Report as of FY2007 for 2006GU81B: "Management of the Nanpil River Watershed, Pohnpei Island, the Federated States of Micronesia"

Publications

Project 2006GU81B has resulted in no reported publications as of FY2007.

Report Follows

PROJECT SYNOPSIS REPORT

Project Title: Management of the Nanpil River Watershed, Pohnpei Island, the Federated States of Micronesia

Problem and Research Objectives

Studies being carried out by WERI researchers have shown that the mean annual rainfall for Pohnpei varies from 325 to 200 inches as one move from the mountainous interior to the coastal areas of the island. The negative impacts of these huge amounts of rainfall are soil erosion, land slides, and poor water quality. Sediment lost due to erosion pollutes rivers and as it accumulates offshore, could have a negative impact on mangrove swamps, fisheries, and coral reef communities.

The Nanpil River, which serves as a major source of the domestic water supply for the Island of Pohnpei, is located in the Nanpil Watershed in the North West part of the island. As shown in Figure 1, it stretches between Nett and Sokehs municipalities. The watershed has an area of approximately 3 square miles (US Army Corps, 1988). A 12-ft high dam, completed in 1977, diverts part of the water flow from the Nanpil River for domestic use. The water that is diverted from the dam flows to the water treatment plant located in Nonponmahl. This water is a major source of domestic supply for the island. According to Pohnpei Public Utilities Corporation (PUC), after heavy rains the water treatment plant cannot produce quality water because of high turbidity. During these high turbidity times, the filters require frequent back-washing at intervals as small as 12 hours.

There is a general perception among the many residents of Pohnpei that the day-to-day flow (excluding floods during extreme rain events) in many of Pohnpei's streams has been reduced from what it was a decade ago. There are several possible reasons for reduced stream flow in Pohnpei, such as: land use practices, climate change, construction of municipal roads and population growth. It is the purpose of this project to begin acquiring baseline measurements of all the relevant physical characteristics of the watersheds. Analysis of these characteristics can lead to recommendations that will assist the local government in implementing informed watershed management/protection plans. In the future it may be necessary to study two or more watersheds that have differing degrees of alterations by human activities to better characterize the affects of man's activities.

The objectives of this project were to: 1) install stream level, sediment, and rain gages at selected sites within the Nanpil Watershed; 2) monitor the gages and develop rating curves for stream level versus flow at the selected site; 3) develop a relationship between stream flow, sediment load and rainfall; and 4) develop a watershed characteristic database for future use. This project has generated baseline information and correlations among the dynamic components of the Nanpil watershed environment.

The baseline information will be used for future comparison between the Nanpil watershed and the ongoing study of the Enipein Watershed. The findings will reveal the impact of the various activities such as land clearing, land slides/slope failures, and population growth on the water quality of the streams in the watershed. This information will help various parties such as the Conservation Society of Pohnpei (CSP), Land Management, Pohnpei EPA, and local mayors to implement plans for protecting the watersheds in Pohnpei. Pohnpei's Public Utilities Commission (PUC) will be able to operate the water treatment plant more efficiently by knowing the relationship between the level of the stream's turbidity and the available water at the stream. Also the information obtained in this project may be used by Pohnpei's Weather Service to enable them to provide flash flood warnings for the Nanpil River.

Methodology

To complete the project three tasks were undertaken: site selection, instrument installation, data collection and analysis and development of a baseline data base. The former US Geological Survey (USGS) gaging station lies one-half mile above the PUC's water supply intake structures (Figure 2). This site was selected for installation of a level logger for measuring the stream level. The reasons this site was selected include: easy accessibility, natural or man-made protection from flooding; and availability of places in the streams where manual stream flow measurements could be easily made. Another favorable asset of this site is that past USGS stream flow and stream level data could be used to assist in re-establishing the rating curve between stream stage and stream discharge.

With the help of CSP, the old USGS gage station was cleared of debris and sediments that had accumulated for the last 10 years. One level logger, as shown in Figure 3, was installed in the old USGS gage house structure. The location and elevation of site was surveyed and recorded. The function of the level logger is to measure the changes of the river depth (stage) versus time. The level logger stores the data internally on site for downloading at a later date. We found that the logger could easily hold two months of data (recorded at 5 minute intervals) between downloads. To make necessary adjustment for barometric pressure changes, a barometric logger was installed at the old USGS gage station. All Level and barometric data was taken at 5 minute intervals. Two personnel from CSP were trained in stream flow measuring techniques. The manual streamflow measurements were used to supplement the old USGS stream level and streamflow data in the development of a rating curve of flow vs. level for the site as shown in Figure 4. Direct streamflow measurements were made on a monthly basis and the level and baro-loggers were downloaded every other month.

