damage Assessment

Short-term Action Report–April 2000



Honduras: Assessment of Port Infrastructure Damage Caused by Hurricane Mitch, 1998

Acknowledgments

This was the first ONE DOT project of its kind and the coordination efforts of RSPA's Office of Emergency Planning to help make Phase I a success is very much appreciated. The team wishes to express a special thanks to William Medigovich, Director, and Janet Benini of the Office of Emergency Transportation, Research Special Programs Administration (RSPA), U.S. Department of Transportation for their coordination efforts and support in the implementation of the Phase I Report. Their close working relationship with USAID, who funded this project, facilitated the completion of the report.

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Waterside Infrastructure Team

LT Hector Avella, U.S. Coast Guard

LT Curtis Shaw, U.S. Coast Guard

Nelson Sanchez, U.S. Army Corps of Engineers

Edwin Levine, U.S. National Oceanic and Atmospheric Administration

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Jose Torres, U.S. Federal Highway Administration

Luis Sandoval, U.S. Federal Highway Administration

Institutional Framework Team

Francis Mardula, U.S. Maritime Administration

Richard F. Moore, U.S. Geological Survey

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Glossary of Terms and Acronyms

Banco Mundial	World Bank
BID	Banco Interamericano de Desarrollo(Inter-American Development Bank)
COCATRAM	Comisión Centroamericana de Transporte Marítimo (Central American Maritime Transport Commission)
CO-OPS	Center for Operational Oceanographic Products and Services
COPT	Captain of the Port, United States Coast Guard terminology
DGPS	Differential Global Positioning System
ENP	Empresa Nacional Portuaria (National Ports Authority, Honduras)
EPN	Empresa Portuaria Nacional (National Ports Agency, Nicaragua)
FHWA	Federal Highway Administration, U.S. Department of Transportation
INCAE	Instituto Centroamericano de Administración de Empresas (Central American Institute for Public Administration)
INETER	Nicaragua Institute for Terrestrial Studies
km	kilometers, a metric measure of distance, approximately five-eighths of a mile.
m	meters or metres (The basic metric measurement, 39.3700 inches or 5.3996x10^-4 nautical mile, or 6.2137x10^-4 statute mile)
MARAD	Maritime Administration, U.S. Department of Transportation
MARENA	Ministerio de Recursos Naturales y el Ambiente (Environment and Natural Resources Ministry, Nicaragua)
MARPOL 73/78	International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 relating thereto
MTI	Ministerio de Transportacion e Infrastructura (Ministry of Transportation and Infrastructure, Nicaragua)
MLLW	Mean lower low water
MSL	Mean sea level
mph	miles per hour
NIMA	National Imagery Mapping Agency, formerly the U.S. Defense Mapping Agency
nm	nautical miles **(**approximately 1.1 miles).
NOAA	National Oceanic and Atmospheric Administration, U.S. Department of Commerce
OAS	Organization of American States
OET	Office of Emergency Transportation, U.S. Department of Transportation
RSPA	Research and Special Projects Administration, U.S. Department of Transportation
SOPTRAVI	Secretaría de Obras Públicas, Transporte y Vivienda (Ministry of Public Works, Transport, and Housing, Honduras)
U.S. DOT	U.S. Department of Transportation
USACOE	United States Army Corps of Engineers
USAID	Agency for International Development, United States
USCG	United States Coast Guard, U.S. Department of Transportation
USGS	United States Geological Survey, U.S. Department of the Interior

Executive Summary

The U.S. Department of Transportation (U.S. DOT), Maritime Administration (MARAD), was authorized to conduct port damage assessments in Honduras and Nicaragua ports damaged by Hurricane Mitch. Honduras and Nicaragua made the original request for technical assistance through the Organization of American States (OAS) in December 1998. Resolutions adopted at the XX Meeting of the Permanent Technical Committee on Ports of the OAS, held in December 1999 in Santiago de Cali, Colombia, authorized MARAD to organize a U.S. multi-agency team to be sent to Honduran and Nicaraguan ports to evaluate port damages. As provided in the OAS mandate, the Republic of Guatemala, in cooperation with MARAD, helped to coordinate this effort. The focus of the assessment is to develop a near-term and long-term port recovery and improvement action plan that will restore high productivity ports to fully operational status. This will help stimulate economic recovery of the affected Central American countries.

The multi-agency team has conducted onsite investigations and interviewed appropriate government and private sector stakeholder groups (see stakeholder names in Attachment 1). Included in these groups are Crowley Maritime Transport, Maersk/Sea-Land Services, Chiquita Brands International, Inc., and Dole Food Company, Inc. The team evaluated port operations and infrastructure (including road access), legal authorities, organizational structures affecting port operations, and infrastructure. In addition, a comprehensive assessment of both waterside and landside infrastructure was conducted. This assessment included:

- Navigation channels
- Anchorage areas
- Turning basins
- Berthing areas
- Off-loading cargo areas
- Marine terminals and warehouses
- Port security and safety
- Port access roads
- Major upland road connectors
- Environmental Protection

An advance team visited Honduras and Nicaragua from October 17 to 22, 1999, to prepare for the deployment of teams in the field. In Honduras, three teams visited Puerto Cortés and the Port of Castilla

from November 19 to 23, 1999, and the Port of San Lorenzo from January 23 to 28, 2000. In Nicaragua, the teams visited the ports of Corinto and Sandino from January 23 to 28, 2000.[1]

This report completes the first phase of the assessment and recommends specific actions that can be implemented within a 6-month to 1-year timeframe. Phase II is focused on a detailed analysis with recommendations for long-term solutions to remedy physical, economic, environmental and institutional conditions in Honduras. The second phase, Long-term Action Report is due on or about August 31, 2000. Exhibit ES-1 lists the total costs anticipated by type of project.

Exhibit ES-1
Total Cost for Honduras Projects

Honduras Cost Recommendations	Cost (U.S. dollars)
Grand Total	**$21, 862,210**
Navigation aids	$50,038
Water level gauge system	$80,000
Environmental response system	$14,674,172
Port security	$686,000
Roads and bridges	6,374,000

Exhibit ES-2 summarizes the specific team recommendations for short-term actions to remediate hurricane damage incurred from Hurricane Mitch and their expected costs.

Exhibit ES-2
Recommendations for Short-Term Actions

Project Area/Project Description	Cost (U.S. dollars)
Navigation Aids	
1. Puerto Cortés—Repair Punta Caballos light	Estimates vary
2. Puerto Cortés—Install range markers	$18,200
3. Puerto Cortés—Install sea buoy	$15,919
4. Port of Castilla —Install sea buoy	$15,919
Water-Level Gauges	
Install water level gauges systems at the Ports of Cortés and Castilla, to include a meteorological monitoring station with a voice modem as described in Attachment 2.	$40,000 each
Dredging	N/A
General Issues	
No funding is available from World Bank for dredging in Honduras	
No funding is available for studies	

Project Area/Project Description	Cost (U.S. dollars)
Disposal management experience is needed to handle the upland disposal areas better	
Contracts for dredging to other countries can get expensive	
ENP wants to get out of dredging business and hire contractors to perform the work	
Environmental Response Systems	
Canadian Environmental Management System (EMS)	
Phase I—Environmental audit and preliminary survey of equipment and training requirements	$224,172
Phase II—Detailed survey of requirements and preparation of tender documents	$950,000
Phase III—EMS implementation, environmental emergency response plan implementation, and contaminated lands and waters management, including equipment acquisition and staff training	$13.5 million
Port Security—Puerto Cortés	
Guard equipment, purchase uniforms, weapons, belts, and accessories	$75,000
Purchase/install portable and base station communication systems	$50,000
Purchase three small patrol security vehicles and four mountain bikes for roving patrols	$40,000
Develop a security plan, hire contractor to write and implement a security plan for the port	$100,000
Repair/replace perimeter fencing to meet international standards	$200,000
Pass & Badge system, Purchase/contract for staff, worker, and visitor identification badges to improve control of unnecessary personnel in the port	$20,000
Remote security, install cameras, sensors, and alarms as necessary to complement/assist guards	Price depends on complexity of desired system
Port Security—Port of San Lorenzo	
Install new guard booth at main gate that is adequate for supporting guards at this post	$40,000
Purchase uniforms, weapons, belts and accessories	$15,000
Communications equipment (five additional radios)	$4,000
Purchase barricades and lights to establish an interim security checkpoint until a permanent structure can be installed	$30,000
Hire contractor to write and implement a security plan for the port	$50,000
Purchase two small patrol vehicles and two mountain bikes for roving patrols	$40,000
Pass & Badge system, purchase/contract for staff, worker, and visitor identification badges to improve control of unnecessary personnel in the port	$20,000
Port Access Roads/Road Connectors	
1. Rio Silin Bridge—North abutment failed; recommend replacement with a longer single span structure	$409,000
2. CREM Culvert—Washed out culvert; construction of double 3x2 box culvert planned; also recommend slope protection and sound hydraulic study	$51,000 (study and slope protection)
3. Rio Agua Bridge—No damage	—
4. Relief Bridge #9 Rio Aguan—Roadway washed out for 1 kilometer—recommend:	
Providing slope protection for entire section	$136,000
Reconstructing road and bridges	$817,000

Project Area/Project Description	Cost (U.S. dollars)
5. Relief Bridge #8 Rio Aguan—Two piers collapsed affecting four spans—bridge length 100 meters; recommend entire bridge be replaced	$1,362,000
6. Rio Aguan Bridge—No damage observed	—
7. Existing Relief Bridge—One pier failed damaging two spans	$1,362,000
8. Roadway washed out—recommend building a new relief bridge	$218,000
9. Embankment washed out; recommend that a new relief bridge replace 2-feet x 6-inch culverts	$218,000
10. CA13—Damage to frame as a result of settlement; recommend 20 meter bridge and 50 meter road	$272,000
11. Rio Guaymon Bridge —125-meter bridge; recommend structure replacement (a possible lower cost alternative would be to conduct a study of the amount of damage and design a retrofit if the damage is not extensive)	$1,022,000
12. Toyos Sector Bridge—Pavement damage; recommend wall construction and bank protection	$20,000
13. Rio Leon Area—Recommend 30-inch minimum culvert pipe diameter	—
14. Roadway Washout (N15.66110, W87.33685)—Recommend 30-inch minimum culvert pipe diameter	—
15. Roadway, Washout (N15.61645, W87.12403)—Roadway, embankment, and culvert washed out; recommend inlet channel be re-aligned, and culvert and embankment slopes be protected	$10,000
16. Rio Perla Bridge —Bridge severely damaged; Swedish government funding a new bridge; studies and design are underway	No cost estimate
17. Rio Bonito Bridge—Bridge length 80 meters; Swedish government replacing bridge	No cost estimate
18. Rio Danto Bridge—Bridge has scour problems; bridge is only access to La Ceiba; further studies required to determine amount of damage	No cost estimate
19. Rio Cangrejal—Bridge Saopin—270 meter, nine-span bridge damaged; south abutment #1 destroyed and one of the piers is settling; Swedish government will design and build new bridge	No cost estimate
20. El Aire Sector—Corrugated metal pipe washed out and temporary bridge was constructed; proposing construction of 3-feet x 72-inch concrete pipe culvert; design of culvert should be validated by a hydraulic study	No cost estimate
21. Saba roadway—Roadway washed out; Swedish government will re-align road and construct new bridges	No cost estimate
22. Rio Tocoa Bridge—Bridge in good condition; streambed has risen; recommend that a higher bridge (80 meters long) be built	$341,000
23. Roadway access to Trujillo to Puerto Castilla—Extensive alligator cracking of roadway; side ditches obstructed by heavy vegetation; recommend thick pavement overlay (3 to 4 inches) and improvement to drainage	$136,000

Introduction

This Port Damage Assessment originated from a request submitted to the Organization of American States (OAS) Inter-American Port Conference, held in Cali, Columbia, in December 1998. At that time, both Honduran and Nicaraguan port officials requested technical assistance in response to the damages caused by Hurricane Mitch. The OAS Conference members passed a resolution delegating the Republic of Guatemala to coordinate a general port damage assessment in Central America and for the U.S. Department of Transportation (U.S. DOT), Maritime Administration (MARAD), Office of Ports and Domestic Shipping, Division of Ports, to provide technical assistance.

