A motor grader is indispensable for daily maintenance and repair work of rough surface roads. Although DPWH has a grader which is comparatively new, with seven (7) years of operation, an additional one is required to periodically maintain the roads with a length of 14.4 km to be constructed and improved under the Project.

A dump truck is necessary for hauling materials (fill materials and gravel) for the repair of roads. As the existing dump trucks of DPWH are overages, with 15 years of operation, the procurement of a new dump truck is essential.

A pick-up truck will be used for hauling the submergible pump and small quantities of materials and for inspection purposes.

A submergible pump is necessary for removing water for repair work of crossing structures and filling work in the low-lying land. A pump driven by a small engine and durable for operation in water mixed with soils is desirable.

A small vibrating roller is quite suitable for backfilling and compaction near the structures and small-scale embankment and compaction work. Therefore, it is imperative for the maintenance of roads, but DPWH has no vibrating roller.

A generator was requested for the purpose of night work but is considered unnecessary because urgent repair work will not be required.

3-2-6. Examination of Necessity of Technical Cooperation

The request includes the construction of the infrastructures necessary for agricultural development and farm village improvement and the procurement of equipment for operation and maintenance. As for the operation and maintenance of the completed facilities, the agencies concerned in the Philippines have considerable experience and the capability of guiding the farmers. Furthermore, by preparing the

operation and maintenance manuals for each project component in the course of the detail design/construction supervision stage, more efficient and effective maintenance can be expected.

3-2-7. Basic Policy of Cooperation

The Project, as a result of the above examinations, has been confirmed in its appropriateness and necessity, as have the organic functions and effects of each project component and the capability of the Government of the Philippines for implementation. Inasmuch as the effects of this proposal are suitable for Japan's Grant Aid Program, the Project has been judged as appropriate to be implemented under Japanese grant aid. Consequently, hereinafter, the outline of the plan will be examined and the basic design will be provided. However, as for the project components, it was stated in sections 3-2-4, Examination of Project Components and 3-2-5, Examination of Facilities and Equipment Requested, that a part of the request should be modified.

3-3. PROJECT DESCRIPTION

3-3-1. Executing Agencies and Operational Structure

After the completion of the Project, the facilities, with the exception of the farm-to-market roads, will be operated and maintained directly by the beneficiaries.

As for the irrigation facilities, DA will actively support the agricultural development of the Project and will be concurrently responsible for revitalization of the Irrigators' Service Association in the Bulao area, including its the organization and management. NIA will be in charge of the construction on-farm facilities and provide services to the irrigators' associations, except for the Bulao ISA, in their organization, management and water management.

As for the farm-to-market roads, DPWH has agreed to maintain the completed roads as barangay roads. The maintenance cost of about 6,800 pesos/km for barangay roads has been appropriated as an average

budgetary estimate in 1989. The continuation of this arrangement in the budget will requested for the maintenance of completed roads.

For the village water supply, the Project Management Office for Rural Water Supply of DPWH will handle the construction of communal faucets, if necessary, and the formation and operation of the Barangay Water Works and Sanitation Association, as a part of the spring water development project.

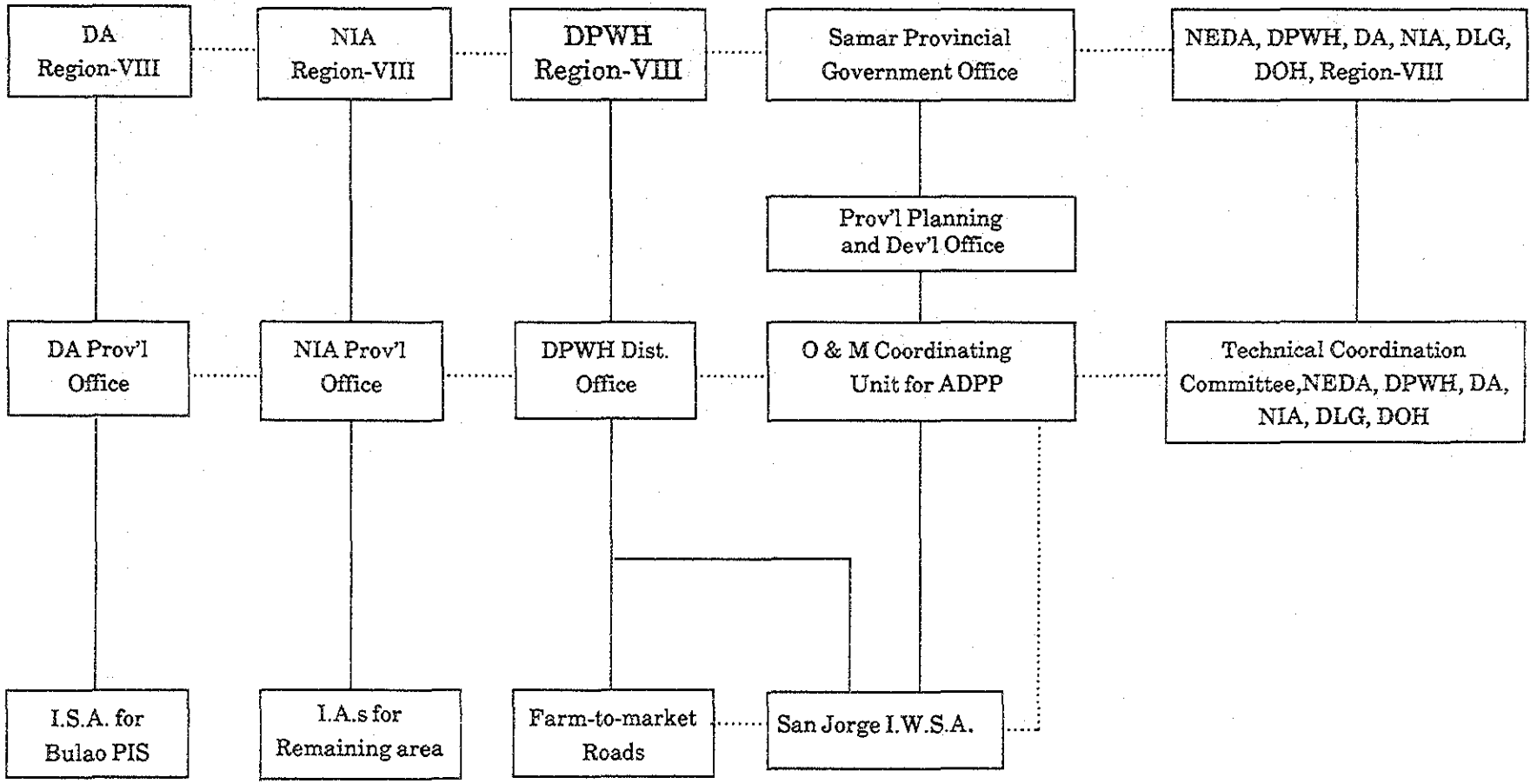
The coordination and monitoring of the work undertaken by the agencies concerned will be dealt with by the governor of Samar province under the recommendation of a technical committee chaired by NEDA. On the municipal level, the coordinating committee chaired by the mayor of the San Jorge municipality shall be organized to make powerful recommendations as a practical institution (Fig. 3-2).

3-3-2. Plan of Operation

The Project will provide for the improvement of infrastructures required for agricultural development in the area; that is, (i) to establish irrigated agriculture by the improvement and construction of irrigation systems, (ii) to improve the distribution of agricultural products and input materials the by arranging farm-to-market roads, (iii) to improve farming conditions, the living environment and the fields of education, research and experiment as agricultural support services through the provision of a village water supply, and (iv) to maintain and operate properly the completed irrigation and road facilities by the procurement of suitable O & M equipment. The outline of the Project components is presented below:

① Irrigation	Gravity irrigation	2 systems with 40 ha
	Pumping irrigation	2 systems with 250 ha
	Total	4 systems with 290 ha
② Farm-to-market roads	Roads to be constructed	2 roads of 6.6 km
	Roads to be improved	2 roads of 7.8 km
	Total	4 roads of 14.4 km
③ Village water supply	Transmission pipeline	13.9 km
④ Equipment for O & M	for irrigation facilities	1 set
	for farm-to-market roads	1 set

FIGURE 3 - 2 ORGANIZATION CHART FOR OPERATIONATION AND MAINTENANCE FOR AGRICULTURAL DEVELOPMENT PROMOTION PROJECT IN WESTERN SAMAR



3-3-3. Location and Condition of Project Site

(1) Irrigation

The Quezon area is situated in the south of the Project area and extends over paddy fields in a low-lying valley bottom in the hilly land within the area of barangay Quezon and the San Jorge municipality, lying to the east of the Maharlika highway. The topographical slope is 1/100 to 1/300. The elevation of the land is two (2) to five (5) meters. The area, which is cultivated paddy fields, is clayey loam and was developed, as a communal irrigation system by NIA in 1977 - 78. However, at present the facilities are not operational due to subsequent flood damages.

The Aurora area is located on the western side of the Maharlika highway and within the area of barangay Aurora and the San Jorge municipality. The topographic conditions are the same as in the Quezon area; that is, a topographic slope of 1/100 to 1/300 and land elevation of two (2) to six (6) meters. The area covers cultivated paddy fields, in which soils are clayey loam, and has been developed as a communal irrigation system by NIA in 1977 - 78, but which is not operational due to subsequent flood damages.

The Bulao area is located in the north and middle part of the Project area and is lying in the alluvial plain extending along the provincial road on the left side of the Gandara River. The topography is about 1/200 ~ 1/400 in slope and has low-lying land in the middle. The soil is sandy loam along the provincial road but prevailingly clayey loam. The pumping irrigation system was constructed within the area in 1978 by FSDC but is not operational due to the pumping facilities and irrigation canals being damaged by flooding in the same year.

The Bulao South area extends through the low-lying land along Baga Oring Creek which joins with the Gandara River near the Maharlika highway to the west and within area of barangays Sapinit, Anquiana and Rosalim. The land is used as paddy fields but is not cultivated over a large area. No irrigation facilities are provided.

(2) Farm-to-market Roads

The Bulao-La Paz road connects barangay La Paz with the provincial road on the other side of the Gandara River. The river has a width of about 60 m between its banks and side slopes with a vertical: horizontal ratio of 1 : 1.0 ~ 1: 1.5, and is covered with vegetation along its shoulders, which are comparatively steep judging from the clayey soils. The traffic between both banks depends on banca using the scanty landing facilities located about 200 m upstream from the proposed bridge point. The distribution of major agricultural products and daily commodities is done by boats between barangay La Paz and Gandara town, at present.

The Quezon - Cantaguic road is the new road connecting eight (8) scattered barangays and extends to the east for a distance of 6.1 km from barangay Quezon along the Maharlika highway to barangay Cantaguic. The designed location of the new road has been aligned along the existing path in the hilly land as much as possible but across the low-lying land (paddy fields or wasteland) in three (3) places.

The Blanca Aurora - Buenavista road is the existing road to be improved on the extension of the provincial San Jorge - Buenavista road, and connects to barangays Buenavista and Blanca Aurora extending along the Gandara River in the north-east of the area. The road runs along the foot of a hill and across some farm-land for about 300 m before reaching barangay Blanca Aurora. On the road, two (2) bridges and one culvert which are completely or nearly impassable due to flood damages exist. Moreover, the road located along the foot of the hill is muddy in many places when it rains and is so deteriorated that it is hard to pass by foot, horse or car

The San Agustin - Pologon road is the existing road which branches off Maharlika highway at a point about two (2) kilometers farther north from San Jorge town in the northwest of the area, and traverses barangays San Agustin, Hinogacan and Pologon in the Gandara municipality. The road is not paved and is so deteriorated as to be impassable by foot, horse or car.

(3) Village Water Supply

The installation of the main pipe for the village water supply will extend from Binubucalan Spring, as the water source, in the north-east of the area to the San Jorge reservoir in the west. The line between the intake point and barangay Blanca Aurora will pass over hilly land with many ups and downs. The transmission pipe will be installed under the shoulder of the existing roads between barangay Blanca Aurora and the San Jorge reservoir. The locations of the pipeline have been selected with the main consideration on facilitating land acquisition and construction.

3-3-4. Outline of Facilities and Equipment

(1) Irrigation Facilities

The basic concept in the design of the irrigation system is to adopt a gravity flow system in order to keep the operation and maintenance costs and initial investment costs down. However, in cases where the benefited farmland (paddy fields) is higher in elevation than than the water level at the intake point, pumping facilities will be designed. After pumping the irrigation water, it will be distributed to the farm plots by the gravity system. The outline of the facilities will be described hereinafter.

1) Quezon Irrigation System

a) Major Works

The service area has been estimated to be 22 ha based on the topographic map with a scale of 1/5,000 and verification of the area during the field survey stage. The diversion facility consists of the diversion dam, which is a concrete retaining wall with a crest length of 23 m and a height of 2.0 m, to dam up the runoff water and the intake.

The main canal will be lined with concrete and located in elevated places along the foot of the hills to facilitate the water distribution. The slope of the canal shall be as steep as possible to prevent the canal from being choked by thick water weeds and siltation. The related structures, such as turnouts, drainage culverts etc., will be planned taking into

account the safety of the canal and water management. The terminal irrigation block will be some five (5) ha in average area due to topographical restrictions. Therefore, the canal will be provided to irrigate a land area of some five (5) ha in maximum. The service road will be designed along the main canal with a total width of 2.5 m and a gravel pavement. The total length of the canal will be 1,090 m.

b) **Project Effects**

The present state of rice cropping is unsteady due to uneven rainfall distribution in the rainy season and idle irrigation facilities. The cropping intensity is currently about 120 percent. After providing the irrigation system under this project, cropping intensity of 130 percent for paddy cultivation will be secured every year. The annual cropped area will be increased by three (3) ha from 26 ha at present to 29 ha in the future through the Project. The yield of paddy will also increase from 1.6 to 3.5 tons/ha, which is the same as the national average yield in irrigated paddy fields, by providing the irrigation facilities and spreading advanced techniques for farming in the remote barangays through extension services utilizing the proposed farm-to-market roads. Paddy production is expected to be increased from 42 tons at present to 102 tons in the future through the Project, which is equivalent to about two (2) times the present level. The increase in production will be 60 tons. Seeing that various agricultural development plans in the Master Plan Study report are proposed to be carried out by DA, further yield increases in paddy and other crops will be expected.

2) **Aurora Irrigation System**

a) **Major Works**

The service area will be some 18 ha, confirmed by topographic map with a scale of 1/5,000 and by field verification. Upstream of the waterfall, with a drop height of about five (5) meters, the diversion dam with a crest length of 8.4 m will be provided to divert the water. The foundation of the

dam will be solid shale. The design concept of the canal alignment, related structures and the area of the unit irrigation block are the same as the ones stated for the Quezon irrigation system.

b) Project Effects

The cropped area will increase from 22 to 24 ha for the same reasons stated in the case of the Quezon area. The paddy yields per ha are also the same as in the Quezon area, as are both the total yield and cropping intensity at present and in the future under the Project. The total production of paddy will be increased from 35 tons at present to 84 tons through the Project, which, in other words, corresponds to more than (2) times the present level. The increase in production is 49 tons of paddy.

3) Bulao Irrigation System

a) Major Works

The Project area is confirmed to be some 130 ha, the same as the area of the request. The pumping station includes suction pit, pumping equipment, delivery pipes and tank. The pump shall be installed at a level higher than flood marks so as not to submerge the engine and designed to respond to great water level variation. The total head for the pump design is estimated to be about 15 m. To fulfill the above conditions, the type of pump will be a vertical shaft mixed flow pump or submergible motor pump. There shall be two (2) pump units with the same specifications from an economical point of view to apply to the water discharge which varies seasonally. The bore of a pump will be 200 to 300 mm. Depending on the type of pump, a storage tank to keep fuel or a transformer is necessary.

Pumped water is costly in terms of operational costs as compared to the costs of a run-of-the river system. In addition, the canals shall be lined with concrete, because they are built on sandy soil, to minimize seepage losses from the canal and control the habitat of snails, an intermediate

host of schistosomiasis. The canal length will be 2,670 m for the main canal and 2,050 m for the laterals. The related structures will include bifurcations, turnouts, drainage culverts, foot planks, etc.

b) **Project Effects**

Since an adequate quantity of water is available for irrigation throughout the year, the cropping intensity of 120 percent at present will be improved to 200 percent. The annual cropped area of 156 ha will be increased by 260 ha in the future through the Project. The yields per ha are to be the same as in the case of the Quezon area both at present and in the future under the Project. The increase in total production of paddy will be 660 tons, as production is estimated to be 250 tons at present and 910 tons in the future through the Project.

4) **Bulao South Irrigation**

a) **Major Works**

The pump, which will be provided for an average area of some 15 ha, will be single suction in type, with a single stage volute casing, 125 to 150 mm in bore and 5 to 7.5 ps in engine output. The engine and pump shall be fixed on a common base for convenience in carrying. The suction pit will be provided near Baga Oring Creek in a concrete structure to facilitate the installation and sectional condition of the pump. The delivery tank is planned to be built near the pump station and on a comparatively elevated place. Eight (8) pumping stations will be provided due to topographic conditions.

The canal shall be lined with concrete to prevent seepage losses from the canal and economize the costs of operation. The related structures and service road will be designed using the same idea as in the case of the Quezon irrigation system. The unit rotation block area will be five (5) ha.

b) Project Effects

The yields per ha and the cropping intensities at present and in the future with implementation of the Project are the same as in the case of the Quezon area and the Bulao area. The annual cropped area of 144 ha at present will be increased by 240 ha under the Project. The total production, therefore, will also be increased from 230 tons at present to 840 tons in the future through the Project. An increase in production of 610 tons can be expected.

