

CHAPTER X ASSOCIATED PROJECTS FOR SUPPORTING REGIONAL SOCIO-ECONOMIC ACTIVITIES

10.1 General

The implementation of water resources development will bring about some inconveniences to the people in the project area, such as the relocation of existing settlements, changes in river environments, disconnection of local communities due to reservoir impoundment, etc. For compensation to those inconveniences, it is worthy of considering the implementation of projects aiming at improvement of people's livelihood and enhancement of regional economic activities. Description hereafter gives the outline of the projects proposed in consideration of this respect.

10.2 Flood Control and Drainage Improvement in Lower Agos

10.2.1 Present Condition

The municipalities of Infanta and General Nakar of Quezon Province are the major municipalities within the Agos River Basin, and the Agos River delineates these municipalities. The town proper areas of these municipalities are located in the flood plain areas of the lower reach of the Agos River (the lower Agos) where Infanta lies on the right bank of the river and General Nakar on the other. To date, these areas have suffered from seasonable floods, which severely damaged public works, irrigation, agriculture, and personal property. The floods also cause bank erosion and scouring which lead to the change of its river course and width.

Based on the review of existing data and site reconnaissance, the characteristics of flood in low-flat area of Infanta and General Nakar municipalities are explained as follows:

- Overbank flow of the Agos River during the high tide, particularly in General Nakar
- Insufficient capacity of drainage canals, especially the Bantilan River
- Inefficient drainage capacity and system (irrigation drains/supply canals)
- Location of the town proper area with ground elevation of 4.5 to 6.0 m in General Nakar and 7.5 to 11.0 m in Infanta

10.2.2 Proposed Flood Control and Drainage Improvement Works

The following three projects are proposed to stabilize the river bank in order to protect the municipality areas from the flood, and to improve the drainage system: (1) river bank protection works, (2) flood control works, and (3) drainage improvement works. The proposed structure measures in the lower Agos are described in Figure 10.1.

(1) River Bank Protection Works

The bank erosion in Barangay Ilog, Infanta, and Poblacion, General Nakar, is serious issue to be considered, especially for those areas in General Nakar. The urgent project implementation in General Nakar is strongly recommended since the town proper area is close to the current river bank. The retaining wall coupled with the gabion spur dikes is recommended to reduce the bank erosion and stabilize the river stream course. A pilot project should be programmed for certain period of time to examine the effectiveness of the spur dikes. Additional spur dikes will then be installed after the confirmation of their effectiveness. The construction of spur dike will sometimes lead to the erosion on the opposite river bank; therefore, the river banks should be monitored and surveyed until such time that the river course is stabilized. The retaining wall in Barangay Ilog is also proposed to prevent from the bank erosion. A preliminary plan is shown in Figure 10.2.

Proposed Structure Measures

The proposed structure measure for bank protection and stream course stabilization are shown in the following table:

Proposed Bank Protection Works

Place	Proposed Work	Length
Town Proper of General Nakar	Boulder masonry revetment work with gabion spur dykes	900 m
Barangay Ilog, Infanta	Boulder masonry revetment work	900 m

(2) Flood Control Works

A 10-year probable flood is adopted for the formulation of the flood damage mitigation plan in the lower Agos with reference to the flood protection levels applied to other flood control projects in the Philippines. The discharge of 10-year probable flood for the lower Agos is estimated at 3,530 m³/sec through the hydrological analysis. With above conditions, the water level of lower Agos is computed and the flood prone area due to overbank flow of the Agos River is estimated as shown in Figure 10.3. The result indicates that the municipality of General Nakar is likely to suffer from the floods of the Agos River. On the contrary, the municipality of Infanta experiences floods in the limited area since most of the area is protected by natural levee.

Therefore, the flood protection dike is proposed on the General Nakar side of the Agos River. To reduce the number of relocation houses and cost of land acquisition, a total length of dike is minimized. The proposed alignment of earth dike is shown in Figure 10.1. Based on the non-uniform flow analysis, the height of the earth dike is estimated to be approximately 2 meters. The new Barangay road is also proposed for the evacuation purpose during the flood period.

