

**CENTER FOR OPERATIONAL OCEANOGRAPHIC PRODUCTS AND SERVICES
IMPLEMENTATION PLAN**

**WATER LEVEL OBSERVATION NETWORK
FOR
EL SALVADOR**

**US Department of Commerce
National Oceanic and Atmospheric Administration
National Ocean Service
February 11, 2000**

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WATER LEVEL OBSERVATION NETWORK FOR CENTRAL AMERICA

BACKGROUND

The Center for Operational Oceanographic Products and Services (CO-OPS) was requested by DOC/NOAA to submit a plan for the reconstruction of the water level observation network in Honduras for the U.S. Department of Commerce's Implementation Plan For Reconstruction Work in Central America (DOCIP). DOCIP is an intergovernmental cooperative effort, funded by Congress, to assist Central American countries affected by hurricane "Mitch" with the reconstruction of damaged infrastructure. USAID 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, USAID 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 the geodetic control networks described in the implementation document Development and Implementation of a Geodetic Framework for El Salvador, Guatemala, Honduras, and Nicaragua prepared by the National Geodetic Survey, NOAA.

OBJECTIVES

The objectives of this activity are:

- 1) install 2 state-of-the-art sea level and meteorological monitoring station, recover historical MSL data and update the local MSL datum at this station to support the development of a geodetic framework for Central America;
- 2) develop a national and regional capacity to install and maintain the station, conduct data acquisition, data analysis, data archiving and data dissemination activities using automated data base management technology; and
- 3) strengthen professional and technical skills of participating agencies as well as national and regional institutions through technology transfer and capacity building.

Successful implementation of this activity is directly related to the degree of participation provided by the participating agencies and national and regional institutions. Presently NOAA is in contact with the Instituto Geografico Nacional (IGN) and the Empresa Nacional Portuaria (ENP) in El Salvador. NOAA will coordinate hands-on training, seminars, and workshops to ensure that the designated host country agencies as well as national and regional institutions are fully capable of operating and maintaining the WLON.

WATER LEVEL OBSERVATION NETWORK (WLON)

Final WLON design and site selections will depend on the results of discussions with the host country agency participants and a site reconnaissance of existing and historical water level sites. A reconnaissance will be conducted by representatives of the host country agency and CO-OPS personnel. Some of the site selection criteria consist of:

- 1) length of the MSL series available;
- 2) adequate bench mark network,;
- 3) adequate facilities and security for long term measurements; and
- 4) for existing site, does the MSL data represent an open coast environment.

The following list was prepared from information in the CO-OPS historical water level archives and IGN station lists in El Salvador. USAID requested that NOAA added a new site to the WLON. The new site is at the entrance to the Rio Lempa River in El Salvador and is required to assist with regulating river flow during dam discharge operations upstream. Timing the discharge with the falling tide or low waters is critical to mitigating upstream flooding. The final WLON will consist of 2 station at La Union and Rio Lempa.

EL SALVADOR

Station	Latitude (N)	Longitude (W)	Years
La Union	13° 20.0'	87° 49.3'	19
Rio Lempa	New Site		

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 voice modem, a 12 V battery and 35 W solar panel, and a permanent bench mark network composed of a minimum of five survey monuments (Fig. 1). The DCP provides on-site data acquisition, storage, and telemetry options, which include GOES satellite, telephone, line-of-sight radio, and on-site download via an RS232 port. GOES telemetry is the primary mode of data retrieval for the WLON, telephone is optional. Since GOES transmission time is critical, the DCP's will be equipped with a GPS board to ensure the system is on the precise UTC time. 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 consistent with the sea level stations in the Caribbean: Planning for Adaptation to Global Climate Change network (Martin, et. al. 1998).

NOAA shall provide engineering support to investigate the possibility of acquiring high quality tsunami measurements (Gonzalez, et. al. 1993) from WLON stations to enhance the Tsunami Warning System (TWS) on the Pacific Coast and to initiate the installation of a warning system on the Caribbean Coast in response to growing concerns of the Tsunami hazard (UNESCO, 1996) in that tectonically active region.

EQUIPMENT PROCUREMENT AND STATION INSTALLATIONS

Equipment procurement and the installation and the operation and maintenance (until December 31, 2001) shall be accomplished through an existing cooperative agreement between NOAA and the General Secretariat of the Organization of American States (GS/OAS) in accordance with Section II.A of the Agreement for Technical Cooperation. CO-OPS shall provide GS/OAS with a set of specifications for the required equipment and a statement-of-work (SOW) for the proper installation, operation, and maintenance of the stations and have GS/OAS manage the contracting requirements. A project monitor shall be provided by NOAA/CO-OPS to ensure compliance with the equipment specifications and SOW.

