HONDURAS

The following table summarizes the Department of Commerce activities in Honduras.

HONDURAS ACTIVITIES

Base Infrastructure Reconstruction

- Reconstruction and improvement of the geodetic network
- Installation of an automatic weather station on Swan Island
- Installation of an upper air measurement system in Tegucigalpa
- Installation of eight automatic rain gages for flood forecast and warning systems – San Lucas, Santa Lucia, San Marco de Colon, El Zuzular, Ocote Bonito, Nueva Armenia, La Union, La Habana
- Installation of a Wide Area Network connecting SMN, SERNA, COPECO for data and information sharing
- Installation of a tide gage at Puerto Cortes
- Installation of satellite workstations under the DOC Regional Program
- Installation of rain gages and an automatic weather station under the DOC Río Lempa Watershed Program

Forecast and Early Warning Systems

- Installation of a flood forecast and warning system for the Río Choluteca
- Installation of a flood forecast and warning system for the Río Aguan (upper)
- Installation of a high resolution flood inundation mapping and display system for the city of Tegucigalpa
- Development of Strategic Plans for hydrometeorological services
- Development of a climate prediction system under the DOC Regional Program

Disaster Preparedness and Response

- Implementation of training programs for forecast, warning, preparedness, and response institutions
- Implementation of programs to increase capacity for local response authorities to prevent, plan for, and respond to spills of oil or other hazardous chemicals

Sustainable, Resilient Coastal Communities

- Development of activities under the DOC Gulf of Fonseca Program

Economic Revitalization

- Support to the Honduran Reforestation Initiative under the DOC Economic Revitalization Regional Program
- Development of activities under the DOC Economic Revitalization Regional Program

BASE INFRASTRUCTURE RECONSTRUCTION

The Department's objectives for this problem area were to accomplish the following:

- Provide a foundation for ongoing reconstruction efforts
- Reconstruct and improve weather forecast and early warning networks
- Promote safe and efficient air and marine transportation
- Provide for a geo-spatial data and water level reference framework
- Ensure that capacity exists to maintain and expand new base infrastructure

To accomplish these objectives, monitoring equipment was installed at various locations throughout the country and programs were developed to appropriately use the data collected by this equipment for a variety of purposes. The Department's goal was to install the most appropriate technology based on local capacities and resources to ensure the highest probability of sustaining the systems.

The hydrometeorological monitoring network was improved and expanded to support and strengthen the weather forecasting and early warning capabilities of the country. An **automatic weather station** was installed on Swan Island, located out in the Caribbean Sea. This station, which measures wind speed and direction, air temperature, humidity, rainfall, solar radiation, and atmospheric pressure on a 10-meter tower, will provide critical meteorological data useful for weather forecasting and for monitoring tropical storms and hurricanes. The data are transmitted via the GOES Satellite Data Collection System (DCS) back to a Digital Readout Ground Station (DRGS) located at SMN in Tegucigalpa (the GOES DCS is operated by the National Oceanic and Atmospheric Administration – National Environmental Satellite, Data and Information Service, NOAA/NESDIS).

Another useful tool for weather forecasting and for providing crucial data for forecasting tropical storms and hurricanes was installed in Tegucigalpa – an **upper air measurement system**. This system consists of meteorological balloons and instrument packages that measure temperature, humidity, and atmospheric pressure. The balloons are tracked to an altitude of 30,000 feet or more by a global positioning system to obtain estimates of wind speed and direction. The Department provided a ground station and expendables for 100 balloon releases.