Proposed Structure Measures

The proposed flood control structures are as follow:

Proposed Flood Damage Mitigation Work

Place	Proposed Work	Length
General Nakar	Flood Protection Dike	1,300 m
	New Barangay Road	400 m

(3) Drainage Improvement Works

To date, the town proper area of Infanta has experienced the inundation from time to time due to insufficient flow capacity of drainage canals and inappropriate drainage system. Presently, the flow capacity of the Bantilan River is computed at 10 to 45 m³/sec. On the other hand, the actual flow discharge of the Bantilan River is estimated to be 50 to 70 m³/sec during heavy rain. Therefore, the drainage improvement work of the Bantilan River and its tributaries is strongly recommended. In addition, the new drainage channel is proposed in the southern part of Infanta to accelerate the inundation subsidence and to drain the rainfall to the southern area and not to the town proper area.

Proposed Structure Measures

The proposed structures for drainage improvement are as follow:

Proposed Infanta Drainage Improvement Works

Place	Proposed Work	Quantity
Infanta	Improvement of the Bantilan River (Open Canal with wet masonry revetment, 15-30m x 1.5m)	2,500 m
	Improvement of Town Drainage Facilities (15 ha)	15 ha
	Improvement of a Southern Drainage Canal (Earth-excavated Channel, 3m x 1m)	1,000 m

(4) Other Proposal

Periodic Monitoring

To maintain the sustainable flood control plan of the lower Agos, the municipality offices should be responsible to make the following arrangement:

- Collection and organization of the flood damage data;
- Periodic monitoring of river stream course and river bank erosion.

Dredging of the riverbed

During the field investigation work, some local residents were requesting to dredge the Agos River to increase its river flow capacity. The dredging will increase the flow area and will improve the flow capacity of the river. The dredging seems attractive measure for flood control; however, considering that the lower Agos River has a steep riverbed, the dredging may not be suitable for a long-lasting measure of flood control. Further examination must be undertaken to confirm its effectiveness.

10.2.3 Project Cost Estimate

The project costs for river bank protection, flood control, and drainage improvement are estimated at US\$ 420,000, USD\$ 330,300, and US\$ 2,420,000, respectively. The project costs are summarized in the following table:

Summary of Project Costs

(Unit: US\$)

Project Name	Project Cost
River Bank Protection	
Infanta	150,000
General Nakar	270,000
Flood Control	
General Nakar	330,000
Drainage Improvement	
Infanta (Bantilan River)	670,000
Infanta (Town Proper Area)	1,600,000
Infanta (Southern Infanta)	150,000

10.3 Projects Proposed for Supporting Regional Socio-Economic Activities

10.3.1 Provision of River Water Use Facility

Water transfer to Metro Manila, planned to be 34.7 m³/sec (3,000 MLD) at the ultimate stage in 2025 onward, will give a consequence of reduction of flow in the river reach downstream from the Agos Dam. Agos Dam will release daily average flow of 26.3 m³/sec through water turbines of the power plant attached to the dam. This flow rate corresponds roughly to 95 % discharge under current natural condition. However, the release from the power plant varies from 4.35 m³/sec to 44 m³/sec depending on the operation mode of the power plant. This causes the daily fluctuation of river water levels, which is estimated to be 1 m.

For removing the people's inconvenience caused by such fluctuation of river water levels, it is proposed to provide a riverbank structure for facilitating the people's use of the river; such as navigation, bathing and washing, at the place where people use the river. The proposed structure is a stairway type of riverbank revetment work, which would be usable at any river water levels for boat landing, bathing and washing. The facility will be provided at 21 places. Figure 10.4 shows the location of the proposed works with a typical section of the riverbank structure. The structure is proposed to be of 10 m wide.

10.3.2 Provision of Access Roads/Footpaths for the Communities

The proposed Agos Reservoir, once impounded, will disconnect the existing traffic paths presently used by people in the area. To compensate this, the project will provide several compensation measures. The proposed facilities are shown in Figure 10.5 and described below.

(1) Access Road to Resettlement Sites

Resettlement scheme for the Agos Dam contemplates the relocation of affected settlements to two (2) new resettlement sites as shown in Figure 10.5. The project

will provide access to those new resettlement sites. The length is tentatively estimated at 14 km.