Guatemala completed the port damage survey, and the United States (i.e., MARAD) provided a review of the technical assistance, specifically for Honduras and Nicaragua. From these elements, MARAD produced an overall analytical report. A major recommendation of the MARAD report was to send a MARAD-led port damage assessment team to Honduran and Nicaraguan ports to validate the damages reported in the Guatemalan port damage survey. The OAS Inter-American Conference accepted the report recommendation, and the Honduran and Nicaraguan governments extended invitations.

Subsequently, MARAD developed a funding proposal to the U.S. Agency for International Development (USAID) to deploy a port damage assessment team in Honduras and Nicaragua. A formal project proposal was made to the USAID White House Reconstruction Working Group on Hurricane Mitch. Congress funded this project, and on Friday, May 21, 1999, the President signed H.R. 1141, a bill making emergency supplemental appropriations for the fiscal year ending September 30, 1999. The U.S. DOT Research and Special Programs Administration (RSPA), through the Office of Emergency Transportation (OET), is administering the funding and is coordinating the U.S. DOT initiative that includes other organizations (i.e., Center for Navigation at Volpe Center and the Organization of American States). These agencies are responsible for the deployment of a Differential Global Positioning System (DGPS) for navigation and a study for reducing the vulnerability of transportation trade corridors in Central America, respectively. RSPA closely coordinates these two U.S. DOT projects, along with MARAD's port damage assessment, to avoid duplication and increase efficiency and impacts between each project. This is the first time DOT agencies received funding to respond to an international disaster since the 1980s. Following a review by an ad hoc USAID Subcommittee on Transportation, the port damage assessment project was funded and integrated into a $1.94 million package. The transportation package proposal contained the following components:

Provide DGPS at Honduran and Nicaraguan ports

Conduct port damage assessments at Puerto Cortés and the ports of La Ceiba and Castilla in Honduras and the ports of Corinto and Sandino in Nicaragua

Conduct a natural hazard vulnerability assessment of transportation and trade corridors in Honduras and Nicaragua

As a followup, USAID requested letters of support from the World Bank and the Inter-American Development Bank, who were members of the USAID Subcommittee on Transportation. Such letters of support for sending the MARAD-led team to Honduras and Nicaragua were obtained by MARAD. The letters provided some assurance that both banks would consider followup recommendations from the port damage assessments.

This short-term action report is part of the first phase of the Port Damage Assessment.

A long-term action report, which will include detailed analysis and long-term options, is part of the second phase and is due on or about August 31, 2000. In the second phase, the Institutional Framework team will be activated and deployed in Honduras and Nicaragua to investigate institutional impediments and economic factors that impact port operations and the national economy. Results of the multi-agency team assessment will be reported to the USAID Subcommittee on Transportation with recommendations to the White House Working Group for Hurricane Reconstruction, coordinated by USAID. Moreover, because of a change in policy in the 1980s when USAID dropped the transportation infrastructure sector and commensurate funding from its program, this U.S. DOT initiative could set a precedent for future opportunities for U.S. DOT to conduct port damage and transportation-related assessments for USAID, provided that international donors support such efforts.

Objective

The objective of the assessment is to conduct an analysis of those ports likely to support the greatest trade throughput in Central America in the next 20 years. The assessment's focus is on the ports that were the most severely damaged by Hurricane Mitch and are experiencing congestion problems. To meet this objective, MARAD organized and led a multi-agency assessment team composed of the U.S. Coast Guard (USCG), U.S. Army Corps of Engineers (USACOE), Federal Highway Administration (FHWA), U.S. Geological Survey (USGS), National Oceanic and Atmospheric Administration (NOAA), and port industry experts from the Port of New Orleans and the Port of Miami.

Methodology

Upon receipt of funds from USAID in September 1999, MARAD organized a Port Damage Assessment Team. To assess the port damage, a multi-agency team visited northern Honduras from November 14 to 19, 1999, and southern Honduras on January 27, 2000. The team's mission was to conduct a detailed evaluation of the port and road infrastructure affected by Hurricane Mitch.

To accomplish this mission, the team organized the port damage assessment report into two phases. Phase I, a short-term action report, recommends specific actions that can be implemented within a 6-month to 1-year timeframe. Phase II, a long-term action report, is focused on a detailed analysis with recommendations for long-term solutions to remedy physical, economic, and institutional conditions in Honduras.

To accomplish these two phases, MARAD, through a public-port industry partnership, organized a multi-agency assessment team. MARAD recruited the U.S. Coast Guard and the U.S. Army Corps of Engineers, and cooperated with the American Association of Public Ports and the Port of New Orleans and the Port of Miami to provide technical experts for the Port Damage Assessment team. Later, unilaterally, NOAA, from the U.S. Department of Commerce, asked to join the team, bringing their own financial and manpower resources.

The Port Damage Assessment team, which used a comprehensive systems approach to evaluate the transportation system of the ports of Honduras, was organized into four distinct, functional teams. These included the following:

Waterside Infrastructure team to assess shipping and navigational conditions

Landside Infrastructure team to evaluate port operations, terminal infrastructure, and port security

Port Access Roads/Upland Road Connector team to survey adjacent access roads to the port and connecting to freight and cargo production areas (e.g., banana farms and manufacturing plants)

Institutional Framework team to analyze the institutions that affect port development and operations and maritime freight movements. In addition, the Infrastructure Framework team included additional functional areas to review and analyze economic macro-analysis of the national economy, trade-flow patterns, economic forecasts, along with a geo-spatial mapping system, which geographically defines physical infrastructure, political boundaries, and economic and social data

An advance team of leaders was sent to Honduras and Nicaragua to identify port stakeholders and vested interest groups who were affected by Hurricane Mitch. Through the cooperation of the U.S. Embassy in Honduras, specific contacts were identified and meetings were held with Honduran government officials representing the ports of Honduras and the public ministry, which administered the public road systems connecting to Puerto Cortés, Port of Castilla and the Port of San Lorenzo. (The National Ports Authority or Empresa Nacional Portuaria [ENP] of Honduras made a special request to drop the Port of La Ceiba from the port assessment list and replace it with the Port of San Lorenzo. ENP believes that the Port of San Lorenzo sustained more serious physical damages such as dredging and navigation problems resulting from Hurricane Mitch.)

The primary approach to gathering information and data consisted of onsite visits to the ports and a review of key reports and planning documents. The team conducted physical inspections of the road systems, port operations and security, and shipping and navigation operations within each port complex. Meetings were held with port stakeholders individually and in groups, with shippers, such as Texaco Oil, Dole Food Company, Inc., and Chiquita Brands International, Inc., using the port and road infrastructure systems. Conditions requiring immediate attention were documented and incorporated into the Phase I Short-term Action Report.

Background

The devastation caused by Hurricane Mitch was recorded as the largest disaster in the Western Hemisphere in more than two centuries, and the hurricane was the most destructive tropical storm in the hemisphere's history. From October 27 through November 1, 1998, it battered the Caribbean coast and parts of Honduras, Nicaragua, El Salvador, and Guatemala in Central America.[2] Hurricane Mitch reached sustained wind speeds of more than 180 mph while moving into the western Caribbean, but the main destruction resulted from intense rainfall.[3]

The scope and scale of the devastation is still hard to comprehend. For example, in Nicaragua, Hurricane Mitch affected 72 municipalities, and an estimated 865,700 people. Of these, 394,700 were children, concentrated in 144,300 families. Reports list 2,394 deaths, 938 missing, and 287 wounded.[4] In Honduras, a country with a population of 6 million, reports indicate 7,000 dead, 2,000,000 injured, and 1,000,000 homeless from the storm.[5]

In addition, much of the transportation and communications infrastructure of Honduras and Nicaragua was devastated. Towers and bridges were destroyed and roads were buried by landslides or washed away by floods.[6]

The storm track was westward through Honduras, into El Salvador and Guatemala. It affected all aspects of these economies and passed through major population centers.

Exhibit 1 depicts the location of Honduras and its ports and roads.

Exhibit 1

Map of Honduras

Waterside Infrastructure

The Waterside Infrastructure team, led by Team Leader LT Hector Avella, is organized as follows:

> Navigational Aids and Water-Level Gauge Systems—LT Hector Avella, USCG, and Mr. Doug Martin, NOAA, LT Curtis Shaw, USCG, Mr. Edwin Levine, NOAA, and Mr. Mark Bailey, NOAA
>
> Dredging Survey—Mr. Nelson Sanchez, U.S. Army Corps of Engineers
>
> Environmental Response Systems—LT Curtis Shaw, USCG, and Mr. Edwin Levine, NOAA

The Navigational Aids and Water-Level Gauge Systems team concentrated on assessing the possible damage affecting safe navigation, precipitated by Hurricane Mitch, in selected ports of Honduras and Nicaragua. The Dredging Survey team members reviewed plans and projects, and conducted onsite port visits to assess the extent of siltation caused by Hurricane Mitch. Because of the broad expertise of the NOAA and USCG team members, the Environmental Response System team also assessed the current oil spill and hazardous material release response capabilities of the various ports visited. The Environmental Response Systems team focused on determining the presence, availability, and effectiveness of contingency plans, which would be activated in the event of similar environmental disasters.

The information obtained from the various ports visited was mostly gathered through meetings with government port authority personnel, pilots, shipping agents, and government emergency response personnel. In addition, the team reviewed all available reports, studies, and guidelines, as cited in Attachment 1. Per the objectives of the short-term report, the Waterside Infrastructure team addressed navigation aids (including water-level gauges), dredging, and environmental response systems.

