Philippines

Pasig River Flood Warning System Project

Report date: March 2001
Field survey: September 2000

1. Project Profile and Japan's ODA Loan

Project Area Location Map: Manila and environs

Rosario Central Monitoring Facility

1.1. Background

This project pertains to the Mangahan floodway constructed for flood control in the Manila area as part of the Pasig River Flood Control Project. Initial plans were to repair the Rosario weir, which is the sluice of the floodway. However, after the project started, the region surrounding Laguna de Bay (known as Lake Laguna) was hit by a flood disaster and water was discharged from the floodway. Therefore, in order to reduce flood damage around the lake, the design of the weir was altered to make it a movable structure to enable lake water to be drained through the Mangahan floodway when the water level is high. After the completion of the floodway (June 1984), flood water rushed in when the weir was opened. This situation necessitated a warning system to protect people's lives and property from flood and a telemetering system[1] (see Figure 1 for the system structure) to enable timely and effective operation of the weir.

1.2. Objectives

The objectives of the project were to introduce a flood warning system in the Mangahan floodway project in order to protect people's lives and property from artificial flooding of the floodway caused by the operation of the weir, and to enable timely and effective weir operation using the telemetering system.

[1] A system to transmit measurement data collected at remote points to individual stations. Considering that opening the weir takes time (about 1 hour to open fully), it is necessary to predict the approximate volume of floodwater around the weir; a purpose fulfilled by the telemetering system.

1.3. Project Scope

The ODA loan covered the foreign currency portion of the cost of procuring materials and services necessary for the implementation of the project. The loan agreement was signed in FY 1983.

1.4. Borrower/Executing Agency

The government of the Republic of the Philippines/Department of Public Works and Highways (DPWH, former MPWH)