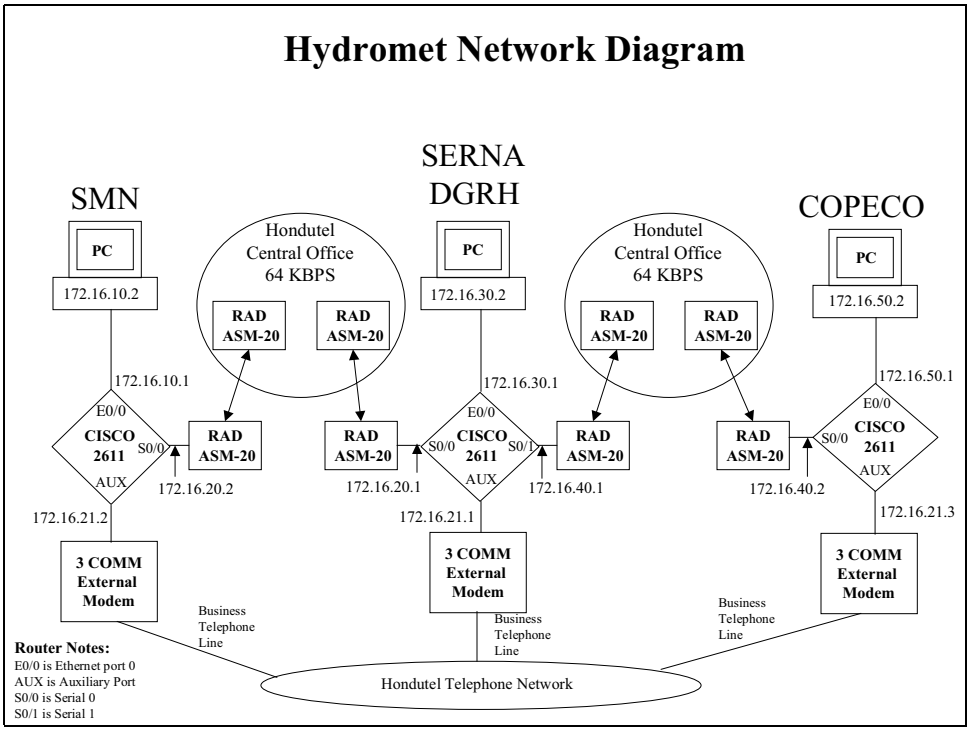
Upper Air System Balloon and Instrument Package

In support of the flood forecast and warning systems, the Department installed a network of **automatic rain gages** in the Río Choluteca and Río Aguan basins. These rain gages collect the data and transmit it via the GOES Satellite Data Collection System (DCS) back to the DRGS at SMN in Tegucigalpa. The data are then used as input to the hydrologic models used in the flood forecast and warning system.

Automatic Rain Gage Locations - Honduras

Automatic Rain Gage at Zuzular

In order to share data and information regarding potential floods, tropical storms, and hurricanes, the Department installed a **Wide Area Network** (WAN) to connect all three agencies. The WAN is especially critical for transmission of data from the monitoring networks (received at SMN through the DRGS) to SERNA and COPECO (where the flood warning and forecast systems are located). The WAN is operated by HONDUTEL.



Hydrometeorological Wide Area Network

The **tide gage** installed at Puerto Cortes is part of the Water Level Observation Network for Central America (RONMAC) installed by the Department as part of the Hurricane Reconstruction Program. The primary purpose of RONMAC is to provide support for the development and improvement of the geodetic framework of Central America. However, information and data derived from RONMAC will also be used in decision-making by a variety of national and regional agencies responsible for coastal resource management. Coastal management agencies will use these data to assist with monitoring the water quality, impact of sea level rise as a result of global climate change, and preparing coastal zone management plans. Regulatory agencies will use the data for permitting and enforcement and to determine marine boundaries for jurisdiction and managing offshore minerals resources. Emergency management agencies will use the data to prepare storm evacuation maps, to assist with early coastal hazard warnings for hurricanes and tsunamis, and coastal sea level predictions associated with climate change. Data from the RONMAC supports the design, development and construction of harbor facilities to enhance maritime commerce, production of accurate nautical charts, and improvement of marine nowcasts and forecasts. RONMAC stations will also have the capability of providing real-time water level and meteorological data to large vessels (oil tankers, containers, and cruise) and port officials to improve safe navigation and docking operations.