(2) Footpaths

In addition to access facilities to the settlement sites, a trunk footpath connecting Agos Dam and Barangay Daraitan will be built. A footpath will also be built along the Kanan River. These footpaths will facilitate the people's access to shops, schools, medical facilities and other public facilities located at Barangay Daraitan and Barangay Magsaysay. Total length of the footpaths is estimated at some 30 km.

(3) Reservoir Crossing Facility

At the locations where local people have to cross the reservoir, a boat landing facility will be provided at 6 locations, including one near the Agos Dam, to facilitate the people's traffic across to the reservoir and also travel from and to the upstream area. The proposed locations are shown in Figure 10.5.

The boat landing facility is a sloped masonry concrete structure similar to the riverbank structure shown in Figure 10.4. It extends from the MOL (EL. 133m) up to the FSL (EL.159m) in elevation, with a width of 2 m.

(4) Access to Barangay Daraitan

The upstream end of the Agos Reservoir reaches close to the Barangay Daraitan village proper. When the reservoir water level is lower than the Full Supply Level (FSL at EL.159 m), the river flow condition is unchanged from the present. However, the reservoir raises the river water level by about 2 m when the reservoir is at its FSL. This makes the access by vehicle a little difficult, where presently vehicles can cross the shallow part of river in the dry season.

To provide a permanent access measure to the village, construction of an access road (2 km) with two bridges (70m+80m) is planned. The proposed alignment of access road and bridges is shown in Figure 10.6.

10.3.3 Flood Protection Bund for Barangay Daraitan

It is foreseen that flood water levels at the Barangay Daraitan would become slightly higher than the present levels due to backwater effect when the reservoir water level is at FSL. This suggests the provision of a flood protection bund along the perimeter of the village on the left bank. Drainage of the inner land will be by gravity through drainage sluices. Figure 10.6 shows a preliminary layout plan of the flood protection bund.

10.3.4 Establishment of a Manpower Training Center

Some of the project-affected families (PAFs) will have to change their occupation due mainly to resettlement outside the present livelihood area, though the relocation is within the same Barangay. As a program of supporting the sustainable livelihood of those affected people, a manpower training center will be established at a place where the people prefer (e.g. Barangay Daraitan, Agos Damsite or a new

resettlement site). The center will be operated by the project during the construction period and later transferred to the municipality concerned after the construction works.

10.3.5 Establishment of a Health Center

Hearing at the public consultation revealed the people's strong need for establishing a health center in the vicinity. The proposed work is to build a new health center with the minimum required equipment, being staffed by a physician, a nurse and a mid-wife. The new center will be located either at Barangay Daraitan or new resettlement site. The health center will be operated by the project during the construction period and later transferred to the municipalities concerned.

10.3.6 Cost Estimate

The costs required for the above-proposed work is estimated roughly to be US\$ 5.0 million equivalent or Peso 260 million equivalent (See Annex I of Volume V).

10.4 River Maintenance Discharge

One of the concerns raised by the people at the public consultations and workshops was whether the Agos Dam would release an appropriate quantity of river maintenance flow to the downstream.

As stated above, Agos Reservoir will deliver the water of 3,000 MLD or 34.7 m³/sec to Metro Manila at the ultimate stage around year 2025. The annual total volume of water transfer corresponds to 30 % of the annual runoff yield of the Agos River Basin.

Under this condition, daily average release from the Agos Dam to the downstream is 26.3 m³/sec during the dry season, which corresponds to the present 95% discharge, as stated before. This ensures that the present minimum flow condition would still be maintained even after 2025. The flow released for the period before 2025 is more than the above rate (e.g., about 43 m³/sec when the water transfer to Metro Manila is a half rate; i.e., 1,500 MLD or 17.35 m³/sec).

This Study looked into the river conditions in the downstream reaches from viewpoints of people's river use, riverbed degradation, navigation, riverine fishery, riverine scenery and ecology, potential water demand and salt water intrusion. The Study has assessed, though at a preliminary study level, that the minimum flow of 4.5 m³/sec should be secured in the downstream reach for satisfying the potential irrigation water demand in the future. This flow rate can be assured if the Agos Dam releases a minimum flow of 4.35 m³/sec. Annex I describes a detail of this assessment.