Navigation Aids and Water-Level Gauge Systems

The Navigation Aids and Water-Level Gauge Systems team includes Team Leader LT Hector Avella, USCG, Mr. Doug Martin, NOAA, LT Curtis Shaw, USCG, Mr. Edwin Levine, NOAA, and Mr. Mark Bailey, NOAA. Exhibit 2 summarizes the team's short-term project recommendations for improving port navigation aids.

Exhibit 2
Short-Term Project Recommendations

Project Name	Project Description	Cost (U.S. dollars)
PUERTO CORTÉS		
Punta Caballos	Repair Punta Caballos light	Estimates vary
Range Markers	Install range markers	$18,200
Sea Buoy	Install sea buoy	$15,919
PORT OF CASTILLA		
Sea Buoy	Install sea buoy	$15,919

Puerto Cortés Navigation Aids—Findings

Puerto Cortés occupies the northern part of the bay of the same name. National Imagery and Mapping Agency (NIMA) navigational chart 28170 (Approaches to Puerto Cortés) shows deep waters to within approximately 2 nautical miles WNW of Punta Caballos and a 50-fathom curve located approximately 4 nautical miles WNW of Puerto Cortés. The entrance channel is located on the north side of the bay on the west extremity of a low industrial peninsula known as Punta Caballos.

In general, with the existing aids to navigation, the vessel masters and pilots consider the port to be a safe harbor. Currently, no navigational impediment restricts or endangers vessels from making daylight approaches to Puerto Cortés. However, one of the light structures is out of service, and the entrance channel buoys need maintenance. Entering the harbor after sundown is permitted only if permission is obtained from local port authorities; however, the lack of proper range lights and the nonoperating Punta Caballos light makes this maneuver less than safe.

Deep draft vessels have only one access channel into the port. These vessels approaching Puerto Cortés can navigate using prominent coastal features of the peninsula, which provide an excellent radar return useful in determining a vessel's position. Refinery towers located about 0.3 nautical miles east of the Punta Caballos light and a water tank 2.3 nautical miles southeast of Punta Caballos are good landmarks. These coastal features and other land marks such as tanks and radio towers assist the navigator in fixing the vessel's position or directing the vessel's course. However, these features are excluded from the definition of an aid to navigation. Punta Caballos can also be identified by the Punta Caballos light (Lat. 15° 51.2' N Long 87° 57.6' W[7]), a red and white metal tower supporting a white flashing light, and having a nominal range (maximum distance at which a light may be seen in clear weather) of 20 nautical miles. The Punta Caballos light is the first navigational aid a vessel captain would use in determining land-fall; however, Hurricane Mitch damaged the Punta Caballos light, and it was nonoperational at the time of this report. Exhibit 3 describes the port's navigational aids.

North channel access to the terminals is 0.6 nautical miles long and 0.35 nautical miles wide with average depths of 13 to 27 meters. It is marked by four fixed aids to navigation (see Photo 1). All aids were confirmed to be on station by a GPS receiver, and the team was informed that all the lights were functional; however, this could not be confirmed.

Exhibit 3
Puerto Cortés Navigational Aids

Aid Number	Position	Characteristic	Structure
16482—Punta Caballos light	15 51.2	Fl W, height 58 meters	Range 20 nautical miles, red and white metal tower, flashing white light
16430.1—No. 1	15 51.2 87 57.8	Iso.G. period 2”	Green articulated light
16430.3—No. 3	15 51.2 87 57.7	Q.(3)G	Green articulated light
16430.4—No. 4	15 50.5 87 58.3	Q.(3)R.	Red articulated light

Photo 1. *No. 3 Entrance Channel Marker*

Vessels waiting for berthing space have ample anchorage and turning basin areas with depths of 11 to 20 meters, mud or sand, about 0.4 nautical miles from shore. Navigational harbor charts for the Puerto Cortés do not show specific anchorage berths and also lack detailed swing areas. Ships of various types and sizes require swing areas to determine if hazards exist within the swing circle. If vessel traffic is expected to increase, which ENP is forecasting, designated anchorage areas should be established. Exhibit 4 describes the type, length, and draft of vessels that arrive in Puerto Cortés. The current depth of the entrance channel and the turn basin do not constrain by draft any of the vessels that have visited Puerto Cortés. Photo 2 shows the typical vessel that arrives into Puerto Cortés.

Exhibit 4

Largest Size Vessels that Have Arrived in Puerto Cortés, 1998

Vessel Type	Vessel Name	Gross Regis (in tons)	Length Overall (meters)	Draft (meters)
Conventional Carrier	Managua	15893.00	173.00	7.9
Dry Bulk Carrier	Spring Wallow	24111.00	185.00	8.8
Crude Oil Tanker	3 Maj	39886.00	225.00	7.9
Refrigerated Banana	Chiquita Italia	13049.00	158.10	10.4
Banana Lo-Lo	Frances L.	19595.00	203.00	7.6
Container Vessel	Copiapo	29912.00	202.00	9.8
Ro-Ro	Dolores	16940.00	170.00	7.0

Puerto Cortés Navigation Aids—Recommendations

The following recommendations were discussed and strongly endorsed by ENP pilots. The recommendations are listed in order of priority.

Photo 2. *Typical Vessel in Puerto Cortés*

Repair Punta Caballos light

Repair range markers: As previously mentioned, lighted navigational range markers would significantly contribute to the safe approach to Puerto Cortés, especially during nighttime navigation. Ranges are pairs of aids to navigation (fixed land structures, located some distance apart and one higher than the other), lighted or unlighted, and positioned so that a line between them extended over water marks a preferred channel. When the front and rear marks or lights are aligned, a navigator is guided safely past shoals or obstructions. Ranges can also be used to mark turning points on channels or to establish specific directions for compass adjustment. The range markers would be constructed so as to project a line indicating the center of the north-channel entrance of Puerto Cortés and located approximately in position Lat. 15° 47.5 N Long 87° 59.0W. The approximate cost is shown in Exhibit 5.

Exhibit 5
Range Markers Repair Cost

Project	Approximate Cost (U.S. dollars)
Range towers with cement base (2)	$15,000
14-foot lanterns (2)	3,200
Total	**$18,200**

Install Sea Buoy: A sea buoy is also recommended in a location within 1 nautical mile north of the channel entrance. This would greatly aid navigators in fixing their positions and bringing their vessels around to line up with the entrance. Exhibit 6 shows the approximate sea buoy installation costs.

Exhibit 6
Sea Buoy Installation Costs

Project	Approximate Cost (U.S. dollars)	
Buoy 8x26LR	$11,110	
Battery box	470	
1 ½ inch chain (need 2 shots)	1138	(per shot)
1 ¼ inch chain (need 2 shots)	577	(per shot)
1 ¼ inch x 15 foot bridle	139	
Misc. gear (light, batteries)	770	
Total Costs	**$15,919**	

Port of Castilla Navigation Aids—Findings

The Port of Castilla is located on the south side of Cabo de Honduras, a large peninsula located on the north side of Trujillo Bay in position Lat 16° 00'N Long 85° 58' W. The north shores of Trujillo Bay are low, swampy, and wooded and offer no prominent landmarks. The Port of Castilla is exclusively used by the Standard Fruit Company to export bananas. There is a marginal wharf, 150 meters long and 38 meters wide, with a depth alongside of 14 meters. NIMA navigational chart 28142 (Port of Castilla) depicts the entrance to Port of Castilla as an ample natural bay with very safe and plentiful water.

Exhibit 7 shows the 1998 statistics of the largest vessels arriving at the Port of Castilla. The Bay of Trujillo is about 7 nautical miles wide at its entrance and recedes 5 nautical miles east to its head. A shallow channel at the east of the bay leads into a spacious lagoon. Depths in the central part of the bay range from 11.9 meters to 56 meters. A 20 meter curve lies just off the pier at Puerto Castilla and extends

east and west 0.3 nautical miles offshore. Callo Blanco, a dangerous reef, lies about 5 nautical miles south of Punta Caxinas (located at the western end of Cabo de Honduras). An 18-meter depth was reported (1984) to lie 1 mile SSW of the W extremity of Cabo de Honduras, and a 10-meter depth was reported to lie 2.3 nautical miles WNW of the same point. Vessels generally approach the Bay of Trujillo from the west and pass 1 to 1.5 nautical miles off Punta Caxinas.

Exhibit 7

Largest Vessels That Have Arrived in Puerto Castilla in 1998

Vessel Type	Vessel Name	Gross Regis (in tons)	Length Overall (meters)	Draft (meters)
Passenger vessel	Rotterdan VI	59652.00	238.00	6.2
Conventional carrier	Hansa Stockholm	10842.00	157.00	9.5
Dry Bulk carrier	Ellinis P.	13661.00	164.33	9.8
Refrigerated banana	Cuenca	11695.00	152.40	9.5
Banana lo-lo	Dole Honduras	16500.00	179.00	8.6
Timber vessel	Duna	1933.00	79.80	5.1
Container vessel	Dole Honduras	16500.00	179.00	8.6
Ro-ro	Regal Voyager	12547.00	141.60	5.5

Port of Castilla Navigation Aids—Recommendations

The Port of Castilla is devoid of any navigational aids, designated anchorage areas, or a turning basin. However, these shortcomings are not Hurricane Mitch related. All damages caused by Hurricane Mitch, related to navigation, were concentrated on the pier, which has since been repaired. No navigational impediment would preclude the safe navigation of deep draft vessels into the Port of Castilla. The team recommends that a sea buoy be installed in a location within 2 nautical miles west of Punta Caxinas. This would need to be prioritized with other navigation projects. Given the safe, natural harbor that the Port of Castilla enjoys, this project would not be a priority.

Port of San Lorenzo Navigation Aids—Findings

The Port of San Lorenzo is located on the pacific coast of Honduras within the coastal shores of the Gulf of Fonseca in position 13° 24’ N., 87° 25.5’ W (World Port Index No. 15570). The main pier, which provides four berths, is T-shaped and is 296m long and has a depth of 8.9 to 10m alongside (See Photo 3). Vessels of up to 176m in length, 32m beam, and 7.1m draft can be accommodated.

(**Photo 3**. T-pier, San Lorenzo)

The Gulf of Fonseca is a large bay that shares its boarders with El Salvador to the west, Honduras to the northeast and Nicaragua to the southeast. The entrance to the bay is approximately 14nm wide and has an average depth of 30m. The surrounding coastal features and prominent small islands in the bay provide excellent radar return and visual references necessary to determine ones position. Located on the northeast side of the bay is the beginning of a 16nm approach channel to the Port of San Lorenzo, marked with thirteen lighted navigational buoys (listed below) and 17 unlit smaller can buoys. The approach channel entrance also indicates the commencement of a 9m-depth curve. Port Authority officials stated that most of the navigational buoys were dragged off station during Hurricane Mitch; however, all the buoys were placed back on station.