One Turbidimeter Measurement Device (TMD) was installed at the dam site as shown in Figure 5. The TDM has been measuring the turbidity (NTU) at fifteen (15) minute intervals. The turbidity and flow data will be used to develop a relationship between streamflow and turbidity.

Two recording tipping bucket rain gages were installed in the basin (see Figure 1) and the data from the gages will be used to develop rainfall vs. runoff modeling characteristics for the watershed. The rainfall data, which had 1-second time resolution, was downloaded from the gages every two months.

Principal Findings and Significance

The water level (stage) changes have been recorder by the level logger at the old USGS site. The flow rate at the selected site using a portable flow meter has been measured. These data with the flow vs. depth that is available from past measurements by the US Geological Survey helped us to develop a preliminary rating curve (stage versus flow) for the Nanpil River. This will enable us to estimate the flow rate in the Nanpil River at the stream gage site. The data collection and analysis will be continued until a reliable rating curve has been developed.

The level of turbidity at the Nanpil dam has been collected for the last five months. The relationships between streamflow, rainfall, and turbidity were also examined. As shown in Figure 6, there is a close association between rainfall, streamflow and changes in turbidity in the stream. The flashy response characteristic of the stream indicates rapid flooding in the stream and also elevated soil erosion. The time to stream flow peak for a given rainfall event is in the order of 1 hour. In examining the data there seems to be a direct correlation between stream flow and turbidity. As more streamflow and turbidity data is gathered we will be carrying out a correlation analysis of the streamflow vs. turbidity data to further define this relationship. We will also be modeling the basin using the US Army Corps of Engineers Hydrologic Modeling System (HMS). After the modeling parameters have been developed from calibration studies using measured data, we will be able to examine the impacts of storms such as typhoons that bring huge amounts of rain at very high rainfall intensity rates to Pohnpei.