(2) Farm-to-market Roads and Bridges

a) Major Works

The roads to be constructed or improved are planned to connect the main roads with scattered village roads in the area and also function as farm roads and barangay roads for the distribution and transportation of agricultural products and input materials, and the movement of daily commodities and inhabitants to activate production in the area. The major works, of which the total length of roads is 14.4 km, are presented below:

Name of Roads	Length	Major Structures
New Roads		
Bulao - La Paz	0.5 km	Bridge L ≒ 70 m (new construction)
Quezon - Janipon	6.1 km	
Sub-total	6.6 km	
Roads to be Improved		
Blanca Aurora - Buenavista	4.1 km	Bridge L ≒ 23 m (improvement) Bridge L ≒ 40 m (new construction)
San Agustin - Pologon	3.7 km	
Sub-total	7.8 km	
Total	14.4 km	

b) Project Effects

The uses of the roads and their structures and effects in the future are anticipated and represented as follows:

- Products and commodities are presently carried in loads of ten (10) to 15 kg by man-power, taking much time along the

existing roads which are impassable by car and along footpaths in the hilly area. After the improvement of those roads and the construction of new roads, it is expected that distribution will be improved in quantity and quality and the traffic of people will become more active through the introduction of effective transport like trucks, and finally the Project will contribute to generating increased production and enhance the standard of living in the area.

- To activate production and livelihoods on the right bank area in the middle reaches of the Gandara River after provision of the La Paz bridge:

  On the right bank area in the middle reaches of the Gandara River, traffic depends on boats carring a small quantity of goods, and production and livelihoods are not as advanced as those on the left bank area. Therefore, the provision of the La Paz bridge will bring about revitalization of livelihoods, active production, improvement of distribution in quantity and quality and enhancement of the standard of living in the subject area.

- To improve land use along the proposed roads:
  The cultivated land, especially along the proposed Quezon - Cantaguic road, will be increased because of easy access to the fields by carabao and access to markets by car. It is expected that the land will be developed into paddy fields on both sides of the road in the low-lying land and into upland crop field on both sides of the road in the hilly land.

(3) Village Water Supply Facilities

a) Major Works

Raw water will be diverted from Binubucalan Spring and conveyed to the receiving well in the area of barangay Tomogbong through the intake pipeline with a diameter of 250

mm and length of 1.1 km. In the receiving well, the raw water will be quantified and chlorinated, if necessary.

The service water will again be conveyed from the receiving well to the San Jorge reservoir through the transmission pipeline with a diameter of 200 mm and length of about 12.8 km. The water will be served to eight (8) barangays along the pipeline through distribution pipelines branched off the transmission pipeline, and to barangay La Paz though the distribution pipeline across the Gandara River. The San Jorge reservoir with a capacity of 260 m^3 will be installed in an elevated place to cope with the hourly variation of water demand and serve as the intermediate distribution reservoir in the future when serving to the Gandara area. For each barangay, the village communal water supply faucet for the purpose of supplying farming water will be provided.

b) Project Effects

The village water supply will bring forth the following effects.

- Promote diversified farm management and agricultural support services.

  The farming water supply is expected to improve farm management by promoting diversified farming through the breeding of domestic animals and poultry and contribute to active agricultural support services, especially in experiments, research, education and training, and extension services on horticulture and fruit tree cultivation through providing farming water to the Gandara Seed Farm and SNAS.

- Reduce the death rate of domestic animals and poultry from water-borne diseases.

- Improve the living environment and enhance the welfare of inhabitants.

The morbidity of water-borne diseases such as diarrhea, gastroenteritis, etc., is expected to be reduced. Since the work of drawing water in the rural areas is generally undertaken by women and children, they will be freed from this work after the completion of this project component.

- Reduce the expenses for drinking water.
  In the dry season, drinking water is sometimes scarcely available and sells for 50 centavos per gallon. Assuming that the water demand is two (2) liters per person as the minimum requirement, and buying for a family of six (6) persons, the expenses are estimated to be 47 pesos per family a month. On the other hand, the water charge under this project is estimated to be about 15 pesos per family a month, as mentioned hereinafter.

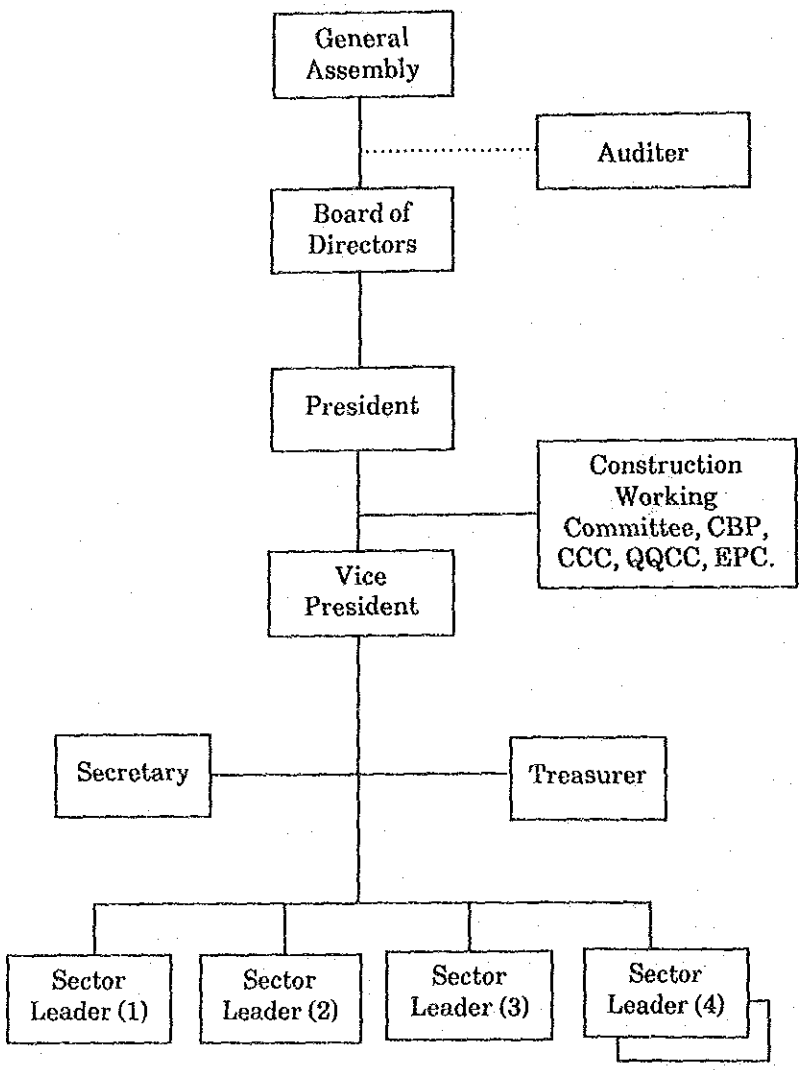
3-3-5. Operation and Maintenance Plan

(1) Irrigation Facilities

The operation and maintenance of completed irrigation facilities will be undertaken for each system by the farmers themselves by organizing an "Irrigators' Service Association" or "Irrigators' Association" under the technical assistance and guidance of DA and NIA, respectively. In either case, the association will have a general assembly participated in by all farmers and the board of directors will provide the operational plan. The president is responsible for the actual operation of the association. Under him, the vice-president, secretary, treasurer and section leaders are elected for each irrigation block unit (Fig. 3-3). The section leaders will deal with the water management, maintenance of facilities and collection of irrigation fees in their control area.

NIA and DA have to assist and guide the association in its organization, operation, water management, operation and maintenance of the facilities, and farming. The restoration work of the facilities damaged due to disasters will be undertaken by the farmers by supplying them with equipment and materials from the disaster fund of NIA and DA. In the case of communal irrigation systems constructed by NIA, the water

FIGURE. 3-3 ORGANIZATION CHART FOR IRRIGATOR'S ASSOCATION



charge per annum, as an installment of the construction cost, is collected at a rate of 1.5 cavans (75 kg) in palay per hectare.

Those institutions arranged by the farmers' management of their irrigation systems are common not only in the communal irrigation systems but also in national irrigation systems and are devised to cope with the administrative policy of the Philippine Government and are preferable because of the participation of farmers in the operation and management of their own facilities.

The annual operation and maintenance costs are estimated as follows:

(Unit: Pesos)

Item	Name of Irrigation System				
	Quezon	Aurora	Bulao	Bulao South	Total
Service Area (ha)	22	18	130	120	290
Personnel Expenses	12,000	12,000	18,000	18,000	60,000
Maintenance Costs	2,049	1,244	14,160	9,8889	27,342
Pump Operation Costs	-	-	177,000	117,540	24,540
Total	14,049	13,244	209,160	145,429	381,882
Per ha (cavans/annum)	1.6	1.8	4.0	3.0	3.3

Note: Estimated based on farm gate price of rice is Pesos 4.0/kg, 11 cavans = 50 kg

(2) Farm-to-market Roads and Bridges

The maintenance of completed roads will be the responsibility in principal of DPWH except for the service road for the operation and maintenance of canals in the irrigation systems. DPWH, as mentioned previously, has a budget arrangement for the maintenance of roads and the district office will be directly responsible for the actual activities, while, as for provincial, city and municipal roads, the respective agencies or office will be in charge of those under their jurisdiction. The roads to be constructed under Japan's Grant Aid Program will be classified into barangay roads in the budgetary item which has been agreed upon in the course of the field survey (Annex 4-2) and will be maintained under the responsibility of DPWH so that there will be no problems in the future.

The annual maintenance costs, expecting that the district office of DPWH in Catbalogan need not change its organization and staff numbers, are estimated as follows:

Repair cost of road surface by motor grader (1 time/annum)

14,400 (m) ÷ 1,300 (m/day) × 2,165 (peso/day) = 23,981 pesos

Restoration cost for gravel pavement(4% of placed quantity/annum)

10,000 (m^3) × 4(%) × 188 (peso/m^3) = 75,200 pesos

Total = 99,514 pesos

(about 6,816 pesos/km/annum)

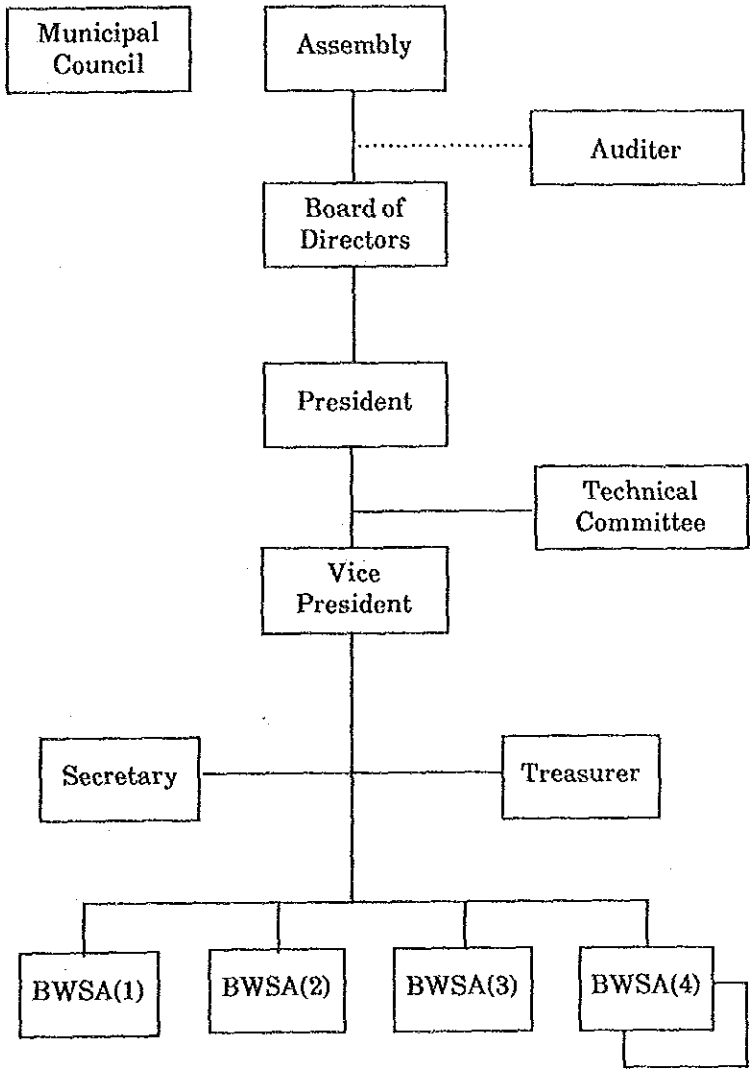
(3) Village Water Supply Facilities

In the Philippines, there in no definite term with regard to village water supply and it is not clear what agency is in charge of the operation and maintenance. In any case, DPWH has agreed to undertake any work on the implementation of the village water supply component and it facilities. Therefore, it is practical that there be institutional arrangements to establish the Barangay Water Works and Sanitation Association and to operate and maintain the facilities by the beneficiaries themselves in accordance with the Accelerated Water Supply Program (RA 6716).

The Barangay Water Works and Sanitation Association will be organized by the beneficiaries at the barangay level to properly operate and maintain the completed facilities. However, the facilities to be constructed under the Project have one water source and involve a lot of barangays so that the integration of this association at the barangay level will be imperative.

The integrated association, called the San Jorge Integrated Barangay Water Works and Sanitation Association, shall be organized (Fig. 3-4). The general assembly in participation with representatives of each barangay will be the primary organ for the operation and management of the association. The board of directors will provide direction and coordination with regard to the operation of the association. The president will be fully responsible for executing the decisions of the board with the assistance of the vice president, secretary and treasurer under him. In each barangay, there will be a water master who will report on the status of system management and

FIGURE. 3-4 SAN JORGE INTEGRATED BARANGAY WATER WORK AND SANITATION ASSOCIATION



collect the water charges. The expenses for the operation, maintenance and repair of facilities will be covered by the water charges collected.

DPWH will be responsible for providing assistance and guidance in the organizational set-up of the integrated association and training of related staff on technical and institutional aspects.

The annual expenses for operation and maintenance of the facilities are estimated at 18 pesos /month/household as follows:

- Costs for repair and/or replacement of damaged portion in pesos (as 2% of construction costs per annum)

per annum	16,200,000 x 0.02	=	324,000 pesos
per month	324,000 ÷ 12	=	27,000 pesos
per household	27,000 ÷ 1,920	=	14 pesos

- Material cost for chlorination

per month	(833 x 8 mgr/lit/0.7) x 22 x 30	=	6,283pesos
per household	6,283 ÷ 1,920	=	3 pesos

- Personnel expenses in pesos

per month	(Lump sum)	=	1,900 pesos
per household	1,900 ÷ 1,920	=	1 peso

- Monthly O & M cost per household

	14 + 3 + 1	=	18 pesos

(4) Equipment for Operation and Maintenance

The equipment for O & M will be procured for DPWH and NIA which are in charge of maintenance work directly, taking into account the necessity of maintenance facilities and mechanical engineers. Both agencies have a motor pool in the vicinity of the Project area and have sufficient experience and capability of maintaining the equipment. Towards this end, the Project will provide DPWH with equipment for the maintenance of farm-to-market roads and NIA with equipment for the O & M of irrigation facilities. In addition, DA will receive a vehicle for the Project area.

1) Equipment for O&M of Irrigation System

The earth works will be the major work for the maintenance of the canal. Squalls, which are typical in tropical areas, bring high intensity rain in a short time and cause erosion particularly of embankments. The canal itself will not collapse because of its concrete lining. However, damaged embankments, which may result in their collapse into concrete lined canals , must be restored at the earliest stage.

Service roads for O&M will be provided along the canal not only to conduct the maintenance of canals and water management but also to function as farming roads. Furthermore, seeing that farmers and their children will not need to pass though areas affected with schistosomiasis, the service road will indirectly contribute to maintaining the health of farmers. Those service roads, being multipurpose, will be able to be used effectively by normal inspections and prompt action to repair damaged portions.

The following equipment will be procured to properly maintain the completed facilities.

Purpose of use	Name of Equipment	Specifications
- Supply, piling & loading of materials for repair(common soil, gravel, aggregates, etc.)	Tractor Shovel	0.4m^3
- Supply of materials for repair (crushed stone) and rock excavation	Handbreaker	40kg/m^2 class air pressure
- For hand breaker	Air Compressor	W/engine (portable) 1.4~2.0m^3/min
- Hauling of materials for repair	Dump Truck	6-ton
- Spreading and compaction	Bulldozer	6-ton
- Leveling of embankments and rough surfaces and spreading	Motor Grader	Blade Length of 3.1m
- Hauling of machines (mixer, etc.)and materials	Pick-up	1-ton load.
- For inspections and surveys	Station Wagon	4WD 5~6 persons
- Estimate/survey of repair work	Survey Equipment	Lump Sum

2) Equipment for Maintenance of Farm-to-market Roads

The maintenance work for farm-to-market roads involves mainly periodical leveling of the surface, mending of gravel pavement and restoration of portions damaged by flooding. To maintain the roads properly and durably, maintenance work is imperative.