The most significant threat to navigation is the enormous amount of debris – rocks, vehicles, tree trunks, and furniture – swept into San Lorenzo bay. Additionally, silting, which was aggravated by subsequent rain storms, has contributed to the disparity of recorded depths along the entrance channel. The team interviewed a San Lorenzo pilot and a captain of a deep draft vessel that was moored at the pier, both classified the entrance channel as unpredictable. Reported soundings in the channel have shown a 2m variance from charted depths, especially in the vicinity of Numbers 11 and 12 navigational buoys. Exhibit 8 lists a description of each navigation aid.

Exhibit 8

Port of San Lorenzo Navigation Aids

Aid Number	Position	Characteristic	Structure
15396.1 – No. 1	13 12.5 87 35.0	F1 G Period 3s	Articulated light
15396.11 – No. 2	13 12.4 87 34.8	F1 R Period 3s	Articulated light
15396.2 – No. 5	13 14.3 87 34.7	F1 G Period 3s	Articulated light
15396.21 – No. 6	13 14.2 87 34.6	F1 R Period 3s	Articulated light
15396.3 – No. 11	13 16.9 87 32.8	F1 G Period 3s	Articulated light
15396.31 – No. 12	13 16.8 87 32.7	F1 R Period 3s	Articulated light
15396.4 – No. 16	13 18.4 87 29.3	F1 R Period 3s	Articulated light
15396.41 – No. 17	13 18.6 87 29.5	F1 G Period 3s	Articulated light
15396.51 – No. 21	13 20.3 87 28.8	F1 G Period 3s	Articulated light
15396.6 – No. 25	13 21.7 87 27.7	F1 G Period 3s	Articulated light
15396.7 – No. 28	13 21.7 87 26.2	F1 R Period 3s	Articulated light
15396.71 – No. 29	13 21.9 87 26.3	F1 G Period 3s	Articulated light
15396.8 – No. 33	13 22.9 87 25.8	F1 G Period 3s	Articulated light

Port of San Lorenzo—Recommendations

The team recommends support of the Volpe initiative, which requires no immediate, additional funding at this time. The Volpe National Transportation Systems Center of the U.S. Department of Transportation currently is working with Port Authorities in Honduras to establish a Differential Global Positioning System (DGPS) for Port of San Lorenzo. In support of the USAID hurricane relief project, the Volpe Center is installing at Port of San Lorenzo a DGPS transmitter that will broadcast signals with vastly improved accuracy over conventional aids. When vessels operating in the Gulf of Fonseca are equipped with DGPS receivers, they will be able to proceed with a position accuracy of 7 meters or better. The installed system will provide DGPS signals that conform to internationally accepted standards that are the norm in the U.S. and many other countries throughout the world. The DGPS service will significantly enhance maritime safety and efficiency while lessening a dependence on visual aids to navigation.

Water-Level Gauges

The Water-level Gauge team, led by Team Leader Doug Martin, NOAA, and Mark Bailey, NOAA, investigated the need to deploy water-level (tide-gauge) and meteorological monitoring systems in Puerto Cortés and the Port of Castilla. NOAA's Center for Operational Oceanographic Products and Services (CO-OPS), was requested to submit a plan for the design and installation of a water-level and meteorological monitoring network for the Department of Commerce Implementation Plan for Reconstruction Work in Central America (Attachment 2 provides water-level gauge specifications). The primary purpose of this network is to support the reconstruction of the Geodetic Control Network in Central America. However, the data from these systems supports a wide variety of marine applications, such as safe navigation, coastal forecast models, coastal resource management, surveying and mapping, coastal engineering, marine boundary determination, and global climate change studies.

MARAD requested that CO-OPS provide a representative to its multi-agency team to assist with the navigation aids component of the MARAD Waterside Infrastructure work plan because of CO-OPS expertise in providing safe navigation products to the maritime community. Specifically, the CO-OPS representative was responsible for assessing the need for the installation of water-level and meteorological monitoring systems in Puerto Cortés and the Port of Castilla, Honduras. To accomplish this task, MARAD arranged site visits to these ports to meet with the port authority officials, pilots, and representatives from the shipping lines. The following findings for each port are a result of meetings with the port authority officials and pilots, and they document the team's short-term findings regarding the condition of each port's navigation aids.

Puerto Cortés Water-Level Gauges—Findings and Recommendations

The Department of Hydrography of the National Port Enterprise and the National Institute of Geography operate an analog-type tide gauge at Puerto Cortés. This station has been in operation since the early 1950s and has made significant contributions to the long-term sea-level observations in the Caribbean. However, the measurement system uses old technology, and it is labor intensive and expensive to operate and maintain. In addition, the data is processed manually and does not provide for real-time access. Both the pilots, Capt. Logan Tajum and Mr. Rene Rosa, and the port officials, Mr. Oscar Delgado and Mr. Luis Funes, indicated that the availability of real-time water-level and meteorological data would improve the safety of docking operations and enhance safe navigation of vessels during in and outbound transits. The team recommends the installation of a state-of-the-art, real-time water-level and meteorological monitoring system for this port. Other benefits of this system include supporting hydrographic surveys, dredging operations, environmental response, and recreational weather information.

Port of Castilla Water-Level Gauges—Findings and Recommendations

Dr. Noe Pineda Portillo, Director General, the National Institute of Geography, operated a tide station at the Port of Castilla for 10 years until it was destroyed by Hurricane Mitch. Dr. Portillo intends to re-install the station using an analog gauge similar to the gauge in operation at Puerto Cortés. Mr. Luis Allenes, Port Superintendent for Dole at the Port of Castilla, and the pilots (Puerto Cortés pilots alternate between Cortés and Castilla) indicated that real-time water-level and meteorological data would improve the safety of port operations. The team recommends the installation of a real-time system at the Port of Castilla.

Port of San Lorenzo Water-Level Gauges—Findings and Recommendations

An Endeco Inc. pressure gauge has been mounted by a tide staff on the pier. It appears to have a barometer to convert the hydrostatic pressure head to water height. The pilot representative and operations superintendent said that the harbor is 0.7m shallower as a result of silting from river runoff during Hurricane Mitch. They indicated that as a result of the silting tidal heights have increased, causing water levels on rising tides to flood areas of the port not previously flooded and threatening some of the port buildings. San Lorenzo is located on the north side of the Gulf of Fonseca, which is bordered by El Salvador, Honduras, and Nicaragua. The navigation channel from open water is 16 nautical miles long and the tidal range is about 3 meters. Winds often cause large anomalies between predicted and actual tides. It is difficult for the pilots to know in advance what the anomaly might be because of the long transit out to the incoming ships and back to the pier. Often winds also cause anchored ships to drag their anchors in the soft mud bottom.

The pilots and port operators agree that real-time tides/meteorology information would be of immense value.

Estimated Gauge System Costs for Castilla/Cortés Ports

The estimated cost of the components of a state-of-the-art, real-time water-level and meteorological monitoring station with a voice modem as described in Attachment 2 is $40,000 (U.S.) per system.

Dredging Survey

The dredging team, led by Team Leader Mr. Nelson Sanchez, U.S. Army Corps of Engineers, met with the port representatives from ENP. The objective was to investigate the damage to navigation channels from silting caused by Hurricane Mitch in Puerto Cortés and the ports of Castilla and San Lorenzo in Honduras. The scope of damage ranges from destruction to reduced navigation channel depths. The Honduras port dredging issues are shown in Exhibit 8.

Exhibit 8

Honduras Port Dredging Issues

Puerto Cortés	
No funding is available from World Bank for dredging in Honduras because of environmental sensitivity	Dredging experience is limited in Honduras
Environmental impacts because of dredging are a concern	No funding is available for studies
Honduras has limited dredging capability	Debris from Hurricane Mitch around the Texaco pier and other piers needs to be removed
Contracts for dredging to other countries can get expensive	Disposal management experience is needed to handle the upland disposal areas better
ENP wants to get out of dredging business and hire contractors to perform the work	
Port of Castilla	
Issues are the same as those in Puerto Cortés although the dredging requirements in Castilla are very small	
Port of San Lorenzo	
Issues are the same as those in Puerto Cortés	Pumping distances to open water site are too far for economical dredging
No government dredge is available in the south of Honduras to make dredging economical to perform	Many shoal areas in the channel are causing navigation problems
Disposal areas to place material adjacent to the channel are lacking	

Puerto Cortés Dredging Survey—Findings

ENP plans on performing maintenance dredging at the La Melza Port, Pier No.5, Extension Pier No.5, Pier No. 4, and Pier De Cabotaje in the year 2000. The estimated volume of dredge material is approximately 63,000 cubic meters at an estimated cost of $2.5 million (U.S.). The access channel to Puerto Cortés has suffered some shoaling, but the dimension of the channel at 0.35 nautical miles wide with average depths of 13 to 27 meters provides sufficient access for the shippers. In the past, ENP used its own 27-inch hydraulic dredge to perform ENP dredging. According to interviews, ENP was looking into hiring contractors for the dredging work in Honduras and providing ENP's dredge to the dredging

industry for its use in the year 2000. This dredge, manned by ENP personnel, is presently performing maintenance dredging in La Cieba because of the shoaling that occurred after Hurricane Mitch.

Texaco, in the past, has dredged in front of its pier with a small portable dredge. A representative from Texaco, Mr. Santos, indicated that shoaling occurs in front of the pier and requires periodic dredging. The sand migrates from the northwest portion of Puerto Cortés and moves down stream into the pier area between Texaco's piers and the Puerto Cortés access channel. The material does not seem to migrate into the access channel but does hamper the Texaco port severely. Before Hurricane Mitch, Texaco indicated that it dredged approximately 250,000 cubic meters of material and last dredged the pier area in 1992 to maintain a depth of 12 meters. Before Hurricane Mitch, port depths were 10.5 meters; now they are 9 meters. ENP and Texaco want port depths of 12 meters, which would require dredging of 400,000 cubic meters. Mr. Santos indicated that because of the problems with sedimentation and because the pier is old in this area, a new dock is being built near the original dock, to be completed in May 2000. The move to a new pier will allow Texaco to avoid dredging this year and maybe in future years, but sedimentation lowered the depth in this area which will cause problems in the future. Mr. Santos recommended that a study be conducted in the area to see if a structural groin/jetty, constructed north of the shoaling problem, would stop the source of sediment into the pier area, and thereby reduce the need for dredging. This is something the Corps of Engineers can accomplish with its experience in jetties and groin construction and sedimentation modeling

The Puerto Cortés access channels experienced no shoaling from Hurricane Mitch. In fact, ENP reported no hazards to navigation on the access channel. The 11- to 12-meter humps in the channel have been there for some time. ENP wants 14 meters in this area, and since 1997 it has been planning to dredge this project to 0.35 nautical miles in width with depths of 14 meters. The quantity of material is estimated to be 1.4 million cubic meters. ENP is waiting for environmental clearances and funding from the Government of Honduras to begin work in this area in the year 2000.