DATA ACQUISITION, DATA ANALYSIS, AND DATA DISSEMINATION

Data acquisition of the GOES telemetry data shall be accomplished via a USGS/NWS GOES ground station located in Central America. National and Regional users will have direct access to all of the data over the INTERNET node being developed by USGS and NWS to support the data collection networks established by each of those agencies (Fig. 2). NOAA shall provide on-site assistance with any operational problems and on-site training on database management and quality control and quality assurance procedures, in addition to providing training at NOAA facilities. Data analysis and data archiving capabilities will be developed within the the IGN and Regional institutions. However, NOAA shall process and analyze one year of sea level (tide) data from La Union and Rio Lempa. During this time, NOAA shall work closely with the IGN and ENP and Regional institutions to provide technical assistance in developing the WLON to it's fullest capacity.

GEOCENTRIC FIXING OF TIDE STATIONS

A minimum of one bench mark at each WLON station shall be occupied with GPS to precisely position the stations in the International Terrestrial Reference Framework (ITRF). Multiple days of GPS observations shall be conducted with GPS receivers and antenna that meet geodetic standards to obtain geodetic quality 3-D positioning of the stations. CO-OPS shall provide on-site training to IGN staff on the standard procedures for conducting precise GPS surveys at WLON stations. Precise positioning of WLON stations in the ITRF provides National and Regional consistency to the network. More importantly, this provides an opportunity to monitor crustal motion at the National and Regional level and determine absolute sea level change in the area.

CAPACITY BUILDING

The IGN and ENP shall participate in the final site selections, instrument installations, and GPS observations. NOAA and contract personnel shall provide on-site training to host country staff during these activities and coordinate the development of in-country tides workshops. These in-country workshops shall be coordinated with the National Weather Service training activities. In addition to the on-site training, NOAA shall provide in-house training to the staff from the IGN on the proper installation, operation, and maintenance of water level stations at a NOAA facility to ensure full capability in all aspects of operating and maintaining the WLON stations. NOAA shall 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 water level data.

BENEFITS TO OTHER PROJECTS/ACTIVITIES IN THE REGION

The primary purpose of the WLON is to provide support for the development and improvement of the geodetic framework of Central America. However, information and data derived from WLON will 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 tsunami, and coastal sea level predictions associated with climate change (Pugh, D. T. and Maul G. A., 1999)

Data from the WLON supports the design, development and construction of harbor facilities to enhance maritime commerce, to produce accurate nautical charts, and to improve marine nowcasts and forecasts. WLON stations will also have the capability of providing real-time water level and meteorological data to large vessels (oil tankers, containers, and cruise) to improve safe navigation and docking operations.

PROPOSED SCHEDULE

The following is the a proposed project schedule which is contingent on completing the final site selections and station network design in each country and implementing an agreement with GS/OAS.

DATE	ACTIVITY	REMARKS
Nov 1999	Site reconnaissance Honduras	Complete
Jan 2000	Site reconnaissance Nicaragua	Complete
Apr 2000	Site reconnaissance Guatemala/El Salvador	
Apr 2000	Submit Regional Implementation Plan to NOS	Completed
Apr 2000	Submit individual country plans	
Apr 2000	Regional coordinating meeting Costa Rica with	

PROJECT SCHEDULE (cont.)

DATE	ACTIVITY	REMARKS
	the CRRH/IOI	
Apr 2000	Quarterly Report to NOS Coordinator	
May 2000	Select contracting process (NWS or OAS)	
May 2000	Submit SOW to contractor for Equipment procurement, station installation, and operation and maintenance (until Dec. 31, 2001).	
May 2000	NOAA initiates training equipment procurement	
July 2000	Coordinating meeting between CO-OPS contractor	

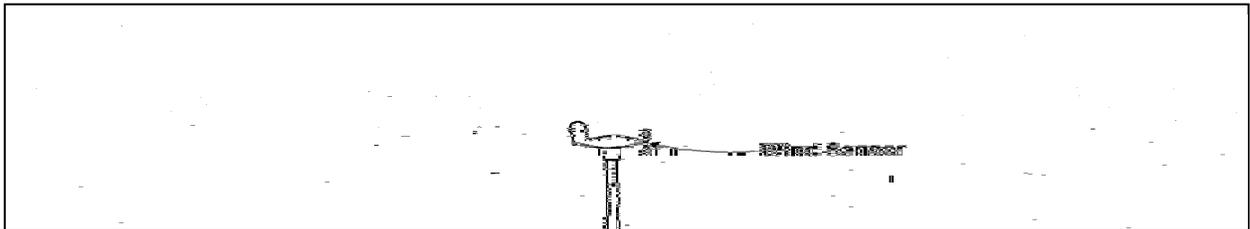
		and NWS/USGC contractors
Jul	2000	Contractor Initiates equipment procurement
Aug	2000	NOAA provide engineering support to develop Tsunami Warning System
Aug	2000	Quarterly Report to NOS
Oct	2000	Contractor initiates station installations and on-site training
Oct	2000	NOAA assists with station installations for Gulf of Fonseca
Nov	2000	NOAA data base management training
Dec	2000	Quarterly Report to NOS
Jan	2001	Inspect water level station installations
Feb	2001	NOAA begins sea level data analysis
Feb	2001	NOAA initiate geodetic fixing of water level stations and on-site GPS training
Apr	2001	NOAA coordinates Tides Workshops
Apr	2001	Quarterly Report to NOS
Jun	2001	Regional Meeting to review WLON data and products
Aug	2001	Quarterly Report
Dec	2001	Final Report - End of Project