Additional equipment to maintain the roads after the completion of the Project will be required as follows:

Purpose of Use	Name of Equipment	Specifications
- Leveling of road surface	Motor Grader	Blade length of 3.1m, 110HP
- Hauling of materials for repair	Dump Truck	6-ton load
- Pushing and compaction of materials and rolled compaction of pavement	Bulldozer	15-ton, 150 HP
- Common compaction and rolled compaction of pavement	Vibrating Roller	1-ton,7HP hand guide type
- Excavation and loading	Backhoe	0.6 m^3, 110HP
- Hauling of small machines	Pick-up	1-ton load
- Water removal	Submergible Pump	ϕ 100mm, 5.5HP

CHAPTER 4. BASIC DESIGN

CHAPTER 4. BASIC DESIGN

4-1. POLICY OF BASIC DESIGN

Components of the Project are;

- construction and rehabilitation of irrigation facilities such as intake facilities, pumping stations and farm ditches,
- construction and rehabilitation of farm-to-market road to connect villages scattered in the Project area with the main road,
- construction of village water supply system for inhabitants living along the Gandara River in the Project area, and
- procurement of operation and maintenance equipment for the irrigation and farm-to-market road facilities of the Project.

The basic design concepts of the above component work are followings.

- to refer and review the design criteria and the typical drawings of structures in NIA and DPWH which those are responsible authorities for operation and maintenance of the facilities aiming at reliable, durable and easy maintenance.
- to determine the type and size of structures taking into account use of local product materials as much as possible.
- to plan a gravity irrigation system with a cropping intensity of 120 to 150 percent depending on an amount of a water source and to design a pump intake facility when any suitable water source is not found.
- to plan the farm-to-market road which has functions of a farm road and public road in the Project area, and to determine the size and structures of the road for traffic of carabao cart for farming, truck for transportation of agriculture products and jeepny for popular transportation in the Philippines.
- to plan the village water supply, putting on a link of multiple purpose farm village improvement, which consists of

mainly farming water for nursing of crops, floriculture and horticulture, breading of domestic animals and poultry and washing of agricultural products and farm machinery and domestic water for realizing the healthy and fresh living of farmers. The plan will be made, foreseeing the medium and long protection in the integrated development based on the strategy in the Master Plan Study.

4-2. STUDY AND REVIEW OF DESIGN CRITERIA

4-2-1. Topographical Conditions

- Topographic map — S = 1 : 50,000 (1982, BCGS) for estimation of catchment area.
- ditto — S = 1 : 5,000 (1977, JICA) for alignment of irrigation and drainage canals, farm-to-market roads and a village water supply system, and for measurement of service area and length of the proposed facilities excluding surveyed sections.
- ditto — S = 1 : 100 (1990, JICA) for the basic design of major structures.
- Longitudinal section of farm-to-market road — SH = 1 : 2,000, SV = 1 : 200 (1990, JICA) for the basic design of farm-to-market roads.
- Longitudinal section of village water supply system — SH = 1 : 2,000, SV = 1 : 200 (1990, JICA) for the basic design of a village water supply system.

4-2-2. Geological and Soil Conditions

Geological exploration at the proposed sites of the La Paz bridge (1990, JICA) will be used for design of the foundation.

4-2-3. Conditions on Design of Facilities

(1) Irrigation Facilities

- Irrigation Water Distribution System

  The rotational irrigation system will be introduced to avoid a trouble under water distribution by farmer's themselves.

- Structure of Irrigation Canal
  The proposed route of irrigation canals will be mainly aligned on silty and sandy soils. The leakage water from the canal will result in a big investment in the construction, which will require a bulk of O & M costs. And also the leakage water will give favorable habitat for snails as an intermediate host of sistsomiasis. Thereby in order to reduce leakage water from the canal, the concrete linning canal will be proposed.

- Size of Irrigation Canal
  The optimum size of an irrigation canal will be proposed considering better farming and easy water management. The minimum size of the proposed irrigation canal will be 35 cm in the depth and 30 cm in the bottom width. The canal will be trapezoid section with a side slope of 1 : 1.

- Allowable Velocity in Canal
  The minimum velocity of 30 cm/sec will be adopted to avoid siltation, grassing and favorable habitat for snails. The maximum allowable velocity of 1.5 m/sec will be adopted for concrete linning canal. By using the Manning formula with roughness coefficient of 0.017 the discharge capacity of a canal will be calculated. The freeboard will be five (5) cm in the depth.

- Operation and Maintenance Road
  To make water management and operation and maintenance of the irrigation systems easy, an O & M road as an all-weather type paved by gravel will be provided along the irrigation canal.

- Appurtenant Structures
  Considering the safety of canal system, various appurtenant structures will be proposed, of which major structures will be canal crossing, road crossing, diversion works, etc.

- Drainage Canal
  Since some amount of excess and operation loss of irrigation water will be concentrated and stagnated in the lowlying portion of irrigation area, the drainage canal will be proposed to drain those water.

(2) Farm-to-Market Road

1) Road Width

The width of one lane road is 12 feet in the lane width and 15 feet in the in total road way according to the DPWH standard. Considering a light weight truck (2 ton) and a carabao cart to be barely passed each other at low speed, the proposed road width will be determined.

2) Design Speed and Allowable Vertical Gradient

The design speed and allowable vertical gradient will be determined at 30 km/hr and 12 percent, respectively. For the Quezon Cantaguic line in hilly land the speed of 20 km/hr and the gradient of 14 percent will be adopted. However, the maximum length of the section with the gradient more than 12 percent shall be 300 m in the distance.

3) Designed Flood Water Level

The Gandara River is on phenomena of unsteady flow overtopping the bank in the flood time. Due to lack of meteoro-hydrological data on the Gandara River basin, the design flood water level will be determined by flood condition reported from inhabitants and flood mark. The clearance between the bridge and the design water level will be taken at 1.5 m in accordance with the DPWH standard.

4) Farm-to-Market Road at Lower Elevation Area

Some part of proposed farm-to-market roads will pass the lower elevation land where is sometimes inundated by flood due to typhoon. The flood mark is about 1.5 to 2.0 m above the ground surface of paddy fields and others vegetated land. The road in the lowly in land will be planned to construct lower elevated road, called as overflow type road, in order to drain the flood water to downstream without inundation in the upstream of road.

(3) Village Water Supply

1) Target Year of the Plan

The target year of this plan to estimate the service population will be determined at the year of 2007, and the numbers of domestic animals and poultry will be estimated based on the development idea in the Master Plan report.

2) Water Supply Plan

The service area of the domestic water supply system covers villages in San Jorge and Gandara municipalities along the Gandara River. The farming water is supplied for breeding of domestic animals, washing and cleaning of farm products and farming tools and machines, and for the Gandara Seed Farm in nursering and pest control and for SNAS in the irrigation water for training/practices and washing water in the central market.

4-3. BASIC PLAN

4-3-1. Plan of Irrigation Facilities

The proposed irrigation land area will be is calculated based on the topographic map with a scale of 1 : 5000, as follows:

Project Area	Proposed Area (ha)	Diversion Method
Quezon	22	Gravity
Aurora	18	- do -
Bulao	130	Pump-up
Bulao South	120	- do -
Total	290	

The proposed irrigation system consists of main, lateral canals and on-farm irrigation facilities. The area of a rotation block will be ranging from 15 to 20 ha in the Bulao area and about five (5) ha in the other areas due to the topographic condition of narrow valley in the proposed irrigation area. The minimum service area of lateral canal is the same as above land area. The irrigation area less than the above

land area will be irrigated through the on-farm facilities to be constructed by the Philippine Government.

(1) Irrigation Planning

The water of the Gandara River and its tributary for the Bulao and the Bulao south areas have not any problem in quality and quantities. In those areas, the double cropping of paddy will be available. In other two areas with gravity irrigation system, the creeks are not dryed-up during the dry season. As the discharge is not enough to irrigate all area during the dry season because of non storage reservoir, so that the cropping area will be reduced up to about 30 percent of the service area, accordingly.

(2) Water Requirement

According to the Master Plan report, the water requirement has been computed, as follows :

- Cropping period
  First paddy cropping : from October to middle of March
  Second paddy cropping : from middle of May to end of September
- Effective rainfall
  The rates of effective rainfall to the total amount of rainfall are 68% during the first cropping period and 70% during the period of the second cropping period, respectively.
- Irrigation efficiency
  Irrigation efficiency of 51% is adopted. (Conveyance loss of 15%, conveyance loss of 20% at on-farm facilities and operation loss of 25% at field)
- Evapo-transpiration
  The estimated evapo-transpiration rates are as follows :

Month	1	2	3	4	5	6	7	8	9	10	11
Rate (mm/day)	2.9	4.5	5.6	6.1	5.9	4.9	4.7	4.8	4.6	4.0	3.6

- Land Preparation
  The water requirement for land preparation is estimated by filling soil layers with water. The application of land preparation water would be served at three stages considering the drying

conditions of soils and cultivated depth of soil by farming.

Item	First crop	Second crop	Remarks
First application	80 mm	110 mm	30 days before TP
Second application	80	110	15 days before TP
Third application	50	50	before TP
Total	210 mm	270 mm	

- Water requirement The water requirement is calculated based on the rate of evapotranspiration (ETo), crop growing factor (kc) and seepage (p=1.0 mm/day)

		First Crop		second Crop				
Month	ETo	kc	ETcrop	kc	ETcrop	P	WR net	WR gross
	mm/day		mm/day		mm/day	mm/day		
1	2.9	1.10	3.2	-	-	1.0	4.2	8.2
2	4.5	1.05	4.7	-	-	1.0	5.7	11.2
3	5.6	0.95	5.3	-	-	1.0	5.3	10.4
4	6.1	0.95	5.8	-	-	1.0	6.8	13.3
5	5.9	-	-	1.10	6.5	1.0	7.5	14.7
6	4.9	-	-	1.10	5.4	1.0	6.4	12.5
7	4.7	-	-	1.25	5.9	1.0	6.9	13.5
8	4.8	-	-	1.25	6.0	1.0	7.0	13.7
9	4.6	-	-	1.00	4.6	1.0	5.6	11.0
10	4.3	-	-	-	-	-	-	-
11	4.0	-	-	-	-	-	-	-
12	3.6	1.10	4.0	-	-	1.0	5.0	9.8

The maximum water requirement of 1.8 lit/sec/ha during the period of the growing stage would be calculated (=14.7 x 10 / 86,400). During the period of land preparation, the water requirement will be calculated as follows.

First cropping WR1 = 10 (LP.A /LD + (LD-1) × A × 5.0/LD)/86,400/0.51

Second Crop WR2 = 10 (LP.A /LD + (LD-1) × A × 7.5/LD)/86,400/0.51

Where ; LP - Necessary amount of water for land preparation in mm
A - Irrigation area in ha
LD - Period of land preparation in days

(3) Size and Structure of Irrigation Canals

Trapezoid section of concrete lined canals would be proposed. The minimum designed velocity of discharge will be 80 cm/sec. The minimum cross-sectional size of canals will be 30 cm in the bottom width

and 35 cm in the depth. The design water level would be kept at 20 cm above the ground surface of the field.

(4) Appurtenant Structures

- The road crossing across the irrigation canal will be at the 500 m interval by considering the farming works and present traffic condition.

- The siphon or aqueduct structures will be provided for crossing a drainage canal or creek.

- Diversion structures with a measuring devices will be required proper water management.

- The canal aligned along the foot of hilly land will provide with a side ditch at hill-side.

- The other necessary appurtenant structures would be proposed for considering a safety of a canal.

(5) Size and Structure of Drainage Canals

- The drainage module of 14 lit/sec/ha will be applied based on the conditions of two (2) days succeeding rainfall of 304 mm in five (5) years return period and a run-off coefficient of 0.8 referred to the Master Plan report.

- Considering easy maintenance by farmers and destruction of living conditions for snails, a trapezoid drainage canal with the minimum water depth of 30 cm will be provided. The minimum size with 60 cm in the bottom width and 90 cm in the depth will be designed. The top surface width of 50 cm without pavement and the height of 50 cm will be applied for the dike.

(6) Operation and Maintenance Roads

The top width of O & M roads is designed depend on the discharge of a canal.

Discharge (m^3/sec)	Total Width (m)	Paved Width (m)	Thickness of Pavement (cm)
more than 0.3	4.0	3.0	15
Less than 0.3	2.5	2.0	10

(7) Proposed Major Facilities

1) Quezon Area

a) Intake Facility

- Cropping intensity

  The irrigation area of 22 ha would require the maximum irrigation water, except land preparation water of 21.0 lit/sec. On the other hand, the expecting minimum discharge of 6.2 lit/sec calculated based on the data of the Ganoy Creek measurement data, the cropping intensity of 130 percent will be expected.

- Design Flood Discharge

  The design flood discharge of 16.8 m3/sec with a 100 year return period will be estimated based on the Discharge - Frequency - Drainage-Area Relationship.

- The Quezon waterfall has a fall of about 20 m. In the place upstream from the waterfall, good foundation of unweathered rock for structures exist. After diverting the water this point, however, the feeder canal will be needed and result in more investment cost for the structure due to big head. the proposed intake facility, therefore, would be planned at the point of 100 m downstream from the waterfall. And the necessary water will be conveyed to a field. The proposed length of the diversion facility will be 22.7 m.

b) Irrigation Canal

The canal alignment has been determined on the topographic map with a scale of 1/5,000. The total length of the proposed canal will be 1,090 m and the maximum design discharge will be 0.089 m^3/sec in the land preparation time.

2) Aurora Area

a) Intake Facility

- Cropping Facility

  The irrigation area of 18 ha will require a diversion water of 17.2 lit/sec. On the other hand, the estimated discharge during the dry season is 5.7 lit/sec. The cropping intensity during the same period will be 133 percent.

- Design Flood Discharge
  The design flood discharge of 15.4 m^3/sec is calculated as the same method as the Quezon area.

  Since the good foundation for the structure to be proposed and a drop of about five (5) meters are observed at the waterfall, the intake structure with the total length of 8.4 m will be proposed in the upstream of the waterfall. Between the intake and the service area will be connected by a steel pipe.

b) Irrigation Canal

The total canal length of 1,655 m with the maximum water requirement of 73 lit/sec will be required on the topographic map with a scale of 1/5,000.

3) Bulao Area

a) Pump Facility

- Selection of Pump
  The water level difference between the normal and flood water level is about nine (9) meters. The prime mover should be kept to avoid submergence. To meet the above conditions, a vertical mixed flow pump and a submergible motor pump will be adaptable. The latter pump has not so many users in the Philippines and the technique level for the pump is low at present. The operating cost is higher than the mixed flow pump mentioned in hereinafter.

  The vertical mixed flow pump has the following merits.

- It is rather difficult to occur cavitation due to submerged impeller.
- The small space for placement of pump is required.
- Since supplemental pumps are not necessary, operation will be easy.
- The pump floor elevation shall be higher, in order to avoid submergence of pump.

To wards this end, the vertical mixed flow pump has been selected for the area.

- Discharge of Pump
  The maximum pump operation time shall be 20 hours a day and the remaining four (4) hours will be provided for the ordinary maintenance. The proposed pump capacity of 23.184m^3/min will be given.

- Decision of Pump Number

  According to the monthly water requirement, the number of the month which monthly water requirement is between 50 and 60 percent of the maximum water requirement is three (3) and between 60 and 70 percent is four (4), respectively. In the case of such fluctuation of discharge, one pump equipment operation is not economical. In this pan, two (2) pump equipment will be proposed. The standby pump will not be proposed because the proposed pump type is most popular in the country. The size of each pump is the same by considering easy operation and maintenance and change of spare parts.

- Decision of Pump Diameter

  The pump diameter is determined as follows.

$$D = 90\sqrt{Q} = 90 \times \sqrt{11.592}$$

$$= 306 \fallingdotseq 300 \text{ mm}$$

- Type of Prime Mover

  The prime mover type is decided based on the economic operation cost and possibility of mover power source. SAMELCO-I has an expansion of distribution line, which is running near the proposed pump site, to be provided by the end of this fiscal year. It is easy to be obtain electric current from the line. This electricity is not stable and has many brownout. The engine mover is most popular for a pump in the Philippines. The fuel is also stably supplied to consumers.

- Estimation of Annual Operating Cost by Electric Mover

Month	Daily Net W. Req't (mm/day)	W.R for L.P	Total	Monthly Total	*1 Monthly Rainfall	Monthly Effective Rainfall	Net W. Req't	Gross W. Req't	Operation Time
1	4.2	-	4.2	130.2	234.4	159.4	-	-	-
2	5.7	-	5.7	159.8	147.0	100.0	59.6	116.9	216
3	5.3	-	5.3	164.3	139.1	90.0	74.3	145.7	270
4	6.8	-	6.8	204.0	109.9	76.9	127.1	249.2	461
5	7.5	8.7	16.2	502.2	168.2	117.7	384.5	753.9	1,396
6	6.4	-	6.4	192.0	203.5	142.5	49.5	97.1	180
7	6.9	-	6.9	213.9	246.3	172.4	41.5	81.4	151
8	7.0	-	7.0	217.0	218.3	152.8	64.2	125.9	233
9	5.6	-	5.6	168.0	262.8	184.0	-	-	
10	-	-	-	-	-	-	-	-	-
11	-	-	-	-	-	-	-	-	-
12	5.0	6.8	11.8	365.8	304.0	206.7	159.1	312.2	578
Total									3,485

Note : *1 refer to page C-5, Appendix-I, Master Plan Report
*2 refer to page C-20, - do -
Pump capacity 11.592 m³/min x 60 min / 130 ha = 0.54 mm/hr

Basic charge 45 kw x 2 nos. x 15 peso/kw	=	1,350
Consuming charge 45 kw x 3,485 hr x 2.5 peso/kw x 1.2*	=	470,475
VAT (10% of above)	=	47,183
Total		519,008
		(say 519,000)

Note: * loss at transformer, etc.

- Estimation of Annual Operating Cost by Diesel Engine Mover The fuel consumption of 100 gr/ps.hr, the annual operating time of 3,485 hr and the engine power of 72 ps are applied for estimation of the cost.