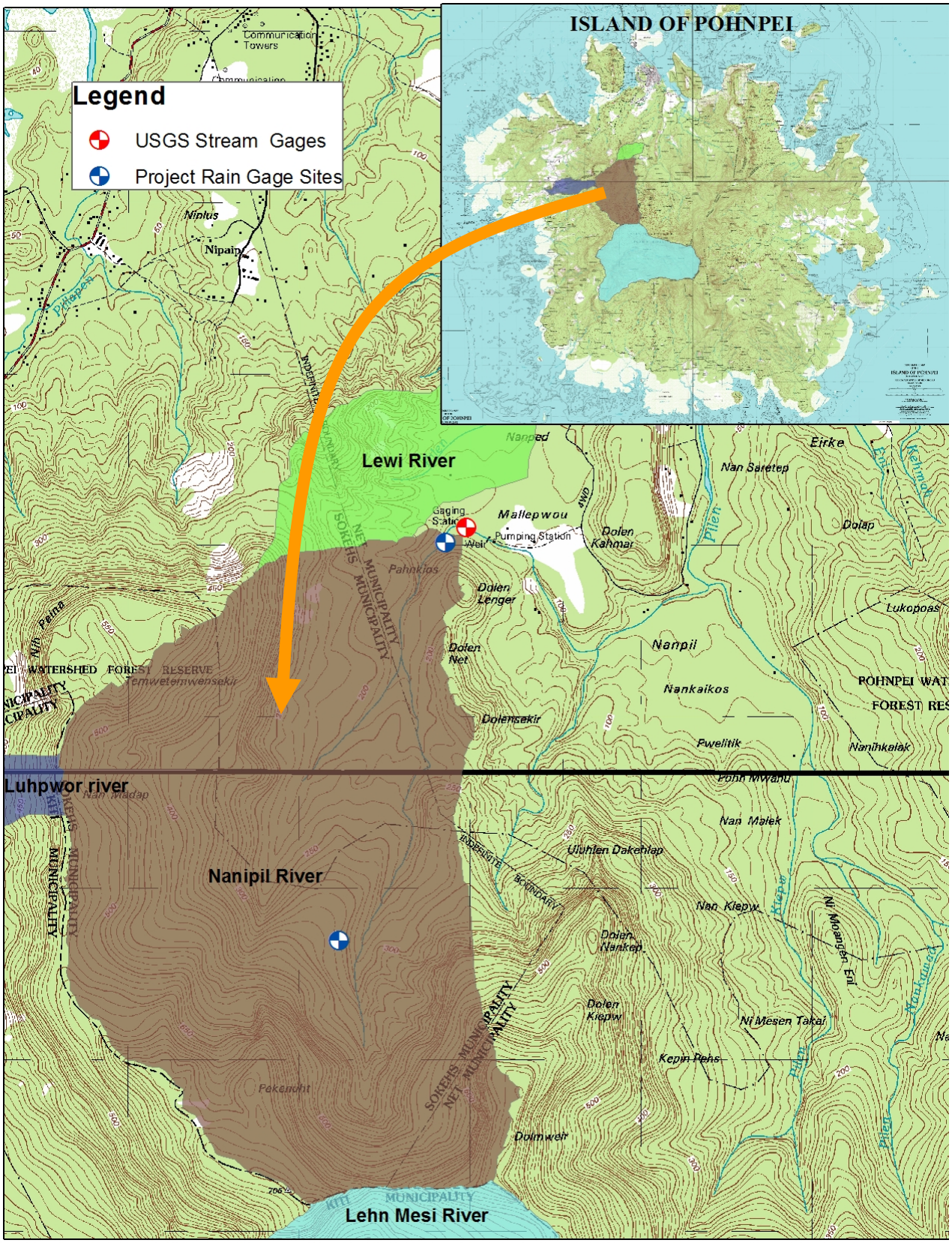

Figure 1. Nanpil Watershed, Sokehs and Nett Municipalities, Pohnpei Island.

Figure 2. The US Geological gaging station on Nanpil River, Pohnpei Island

Figure 3. Hobo Water Level Logger

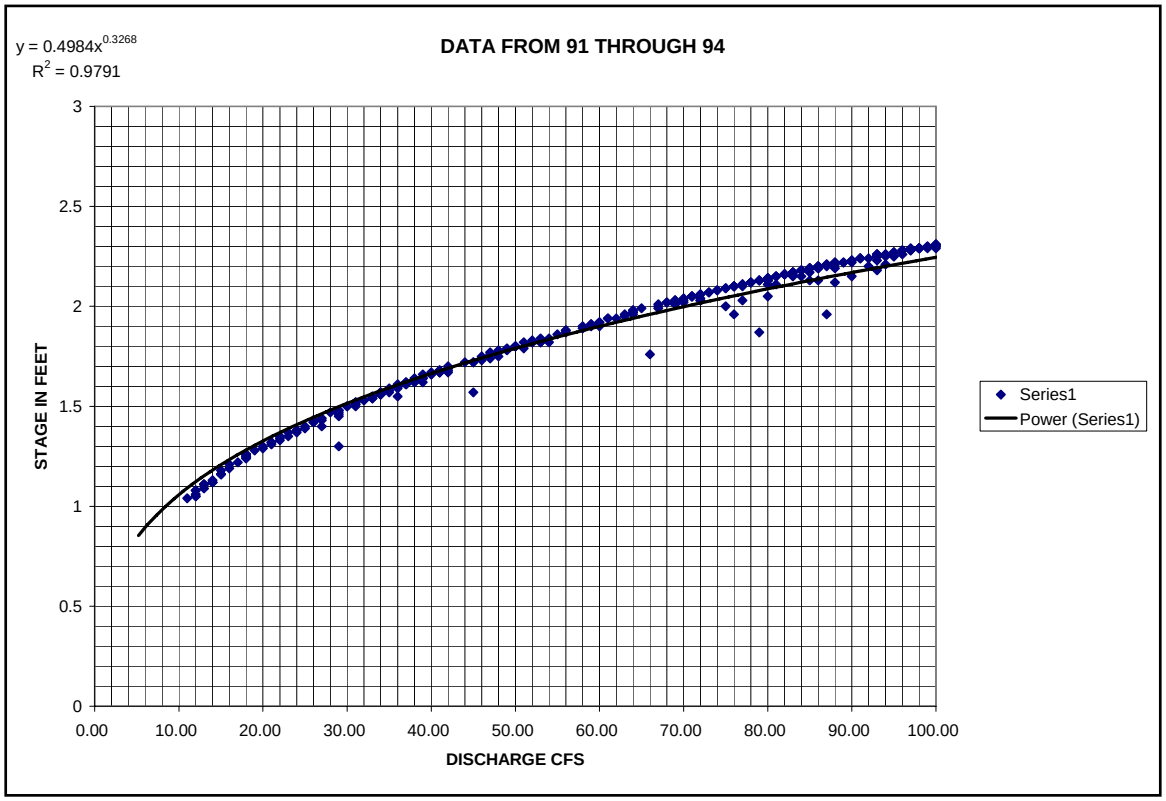

Figure 4 Rating curve for Nanpil stream gage above the PUC diversion dam.