Based on the assessment above, the following concept is proposed in determining the river maintenance flow:

- (a) Agos Dam will release the minimum discharge of $4.35 \text{ m}^3/\text{sec}$ under any extreme conditions. This will suffice the long-term water demand in the downstream area ($4.5 \text{ m}^3/\text{sec}$).

Note: The balance between $4.5 \text{ m}^3/\text{sec}$ and $4.35 \text{ m}^3/\text{sec}$ is met by runoff yield from the residual basin downstream of the Agos Dam

- (b) Under the normal condition, daily average release from the Agos Dam will be $26.3 \text{ m}^3/\text{sec}$ during the dry season. This can maintain the minimum flow regime not different from the present condition.
- (c) Flow regime during the flood season will remain unchanged from the present.
- (d) In quantitative term, the allocated use of water resources is 70 % for the Agos River Basin and 30 % for water supply to Metro Manila, respectively.

The above will be explained to the LGUs and people in the Agos Lower Reach accordingly.

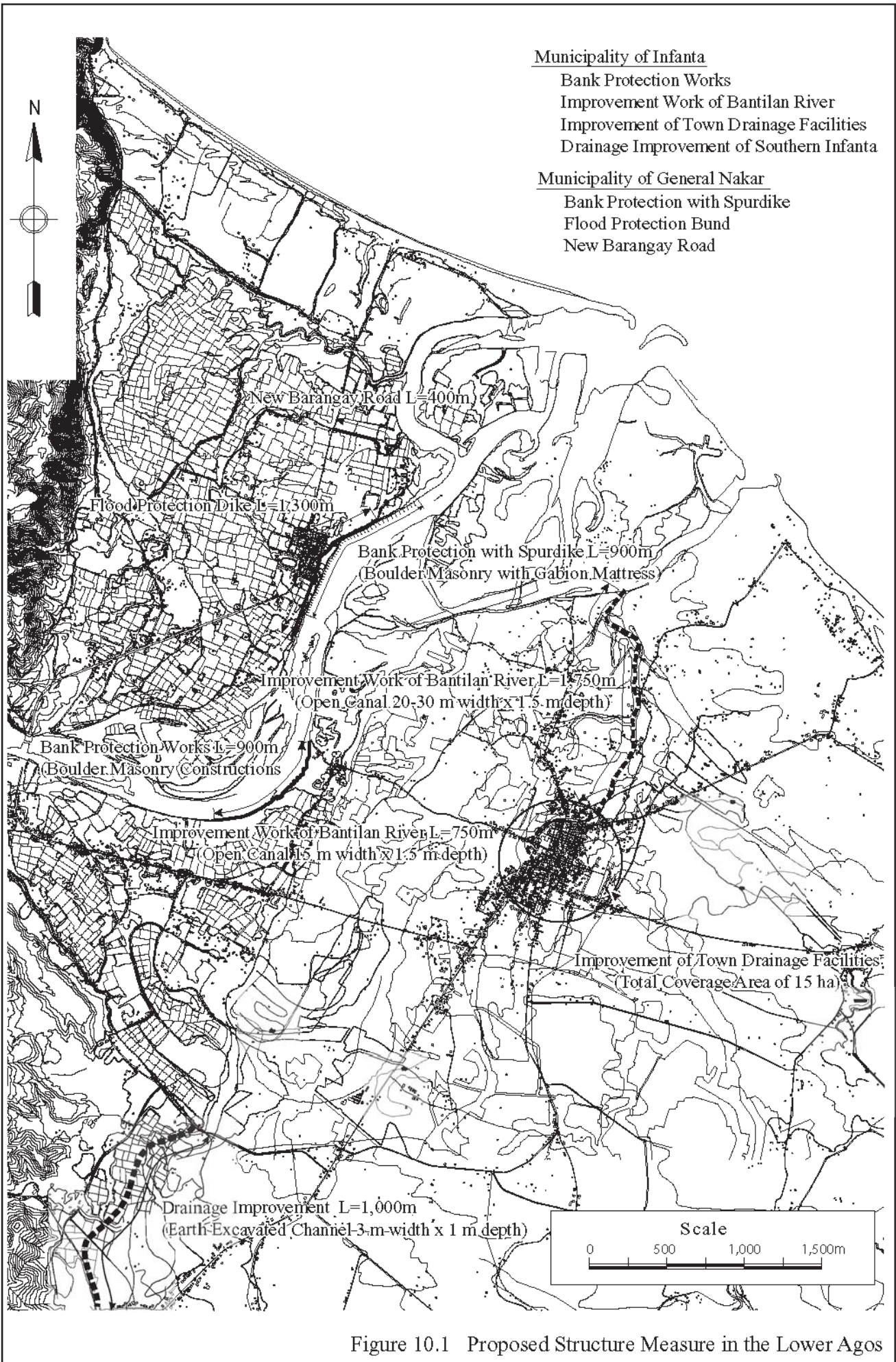


Figure 10.1 Proposed Structure Measure in the Lower Agos

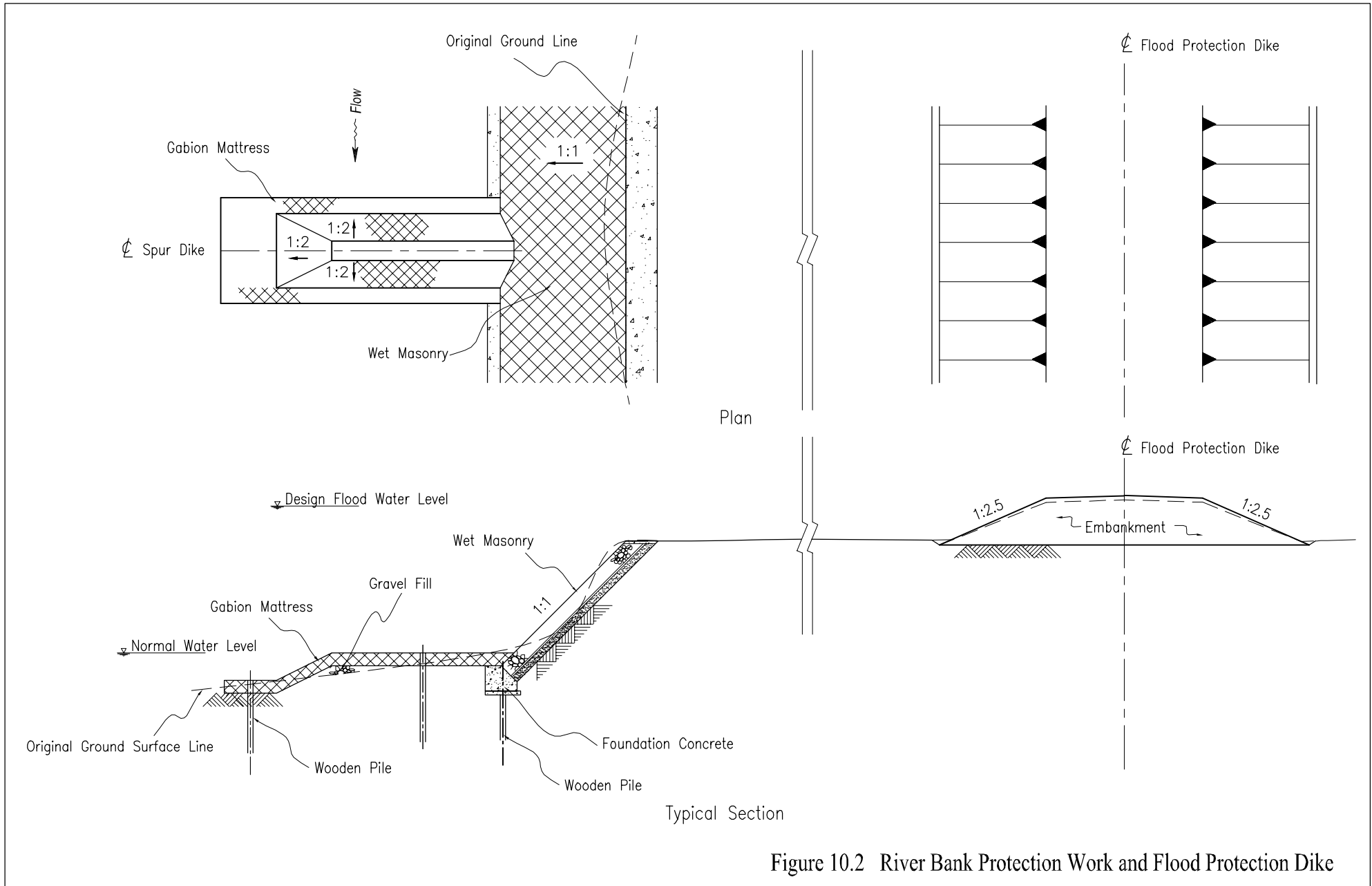
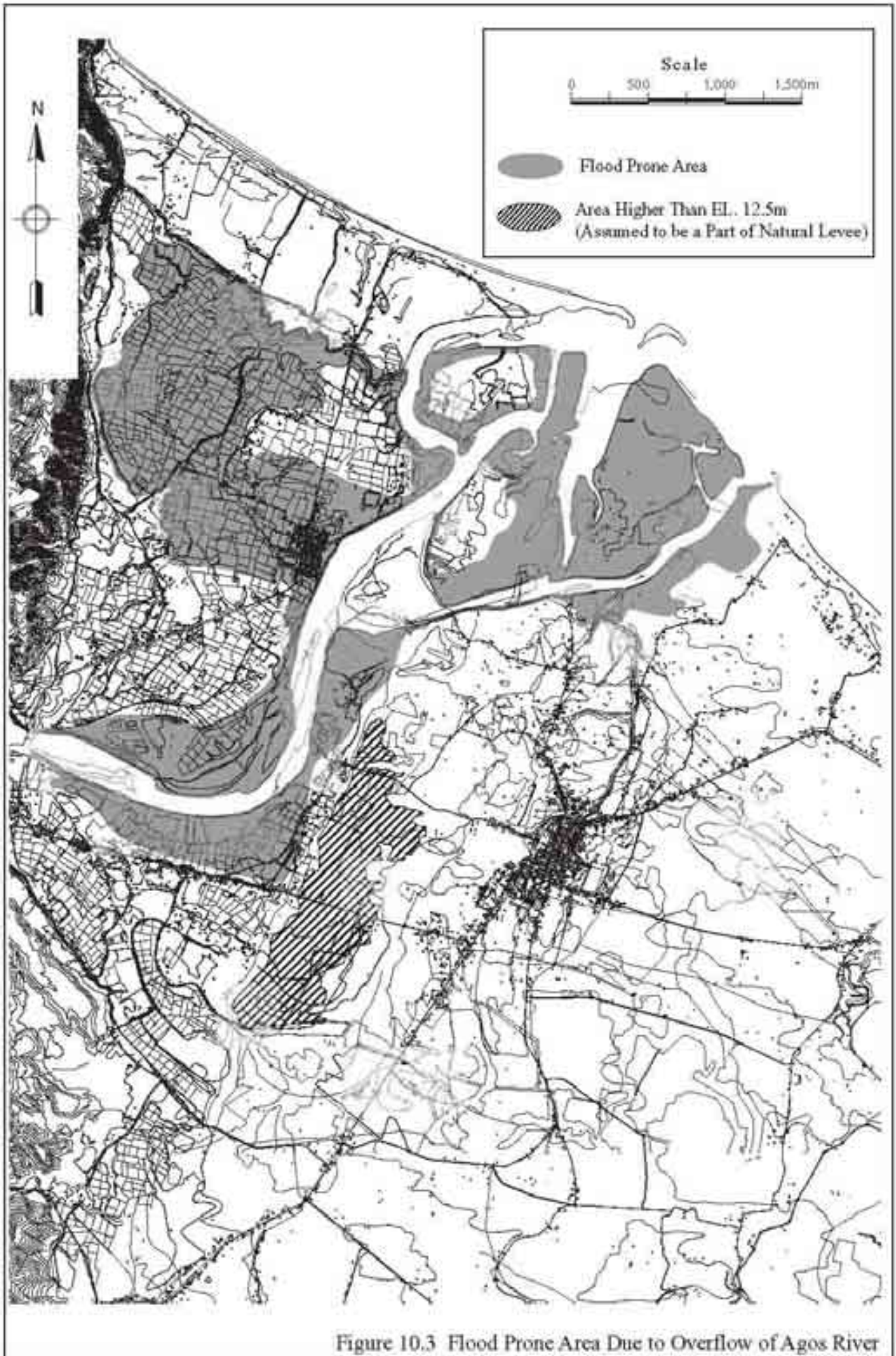