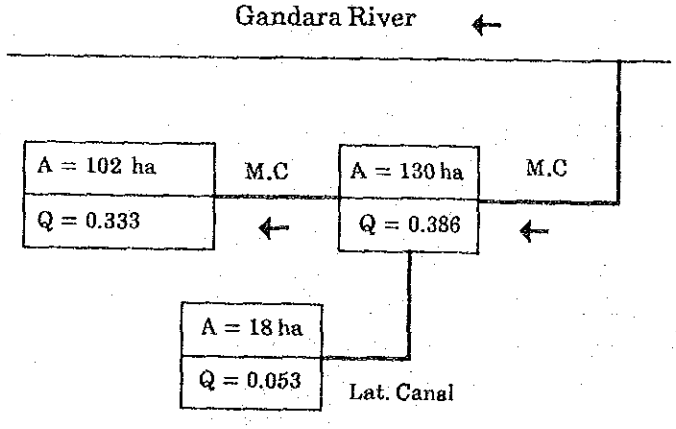
  Fuel to be required is 30,231 lit (=72 ps×3,485 hr× 100/1,000/0.83)
  Fuel cost 30,231 x 5.06 peso/lit = 152,969 pesos
  Other oil charge (5% of Fuel cost)
  152,969 x 0.05 = 7,648 pesos
  The total annual operating cost is, therefore, 160,617 pesos

- Decision of Prime Mover
  Based on the above study, the prime mover of diesel engine mover system will be applied for this plan.

b) **Irrigation Canal**

- Systematic diagram of irrigation system
  The systematic diagram of the irrigation system is shown in Figure 4-1.

FIGURE 4-1 SYSTEMATIC DIAGRAM OF IRRIGATION SYSTEM (BULAO AREA)

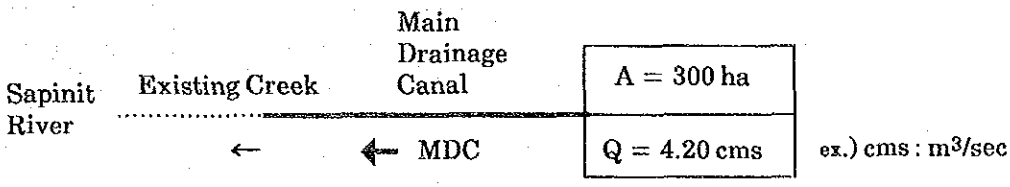


- Irrigation Canal
  The total lengths of the proposed main and lateral irrigation canal are 2,670 and 2,050 m, respectively. the maximum design discharge of 0.386 m^3/sec will be required.

c) **Drainage Canal**

- Systematric diagram of drainage system
  The systematic diagram of the drainage system is shown in Figure 4-2.

FIGURE 4-2 SYSTEMATRIC DIAGRAM OF DRAINAGE SYSTEM (BULAO AREA)



- Size of Drainage Canal

Design discharge	4.2 m^3/sec
Length	1,100 m

4) Bulao South Area

a) **Pump Facility**

- Selection of Pump Type
  The beneficial area is submerged during the heavy rainfall period caused by typhoon, etc. The frequency of inundation is less than once a year. The fixed pump station facility against this inundation will be costly and not economical due to big investment for civil works. In this area, each irrigation area is as small as 10 to 20 ha. On the occasion of this situation, a removable or portable pump in small scale will be suitable. The portable pump is moving up during the period of rainy season, because of unnecessary irrigation water and high possibility of flood occurrence. The total water head of 15 m have been calculated based on the section and delivery water level and the friction loss on the delivery pipe.

- Discharge of Pump
  The average irrigation area of 15 ha requires 57 lit/sec. The maximum operation time is 20 hours a day. The total discharge is 4.32 m^3/min.

- Number of Pump
  Two (2) sets with the same capacity of pump equipment will be proposed to reduce the operation cost. The pump capacity of each set is 2.16 m3/min.

- Design of Pump Diameter

  $D = 90 \sqrt{Q} \doteqdot 125$ mm
  (the same as Bulao area)

- Prime Mover Type
  The diesel engine prime mover type is recommendable because of no electricity and movable type of pump. the required power of the mover has been calculated at 10 ps.

- Total annual operating hours

Month	Daily Net W. Req't (mm/day)	W.R for L.P	Total	Monthly Total	*1 Monthly Rainfall	Monthly Effective Rainfall	Net W. Req't	Gross W. Req't	Ope-ration Time
1	4.2	-	4.2	130.2	234.4	159.4	-	-	-
2	5.7	-	5.7	159.8	147.0	100.0	59.6	116.9	136
3	5.3	-	5.3	164.3	139.1	90.0	74.3	145.7	169
4	6.8	-	6.8	204.0	109.9	76.9	127.1	249.2	290
5	7.5	8.7	16.2	502.2	168.2	117.7	384.5	753.9	877
6	6.4	-	6.4	192.0	203.5	142.5	49.5	97.1	113
7	6.9	-	6.9	213.9	246.3	172.4	41.5	81.4	95
8	7.0	-	7.0	217.0	218.3	152.8	64.2	125.9	146
9	5.6	-	5.6	168.0	262.8	184.0	-	-	-
10	-	-	-	-	-	-	-	-	-
11	-	-	-	-	-	-	-	-	-
12	5.0	6.8	11.8	365.8	304.0	206.7	159.1	312.2	363
Total									2,189

Note : *1 refer to page C-5, Appendix-I, Master Plan report
*2 refer to page C-20, - do
pump equivalent capacity = 2.160 m^3/min x 8 sets x 60 min/120 ha = 0.86 mm/hr

- Estimation of Annual Operation Cost of Pump
  Based on the hourly fuel consumption of 100 g/ps.hr, the total annual operation hours of 2,189 hr, the required prime mover of 10 ps and required number of pump of eight

(8) sets, the total fuel consumption has been calculated at 21,099 lit. The annual operation cost including the other oil costs (5% of fuel cost) is 112,099 pesos (the price of diesel oil of 5.06 pesos/lit).

b) Irrigation Canal

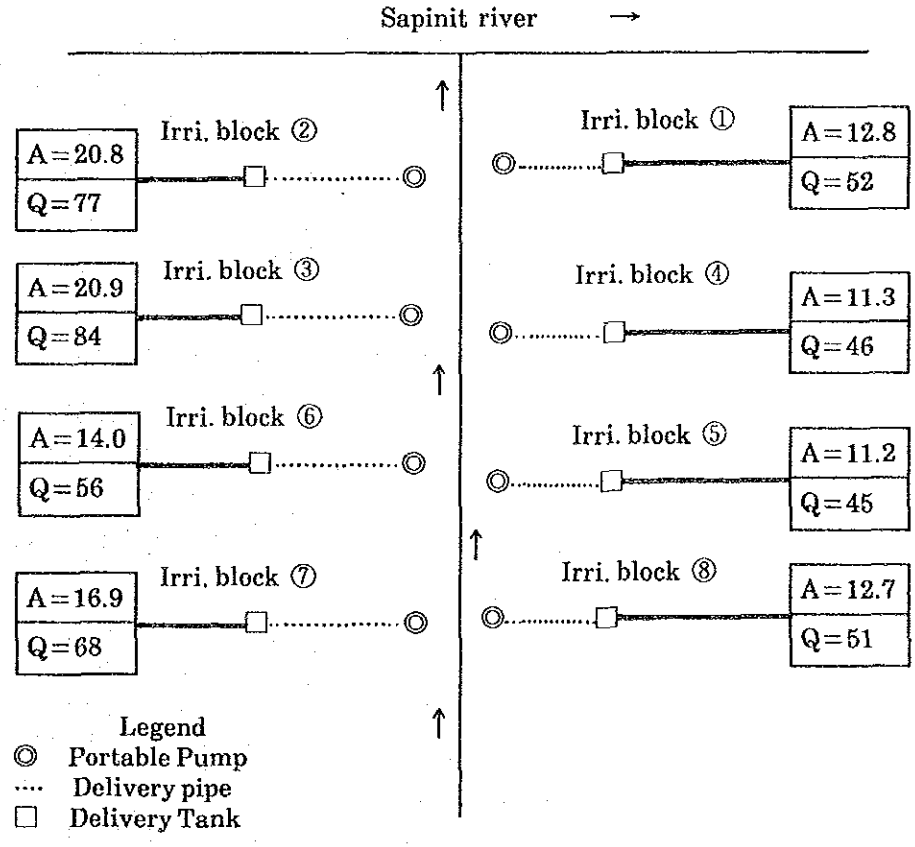
- Irrigation Area by Block

Block No.	1	2	3	4	5	6	7	8	Total
Irri. area	12.8	20.2	20.9	11.3	11.2	14.0	16.9	12.7	120.0
Canal length (m)	490	500	870	790	510	750	860	750	5,520
D.M.R (lps)	52	81	84	146	45	56	68	51	
Pump (set)	1	1	1	1	1	1	1	1	8

- Systematic Diagram of Irrigation System

The systematic diagram of the proposed irrigation system is shown in Figure 4-3.

FIGURE 4-3. SYSTEMATIC DIAGRAM OF IRRIGATION SYSTEM (BULAO SOUTH AREA)



4-3-2. DESIGN OF FARM-TO-MARKET ROAD

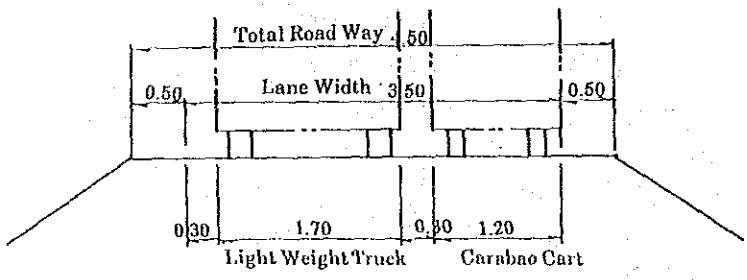
(1) Route Selection

The route of roads to be constructed is reviewed taking economic advantage and stability of topographic conditions into consideration. The road has functions of farming and common use. On the other hand, the route of roads to be rehabilitated is basically traced the existing route with small route changes at a part of the roads and with modification of vertical gradients of the roads for safety driving of vehicles and easy operation and maintenance works.

(2) Width of Road

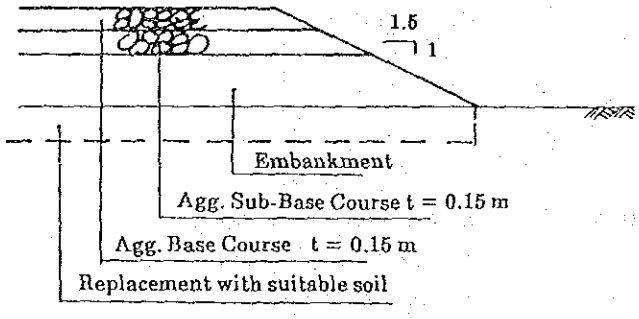
The road widths of 3.5 m in lane width and of 4.5 m in total road width are designed for passage of a carabao cart and a light weight truck such as a pickup truck, a jeepny, etc. as shown in the following figure.

Passage of a Carabao Cart and a Light Weight Truck



(3) Pavement

Gravel pavement is applied taking economical construction cost, materials available near the Project area and roads passable even during the rainy season into consideration. Furthermore, concrete pavement shall be applied at the section of a steep gradient (Slope ≧ 12%) for the safety driving. The typical section is shown as follows.



(4) Bridge

The foundation of the proposed La Paz bridge is the silty clay layer and not enough to support the heavy loads of the bridge. One span truss bridge, 70 m span length, at this foundation has been selected after studying the bridge type on economy, easy operation and maintenance, fine sight and reliable construction method as summarized in the following comparison Table. The Blanca Aurora bridge with one span truss of 40 m span length has been selected after studying the same manners as the La Paz bridge.

(5) Road Structure at Lower Elevation Area

The road height of 0.7 to 1.0 m above the natural ground surface will be designed where the road is aligned at the lower elevation area such as a paddy field, an uncultivated area, etc. The flood will flow down at 0.8 to 1.0 m over the proposed road surface. The grouted rip-rap walls with a side slop of 1 : 1 will be planned for protection of the road against flood. The necessary length of rip rap protection works at the both sides, the upstream and downstream portions of the road, will be placed to prevent the road facilities from erosion caused by overflow during the flood.

4-3-3. Village Water Supply Facilities

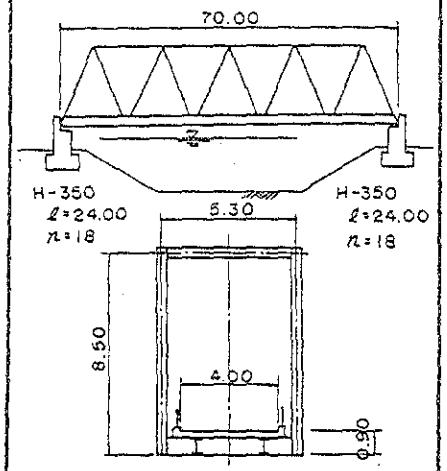
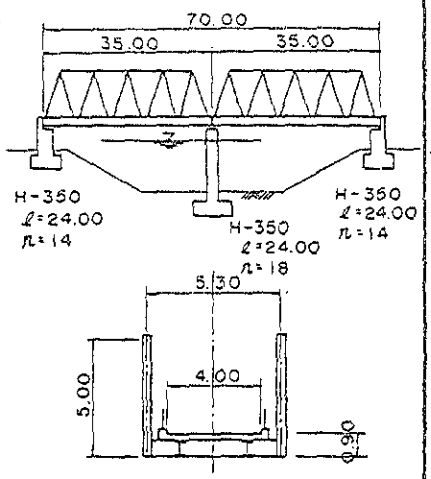
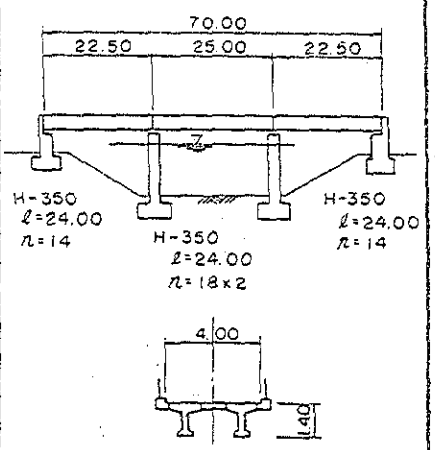
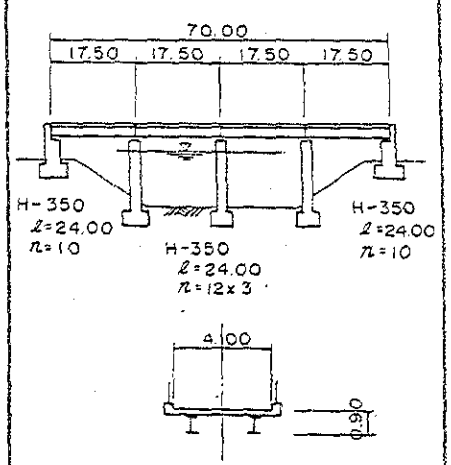
1) Water Service Area and Service Population

The water service area consists of 15 barangays in the San Jorge municipality. These barangays are mostly located along the proposed transmission pipeline from barangay Tomogbong to poblacion of San Jorge. Barangays La Paz and Monbon, located at the right bank of the Gandara River, are also served water across the River. The service population of the village water supply facility is planned at 11,259 or 1,920 households forecasted at the year 2007.

2) Water Demand

The water demand consists of farming water of 438 m^3 per day, or equivalent to 53 percent of the total demand and domestic water of 395 m^3 per day or 47 percent of the total. The total demand is, therefore, 833 m^3 per day. The farming

COMPARISON TABLE OF BRIDGE TYPE (LA PAZ BRIDGE)

TYPE		1-SPAN STEEL TRUSS BRIDGE	2-SPAN STEEL TRUSS BRIDGE	3-SPANS PRESTRESSED CONCRETE GIRDER BRIDGE, POST-TENSION	4-SPANS H-STEEL BEAM BRIDGE
GENERAL PLAN					
CONSTRUCTION COST	SUPERSTRUCT.	16600 × 10^3 PESOS	15,000 × 10^3 PESOS	11,000 × 10^3 PESOS	8,400 × 10^3 PESOS
	ABUTMENT & PIER	3,100	4,700	6,700	7,200
	TEMPORALLY WORKS	-	2,400	3,300	4,400
	TOTAL	19,700	22,100	21,000	20,000
	COST RATIO	(1.00)	(1.12)	(1.07)	(1.02)
ADVANTAGE & DISAD.	ECONOMY	The most economical type. Long span but light weight superstructure.	High cost of temporary works for the construction of pier.	Same as 2-spans bridge.	The second economical type. Many difficulties for the dewatering works.
	MAINTENANC	Necessity of periodical painting works, generally one time per 10 years.	Same as 1-span bridge.	Un-necessity of particular maintenance works.	Necessity of periodical painting works, but only small area.
	SIGHT	Short length of approach road to bridge by reason of low height of girder. Possibility of color selection for the painting works of the superstructure.	Low height of girder. Possibility of color selection for the painting works	The longest length of approach road to bridge by reason of the highest height of girder. High hindrance ratio to river stream.	The highest hindrance ratio to river stream. Same as other steel bridge.
	CONSTRUCTION WORKS	No construction works in the river stream. No particular disturbance on occurrence of flood.	Necessity of temporary bridge and coffer dam by sheet pile for construction of center pier.	Necessity of same temporary works as 2-spans for construction of two piers. Longer construction period. Complicated procedure for quality control of post-tensioning works.	Necessity of same temporary works as 2-spans for construction of three piers. Longer construction period by reason of works in the river stream.

water will be also served to the Gandara Seed Farm and the trial farm of SNAS. The daily maximum demand will be 1,083 m^3 per day using the daily peak factor of 1.3.