PROPOSED BUDGET

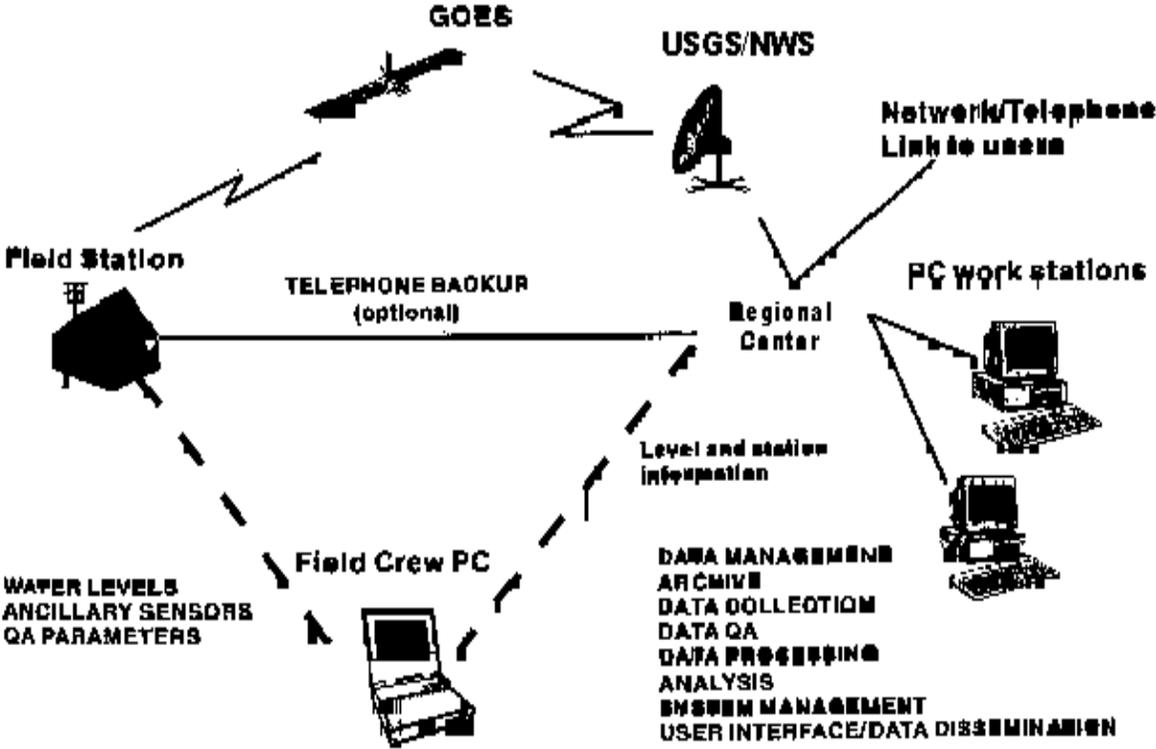
The following proposed budget (Appendix 1.) is associated with the activities shown in the proposed project schedule. These estimated cost may be different than the actual cost, particularly those associated with the contracting of services. The project activities and budget items will be used as tracking milestones for the Quarterly Reports to NOS.

REFERENCES

- UNESCO, 1990. "Global Sea Level Observing System (GLOSS) Implementation Plan". Intergovernmental Oceanographic Commission Technical Series 35.
- Martin, D. et. al. 1998. "Caribbean Sea Level Monitoring Network". Proceedings International Symposium on Marine Positioning, Melbourne, Florida.
- Gonzalez, F. et. al. 1993. "U.S. Tsunami Measurement Capabilities". Proceeding of the Third US-Japan Tsunami Workshop in Japan.
- UNESCO, 1996. "IOCARIBE Tsunami Warning System Workshop". University of the Virgin Islands, St. John, Virgin Islands, May 23-24, 1996.
- Pugh, D. T. and Maul, G. A., 1999. "Coastal Prediction for Climate Change." Coastal Ocean Prediction, Coastal and Estuarine Studies 56, Pages 377-404, American Geophysical Union.



Data Acquisition, Analysis, Archiving and Dissemination



APPENDIX 1.

PROPOSED BUDGET (\$K)

ACTIVITY	ESTIMATED COST
NOAA Project Management	35
Contract Monitor	
Travel	
Training	
GS/OAS Program Management	75
Administration and Support	
Travel	
Training	
Regional Coordination	
Equipment Procurement (4 systems)	162
Station Design, Installation and O&M (through 12/31/01)	22
NOAA Data Analysis	15
Data Recovery	10
Geodetic Fixing of Water Level Stations	15
NOAA Engineering Support for Tsunami System	10
Freight	5
TOTAL	349