Figure 10.2 River Bank Protection Work and Flood Protection Dike



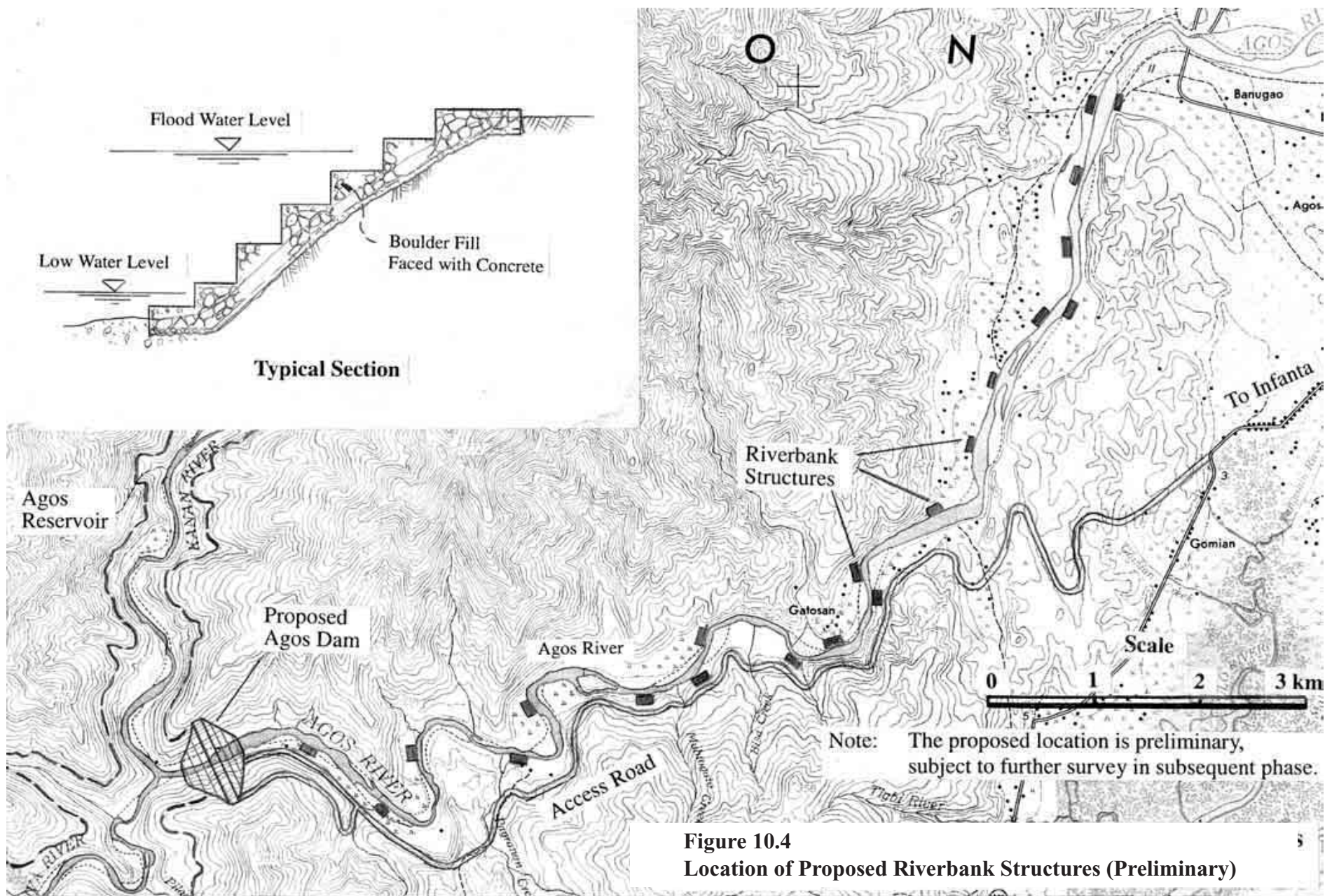







Figure 10.4
Location of Proposed Riverbank Structures (Preliminary)

LEGEND

	Access Road
	Access Path (Horse Path Grade)
	Footpath
	Boat Landing Place for Reservoir Crossing
	Bridge
Note: Layout and location of the proposed facilities are preliminary subject to further survey in subsequent phase.	