3) Intake Facilities

The water source is the Binubucalan spring which has a sufficient discharge throughout the year. The water quality is in compliance with the Philippine drinking water standard. The intake facilities will consist of two intake boxes, intake pipeline, and receiving well. The intake box will be made of stainless steel pipe with a diameter of 1,500 mm. The intake pipeline made of ductile cast iron pipes with a diameter of 250 mm and the length of 1,120 m connects the intake boxes and the receiving well and conveys about 1,260 m3 per day of village water from Binubucalan spring to the receiving well in Tomogbong. The receiving well of concrete structure will have about 60 m^3 of effective volume and be equipped with measuring device of quantity of intake water and chlorination equipment.

4) Transmission Pipeline

The water will be transported to the service area by a transmission pipeline with a diameter of 200 mm. The pipeline consists of a ductile cast iron pipe of 2,800 m in the length and a fiberglass reinforced plastic mortar pipe of 10,000 m in the length. The pipeline will be mainly placed under the existing road.

5) Distribution Facilities

The distribution pipelines will be branched off to all barangays from the transmission pipeline except for San Jorge poblacion which will be supplied from the San Jorge distribution reservoir. The distribution reservoir of a concrete structure will effectively function to meet the daily peak demand and the capacity will be 260 m^3. The distribution pipelines will be connected to village communal faucets in all barangays mentioned before. The pipelines with 25 to 150 mm in diameter have a total length of 7.4 km.

The total number of public faucets is thirty for the whole service area.

4-3-4. Operation and Maintenance Plan

The ordinary operation and maintenance works are important to keep the irrigation and farm-to-market road facilities in good conditions. The number and scale of procurement will be determined in consideration of the number and scale of the existing equipment and equipment requested.

(1) Irrigation

Operation and maintenance works of the irrigation facilities in the four (4) proposed areas with the service area of 290 ha in total, consist of the ordinary O & M works of the main, lateral irrigation facilities included O & M roads and the rehabilitation works of the facilities damaged by unexpected typhoon and/or flood. Even in case of the former one, the manual operation works takes much time to repair the facilities such as canals and O & M roads, long time discontinuations of water supply results in farming works late or impossible.

The O & M works of the on-farm facilities should be shouldered by the farmers themselves. Taking into consideration the number and scale of the existing equipment held by the NIA provincial office and the scale of the proposed irrigation facilities, the big scale of equipment will not be necessary and the medium and small scales of equipment will be more suitable for those works. The later scales of equipment can reduce and save the operation and maintenance costs. And the present operators of those equipment do not need the additional training on operation and maintenance of equipment. They can apply the present technique to operate and maintain those equipment and can operate them in the proper condition.

The dump truck and tractor shovel are necessary for cutting, loading and transporting the construction materials, mainly earth and gravel materials. The bulldozer and motor grader can spread and compact those materials in effectively. For excavation of earth and rock, the backhoe and hand breaker with a compressor are good for excavating and breaking soils and stones. The pick-up truck can transport various and

necessary construction materials. For surveying, designing, drawing and estimating the volume and costs to rehabilitate the facilities, the survey equipment are effective. For research and investigation of the site to be rehabilitated and maintained the facilities, the 4WD car is necessary. In order to achieve the above O & M activities, the following procurement will be required.

Procurement for Irrigation Facilities

Name of Equipment	Specification	Number
Cutting, loading and transporting works		
Tractor shovel	0.4 m^3	1
Dump truck	6.0 m^3, diesel	1
Pick-up truck	1.0 ton, diesel	2
Spreading and compacting works		
Bulldozer	6.0 ton	1
Motor grader	Blade width 3.1 m	1
Excavation works		
Back hoe	0.6 m^3	1
Hand breaker	40 kg class, air compress type	2
compressor	w/Engine, portable type 1.4 to 2.0 m^3/min	1
Investigation and research works		
Station Wagon	4WD, 5 to 6 person	1
Survey equipment		
Electronic distance meter	w/ prism, case	1
Theodrite	w/ tripod	1
Auto-level	w/ tripod	1
Road	stadia, aluminum, 5 m	5
Pole	aluminum, 3 m	5
Measuring tape	Eslon, 50 m	1
- ditto -	Eslon, 100 m	1
Planimete	Manual	1

(2) Farm-to-market Road

The proposed length to be operated and maintained is 14.4 km in total, including of 6.6 km of new construction roads and 7.8 km of rehabilitation one. The necessary periodical O & M of the said roads will be done once a year, and the partial maintenance will be done two to three times a year at the place damaged by flood. The O & M equipment which are necessary for the proposed roads, are selected as follows.

Machinery	Specification	Unit
Bulldozer	15 ton, 150 HP	1
Motor Grader	110 HP, Blade width = 3.1 m	1
Dump Truck	6 ton land, 170 HP	2
Backhoe	0.6 cum, 110 HP	1
Vibrating Roller	Hand-guide type, 1 ton, 7HP	3
Pick-up Truck	1 ton load	1
Submergible Engine Pump	Portable type, φ100 mm, 7.5 HP	4

4-3-5 Basic Design Drawings

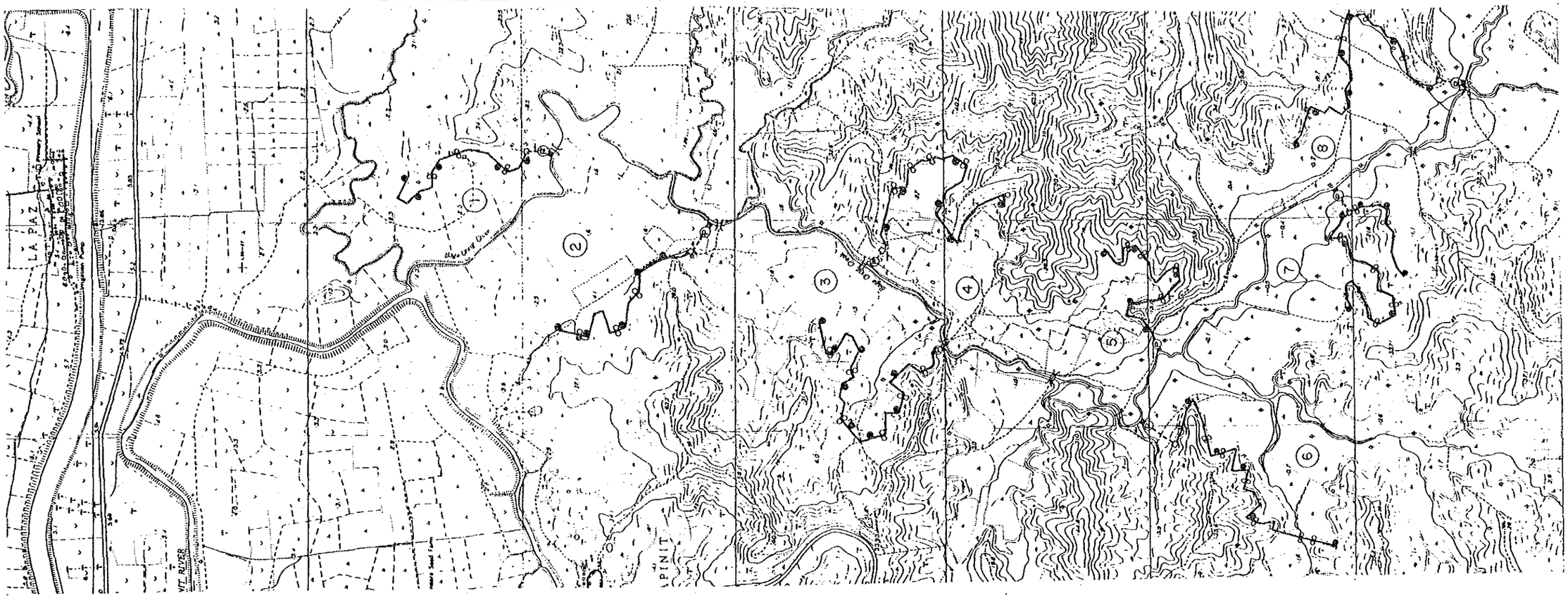
The necessary drawings of the basic design are listed below.

DRAWING LIST

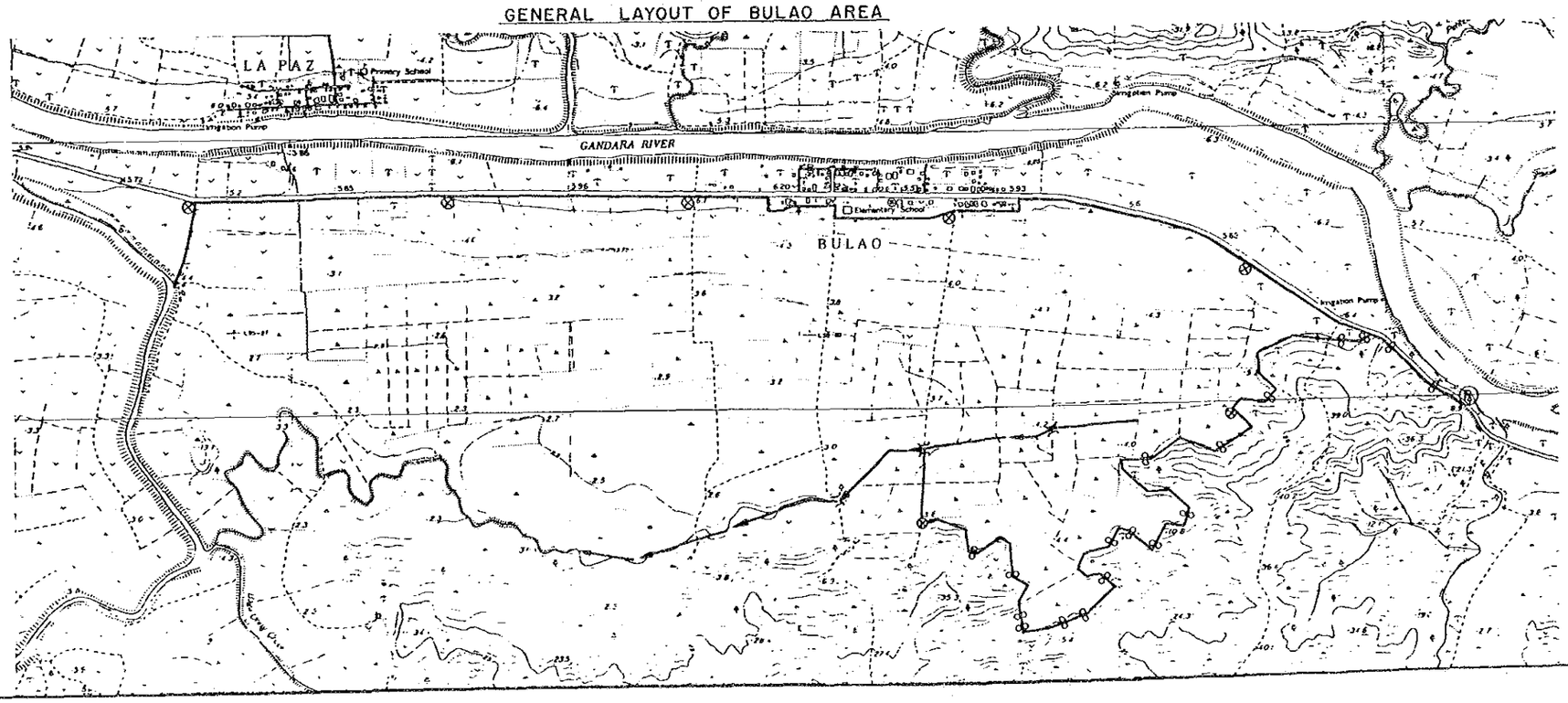
DRW. NO.	TITLE
WS - 001	IRRIGATION FACILITIES GENERAL LAYOUT OF BULAO AREA & BULAO SOUTH AREA
WS - 002	IRRIGATION FACILITIES GENERAL LAYOUT OF AURORA AREA & QUEZON ARE A AND BULAO PUMP STATION
WS - 003	IRRIGATION FACILITIES INTAKE FACILITIES FOR AURORA AREA & QUEZON AREA
WS - 004	IRRIGATION FACILITIES TURN OUT & DIVERSION WORKS
WS - 005	FARM - TO - MARKET ROAD PLANS OF QUEZON~CANTAGUIC AND BULAO~LA PAZ
WS - 006	FARM - TO - MARKET ROAD LONGITUDINAL PROFILES OF QUEZON - CANTAGUIC AND BULAO ~ LA PAZ
WS - 007	FARM - TO - MARKET ROAD LONGITUDINAL PROFILE OF BLANCA AURORA ~BUENAVISTA AND SAN AGUSTIN~POLOGON
WS - 008	FARM - TO - MARKET ROAD TYPICAL CROSS SECTION OF ROAD & CROSSING WORKS
WS - 009	FARM - TO - MARKET ROAD LA PAZ BRIDGE
WS - 010	FARM - TO - MARKET ROAD BLANCA AURORA BRIDGE
WS - 011	FARM - TO - MARKET TOAD RESTORATION OF BUENAVISTA BRIDGE
WS - 012	VILLAGE WATER SUPPLY GENERAL LAYOUT OF WATER TRANSMISSION PIPELINE
WS - 013	VILLAGE WATER SUPPLY BINUBUCALAN INTAKE & TOMOGBONG RECEIVING WELL
WS - 014	VILLAGE WATER SUPPLY SAN JORGE DISTRIBUTION RESERVOIR
WS - 015	VILLAGE WATER SUPPLY -1 LONGITUDINAL PROFILE OF PIPELINE (BINUBUCALAN TO TOMOGBONG)
WS - 016	VILLAGE WATER SUPPLY -2 LONGITUDINAL PROFILE OF PIPELINE (TOMOGBONG TO STA . 2 + 400)
WS - 017	VILLAGE WATER SUPPLY -3 LONGITUDINAL PROFILE OF PIPELINE (STA. 2+400 TO BULANCA AURORA)

IRRIGATION FACILITIES

GENERAL LAYOUT OF BULAO SOUTH AREA



GENERAL LAYOUT OF BULAO AREA



LEGEND

- Irr. Canal
- Turn-out
- Siphone
- Canal Crossing
- Submergable Bridge
- Drainage Canal
- Division Box
- Pump Station
- Suction Pit
- Delivery Tank

SCALE 1 : 5 000

0 100 200 300 400 500

REPUBLIC OF THE PHILIPPINES
AGRICULTURAL DEVELOPMENT AND PROMOTION PROJECT
IN WESTERN SAMAR
(ADPP)

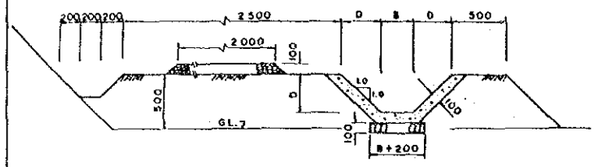
IRRIGATION FACILITIES
GENERAL LAYOUT OF
BULAO AREA & BULAO SOUTH AREA

DATE SURVEYED : FEB. 1990	DRAWING NO.
DRAWN BY :	WS - 001
APPROVED BY :	
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	

IRRIGATION FACILITIES

TYPICAL CROSS SECTION OF IRR. CANAL

NO SCALE

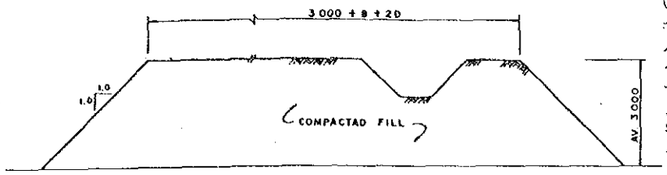


DIMENSION (Unit: cm)

TYPE	B	D
1	30	35
2	40	45
3	45	45
4	50	45
5	60	45
6	60	55
7	70	55
8	70	65
9	80	65

EMBANKMENT FOR CANAL

NO SCALE



BULAO PUMP STATION

PLAN

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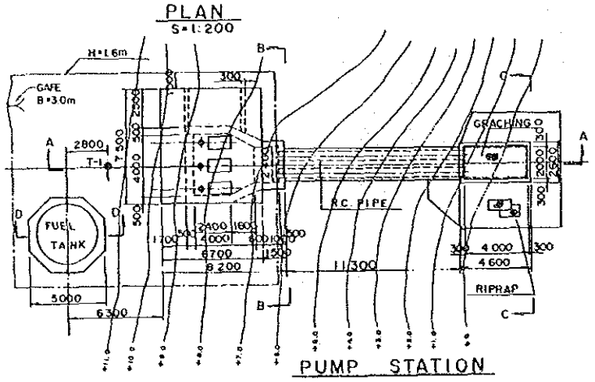

PUMP STATION

SECTION A - A

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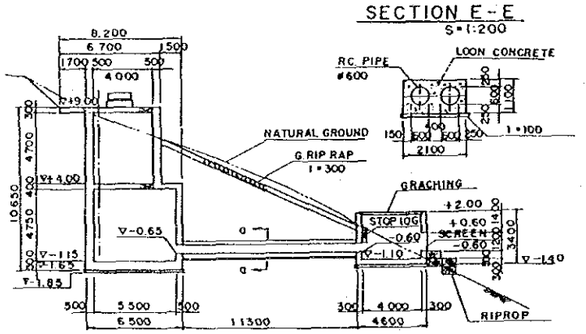