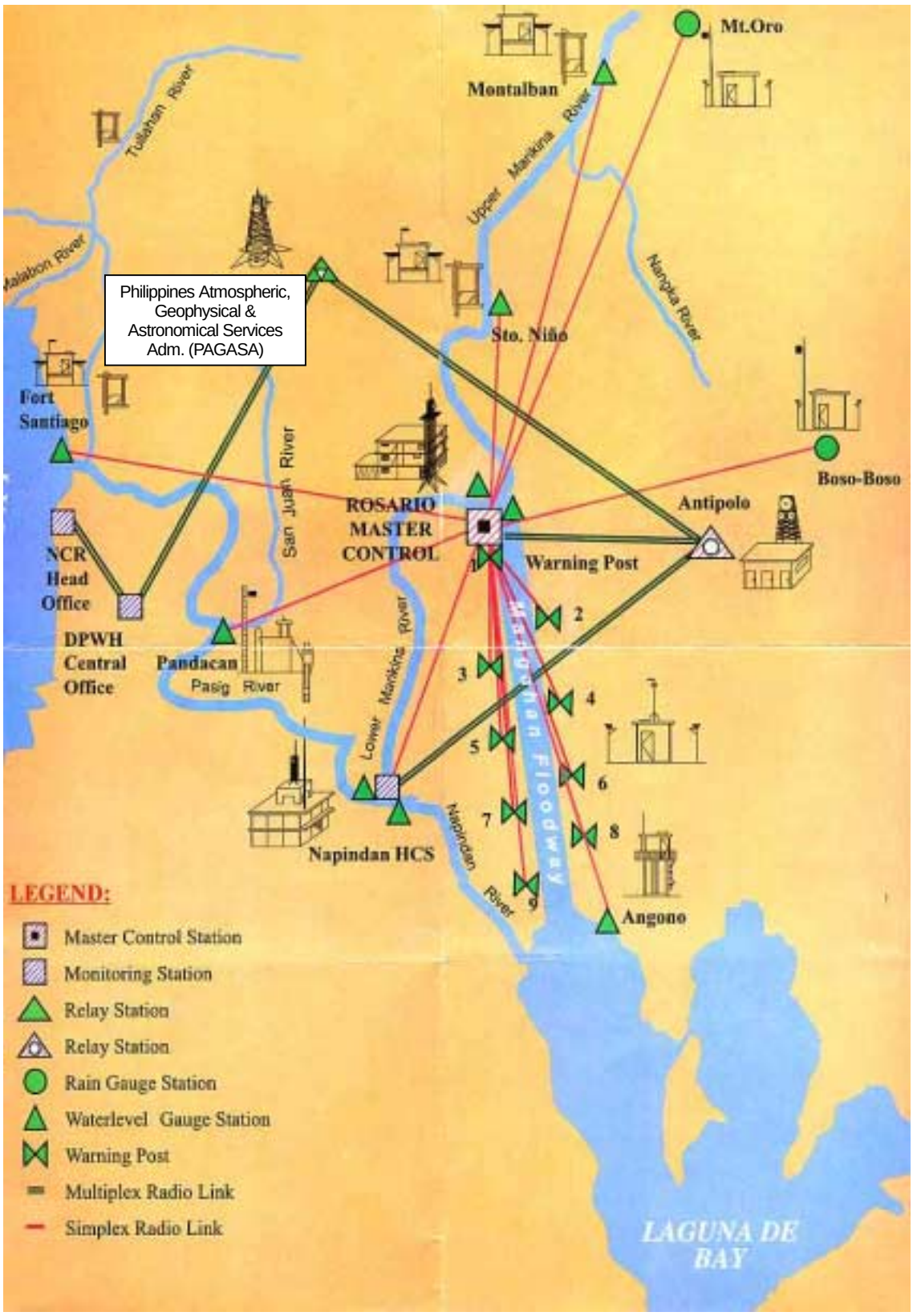

Figure 1 Structure of Telecommunication System

1.5. Outline of Loan Agreement

Loan amount/Loan disbursed amount	¥1.140 billion/¥1.036 billion
Exchange of notes/Loan agreement	July 1983/September 1983
Terms and conditions	Interest Rate: 3.0%, Repayment period (grace period): 30 years (10 years), General untied (partially untied for consulting services)
Final disbursement date	December 1993

2. Results and Evaluation

2.1. Relevance

This project became necessary as an emergency measure to protect people's lives and property after changes were made to the construction plan for the Mangahan floodway under the preceding Pasig River Flood Control Project. Considering that flooding in the region concerned was a frequent occurrence at the time of planning and that it still occurs today, the project plan has been relevant.

2.2. Efficiency

Procedures for contracting consultants and the bidding for the main construction work took longer than expected and the project required 107 months to complete, almost three times as long as the planned period of 36 months. The main cause was the delay in various procedures during the period of transition from Marcos Administration to Aquino Administration, which started after the assassination of Benigno Aquino in 1983. In addition, a problem arose in 1987, in that the communication frequency band to be allotted to the Effective Flood Control Operation System (EFCOS), the backbone of the project, overlapped with that of the fast-expanding mobile communication network. As a result, it was necessary to conduct an additional survey[2] concerning the detailed implementation plan; executed from 1985 to the summer of 1986.

2.3. Effectiveness

(2.3.1.) Advance Warning System Operation

Table 1 shows the operation of the advance warning system since the completion of the project. At present, the advance warning system is operating normally including appropriate gauging of rainfall and water levels at each gauge station and patrols by the executing agency. This system, which was designed to collect hydrologic data and transmit warnings to areas near the floodway, is centrally controlled by the Rosario Station (master control station). This station is equipped to check for data omissions by remote monitoring. Under these controlling mechanisms, the system is fully utilizing its functions.

[2] Plans were to use the 800MHz frequency band, the same band as is used by the existing PAGASA-DPWH system. However, it has been fully taken up by the mobile communication network, etc. and became unavailable. Therefore, the plan was changed to use the 2GHz frequency band.

Table 1 Issuance of Advance Warning

Period	1993 (completion year)	1994	1995	1996	1997	1998	1999
Transmission days	3	3	3	1	2	2	5
(Frequency)							
Siren	(3)		(1)	(1)	(2)	(2)	(3)
Audible alarm			(1)				
Announcement	(3)	(3)	(3)		(2)	(2)	(5)

Source: EFCOS Office of DPWH

Note: In 1993, for example, advance warnings were issued on three days. On June 8, a combined warning was issued by siren and announcement.

(2.3.2.) Residents' Reactions to Warnings

In response to our interview, the residents around the floodway informed us that they understood the meaning of warnings and would prepare for evacuation upon hearing the alarm. The executing agency pointed out that in some cases residents were slow to react to evacuation advice. The executing agency, on its part, has been making efforts to facilitate understanding among residents through explanatory and educational activities on the necessity of issuing a warning prior to the start of weir operation.

Although some residents said that warnings were late in some cases, the warning system was generally given a favorable evaluation. Residents recognized the importance of the warnings in saving their lives and acted properly. It is concluded that the water discharge warnings on the Mangahan floodway have been effective in protecting the lives and property of the residents in surrounding areas.

(2.3.3.) Operation of Telecommunication Facilities

The multiple radio equipment, comprising the circuits used for distribution of data from the Rosario station to each monitoring station and for communication among stations, has been working normally since it was installed and is maintained in good condition. However, the power generator (20KVA) of the emergency electric supply unit, which was installed to secure system operation in the event of a power failure, broke down 5 or 6 years ago and has been inoperable since. Another problem is the competition for the frequency band used for telecommunications mentioned above. There are plans to rehabilitate the power generator (20KVA) using grant aid from Japan. In the meantime, however, the (underground) cable connecting Philippines Atmospheric, Geophysical & Astronomical Services Adm. (PAGASA) and this system was severed erroneously during road works. This problem has been dealt with by emergency repair (full-scale repairs will be mentioned later).

The gates of the Rosario weir and the Napindan weir are operated based on estimates of flow rate and water level made using data collected at the Rosario station. Hardware and data storage are generally favorable. According to the operation

records for Rosario weir included in the annual report submitted by the executing agency, the weir has been operated based on the collected data. In this regard, the objective has been achieved.