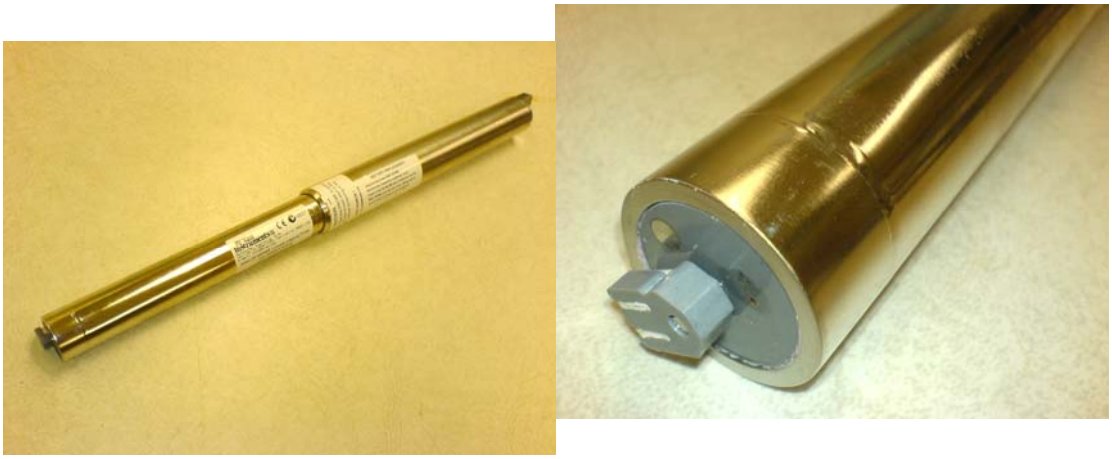

Figure 5. Turbidemeter.

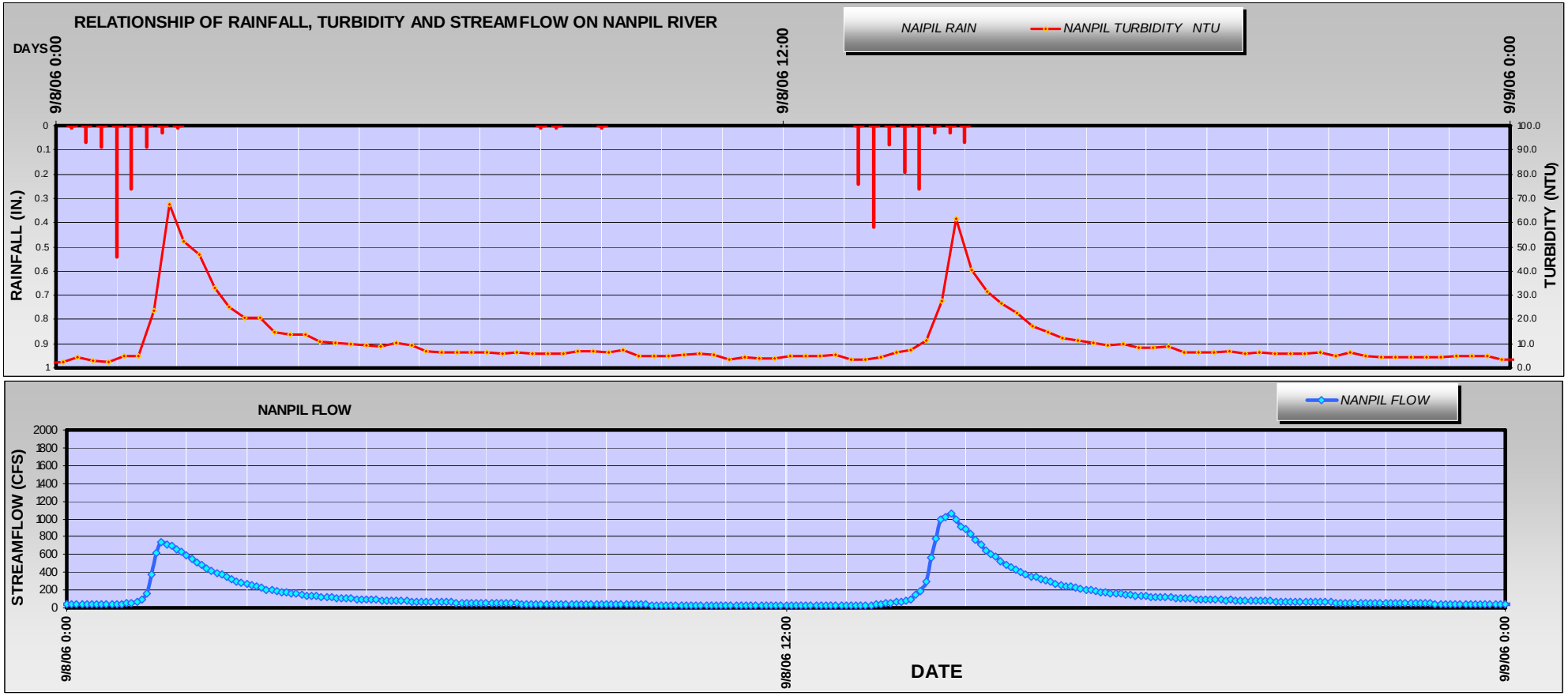

Figure 6. Rainfall vs Streamflow and Turbidity on Nanpil River September 9, 2006.