SECTION E - E

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SECTION B - B

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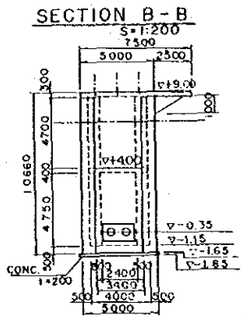

SECTION C - C

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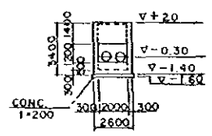

SECTION D - D

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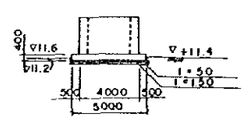

PUMP HOUSE

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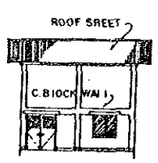
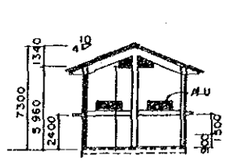
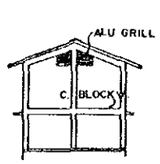
SOUTH ELEVATION



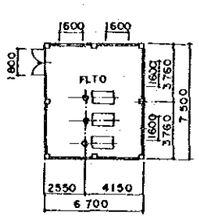
SECTION



EAST ELEVATION



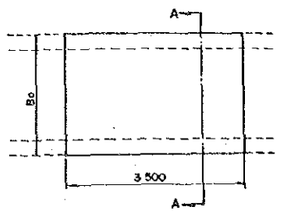
PLAN



CANAL CROSSING (B-TYPE)

PLAN

NO SCALE



SECTION A - A

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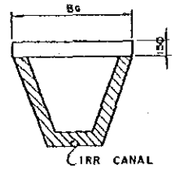

DIMEUSION

TYPE	Bo (cm)	IRR CANEL TYPE
1	125	1
2	150	2
3	155	3
4	160	4
5	190	5.6
6	220	7.8
7	230	9

DIVISION BOX

PLAN

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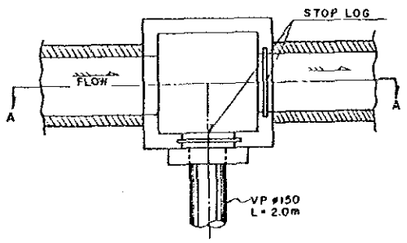

SECTION A - A

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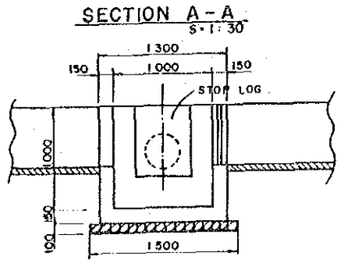
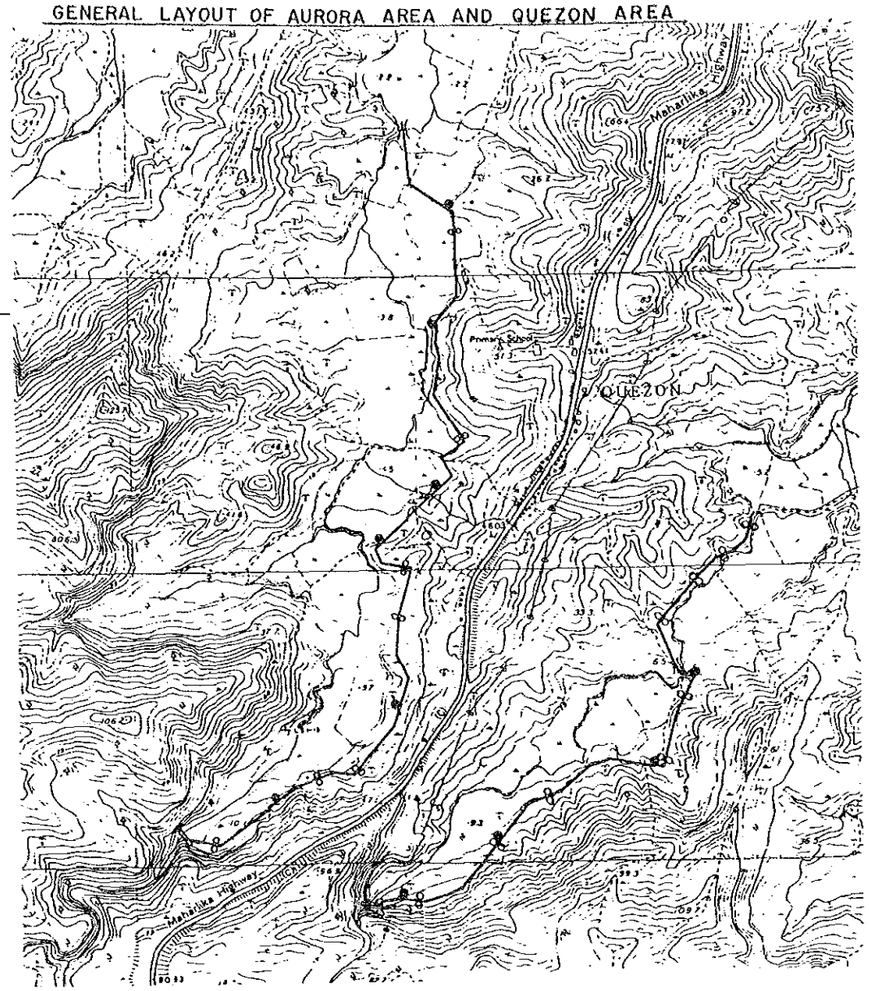


GENERAL LAYOUT OF AURORA AREA AND QUEZON AREA



LEGEND

- Irr. Canal
- Turn-out
- Siphone
- Canal Crossing
- Submergable Bridge
- Drainage Canal
- Division Box

SCALE 1 : 200

0 1 2 3 4 5 6 7 8 9 10 20

SCALE 1 : 5000

0 100 200 300 400 600

REPUBLIC OF THE PHILIPPINES
AGRICULTURAL DEVELOPMENT AND PROMOTION PROJECT
IN WESTERN SAMAR
(ADPP)

IRRIGATION FACILITIES
GENERAL LAYOUT OF AURORA AREA & QUEZON AREA AND BULAO PUMP STATION

DATE SURVEYED: FEB. 1990	DRAWING NO.
DRAWN BY :	WS - 002
APPROVED BY :	

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

IRRIGATION FACILITIES

INTAKE FACILITY FOR AURORA AREA

PLAN
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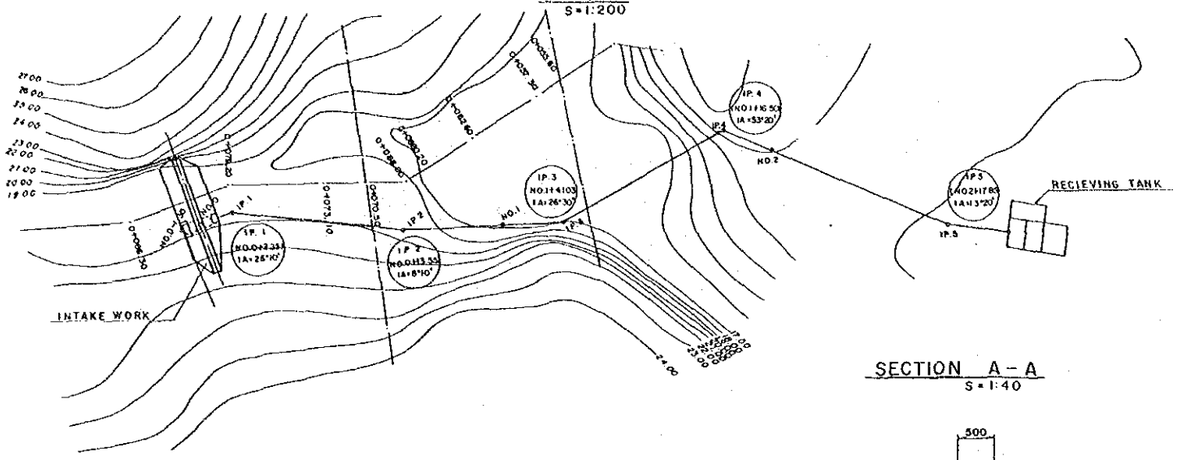

INTAKE WORK
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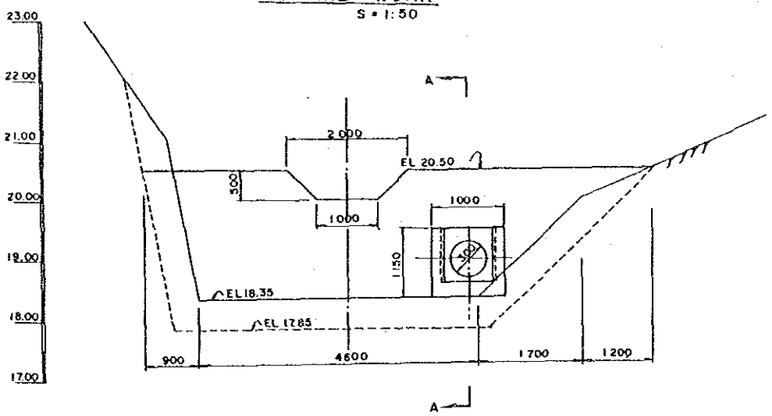

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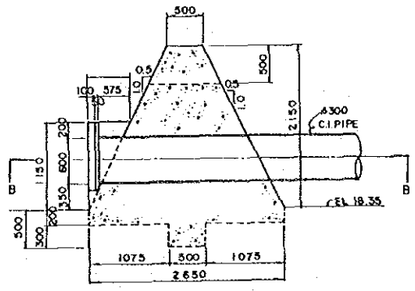

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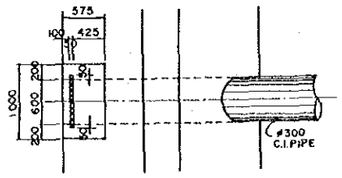
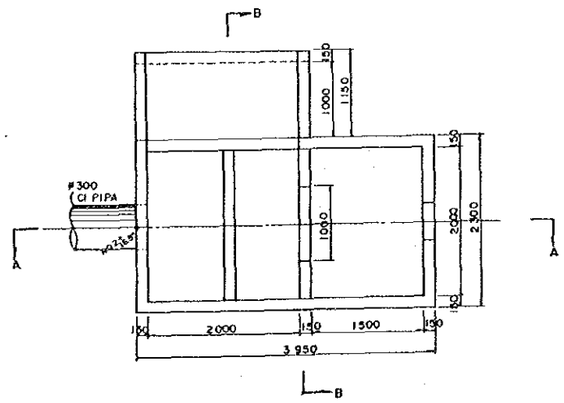


PLAN OF RECIEVING TANK
S = 1:40



SECTION A - A
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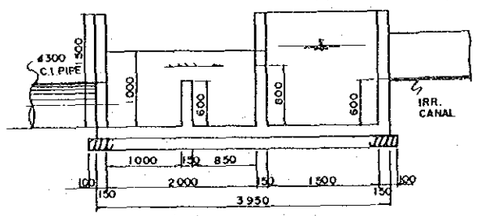

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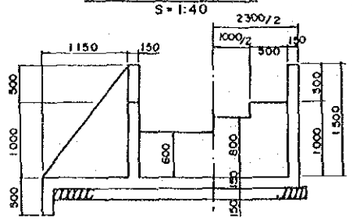

PIPE SUPPORT

PLAN
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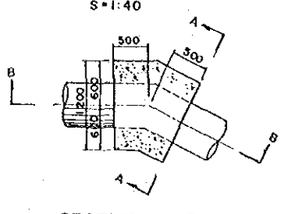

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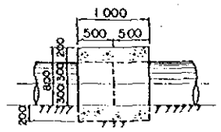

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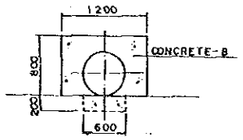

SUCTION PIT FOR BULAD SOUTH AREA

PLAN
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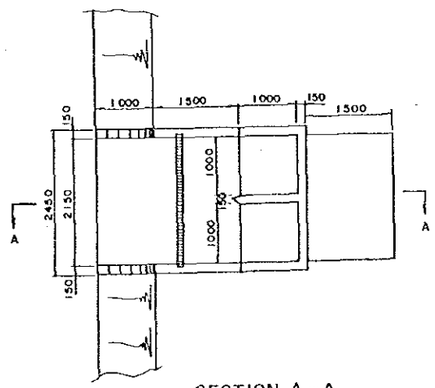

SECTION A - A
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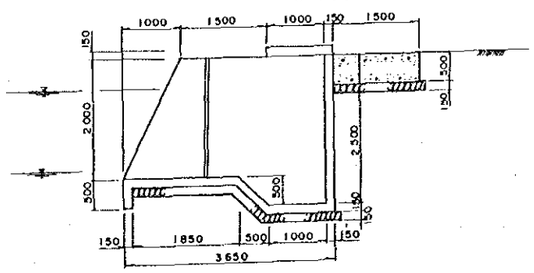
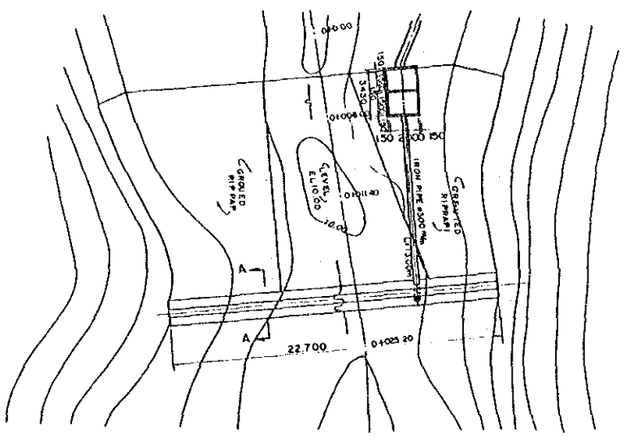
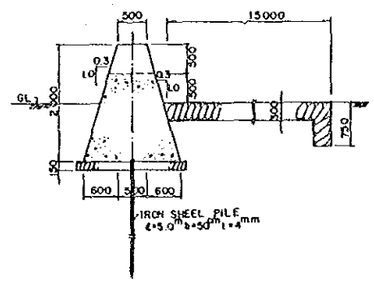


INTAKE FACILITY FOR QUEZON AREA

PLAN
S = 1:200



SECTION A - A
S = 1:50



SCALE 1 : 200
0 1 2 3 4 5 6 7 8 9 10 20

SCALE 1 : 50
0 1 2 3 4 5

SCALE 1 : 40
0 1 2 3 4

REPUBLIC OF THE PHILIPPINES
AGRICULTURAL DEVELOPMENT AND PROMOTION PROJECT
IN WESTERN SAMAR
(ADPP)

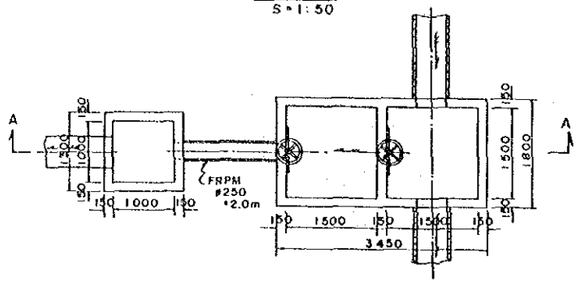
IRRIGATION FACILITIES
INTAKE FACILITIES FOR AURORA AREA
& QUEZON AREA

DATE SURVEYED : FEB. 1990	DRAWING NO.
DRAWN BY :	WS - 003
APPROVED BY :	
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	

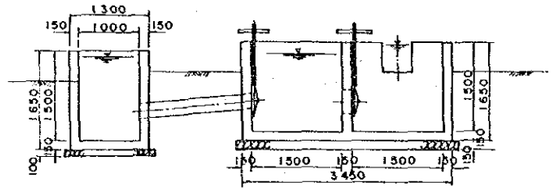
IRRIGATION FACILITIES

TURN OUT

PLAN
S = 1:50



SECTION A – A
S = 1:50



CANAL CROSSING

PLAN
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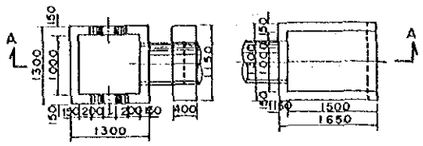

SECTION A – A
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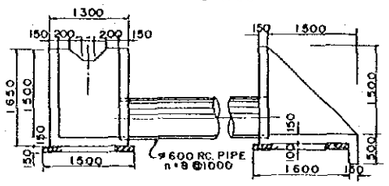
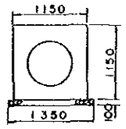
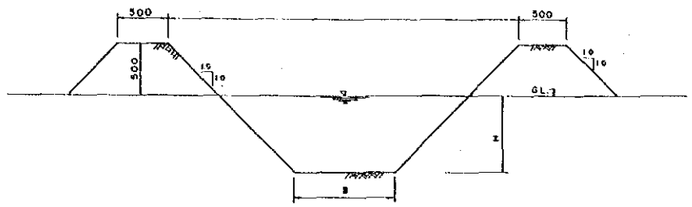




TYPICAL CROSS SECTION OF DRAINAGE CANAL

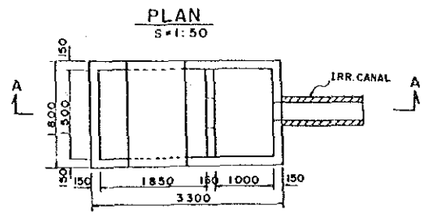


DIMENSION (Unit: m)