2.4. Impact

(2.4.1.) Reduction of Flood Damage

Table 2 shows the amount of flood damage to Pasig and Marikina Rivers calculated at the time of appraisal and after project completion. The instances of flood damage have decreased since completion of the project with the result that the amount of damage has also decreased. It is difficult to determine if this reduction has been rendered solely as an effect of the project. However, given that system operation has generally been smooth, it would be quite possible to assume that the project has had a positive impact.

Table 2 Comparison of Amount of Flood Damage

Period	Before implementation Average in 1970-1980	After implementation Average in 1993-1998
Amount of flood damage (thousand pesos)	49,300	23,587

Source: the pre-project figure was calculated using JBIC data, and that for after the project was based on the data submitted by EFCOS

Note: these amounts are based on the market rate of the peso. Taking into consideration the depreciation of the peso after the start of the project, it is assumed that flood damage in real terms has been reduced by a larger amount than that shown above.

As compared with the situation before the start of the EFCOS project as a whole, including this project, the area of the flood plain around the region covered by the project has been reduced as shown in Table 3.

Table 3 Comparison of Flood Plain Area

Period	Before EFCOS	Present
Area of flood plain (Km^2)	63	39

Source: “Project for Rehabilitation of the Flood Control Operation and Warning System in Metro Manila” Japan International Cooperation Agency, March 2000

(2.4.2.) Technology Transfer

According to the executing agency, they have acquired knowledge of problem-solving techniques relating to the operation of communication equipment as well as the knowledge of preventive maintenance via the implementation of this project. It is concluded that, by installing new communication equipment for this project, the executing agency has acquired new knowledge on the entire advance warning system.

2.5. Sustainability

The EFCOS project office, which is responsible for operation and maintenance of the project, had 31 employees as of the end of September 2000. These employees operate the Mangahan floodway and the Napindan floodgate in parallel. Their duties also include collection and analysis of hydrologic data, and periodic maintenance of facilities and equipment within the area covered by the project. The number of employees is considered proportionate.

The budget for operation and maintenance has been approved almost as requested every year, although small reductions have been made from the requested amount in recent years.

A more fundamental issue is that renewal and improvement of equipment is necessary in light of the rapid advancement of technology and intensifying competition for the frequency band of the communication system. Using existing equipment, the data collected for the analysis of flood rate is entered manually. Accordingly, it takes time to calculate flood rates and operate the weir. In addition to the rapid technological advances, possible future competition with the mobile communication network for a particular frequency band[3] will necessitate some adjustment. In order to cope with this situation, renewal of equipment and expansion of facilities were implemented in this fiscal year (2000) using grant aid from Japan. The same grant aid was used to execute full-scale repairs to the underground cable that was severed during road works. If these measures bear fruit, problems with technology and equipment will be improved and, thus, more efficient and stable operation and maintenance of the executing agency will be realized.

Table 4 Change in Operation and Maintenance Expenditure

Unit: million pesos

Period	1994	1995	1996	1997	1998	1999	2000
Requested budget	7.2	23.0	25.0	20.0	20.0	15.648	15
Approved budget	7.2	22.0	23.1	20.0	20.0	6,8	11.8
Actual expenditure	6.84	19.8	19.63	17.00	15.00	n.a.	n.a.

Source: EFCOS Office of DPWH

[3] Permission of the National Telecommunication Commission (NTC) has been obtained for the use of the frequency band of 2GHz. At the same time, it was agreed to negotiate for alteration in the event that competition occurs for that frequency band in the future.

Comparison of Original and Actual Results

Item	Plan	Results
1. Project scope	Establishment of hydrologic gauge stations 2 rain gauge stations 5 water level gauge stations Installation of flood warning equipment 8 warning posts 2 patrol cars Installation of telecommunication facilities Telecommunication network covering gauge stations, warning posts, Rosario weir operation station, and the total controlling office at the head office of DPWH in Manila. The information received by DPWH is automatically transmitted to NFFO in PAGASA via the existing communication line. Consulting Services (Note 1) Foreign consultants 87M/M Local consultants 46M/M	Same as the plan 93.4M/M 380.28M/M
2. Implementation schedule	January 1984 to December 1986 (36 months) Establishment of hydrologic gauge stations: January to December 1985 Installation of flood warning equipment / installation of telecommunication equipment: February 1985 to March 1986 Consulting services: January 1984 to December 1986	December 1984 to October 1993 (107 months) March 1991 to October 1992 September 1990 to October 1993 March 1985 to October 1993
3. Project cost Foreign currency Local currency Total ODA loan portion Exchange rate	 ¥1.140 billion P11,731,000 (¥351 million) ¥1.491 billion ¥1.140 billion P1.00=¥29.92	(Note 2) ¥1.036 billion P27,034,500 (¥180 million) ¥1.2156 billion ¥1.039 billion P1.00=¥6.66

Note 1: M/M of consulting services of the plan is the foreign currency portion covered by the ODA loan. Details of the local currency portion are unknown. M/M of local consultants of the results includes 272.05M/M for clerical work.

Note 2: The local currency portion is the contract amount.