The Puerto Cortes station consists of an air acoustic water level sensor, a backup pressure water level sensor, a protective well, meteorological sensors, a data collection platform (DCP), GOES satellite radio transmitter, a voice modem, VHF radio, and a permanent bench mark network composed of a

minimum of five bench marks. GOES telemetry is the primary mode of data retrieval for RONMAC, telephone retrieval is optional. In addition to the sea level monitoring, it is important to understand coastal processes from the standpoint of "air-sea interaction". To accomplish this, other physical attributes were designed into the system. The additional sensors included the following: sea surface temperature, air temperature, barometric pressure, rainfall, solar radiation, wind speed and direction, and relative humidity.

Honduras Tide Gage Location

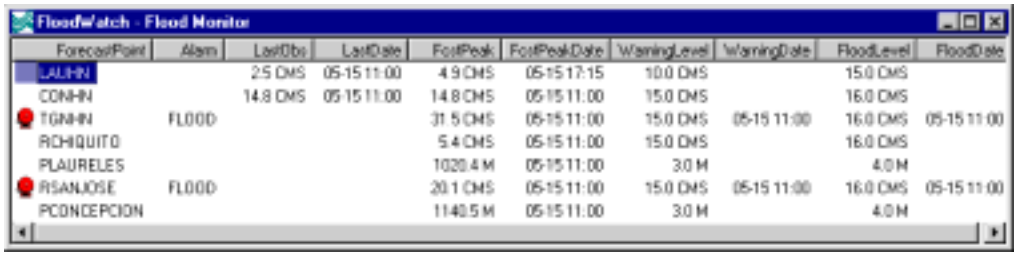
Puerto Cortes Tide Gage Station

The Department reconstructed and improved **geodetic networks** in Honduras. Components included: continuously operating reference systems (CORS) installed in Tegucigalpa and San Lorenzo, with dual frequency global positioning system (GPS) receivers, 24 hour continuous tracking capability, and 1-2 cm accuracy, analysis and processing of a high accuracy GPS reference network; training in station installation and GPS data processing, and links to international GPS networks. Improvements in local and regional geodetic information and infrastructure will support economic development, the effective management of property and natural resources, and improve preparation for and response to future natural disasters.

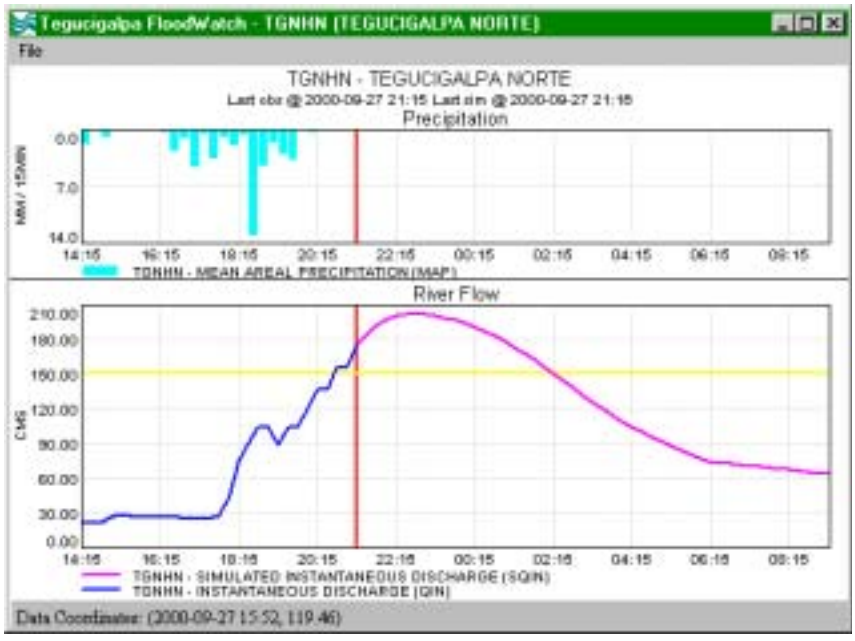
Also see the DOC Río Lempa Watershed and Regional Programs sections for additional Base Infrastructure Reconstruction activities.