Puerto Cortés Dredging Survey—Recommendations

The team recommends that a study be performed to look at the possibility of constructing a jetty or groins on the northwest side of the port adjacent to the Texaco refinery to slow down the sedimentation of sand into the port facilities.

For the access channel, instead of dredging the channel, a navigation model should be performed to see if it is more economical to use less channel dimensions by reducing the channel width from 0.35 nautical miles wide to 0.15 nautical miles. This is still wider than most of the port channels in the United States. This option would be more protective of the environment.

The team recommends the government of Honduras pursue international donor funding for dredging. If funding is made available, the United States can provide dredging contract expertise to the Honduran government and assist in preparing plans and specifications for contracting with the world dredging industry for dredging operations. The U.S. government can also provide information on the availability of American dredging companies willing to perform dredging contracts.

The team also recommends that the government of Honduras survey its port channels every 6 months or more to provide better condition surveys. This will help the government to manage its dredging needs more effectively. Contracting with hydraulic survey companies that have the proper survey technology can provide the survey expertise. The United States can provide technical assistance to the Honduran government regarding the environmental impacts of dredging.

Port of Castilla Dredging Survey—Findings

No dredging has been performed in the Port of Castilla in the past 10 years. Mr. Delgado, from ENP, indicated that a very small shoaling occurred after Hurricane Mitch in front of the northwest pier corner. Approximately 1,000 cubic meters of dredge material will be removed in the year 2000. ENP has indicated that this is not a priority but would like to dredge this small amount and place the material upland into an open field next to the port.

Port of Castilla Dredging Survey —Recommendations

The Port of Castilla has natural depth and the need for dredging is very limited. Therefore, the team recommends that the government of Honduras survey the channel every 6 months to provide up-to-date condition surveys. The surveys would benefit the Bar pilots who use the port facilities.

Port of San Lorenzo Dredging Survey —Findings

This 17.5 nautical miles long inland channel has 35 buoys marking the channel width of 0.075 nautical miles. Depths range from 6.7 to 10.7 meters. ENP has had many problems with shoaling in this area. The big problem is dredge availability and disposal areas; there are no government dredges in south Honduras. The port plans to offer contracts to dredge the access channel, estimated to cost $375,000 (U.S.). Most of the dredging was needed before Hurricane Mitch. Dredging will provide depths of 11 to 12 meters.

Port of San Lorenzo Dredging Survey —Recommendations

The team recommends performing a study on the dredging needs and the real estate needs for dredge material disposal areas. If the dredge material disposal sites are small and have limited capacity, the U.S.

government can provide expertise as it pertains to dredge material management to prolong the life of the disposal areas.

The team also recommends that the government of Honduras survey the channels of the Port of San Lorenzo every 6 months to document conditions. The surveys would benefit Bar pilots navigating these channels.

Environmental Response Systems

The in-country environmental assessment of the Republic of Honduras was conducted from November 14 to November 19, 1999 and on January 26 and 27, 2000, to determine the regulatory compliance and environmental response posture of the country. The assessment, led by Team Leader LT Curtis Shaw, USCG, and Mr. Edwin Levine, NOAA, was aimed at identifying specific areas where international monetary funding may assist in the recovery of any marine environmental management systems damaged as a result of Hurricane Mitch. The assessment also looked for methods to improve environmental management systems, using international monetary funding, that would have long-term, positive impacts on the economy.

Background

Honduras is one of the poorest countries in the Western Hemisphere. Because of the limited economic resources and other factors, such as education regarding international environmental compliance response standards, environmental management itself has not been a priority. Although Hurricane Mitch did not damage any environmental protection structures or pollution response equipment, it did destroy the navigation aids systems on the Atlantic Coast that served to protect the environment and it washed out the foundations of 12 pipeline support structures in the port facility of San Lorenzo on the Pacific side. As noted in other sections of this report, Hurricane Mitch also devastated the highway infrastructure and destroyed bridges, many of the beaches, and a significant portion of the agriculture, which is the mainstay of the Honduran economy. With such devastation, environmental management and protection may not seem to be a high priority for international monetary funding. However, a prime opportunity now exists to integrate modern environmental management systems as a part of the rebuilding effort. Without monetary subsidies allocated specifically for environmental program development, it is unlikely that the government of Honduras will undertake such efforts on its own to the degree that will be effective in protecting the environment and in improving the compliance posture for shipping and receiving and storing hazardous materials in accordance with internationally accepted standards. Developing an environmental management system for managing such commodities that recognizes and incorporates international standards and practices is important to the long term economic growth and development of the country.

Puerto Cortés is the largest port in Honduras and is also one of the most important port facility complexes in Central America. As noted earlier, Puerto Cortés handles the bulk of the cargo transported into and out of Honduras and virtually all of the hazardous materials. By looking at the environmental response and compliance program in Puerto Cortés, the team focused on the most critical areas where improvements to environmental management practices would have the greatest impact. Consequently, Puerto Cortés was the focus of the environmental investigation; however, the team also compared smaller port facility operations to those of Puerto Cortés. Attachment 3 provides additional assessment of the Bay Islands environmental response systems, which was not part of the port damage assessment project but met NOAA requirements. The following describes the most critical issues to be addressed in the near-term.

Environmental Issues

The issues regarding environmental response are pervasive and fundamental, and affect all levels of government. The main issues to be addressed in the context of short-term actions to remediate damage from Hurricane Mitch are as follows:

: Oil and hazardous materials transportation can be expected to increase as the population continues to grow

: The government of Honduras has not actively engaged in an environmental compliance program for the transport of hazardous materials because of the lack of resources

: Port officials and environmentalists cite lack of awareness, training, environment protection laws, and pollution response equipment as significant hurdles to overcome in developing a contemporary environmental protection program. Port officials have virtually no training in oil spill or hazardous materials response and have no equipment or contracts in place to assist them with an operational response

: Honduras has no pollution response contractors, and the local fire department is untrained for any large-scale response

Currently, no environmental regulations are in place for vessels conducting bunkering operations.

: Equipment for containing and responding to such a spill, other than the resources of Texaco on the East Coast and Petrosur on the West Coast, is virtually nonexistent and would have to be shipped in from possibly as far as Puerto Rico or Miami. Honduran environmental officials are not trained in oil or hazardous materials response operations

: The entrance to the harbor and areas outside the channel and surrounding the Bay Islands are hard bottom (reefs and rocks). As noted earlier, numerous navigation aids were destroyed or knocked off station as a result of Hurricane Mitch

No emergency response plans are in place on the islands for pollution spills

Key Institutional Opportunities

The most significant current event for environmental protection for Honduras is the International Partnership Agreement between D'Aragon Desbiens Halde Associes Lte of Canada (DDH) and ENP. This agreement is already underway and will, if completed, create and implement an environmental management system (EMS) for the harbors operated by ENP. The project has three phases, which are described in Exhibit 9. The government of Canada is funding the first phase of the project. Subsequent funding will come from Canada and the government of Honduras.

The U.S. Department of Commerce, NOAA, would like to develop a model port in Central America. Working with Honduran environmental agencies and using existing local marine management programs, NOAA would provide technical assistance to develop a template for a port or regionally specific contingency plan for response to oil or hazardous materials releases. The goal ultimately is to develop a prototype contingency plan for spill response that would serve as a model for ports in Central America.

Recommendations

Based on findings, the team recommends supporting the Canadian DDH program as shown in Exhibit 9.

Exhibit 9

DDH Environmental Management System (EMS)

Project Name	Project Description	Estimated Cost (U.S. dollars)
Phase I	Environmental audit and preliminary survey of equipment and training requirements	$224,172
Phase II	Detailed survey of requirements and preparation of tender documents	$950,000
Phase III	EMS implementation, environmental emergency response plan implementation, and contaminated lands and waters management, including equipment acquisition and staff training	$13.5 million

In addition to the three-phase project that is being financed through Canada, the team recommends the additional following actions:

: Recommend that the government of Honduras and ENP each match the DDH funding in some proportion

: Establish an active environmental compliance program in Honduras for the transportation of hazardous materials that is compatible with international standards

: Establish an active pollution contingency and response program to prevent and respond to spills that may threaten the Honduran people, the aquatic environment, and the economy. This may be initiated through the DDH agreement and supplemented by the NOAA model port project and/or outside training available through the U.S. Coast Guard or other agencies with exportable environmental training programs.

: Establish an alliance between the government of Honduras, Petrosur and Texaco to develop contingency plans for responding to oil spills and hazardous material releases in Puerto Cortés and San Lorenzo.

: Foster partnerships with industry leaders, local response officials, and environmental officials. Any projects involving training and education in Puerto Cortés should include representatives from San Lorenzo and the Bay Islands

: Fund and repair the pipeline structures damaged by Hurricane Mitch at the port facility of San Lorenzo.

Landside Infrastructure

The Landside Infrastructure team includes Team Leader Mr. Kyle C. Jones of the Port of New Orleans (engineering and port operations), CPO Mark Petrick of the U.S. Coast Guard (security and safety), Mr. Aguedo (Ed) Bello of the Port of Miami (engineering and port operations), and Mr. Roger Burke, U.S. Army Corps of Engineers. The Landside Infrastructure team evaluated the land-based terminal at each port with emphasis on security, condition of physical infrastructure and equipment, and cargo operations. In addition, the team looked at port operations, and identified port users and defined their roles in the port community. This included inspecting port facilities and meeting with port officials and port users such as stevedores, freight forwarders, shippers, private contractors, and union officials. Port operations and port infrastructure will be examined in more detail in the Phase II Long-term Report.

Port Security and Safety

The primary security force for each port was composed of ENP employees. Each port had an ENP security chief who reported to the ENP port superintendent. The most common problems included inadequate security force training and disabled or inadequate security equipment. Exhibit 10 summarizes the team's recommendations for improving security in Honduras ports.

Exhibit 10
Recommendations for Improving Port Security

Project Name	Project Description	Cost (U.S. dollars)	Priority Status
PUERTO CORTÉS			
Equipment for guards	Purchase uniforms, weapons, belts, and accessories	$ 75,000	1
Communications system	Purchase/install portable and base station radios allowing security guards to communicate and coordinate responses to incidents	50,000	1
Security vehicles	Purchase three small patrol vehicles and four mountain bikes for roving patrols	40,000	1
Security plan	Hire contractor to write and implement a security plan for the port	100,000	1
Improve perimeter fencing	Repair/replace perimeter fencing to meet international standards	200,000	1
Pass and badge system	Purchase/contract for staff, worker, and visitor identification badges to improve control of unnecessary personnel in the port	20,000	1
Remote security	Install cameras, sensors, and alarms as necessary to complement/assist guards	Price depends on complexity of desired system	2
PORT OF SAN LORENZO			
New guard booth	Install new guard booth at main gate that is adequate for	40,000	1

Project Name	Project Description	Cost (U.S. dollars)	Priority Status
	supporting guards at this post		
Equipment for guards	Purchase uniforms, weapons, belts and accessories	$15,000	1
Communications equipment	Purchase five additional radios to augment the radios presently used by the guards	4,000	1
Interim checkpoint at main highway entrance	Purchase barricades and lights to establish an interim security checkpoint until a permanent structure can be installed	30,000	1
Security plan	Hire contractor to write and implement a security plan for the port	50,000	1
Security vehicles	Purchase two small patrol vehicles and two mountain bikes for roving patrols	40,000	1
Pass and badge system	Purchase/contract for staff, worker, and visitor identification badges to improve control of unnecessary personnel in the port	20,000	1

Puerto Cortés—Port Security Findings

Puerto Cortés has no current security plan. Port users report that the incidences of cargo theft rose significantly after Hurricane Mitch and that they remain alarmingly high even though more than 1 year has passed since the hurricane struck Honduras.