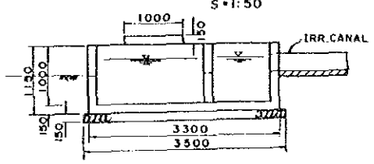
TYPE	B	H
1	0.90	1.5
2	1.20	1.5
3	1.50	1.5
4	1.80	1.5
5	2.10	1.5
6	2.40	1.5
7	2.70	1.5

DELIBERY TANK FOR BULAO SOUTH AREA

PLAN
S = 1:50

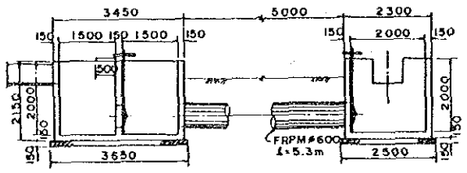


SECTION A – A
S = 1:50

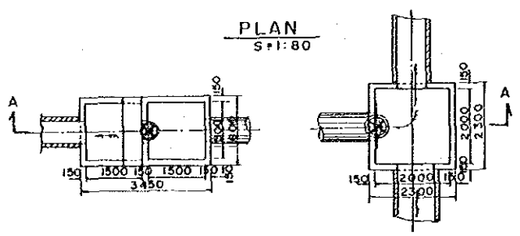


DIVERSION WORKS

SECTION A – A
S = 1:80

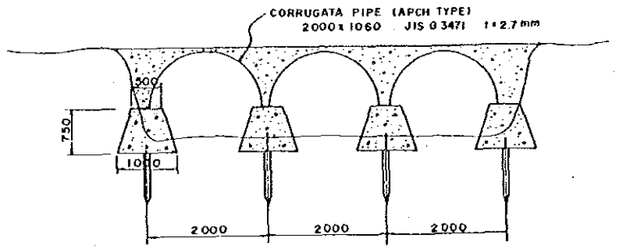


PLAN
S = 1:80

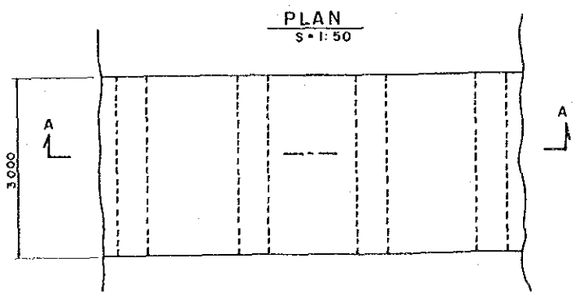


SUBMERGEBLE BRIDGE

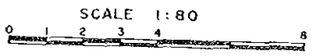
SECTION A – A
S = 1:50



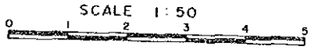
PLAN
S = 1:50



SCALE 1:80



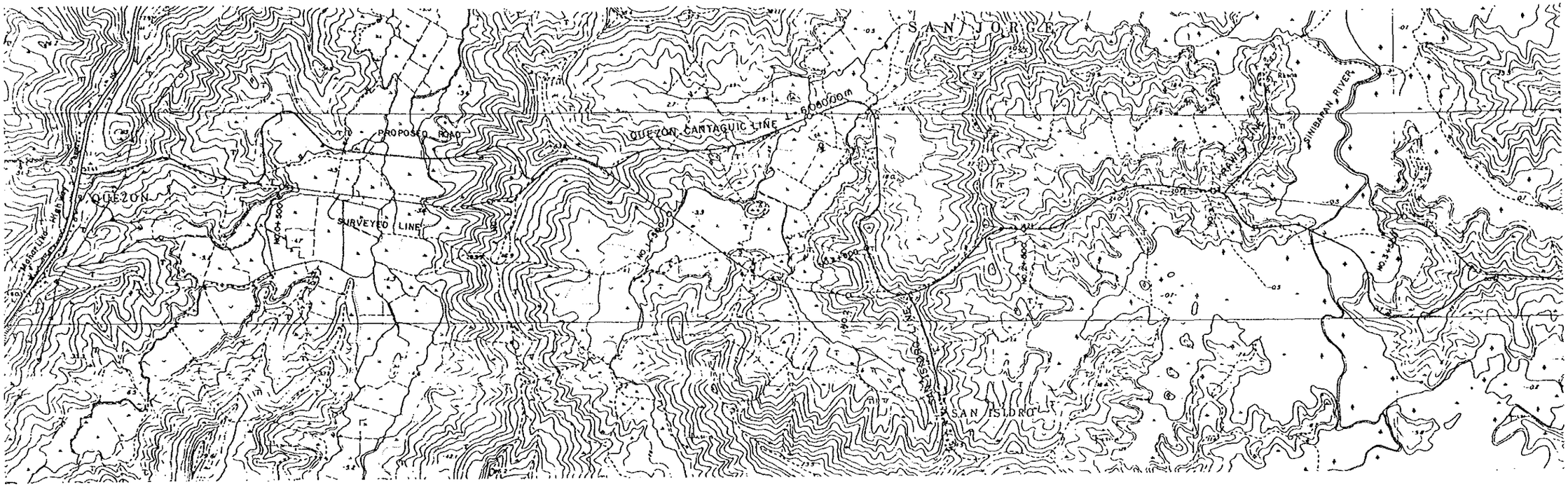
SCALE 1:50



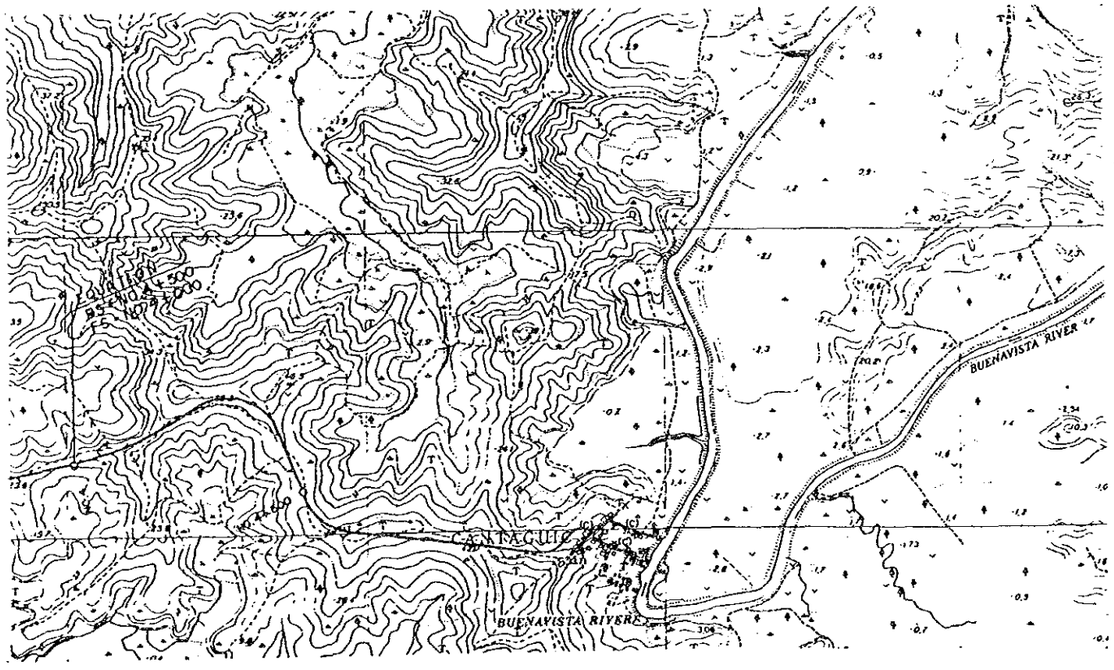
REPUBLIC OF THE PHILIPPINES AGRICULTURAL DEVELOPMENT AND PROMOTION PROJECT IN WESTERN SAMAR (ADPP)	
IRRIGATION FACILITIES TURN OUT & DIVERSION WORKS	
DATE SURVEYED; FEB. 1990	DRAWING NO.
DRAWN BY :	WS - 004
APPROVED BY;	
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	

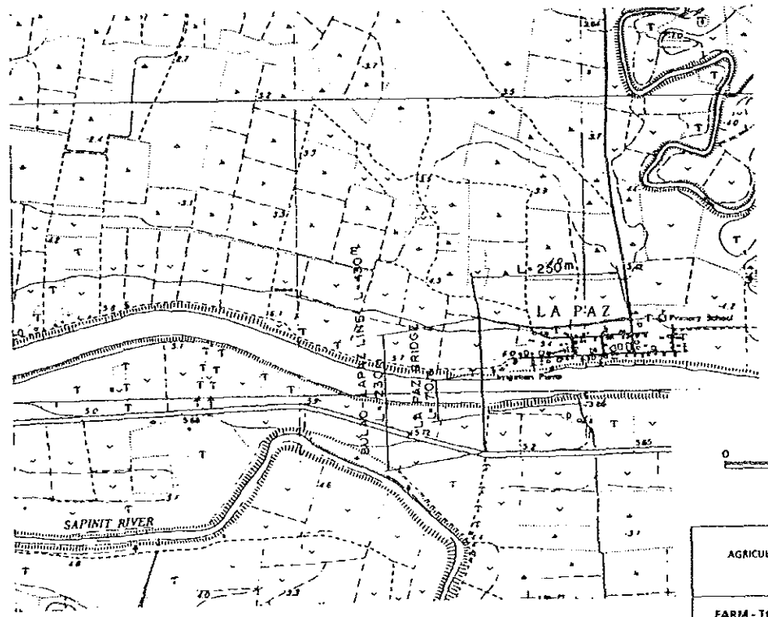
FARM-TO-MARKET ROAD

PLAN OF QUEZON - CANTAGUIC



PLAN OF BULAO - LA PAZ





SCALE 1:5 000

0 100 200 300 400 500

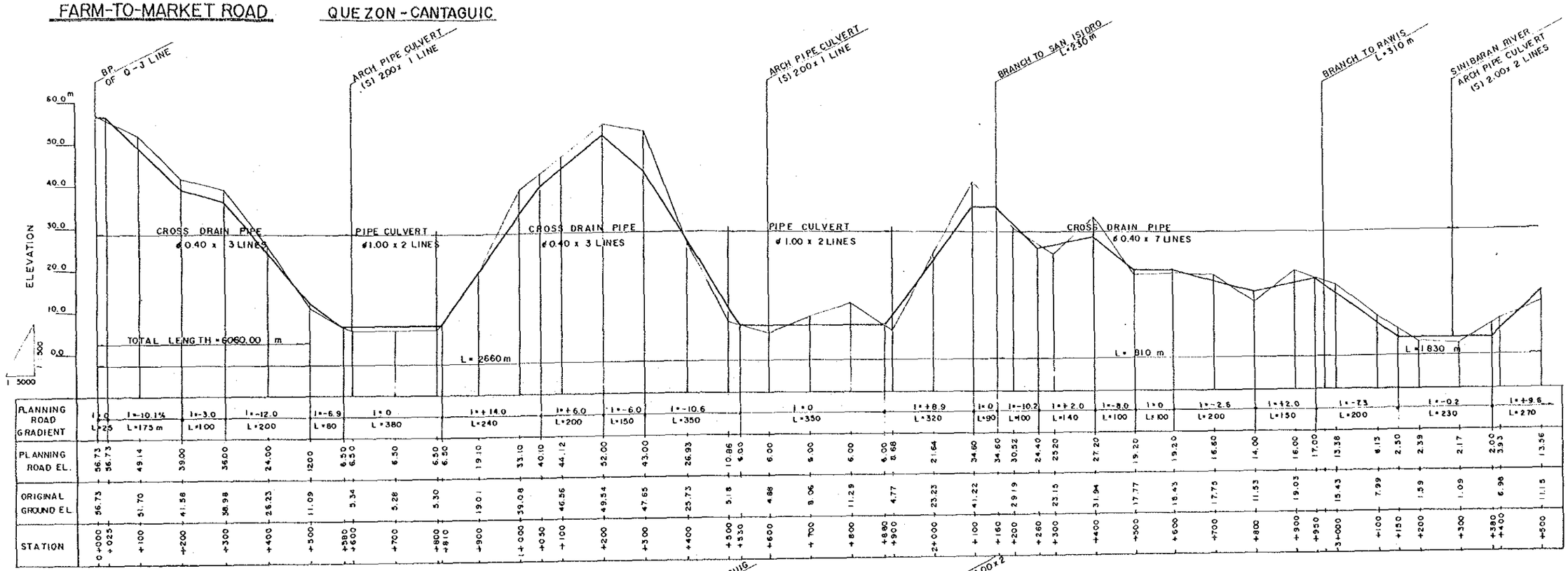
REPUBLIC OF THE PHILIPPINES
AGRICULTURAL DEVELOPMENT AND PROMOTION PROJECT
IN WESTERN SAMAR
(ADPP)

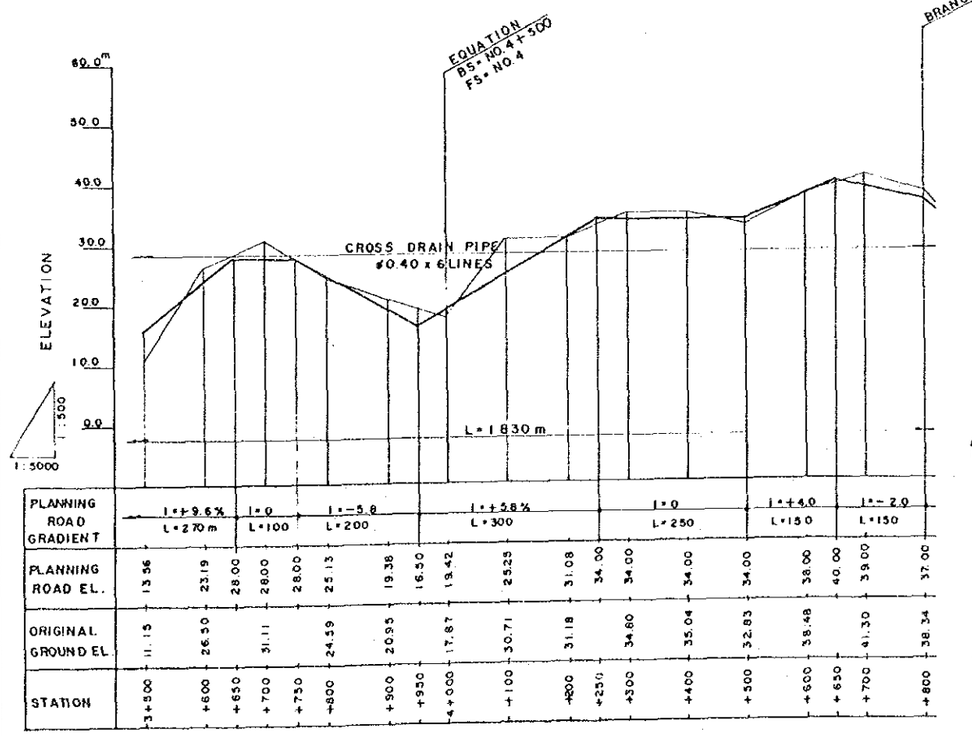
FARM-TO-MARKET ROAD
PLAN OF QUEZON-CANTAGUIC AND
BULAO-LA PAZ

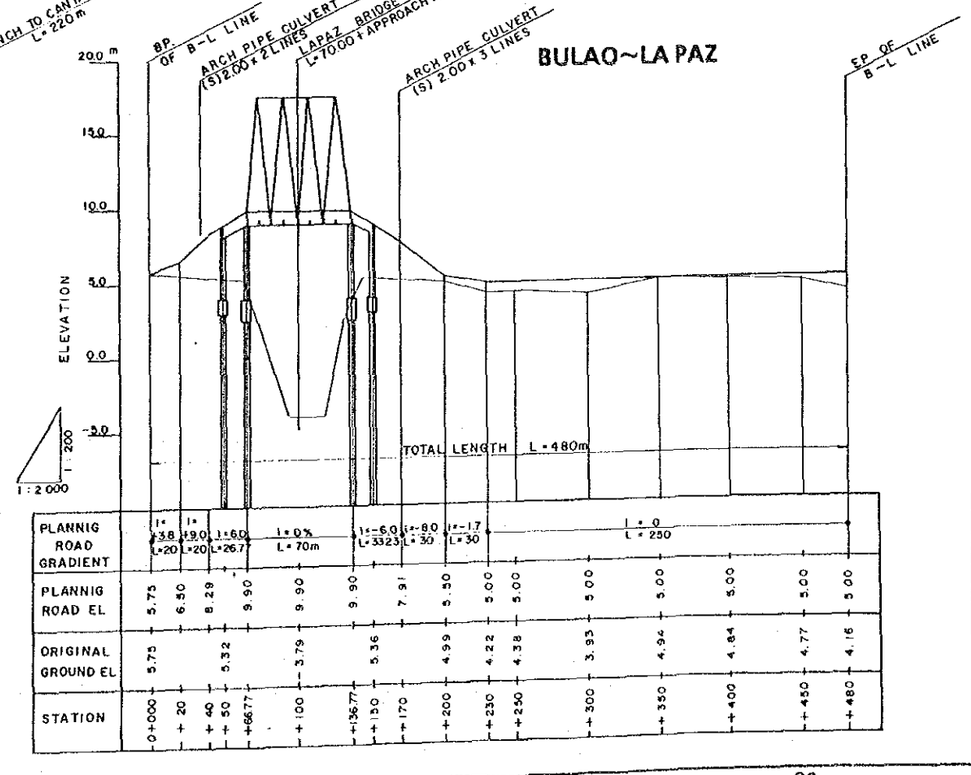
DATE SURVEYED: FEB. 1990	DRAWING NO.
DRAWN BY :	WS-005
APPROVED BY :	