FORECAST AND EARLY WARNING SYSTEMS

The Department installed **flood forecast and early warning systems** in two key river basins in Honduras – the Río Choluteca and Río Aguan. These systems are comprised of an automatic rain and stream gage monitoring network and hydrologic models calibrated for both basins. The modeling system used in both basins, FloodWatch, simulates the hydrologic response of the basins as a function of input rainfall, observed streamflow, reservoir information, and other data. Streamflow forecasts are generated at points along the river called forecast points. The system is designed to allow operator interaction or to be run in a more automated mode. The operator can also input quantitative rainfall forecast information to further enhance the hydrologic forecasts. The Department worked closely with the U.S. Geological Survey (USGS) who installed the streamgages needed for the systems. The FloodWatch system is installed at both SERNA and COPECO in order to ensure redundancy, sustainability, and to satisfy the operational needs of both agencies. Data needed by the systems are available on the WAN installed by the Department connecting SMN, SERNA and COPECO. Displays are available in tabular or graphical form.



Tabular Flood Monitor Showing Flood Status at Forecast Points



Graphical Display for a Particular Forecast Point

For the Río Choluteca system, river forecast points are located at Apaciliagua, Ojo de Agua, Paso la Ceiba, Sagastume, Presa las Laureles, and Presa Concepcion – all corresponding to streamgages installed by the USGS. For the Río Aguan, river forecast points are located at Sabana Larga,

Olanchito, and Río Mame. Key communities include Tegucigalpa and Choluteca for the Río Choluteca system and Olanchito for the Río Aguan.

Flood Warning and Forecast Systems - Honduras

As part of the flood warning system for the Río Choluteca, the Department added a unique capability to **display actual and forecast inundated areas** for the city of Tegucigalpa. Using the outputs from the FloodWatch forecast system and detailed Digital Elevation Model (DEM) and ortho-photo data obtained from the USGS, the Department developed a real-time system named FloodMap to display areas potentially inundated during flooding conditions. This capability is installed at both SERNA and COPECO and is a useful tool for emergency managers. A sample FloodMap display (for a simulated Hurricane Mitch type event) is shown below.

FloodMap Output for Tegucigalpa (Simulated Flood)

An additional activity under this problem area was the **development of strategic plans** for the operations of the hydrometeorological services and consequent improvement of forecast and early warning capabilities. This activity was deemed important since, in general, these services are poorly funded and do not have high esteem within each government. The purpose of the plans was to provide guidance and direction for strengthening the services, a process begun during the Department's Hurricane Reconstruction Project. During the course of developing the plans, the directors of each service were interviewed regarding current operations, mandates, and vision for strengthening the services. Based on these interviews, a simple, inexpensive strategy was developed to assist with continued or further strengthening. The theme was the same for each country as all faced the same problems and issues – funding and poor visibility. The plans, which were transmitted to each USAID mission, focused on the following key themes – implement a technical advisory committee comprised of members from other government agencies, academia, and industry to help develop future strategies for advancing the agency (to improve credibility within the government); promote better coordination with other key institutions in the government; promote higher visibility with the media through press releases, interviews, regularly scheduled programs, Internet web pages; develop a risk assessment capability for preventing, reducing and managing risks for extreme natural phenomena (e.g., develop risk atlases); improve information and data processing capabilities; and continue developing sound approaches to system maintenance and upgrading monitoring networks.

Also see the DOC Regional Programs section for additional Forecast and Early Warning System activities.