Security Force Issues: Puerto Cortés had two levels of security forces. ENP personnel patrol the gates and open areas, while the private leaseholders employ their own guards within their leased areas inside of the port's main security fence. ENP guards lacked identification, proper uniforms, and weapons. In addition, they did not have adequate communications equipment or vehicles. The private guards for the leaseholders were generally better equipped than the ENP guards but were still below standard. Poor communication seems to exist between the ENP and port users, as well as between the ENP guards and the private guards. In some cases an atmosphere of mistrust seemed to exist between the two groups of security.

Photo 4. *Entrance gate near Administration Buildings*

Equipment Issues: The perimeter security fence has several damaged areas and some areas where the fence is below standard height. Because the port is situated directly adjacent to the city of Cortés, open space zones are virtually eliminated, which exacerbates the fence vulnerability. Also, some buildings outside the port adjoin the perimeter fence, making illegal access easier. Currently, no remote systems (e.g., cameras and motion sensors) have been installed to assist the guards. The truck entrance gate is generally secure; however, the entrance near the administration buildings is poorly guarded, and unauthorized people were seen entering the port at this gate.

Photo 5. *Railroad gate in Security Fence Left Open and Unattended*

Puerto Cortés—Port Security Recommendations

The following are recommendations to solve the immediate security problems identified:

Provide seaport security training for guards

Hold periodic meetings among port users, ENP management, and ENP guards to discuss security issues

Provide guards with proper uniforms, weapons, and accessories

Provide ENP guards and private guards with radio equipment

Purchase vehicles for roving patrols and for shorter response times

Develop and implement an interim security plan

Repair and/or replace damaged security fencing. Add razor wire or other more stringent improvements where adjacent buildings are close to the fencing

Institute a pass and badge system for identifying authorized persons both at the gates as well as within the port terminal

Purchase and install remote security cameras, sensors, and alarms to assist guards

Port of Castilla—Port Security Findings

After inspecting the facilities at the Port of Castilla and discussing security with the port users and ENP, no significant security problems were found.

Port of Castilla—Port Security Recommendations

There are no security recommendations for the Port of Castilla.

Port of San Lorenzo—Port Security Findings

The Port of San Lorenzo has a generally effective security force for landside operations despite lacking proper equipment. However, a current security plan does not exist, and the team identified some specific problems to be addressed. The guards did not have appropriate personal protection equipment such as holsters or modern weapons. The waterside security operation lacks the resources to perform the work effectively. The security personnel employed at the port do not have any seaport security training, except for the chief of port security.

The perimeter security fence around the main port operational area was observed to be good condition. The main gate was operating adequately except for the main guard booth, which was in poor condition. In addition, no security checkpoint was operating at the main entrance from the highway to the ENP port property.

Port of San Lorenzo—Port Security Recommendations

The following are recommendations to solve the immediate security problems identified:

Replace the guard booth at the main gate

Provide seaport security training for guards

Provide guards with proper uniforms, weapons, and accessories

Provide guards with additional radio equipment

Install an interim security gate/checkpoint at main highway entrance to the port

Develop and implement an interim security plan

Purchase vehicles for roving patrols and for shorter response times

Institute a pass and badge system for identifying authorized personnel requiring access to the port

Port Access Roads/Road Connectors

Port access roads, upland roads and bridges were severely affected by Hurricane Mitch. As part of the U.S. DOT multi-agency team conducting hurricane damage assessment of the ports and port access roads resulting from Hurricane Mitch, the Port Access/Road Connectors team surveyed the roads and bridges through field inspections. The Road team includes Team Leader Mr. Robert Gorman, Mr. Jose Torres, and Mr. Luis Sandoval, all employees of FHWA.

Honduras Port Access Roads/Road Connectors—Findings

FHWA conducted a damage assessment for route CA13 connecting San Pedro Sula to the Port of Castilla from November 16 through 18, 1999. Eng. Gerardo Alfredo León, from the Honduran Secretaria de Obras Públicas, Transporte y Vivienda (SOPTRAVI), accompanied the team during this inspection. The team started at Port Castilla and proceeded northwest on route CA13. A review of development agency reports indicated that some of the damaged roads and bridges have already been identified for specific development projects, sponsored by either the World Bank or the Swedish government. However, funds for a significant amount of the repairs have not been allocated. Therefore, the team's review includes estimates of the funding needs, pending funds, and assigned priorities to the repairs needed.

Exhibit 11 summarizes the individual projects and associated costs, and precedes brief descriptions and associated photos documenting the extent of damage.

Exhibit 11

Projects and Associated Costs

Project No./Name	Project Description	Cost (U.S. dollars)	Priority Status
1. Rio Silin Bridge	North abutment failed; recommend replacement with a longer single span structure	$ 409,000	1
2. Regional Center for Military Training (CREM) culvert	Washed out culvert; construction of double 3x2 box culvert planned; also recommend slope protection and sound hydraulic study	51,000 (study and slope protection)	1
3. Rio Agua Bridge	No damage	—	—
4. Relief Bridge #9 Rio Aguan	Roadway washed out for 1 kilometer—recommend:		
	Providing slope protection for entire section	136,000	1
	Reconstructing road and bridges	817,000	1
5. Relief Bridge #8 Rio Aguan	Two piers collapsed affecting four spans—bridge length 100 meters; recommend entire bridge be replaced	1,362,000	2
6. Rio Aguan Bridge	No damage observed	—	—

Project No./Name	Project Description	Cost (U.S. dollars)	Priority Status
7. Existing Relief Bridge	One pier failed damaging two spans	1,362,000	2
8. Roadway washout	Roadway washed out; recommend building a new relief bridge	218,000	2
9. Embankment washout	Embankment washed out; recommend that a new relief bridge replace 2-feet x 6-inch culverts	218,000	—
10. CA13	Damage to frame as a result of settlement; recommend 20 meter bridge and 50 meter road	272,000	1
11. Rio Guaymon Bridge	125-meter bridge; recommend structure replacement (a possible lower cost alternative would be to conduct a study of the amount of damage and design a retrofit if the damage is not extensive)	1,022,000	1
12. Toyos Sector Bridge	Pavement damage; recommend wall construction and bank protection	20,000	2
13.Rio Leon Area	Recommend 30-inch minimum culvert pipe diameter	—	—
14. Roadway Washout (N15.66110, W87.33685)	Recommend 30-inch minimum culvert pipe diameter	—	—
15. Roadway, Washout (N15.61645, W87.12403)	Roadway, embankment, and culvert washed out; recommend inlet channel be re-aligned, and culvert and embankment slopes be protected	10,000	2
16. Rio Perla Bridge	Bridge severely damaged; Swedish government funding a new bridge; studies and design are underway	No cost estimate	—
17. Rio Bonito Bridge	Bridge length 80 meters; Swedish government replacing bridge	No cost estimate	—
18. Rio Danto Bridge	Bridge has scour problems; bridge is only access to La Ceiba; further studies required to determine amount of damage	No cost estimate	2
19. Rio Cangrejal – Bridge Saopin	270 meter, nine-span bridge damaged; south abutment #1 destroyed and one of the piers is settling; Swedish government will design and build new bridge	No cost estimate	—
20. El Aire Sector	Corrugated metal pipe washed out and temporary bridge was constructed; proposing construction of 3-feet x 72-inch concrete pipe culvert; design of culvert should be validated by a hydraulic study	No cost estimate	—
21. Saba roadway	Roadway washed out; Swedish government will re-align road and construct new bridges	No cost estimate	—
22. Rio Tocoa Bridge	Bridge in good condition; streambed has risen; recommend that a higher bridge (80 meters long) be built	341,000	2
23. Roadway access to Trujillo to Puerto Castilla	Extensive alligator cracking of roadway; side ditches obstructed by heavy vegetation; recommend thick pavement overlay (3 to 4 inches) and improvement to drainage	136,000	2

1. Bridge over Rio Silin (N15.93100, W085.89073). The north abutment failed because of scour (see Photo 6). A temporary bridge was installed but the structure failed in subsequent heavy rains. The Team recommends that the existing bridge be replaced with a longer single-span structure. The estimated cost is $409,000 (U.S.). This project is not included in any proposed repairs (priority 1).

2. Culvert washed out in front of CREM (N15.91071, W085.85396) (see Photo 7). Damage was caused by additional heavy rains. Existing plans call for the construction of a double 3 x 2 foot box culvert. In addition to the planned work, the team recommends that the fill slopes be protected from erosion and the outlet be protected from scour. The proposed work is acceptable provided that it is validated by a sound hydraulic study. The estimated additional cost of the study and slope protection is $51,000 (U.S.) (priority 1).

3. Bridge over Rio Agua Amarilla (N15.85915, W085.81411). There was no observed damage.

4. Relief Bridge for Rio Aguan #9 (N15.84258, W085.79709). The roadway was totally washed out for a length of 1 kilometer (see Photo 8). Some slope protection is underway under an existing reconstruction project at some locations. The team recommends slope protection for the entire section, especially downstream of the floodplain. The estimated cost is $136,000 (U.S.).

Photo 6. *Bridge with North Abutment Failure*

Photo 7. *Culvert Washed Out*

Photo 8. *Existing Bridge also Requires Relief Bridges to Avoid Future Flood Damage*

A stream geomorphology study should be conducted to evaluate any change in river patterns, dimensions, or orientation because of Hurricane Mitch floods. This study is required to locate the proposed relief structures. The team recommends the construction of new relief bridges (bridges are required to prevent the trapping of debris upstream) as determined by the above the study. Assuming that two new relief structures are required, the estimated cost of the new bridges and the road reconstruction is $817,000 (U.S.) (the road reconstruction is included in the existing contract but the cost of the new relief bridges, $681,000 [U.S.], is not). The team also recommends repairs to the bridge approach embankment of the existing bridge at an estimated cost of $34,000 (U.S.). Roadway and bridge reconstruction are ranked priority 1; the geomorphology study and new relief bridges are priority 2.

5. Relief Bridge #8, Rio Aguan. (N15.83306, W085.79116). Two piers collapsed affecting four spans (see Photo 9). The bridge length is approximately 100 meters. The team recommends that the entire bridge be replaced at a cost of $1.362 million (U.S.). This project is included in a future World Bank project (priority 2).