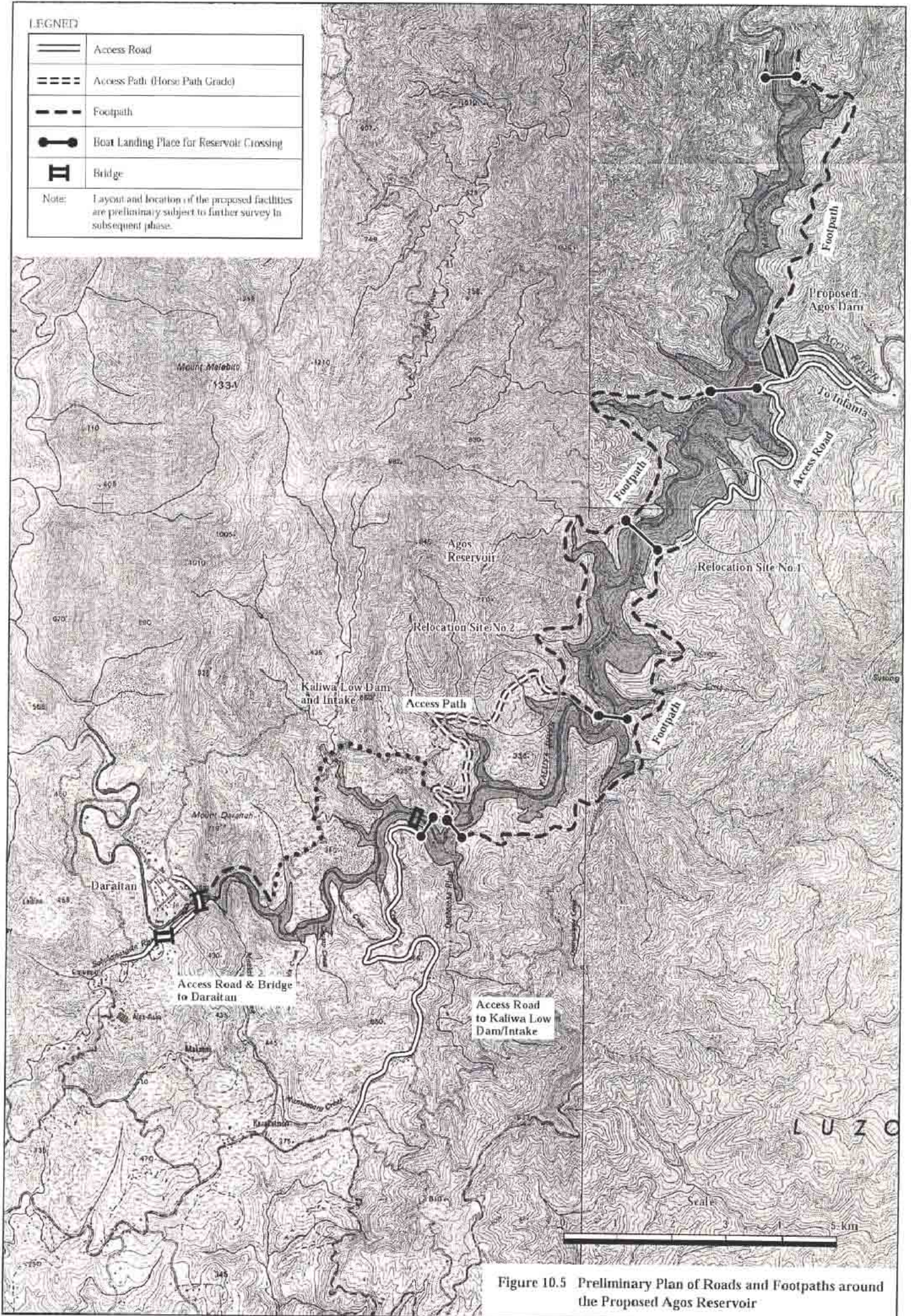


Figure 10.5 Preliminary Plan of Roads and Footpaths around the Proposed Agos Reservoir