DISASTER PREPAREDNESS AND RESPONSE

Many of the DOC activities under the Disaster Preparedness and Response Problem Area involved the implementation of various **training programs and workshops** for the forecast, warning, preparedness, and response agencies. The emphasis of the activities was **capacity building** to better prevent, plan for or respond to disasters or to ensure sustainability of the tools and programs installed and instituted by the Department. Some of these programs involved operations and maintenance of monitoring equipment installed by the Department and others on the collection, analysis, and application of various data and information needed by these agencies to fulfill their missions. Training in this problem area also supplemented various training activities performed in each of the other problem areas. Training activities in Honduras included those shown on the following table.

TRAINING DESCRIPTION	QUARTER ACCOMPLISHED	LOCATION	ORGANIZATIONS TRAINED
Flood Forecasting Workshop	October – December 1999	United States	SMN, SERNA
Satellite Meteorology		Costa Rica	SMN
Satellite Digital Ground Station (DDRGS) Operation and Maintenance	July – September 2000	Honduras	SMN, SERNA
Operation and Maintenance of Automatic Rainfall Stations		Honduras	SMN, SERNA
Operation and Maintenance of PCBASE2 software for DDRGS		Honduras	SMN, SERNA
Operation of FloodWatch Software		Honduras	SMN, SERNA
Operation and Maintenance of PCBASE2 software for DDRGS	October – December 2000	Honduras	SMN, SERNA
Operation of FloodWatch Software		Honduras	SMN, SERNA
Operation of Wide Area Network, Including Routers		Honduras	SMN, SERNA, COPECO
Operation and Maintenance of Automatic Rainfall Stations		Honduras	SMN, SERNA
Contaminant Monitoring in Various Media and Chemical Analysis Techniques		Honduras	SERNA/CESCCO

TRAINING DESCRIPTION	QUARTER ACCOMPLISHED	LOCATION	ORGANIZATIONS TRAINED
Flood Forecasting Workshop and Hydrologic Forecasting and Analysis Course	October – December 2000	United States	SMN, SERNA
Geodetic Surveys	January – March 2001	Honduras	IGN
Operation of FloodWatch Software – output analysis, identification of erroneous results, data error corrections		Honduras	SERNA
Operation and Maintenance of PCBASE2 software for DDRGS		Honduras	SMN, SERNA
Sampling Techniques for Sediment, Fish, and Crabs		Honduras	SERNA/CESCCO
Extension Agents to Promote Sustainable Uses of the Gulf of Fonseca Resources		Honduras	Zamorano Panamerican Agricultural School
Climate Variability and Extreme Events for Central America		Costa Rica	SMN
Tide Gage Regional Technical Training Workshop	April – June 2001	Guatemala	IGN, Empresa Nacional Portuaria, Navy
Operation of FloodWatch Software, Concepts of Flood Forecasting, Operations of Hydrologic Forecast Center		Honduras	SERNA

TRAINING DESCRIPTION	QUARTER ACCOMPLISHED	LOCATION	ORGANIZATIONS TRAINED
RAMSDIS Satellite Workstation Operation, Use of Environmental Data in Meteorological Applications – fire detection, volcanic ash detection, forecasting	April – June 2001	Costa Rica	SMN
Flood Forecast System Operations, Hydrologic Forecast Center Operations	July – September 2001	Honduras	SERNA
RAMSDIS Satellite Workstation Installation and On-Site Training for Operations		Honduras	SMN
Tide Gage Regional Technical Training Workshop	October – December 2001	Costa Rica	IGN, Empresa Nacional Portuaria, Navy
Operation of FloodWatch Software for the Ríos Aguan and Choluteca, Operations of the Flood Inundation Software for Tegucigalpa		Honduras	SERNA, COPECO
Spill Response and Contingency Planning Workshops		Honduras	Empresa Nacional Portuaria, Navy, COPECO
RAMSDIS Satellite Workstation Operation, Use of Environmental Data in Meteorological Applications		Costa Rica	SMN
Hydrometeorological Monitoring System Maintenance Planning and Logistics Workshop		United States	SERNA