Photo 9. *Damage Caused by Collapsing Piers*

6. Bridge over the Rio Aguan. (N15.81154, W085.78257). No damage observed.

7. Existing Relief Bridge (N15.80183, W085.78729). The bridge length is 180 meters. One pier failed, damaging two spans (pier settled approximately 0.90 meters, which damaged a 20-meter-long area). Estimated cost to repair the two damaged spans is $272,000 (U.S.) (priority 1). This repair is included in the World Bank project. The Team recommends that the complete structure be replaced because of the possibility of similar damage to the other elements. The estimated cost for this work is $1.362 million (U.S.) (priority 2).

   Note: World Bank has a contract for embankment repair, some slope protection, and pavement repair including minor drainage and bridge approaches. This contract is for $4,700,000 (U.S.) and includes route CA13 from Saba to Port Castilla, RVA 23 from Olanchito to Saba, and S113 (dirt road) from Planes Sonaguera to CA13. The total length of the highway facility under contract is 210 kilometers. Bridges are not included.

8. Roadway washed out (N15.82249, W085.78611). To prevent a recurrence, the team recommends a new relief bridge, 20 meters long, at a cost of $218,000 (U.S.) (priority 2).

9. Embankment washed out (N15.82453, W85.78782). Although the culverts were not damaged, the team recommends a new relief bridge replacing the 2-foot x 60-inch culverts at an estimated cost of $218,000 (U.S.) to prevent a recurrence.

Proceeding southeast from San Pedro Sula, the Team identified the following projects:

10. La Colorada, Sector Guaimitos, CA13 between Progresso and Tela (N15.50330, W87.69947). Hurricane Mitch created a new flow, joining the existing flow at the structure (see Photo 10). The embankment was washed out and has since been repaired. However, there is damage to the frame as a result of recent settlement. The team recommends a new 20-meter bridge with 50 meters of road reconstruction at a cost of $272,000 (U.S.) (priority 1).

Photo 10. *Embankment Washed Out*

11. Bridge over the Rio Guaymon (N15.51423, W87.66821). The bridge is 125 meters long. Two piers settled, one about 0.5 meters (see Photo 11). The beams were raised and temporary concrete blocks were installed. To reduce the future risks, the team recommends that the structure be replaced at an estimated cost of $1.022 million (U.S.). A possible lower cost alternative would be to study the extent of damage and design a retrofit if the damage is not extensive (priority 1).

Photo 11. *Piers Settled, Bridge Supported by Temporary Concrete Block Between Pier and Deck*

12. Pavement damage over bridge at Toyos Sector (N15.54116, W84.65208). Pavement damaged as a result of flooding above the bridge (see Photo 12). The team recommends that a wall be constructed in front of the open abutment and bank protection be provided on the area of the north abutment (#2) at an estimated cost of $20,000 (U.S.) (priority 2).

    Note: There is a World Bank project for roadway repair from Tela to La Ceiba, not including bridges; however, the estimated cost is unknown.

Photo 12. *Road Damaged by River Overflow*

13. Rio Leon Area (milepost kilometer 117) (N15.66779, W87.33512) between Tela and La Ceiba. Water topped the highway damaging the embankment and the pavement for about 300 meters (see Photo 13). Under an existing contract, reinforced concrete pipes are being installed and the embankment is being restored. This is the continuation of an existing relief structure that suffered minor damage during Hurricane Mitch. The team recommends that, for maintenance purposes, a minimum pipe diameter of 30 inches be used on culverts crossing the main road. The team also recommends flare-end sections at the inlet to improve the capacity of the culvert.

Photo 13. *Large Culverts Needed*

14. Roadway washout (N15.66110, W87.33685) for about 300 meters. Under an existing contract, box culverts and pipe culverts are being replaced. We recommend that the minimum diameter for the pipe culverts be 30 inches.

15. Roadway, embankment, and culverts washed out (see Photo 14). (N15.61645, W87.12403.) Under existing contract, a new 2x48-inch reinforced concrete pipe culvert has been installed and the embankment restored. The team also recommends that to improve the inlet and protect the channel banks, the inlet channel be re-aligned and the culvert and the embankment slopes be protected near the culvert. The estimated cost is $10,000 (U.S.) (priority 2).
16. Bridge over the Rio Perla (N15.69310, W86.98139) was severely damaged (see Photo 15). The government of Sweden is funding a new bridge. Studies and design are underway. A temporary crossing built by the U.S. Army was damaged in recent heavy rains.
17. Bridge over the Rio Bonito (N15.74575, W86.86936) is being replaced by the government of Sweden. A temporary bridge is installed at the location of the damaged bridge. The bridge length is about 80 meters.
18. Bridge over the Rio Danto has scour problems (see Photo 16). This bridge is the only access to La Ceiba. Further studies are required to determine the amount of damage (priority 2).

Photo 14. *Inlet Channel Needs Re-Alignment with Culverts*

Photo 15. *Both Permanent and Temporary Bridges Damaged*

Photo 16. *Scour Problems and Pier Settlement*

19. Bridge Saopin over the Rio Cangrejal (N15.76260, W86.78388). A nine-span bridge that is about 270 meters long suffered major damage during Hurricane Mitch (see Photo 17). The south abutment #1 was destroyed and one of the piers is settling. A new bridge will be designed and built by the Swedish government. Both this bridge and the previous one over the Rio Danto are essential in connecting La Ceiba with the rest of the country.

20. El Aire Sector (N15.70293, W86.50286) corrugated metal pipe washed out (see Photo 18). A temporary bridge was constructed. The consultant on the project is proposing the construction of a 3x72-inch concrete-pipe culvert. This project is included in the ongoing World Bank contract. The design of the culvert should be validated by a hydraulic study.

21. Roadway completely washed out (N15.54406, W86.24429) at Saba (see Photo 19). Apparently, the water level peaked at 3 meters above roadway elevation. Roadway length to the first relief bridge is 2.5 kilometers. The Swedish government will re-align the road and construct new bridges. The first relief bridge (N15.53119, W86.23561) with 12 spans, each 12 meters long, was totally destroyed. The Swedish government is building this project. Main bridge over Rio Aguan was destroyed by

Photo 17. *Pier Settlement Causes Road to Buckle*

Photo 18. *Hydraulic Study Needed*

Photo 19. *Both Permanent and Temporary Bridges Destroyed*

Hurricane Mitch. A temporary bridge is under construction. (The team could no longer continue on the route, and detoured using a parallel dirt route that was approximately 30 kilometers to the east).

22. Bridge over Rio Tocoa (N15.64767, W86.01424) (see Photo 20). The bridge is in good condition but the streambed has risen because of heavy sedimentation, causing the freeboard to be reduced to less than 1 meter. The team recommends that a higher bridge, about 80 meters long, be built at an estimated cost of $341,000 (U.S.) (priority 2).
23. There is extensive alligator cracking in the section of roadway from the access to Trujillo to the Port of Castilla. The structural section of this pavement needs to be enhanced. The team recommends a thick overlay (3 to 4 inches) and improved drainage. The side ditches have been obstructed by heavy vegetation. Estimated cost is $136,000 (U.S.) (Priority 2).

Photo 20. *Heavy Stream Siltation has Raised Water to Hazardous Level*

Photo 21. *Parallel Relief Road Should Be Paved*

Honduras Port Access Roads/Road Connectors—Recommendations

For the past 30 years, all bridges in the United States have been required to be inspected every 2 years. Considering the amount of damage the bridges in Honduras suffered, the team recommends establishing a similar inspection program for periodic bridge inspections. FHWA could arrange for SOPTRAVI engineers to be trained for bridge inspection. Spanish-speaking instructors in Puerto Rico can provide this training. Similar training has been provided to engineers from Costa Rica in the past.

An unpaved road, about 65 kilometers long, runs parallel to CA-13, from the vicinity of Los Planes to about 10 kilometers south of Trujillo (see Photo 21). It has good geometric features, including two full lanes. This road received minor damage during Hurricane Mitch. Because this road can serve as a detour for the section of CA-13 that received major damage, the team recommends that this road be reconstructed and paved to provide redundancy for the road system from La Ceiba to Trujillo. The estimated cost of this work is $10.218 million (U.S.).

SOPTRAVI should establish a program to retrofit all structures with superstructures not connected to the substructure. All bridges observed during this visit lacked the connection between the beams and the abutment or pier. This connection will withstand uplift forces caused by the buoyancy effect and lateral loads.

It was evident that the most common cause of flood damage to the bridges was the scouring of the foundations and consequently their failure. Based on this, the team recommends the following:

Design the replacement bridges to resist scour

Perform an evaluation of existing bridges for vulnerability to scour

Inspect the bridges for scour

Provide scour countermeasures to vulnerable bridges. FHWA offers "Evaluating Scour at Bridges" training in Spanish.

Footnotes

[1] At the request of the Honduran Empresa Nacional Portuaria (National Ports Authority), the Port of San Lorenzo was substituted for La Ceiba.

[2] http://cindi.usgs.gov/events/mitch/briefing/index.html (last updated November 17, 1998).

[3] http://cindi.usgs.gov/events/mitch/briefing/brief9.html (last updated November 17, 1998).

[4] http://vwww.vita.org/disaster/mitch/0081.html (last updated Monday, January 10, 2000).

[5] http://www.cmarkcon.com/mitch/honduras.html (last updated November 25, 1998).

[6] http://cindi.usgs.gov/events/mitch/briefing/brief5.html (last updated November 17, 1998).

[7] Publication 148 List of Lights

Attachment 1—Sources

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Attachment 2—Water-Level Gauge Description

Water-Level Observation Network for Central America

The U.S Department of Commerce, National Atlantic and Atmospheric Administration (NOAA), requested that the Center for Operational Oceanographic Products and Services (CO-OPS) submit a plan for the reconstruct of the water-level observation network in Honduras for the U.S. Department of Commerce Implementation Plan (DOCIP) for Reconstruction Work in Central America. This is an intergovernmental cooperative effort, funded by Congress, to assist Central American countries affected by Hurricane Mitch with the reconstruction of damaged infrastructure. The U.S. Agency for International Development (AID) missions in Central America reviewed the DOCIP and indicated that it was not necessary to install a dense network of water-level stations in Honduras or any of the other affected countries. However, AID did agree that it was necessary to install water-level stations to support the reconstruction and improvement of the Geodetic Control Network in Central America. The following water-level network is designed to provide the required mean sea level (MSL) data to support the development of Geodetic Control Networks in the Republics of El Salvador, Guatemala, Honduras, and Nicaragua.

Water-Level Observation Network (WLON)

Final WLON design and site selections will depend on the results of discussions with the in-country agency participants and a site reconnaissance of existing and historical water-level sites. Representatives of country agency and CO-OPS personnel will conduct the reconnaissance. Site selection criteria consist of (1) length of the MSL series available, (2) adequate benchmark network, (3) adequate facilities and security for long-term measurements, and (4) whether, for existing sites, the MSL data represents an open-coast environment. The following list was prepared from information in the CO-OPS historical water-level archives. The final WLON will consist of about four or five stations selected from the list of historical stations in each country (see Exhibit A-1).

