



## **WATER RESOURCES RESEARCH GRANT PROPOSAL**

**Title:** Contaminant Assessment of Sediments in Tanapag Lagoon, Saipan

**Focus Categories:**

**Keyword Numbers:** 144, 181, 225, 254, 273

**Duration:** June 1999 to May 2000

**Fiscal Year 1999 Federal Funds:** \$31,514

**Non-Federal Funds Allocated:** N/A

**Principal Investigators:** Dr. Gary R.W. Denton and Mr. Rick Wood, WERI, University of Guam, Mangilao, Guam Mr. Brian Bearden, Department of Environmental Quality, Saipan

**Congressional District of University Performing the Research:** N/A

### **Statement of Critical Regional Water Problems**

Tanapag Lagoon is a typical high-island barrier reef lagoon bordering the western shore of central Saipan. It is approximately 9 km long, 3 km at its widest point, and covers an area of around 13 km<sup>2</sup>. Large expanses of patch reef interspersed with sand and rubble provide for a diversity of shallow water habitats and harbor rich assemblages of flora and fauna (Doty and Marsh 1977, Amesbury et al. 1979). In addition to its ecological significance, the Lagoon supports a variety of recreational activities and many of its fisheries resources are traditionally harvested for food by local people. Unfortunately, over the last 25 years or so, increased pressures have been brought to bear on the delicate balance of this environment, in the wake of increased commercial and industrial developments along the adjacent shoreline. Man's inroads into this area are particularly noticeable along the southern nearshore section of the Lagoon between Muchot Point and Flores Point, a distance of approximately 3 km. Within this section lies Saipan Harbor, a commercial port that occupies an area of around 1.6 km<sup>2</sup>. There is also a sewage treatment plant outfall that delivers around 1.6 million gallons of secondary treated effluent into the Lagoon each day; a municipal dump that discharges solid waste into the Lagoon, in violation of the Federal Clean Water Act; a nearby bulk fuel facility, and a recently constructed small boat marina. The area is also heavily inundated by stormwater runoff during the prolonged periods of wet weather.

The municipal dump is of particular concern to the local community, and is perhaps the greatest environmental problem facing Saipan today. It is located at the edge of Saipan Harbor, within the district of Puerto Rico, and has served as the island's primary solid waste disposal site for over 40 years. It covers an area of around 20 acres and towers

some 15-m above sea level at its highest point. Over the years, the Puerto Rico Dump has spread beyond the initial confines of its natural shoreline boundaries, into the Lagoon itself. The records indicate that it was first used by the military shortly after World War II for the disposal of heavy scrap metal (e.g., junk tanks and vehicles) and unexploded ordnance devices (Ogden 1994). Since then, it has been a repository for every type of waste generated on island and is rumored to contain a plethora of toxic chemicals of both military and civilian origin. These are said to include DDT, PCBs, waste oils, solvents, and various heavy metals (Ogden 1994). Unfortunately, the Puerto Rico Dump was never designed for the safe disposal of hazardous wastes. As a consequence, it lacks the necessary physical barriers (e.g., impervious liners and retentive berms) that prevent leachate and stormwater runoff from mobilizing such contaminants into the abutting marine waters. Monitoring performed by Saipan's Department of Environmental Quality (DEQ), and others, verifies that such events have effected subtle water quality changes in this region of Tanapag Lagoon. However, to what extent these changes have impacted the ecological, recreational and commercial potential of the area is currently unknown. The same may be said for contaminants delivered to the Lagoon in discharges from the wastewater treatment plant and in runoff from roads and the commercial sector along the adjacent coastline. The need for a contaminant assessment study is, therefore, very clear and is seen as a first step towards achieving sustainable development of the resources within this environmentally sensitive area. With this in mind, the following proposal seeks funding to support a preliminary sediment-monitoring program within Tanapag Lagoon, with emphasis on the nearshore area between Muchot Point and Flores Point. Bottom sediments are useful 'indicators' of pollution because they act as reservoirs or "sinks" for a variety of freshwater-borne contaminants entering the coastal belt (Bryan 1976). Thus, contaminant levels associated with them are largely a direct function of levels present in the overlying water column. For this reason, sediment analyses are frequently incorporated into aquatic monitoring programs designed to evaluate spatial differences and temporal trends in hydrophobic organic chemicals, metal compounds, and nutrients. In the following study, we intend to focus on sediment levels of some of the more persistent contaminants that have relatively high toxicity and tend to be readily accumulated by aquatic organisms. These include DDT and its analogues, PCBs, PAHs (polycyclic aromatic hydrocarbons), and a range of heavy metals (Phillips, 1977, 1980, Kennish 1992, Laws 1993, Hoffman et al. 1995). All the above are ubiquitous environmental contaminants that commonly occur in landfill leachate, wastewater effluent streams and urban runoff (Murphy and Carleo 1978, Connell and Miller 1984, McElroy 1989, Makepeace et al. 1995). The proposed study is the first part of a two-part program ultimately designed to evaluate the movement of the above contaminants into biological components of the Lagoon. The proposal addresses one of the most critical needs identified by the CNMI Advisory Council Meeting held in Saipan on December 7, 1998.

### **Statement of Results, Benefits, and/or Information Expected**

The study will determine the level and distribution of a range of persistent and potentially toxic contaminants in bottom sediments within Tanapag Lagoon. It will define contaminant concentration gradients with respect to the Puerto Rico Dump, wastewater

and stormwater discharge points, and other potential sources of contamination, and identify geographical areas of concentration. It will also provide the necessary foundation for future assessment and regulation of pollution problems including a sensibly planned and readily implemented monitoring program. Further, it will provide data of value from a public health viewpoint and should be of interest to the community at large. Specific benefits of the study are: (a) an assessment of current levels of contamination in the sediments of Tanapag Lagoon relative to world standards, (b) the identification and delineation of potential 'hot-spots' and point sources of contamination, and (c) the provision of a database vital to the management of Saipan's coastal waters.

### **Nature, Scope, and Objectives of the Research**

The nature of the proposed study is primarily one of assessment monitoring. In scope, the project will consider a range of persistent and potentially toxic contaminants, in sediments from within the prescribed area under investigation. The objectives of the study are as follows:

1. To determine the presence and abundance of DDT (and related compounds), PCBs, PAHs, and a range of heavy metals (Ag, As, Cd, Cr, Cu, Hg, Ni, Pb, Sn and Zn), in bottom sediments from strategic locations within Tanapag Lagoon.
2. To map concentration contours for each contaminant within the area and highlight specific point sources and areas of enrichment.
3. To assess the degree of sediment contamination in Tanapag Lagoon by reference to levels reported in clean and polluted environments elsewhere and with special reference to other tropical regions of the world, including Guam.
4. To develop criteria for distinguishing between clean and contaminated sediments within the Lagoon.
5. To initiate the provision of a sound database with which future levels of contamination may be compared and evaluated.
6. To provide information of value for the upgrading of Saipan's marine water quality monitoring program.