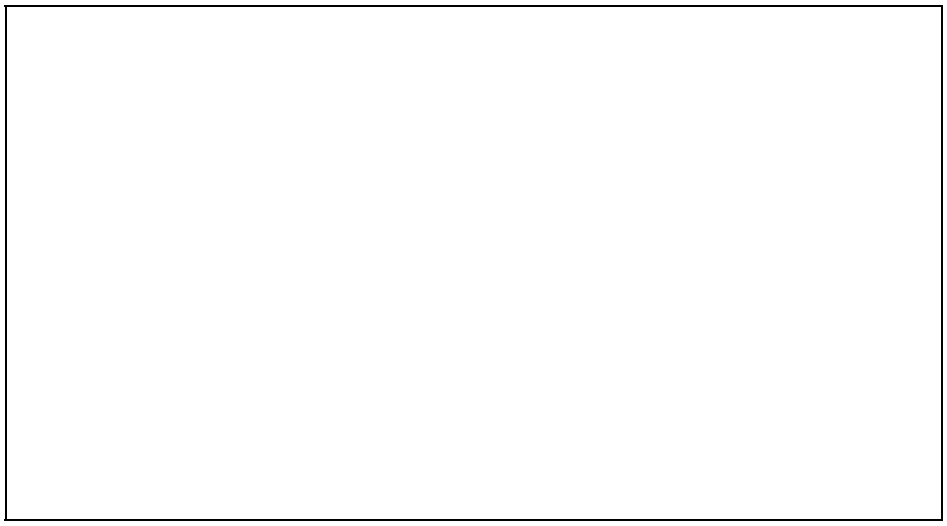
TRAINING DESCRIPTION	QUARTER ACCOMPLISHED	LOCATION	ORGANIZATIONS TRAINED
Operational Meteorology and Hydrology Post Graduate Course	15 Months (2000-2001)	University of Costa Rica	SMN (1 Student)*
Hydrometeorological and Sea Level Monitoring System Installation, Operation and Maintenance Training (done during installation of equipment)	Entire Program	Honduras	SMN, SERNA, IGN, Empresa Nacional Portuaria, Navy

* Thesis title – Análisis de los Eventos El Niño y Niña en la Cuenca del Embalse El Cajón Entre 1972 y 1998.

In addition to the training activities discussed above, the Department also accomplished **spill preparedness and response** activities in Honduras. These activities provided local response authorities with increased capacity to prevent, plan for, and respond to spills of oil or other hazardous chemicals. This was accomplished through a series of activities, culminating in training and workshops.

Products included **Environmental Sensitivity Indexes** (ESI) for Honduras in the Gulf of Fonseca up to the extent of tidal influence and the Caribbean coast. All mapping products are hardcopy atlases and digital data files. Mapping products were developed with significant local expertise input and review. A total of 19 ESI maps were developed for Honduras. The ESI maps show coastal habitat types and important biological and human-use resources. Six major categories of biological resources are included in the atlases: marine mammals, terrestrial mammals, birds, reptiles/amphibians, fish and invertebrates. Human-use resources include protected areas, aquaculture sites, subsistence and commercial fishing areas, archaeological and historical sites, water intakes, boat ramps, recreational beaches, ports and marinas. Interviews were conducted with regional experts for each category of biological and human-use resource.

The intertidal coastal habitats of Golfo de Fonseca were mapped during overflights and ground surveys conducted in February 2000. During this work, an experienced coastal geologist delineated the intertidal shoreline habitats directly onto 1:50,000-scale topographic maps. Prior to the overflights, high resolution, black and white vertical aerial photographs obtained in December 1998 under the USGS Open Skies Program were examined to produce an initial classification. The photographs were particularly important in updating the location and extent of recent aquaculture sites, as well as delineating changes resulting from Hurricane Mitch.