Exhibit A-1
Water-Level Observation Network

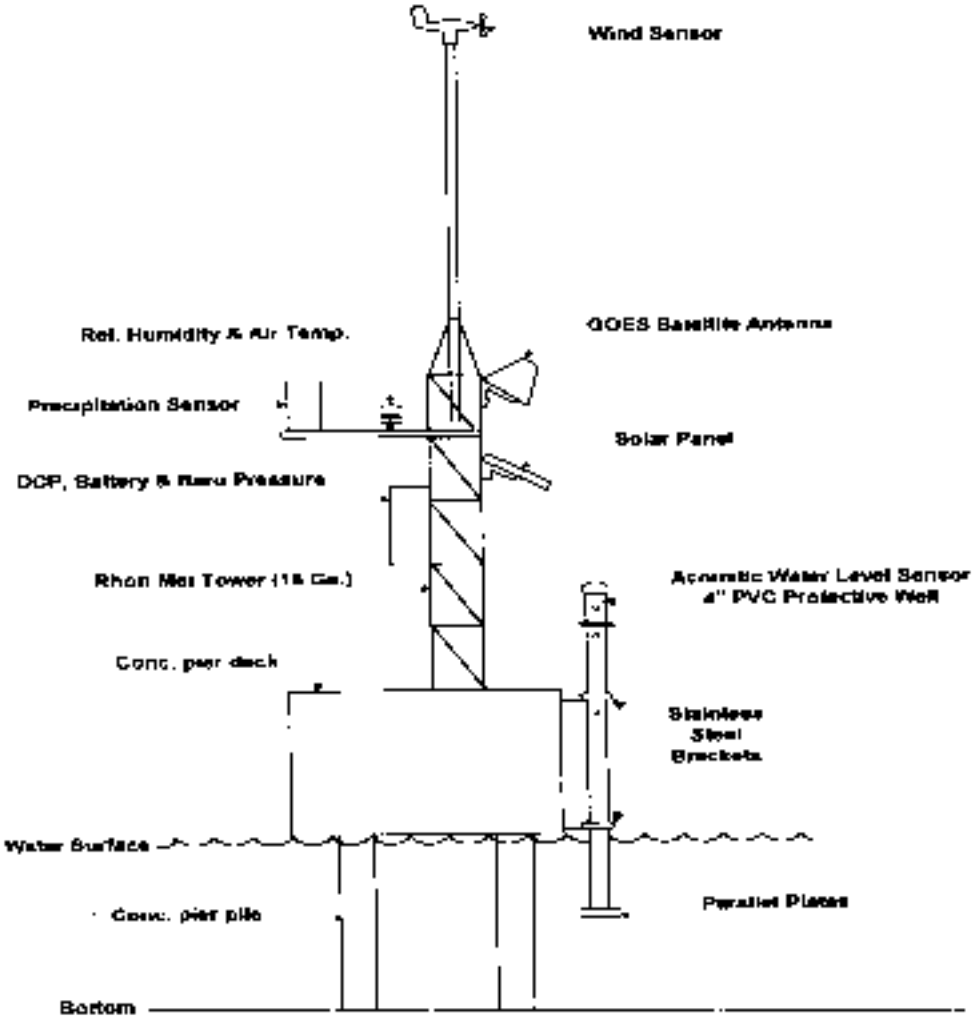
Country	Station	Latitude (N)	Longitude (W)	Years
El Salvador	La Union	13º 20.0'	87º 49.3'	19.0
Guatemala	Port of San Jose	13º 55.0'	90º 49.8'	20.0
	Matias DeGalvez	15º 41.6'	88º 37.2'	6.0
Honduras	Puerto Cortés	15º 50.1'	87º 57.2'	19.0
	Port of Castilla	16º 01.0'	86º 02.0'	13.0

Nicaragua	Port of Cabezas	14º 01.2'	83º 22.9'	11.0
	Bluefield (El Bluff)	11º 59.8'	83º 41.6'	1.0
	Port of Corinto	12º 28.7'	87º 10.1'	4.0
	San Juan Del Sur	11º 15.1'	85º 52.8'	4.5

Station Configuration

A typical station in the Central American WLON consists of an air-acoustic water-level sensor, a backup pressure water-level sensor, a protective well, meteorological sensors, a data collection platform (DCP), a Geostationary Earth Orbiting Satellite (GOES) radio transmitter, a 12 V battery and 35 W solar panel, and a permanent benchmark network comprising a minimum of five survey monuments (see Exhibit A-2). The DCP provides onsite data acquisition, storage, and telemetry options, which include GOES satellite, telephone, line-of-sight radio, and onsite download via an RS232 port. GOES telemetry is the primary mode of data retrieval for WLON; others are optional. WLON station design and components comply with the minimum standards of the Global Sea Level Observing System network of the Intergovernmental Oceanographic Commission (UNESCO 1990) and are consistent with the sea-level stations in the Caribbean as documented in “Planning for Adaptation to Global Climate Change Network” (Martin, et. al. 1998).

Exhibit A-2
Typical WLON Station Configuration



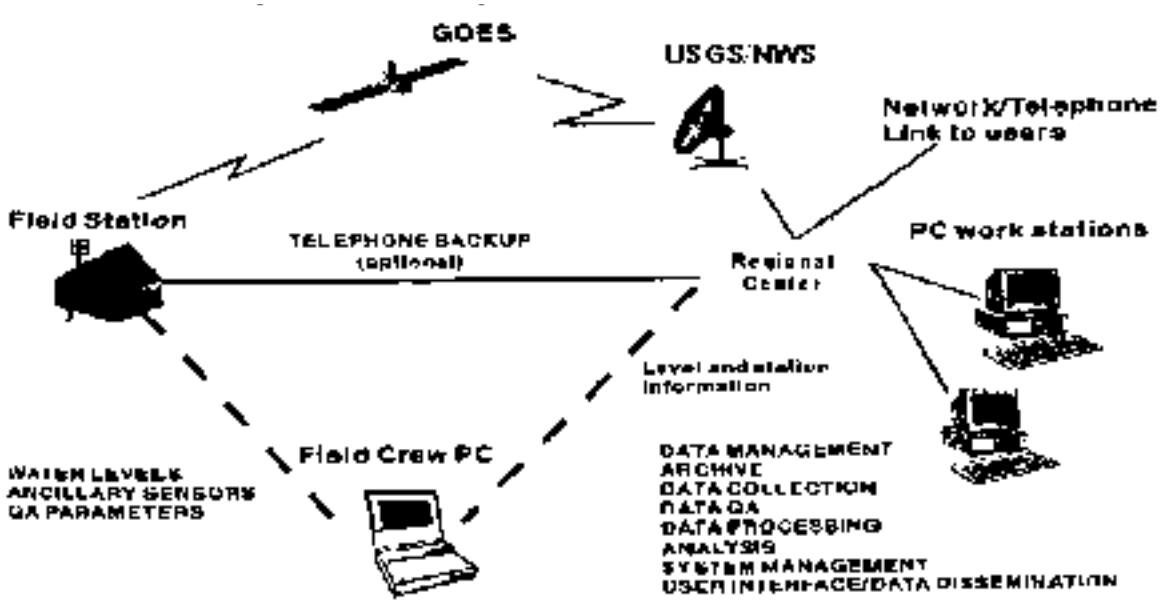
Equipment Procurement and Station Installations

CO-OPS will provide a set of specifications for the required equipment and a statement of work (SOW) for the proper installation, operation, and maintenance of the stations. NOAA/CO-OPS will provide a contract monitor to ensure compliance with the equipment specifications and SOW.

Data Acquisition, Analysis, and Dissemination

Data will be acquired via GOES telemetry and down-linked to a USGS/NWS GOES ground station located in Central America. Users in the region will have direct access to all the data over the Internet node being developed by USGS and NWS to support the data collection networks established by each of those agencies (see Exhibit A-3).

Exhibit A-3
Data Acquisition, Analysis, Archiving, and Dissemination



Geocentric Fixing of Tide Stations

A minimum of one benchmark at each WLON station will be occupied with a global positioning system (GPS) to position the stations precisely in the International Terrestrial Reference Framework (ITRF). Multiple days of GPS observations will be conducted with GPS receivers and antenna that meet geodetic standards to obtain geodetic quality 3-D positioning of the stations.

Capacity Building

The designated national agencies will participate in the site selections, instrument installations, and GPS observations. NOAA and contract personnel will provide hands-on training during these activities. Before

initiating the field activities, NOAA will provide in-house training to personnel from the designated agencies on the proper installation, operation, and maintenance of water-level stations at the NOAA facility in Chesapeake, Virginia, to ensure full capability in all aspects of operating and maintaining the WLON. NOAA will also make available and provide training on the use of quality control and quality assurance and sea-level analysis software to assist with processing and archiving the data.

Attachment 3—Bay Islands Environmental Response Systems Assessment

Bay Islands Environmental Response—Findings

(The Bay Islands were not on the Maritime Administration's itinerary but it was visited by Edwin Levine of NOAA.)

Location—Bay Islands: Roatan, Utila, and Guanaja

Importance of Issue—The population of the Bay Islands is approximately 50,000. All goods (petroleum, produce, wares, etc.) arrive either by ship or plane. The islanders depend 100 percent on outside import of basic supplies. The major source of income on the islands is associated with tourism.

Current State/Condition—Hurricane Mitch destroyed the aids to navigation to the harbor of Coxen Hole. Cruise ships, barges, and transport vessels call on this port regularly. The island of Roatan has no functional lighthouses. While the mayor acts as the head of the local government, no emergency response plans are in place on the islands. The port of French Harbor is the main commercial/sport fishing area on the island. It also has no navigation aids for approaching the harbor.

The airport has a modern runway and air traffic control facility. Commercial jets are able to use this facility. Thousands of tourists arrive each year via the airport. A fire department is available nearby. The one runway is parallel and adjacent to the shoreline. The airport has one boat available for any at-sea rescues. The airport has a meteorological station.

Resulting Transportation Problems—Because of the proximity of coral shoals on the approach to the harbors, vessels are in danger of grounding. Also, a high volume of oil transported from Venezuela to ports along the Gulf of Mexico pose a threat to the fragile coral reef and mangrove ecosystems.

Environmental Response Systems—Recommendations

A study of the navigational requirements of the two major harbors (Coxen Hole and French Harbor) should be undertaken, including the necessity for lighthouses. The airport should be assessed for capabilities to respond to emergency situations. A structure should be in place for emergency response situations (oil spills, chemical releases, natural disasters, etc.). Any projects involving training and education in Puerto Cortés should include representatives from the Bay Islands.

Sources - Bay Islands

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