Environmental Sensitivity Index Map - San Lorenzo, Honduras

Additional guidance documents and a simple trajectory model for the Gulf of Fonseca were also completed. Scenarios were developed and shortfalls identified for **spill contingency plans** in Honduras and other participating countries. Contingency plans, to be completed by the Hondurans, identify resources at risk, response priorities, scenarios, and organizational structures for the region and/or for each country. Standard training tools used by NOAA were modified and translated into

Spanish for use in the final one-week workshop in San Pedro Sula, Honduras. An additional training aid, the Trajectory Analysis Handbook, was developed as part of this effort. The following tools and guidance documents were used during the workshop and distributed to all participants:

1. Aerial Observations of Oil. This guidebook contains pictures of various types of oil spilled at sea and includes definitions and standard terminology used to define oil's appearance on the water.

2. Shoreline Assessment Job Aid. Habitat identification and a methodology for identifying, quantifying and recording shoreline oil impact are provided in this field guide. The habitat depictions correlate to those in the Environmental Sensitivity Index work.

3. Coastal Characteristics. Response technologies for habitats identified on ESI and in the Shoreline Assessment Job Aid are evaluated and discussed in this guidebook.

4. Trajectory Analysis Handbook. The physical processes relevant to determining the movement of oil are summarized and presented in this field guide.

5. Computer Aided Management of Emergency Operations (CAMEO). The CAMEO program was translated into Spanish as part of a separate EPA-sponsored effort, but proved quite appropriate for use in this effort. This tool provides access to response information for 6,090 chemicals, including physical property information and over 60,000 synonyms to assist in chemical identification.

6. Automated Data Inquiry of Oil Spills (ADIOS). The ADIOS program was the only tool used as part of the workshop that was not available in Spanish. Because of the extensive nature of the program, it was not initially considered as part of this technology transfer activity. However, during preparatory activities for the training and contingency planning workshops, it was identified as a useful tool by local agencies - even if it only existed in English. This model has a database of approximately 1,000 oil and oil products. By providing local environmental information (such as air and sea temperature, wind speed, wave heights, and salinity), weathering processes of specific oils can be identified (such as evaporation, dispersion, dissolution, etc.) and relevant property changes over time can be calculated (e.g., viscosity, water content).

SUSTAINABLE, RESILIENT COASTAL COMMUNITIES

See Gulf of Fonseca activities section.

ECONOMIC REVITALIZATION

See Regional activities section.

NICARAGUA

The following table summarizes the Department of Commerce activities in Nicaragua.

NICARAGUA ACTIVITIES

Base Infrastructure Reconstruction

- Reconstruction and improvement of the geodetic network
- Installation of five automatic weather stations – Granada, Esteli, Fátima, Chinandega, Boaco
- Installation of eight rain gages and two stream gages for a flood and river forecast system and a flood warning system – Cinco Pinos, Las Praderas, Guabo, Villa Sandino, Wapi, El Arenal, San Isidro, Teuestepe, Las Banderas (streamgage/rain gage), Piedra Fina (streamgage/rain gage)
- Installation of tide gages at Corinto and Puerto Cabezas
- Installation of satellite workstations under the DOC Regional Program

Forecast and Early Warning Systems

- Installation of a river and flood forecast system for the Río Escondido
- Installation of a warning system (ALERT) for the Río Malacatoya
- Installation of a Local Area Network connecting hydrology and meteorology sections for data and information sharing
- Development of a Hydrologic Forecast Center
- Development of Strategic Plans for hydrometeorological services
- Development of a climate prediction system under the DOC Regional Program

Disaster Preparedness and Response

- Implementation of training programs for forecast, warning, preparedness, and response institutions
- Implementation of programs to increase capacity for local response authorities to prevent, plan for, and respond to spills of oil or other hazardous chemicals

Sustainable, Resilient Coastal Communities

- Development of activities under the DOC Gulf of Fonseca Program

Economic Revitalization

- Development of activities under the DOC Economic Revitalization Regional Program