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

FARM-TO-MARKET ROAD　　QUEZON - CANTAGUIC







SCALE 1 : 2000
0 50 100 150 200

SCALE 1 : 200
0 10 20

SCALE 1 : 5000
0 100 200 300 400 500

SCALE 1 : 500
0 10 20 30 40 50

REPUBLIC OF THE PHILIPPINES
AGRICULTURAL DEVELOPMENT AND PROMOTION PROJECT
IN WESTERN SAMAR
(ADPP)

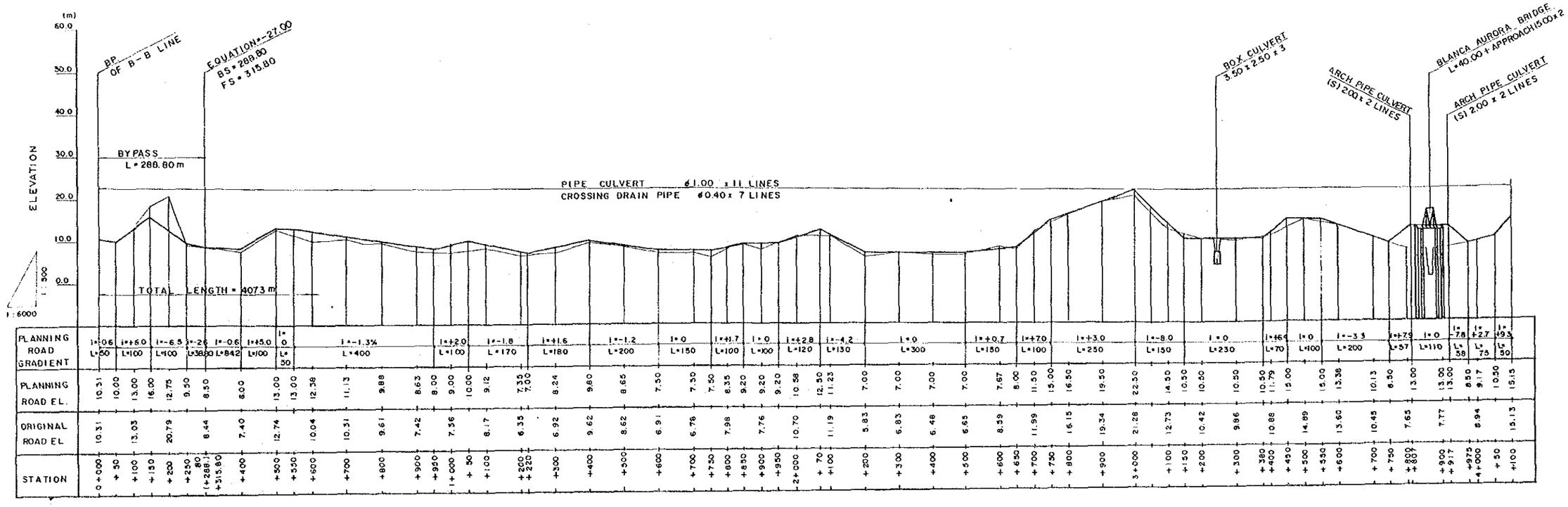
FARM-TO-MARKET ROAD
LONGITUDINAL PROFILE OF
QUEZON~CANTAGUIC AND
BULAO~LA PAZ

DATE SURVEYED: FEB. 1990	DRAWING NO.
DRAWN BY :	WS-006
APPROVED BY:	

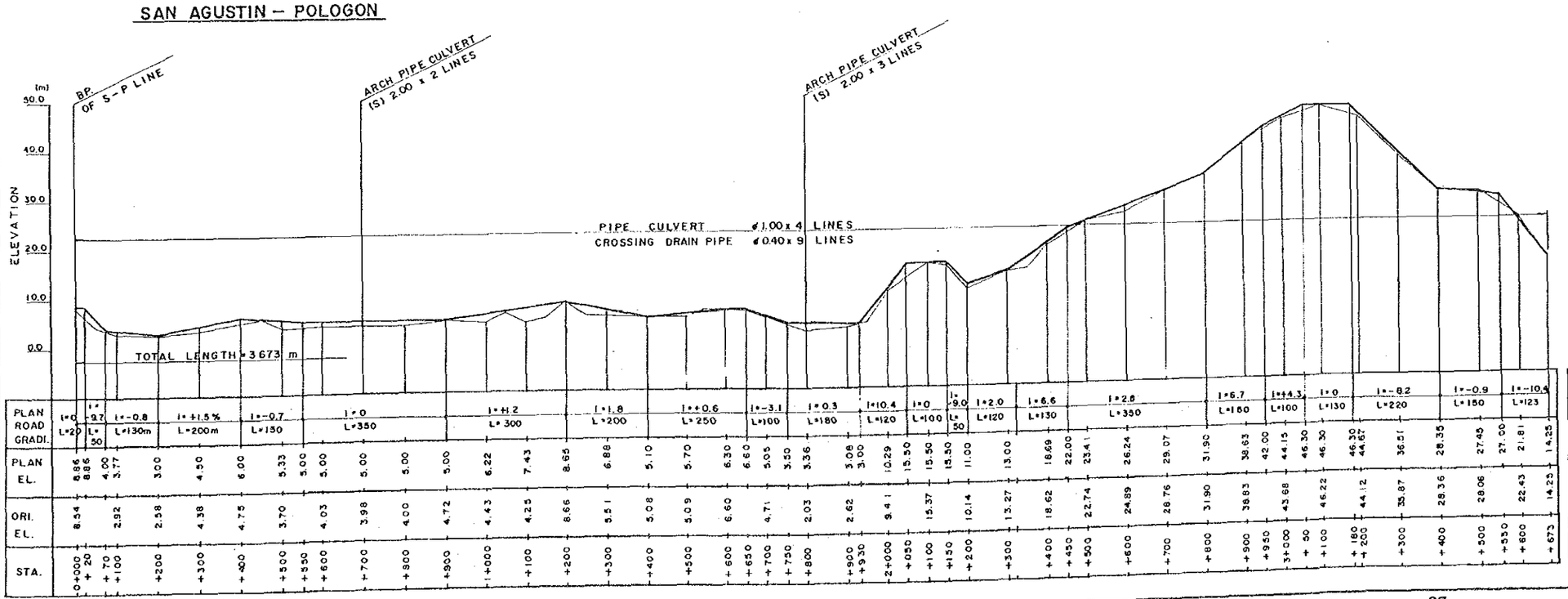
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

FARM-TO-MARKET ROAD

BLANCA AURORA - BUENAVISTA



SAN AGUSTIN - POLOGON



SCALE 1 : 6000
0 100 200 300 400 500 600

SCALE 1 : 500
0 10 20 30 40 50

REPUBLIC OF THE PHILIPPINES
AGRICULTURAL DEVELOPMENT AND PROMOTION PROJECT
IN WESTERN SAMAR
(ADPP)

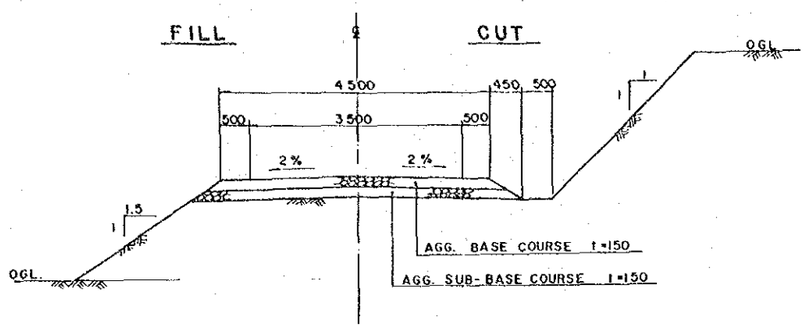
FARM-TO-MARKET ROAD
LONGITUDINAL PROFILE OF
BLANCA AURORA~BUENAVISTA &
SAN AGUSTIN~POLOGON

DATE SURVEYED: FEB. 1990	DRAWING NO.
DRAWN BY :	WS - 007
APPROVED BY :	

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

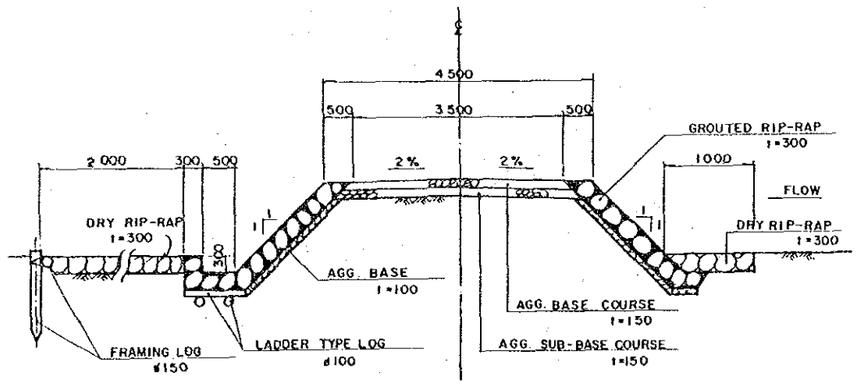
FARM-TO-MARKET ROAD

TYPICAL CROSS SECTION

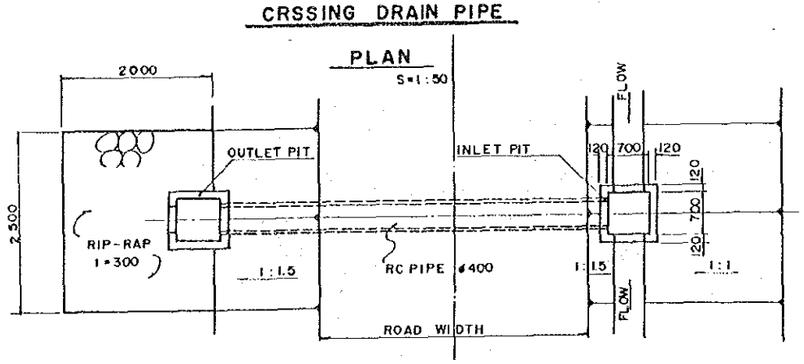


OVER FLOW TYPE ROAD

S=1:50

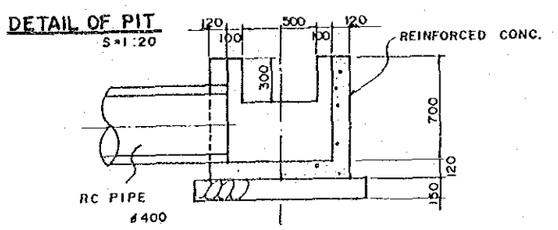


CRSSING DRAIN PIPE



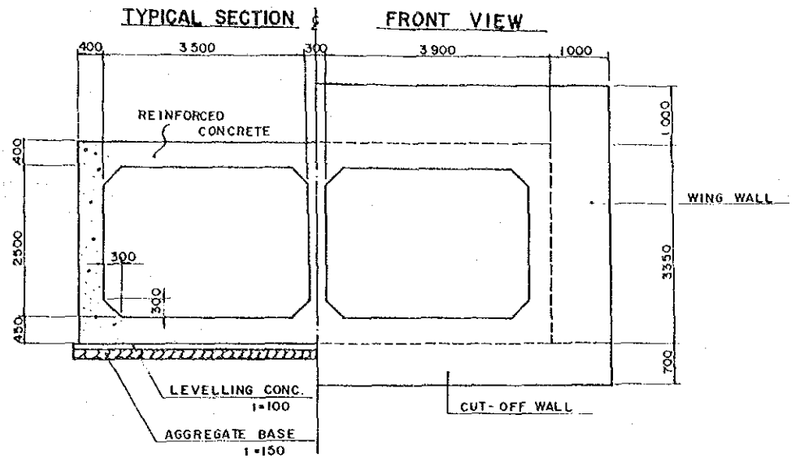
DETAIL OF PIT

S=1:20



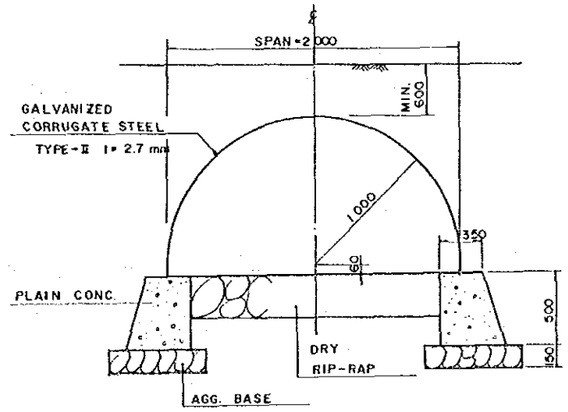
BOX CULVERT AT BLANCA AURORA-BUENAVISTA LINE

S=1:50



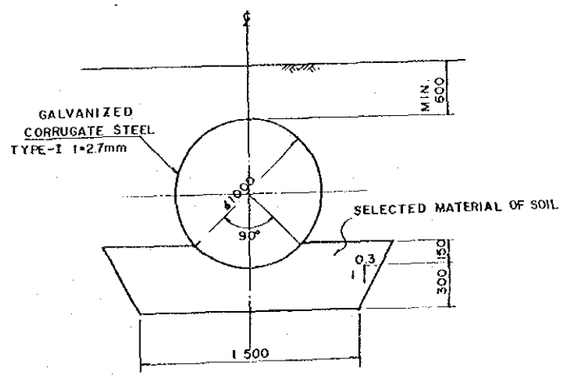
ARCH PIPE CULVERT

S=1:20



PIPE CULVERT

S=1:20



SCALE 1:50

0 1 2 3 4 5

SCALE 1:20

0 1 2

REPUBLIC OF THE PHILIPPINES
AGRICULTURAL DEVELOPMENT AND PROMOTION PROJECT IN WESTERN SAMAR (ADPP)

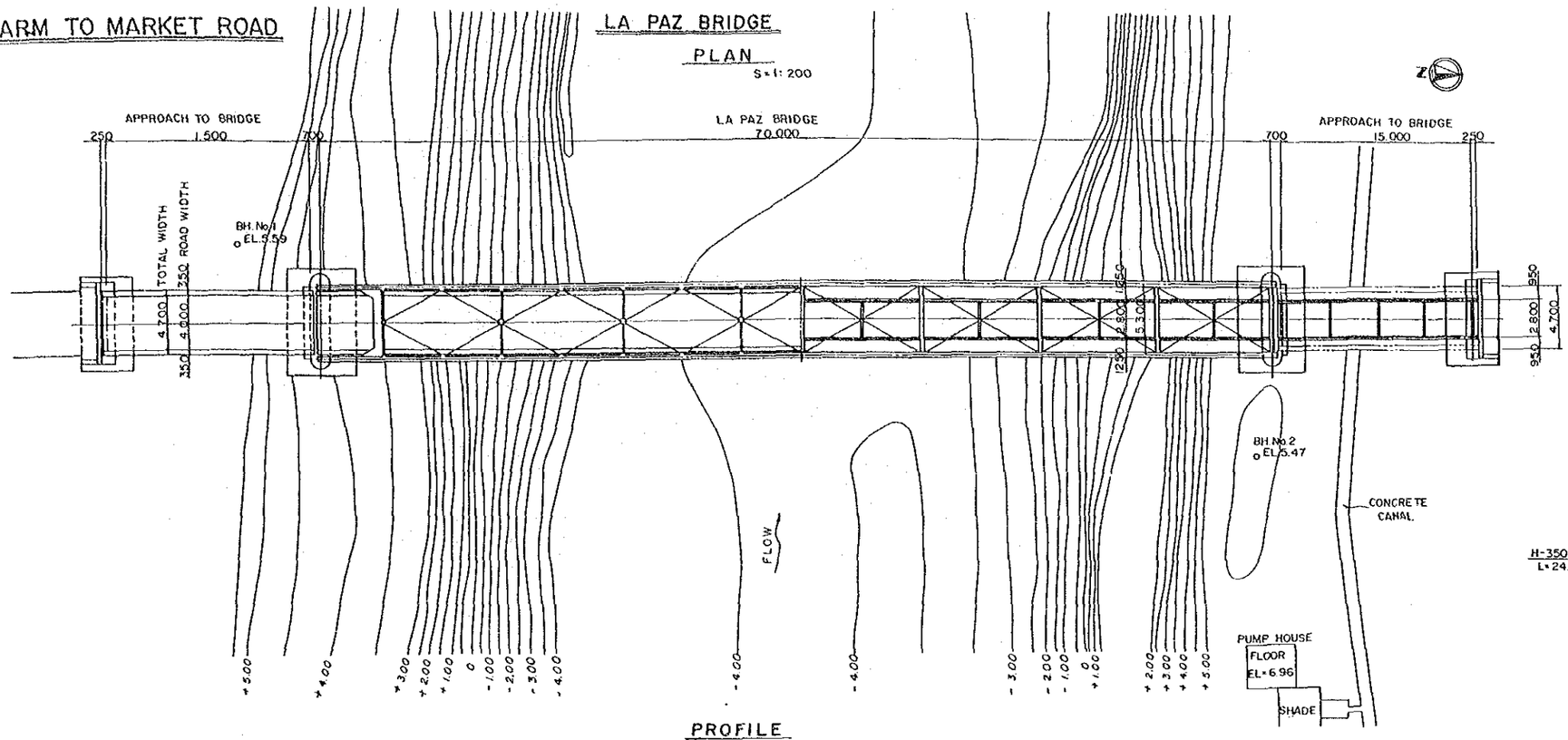
FARM-TO-MARKET ROAD
TYPICAL CROSS SECTION OF ROAD & CROSSING WORKS

DATE SURVEYED: FEB. 1990	DRAWING NO.
DRAWN BY :	WS-008
APPROVED BY :	
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	

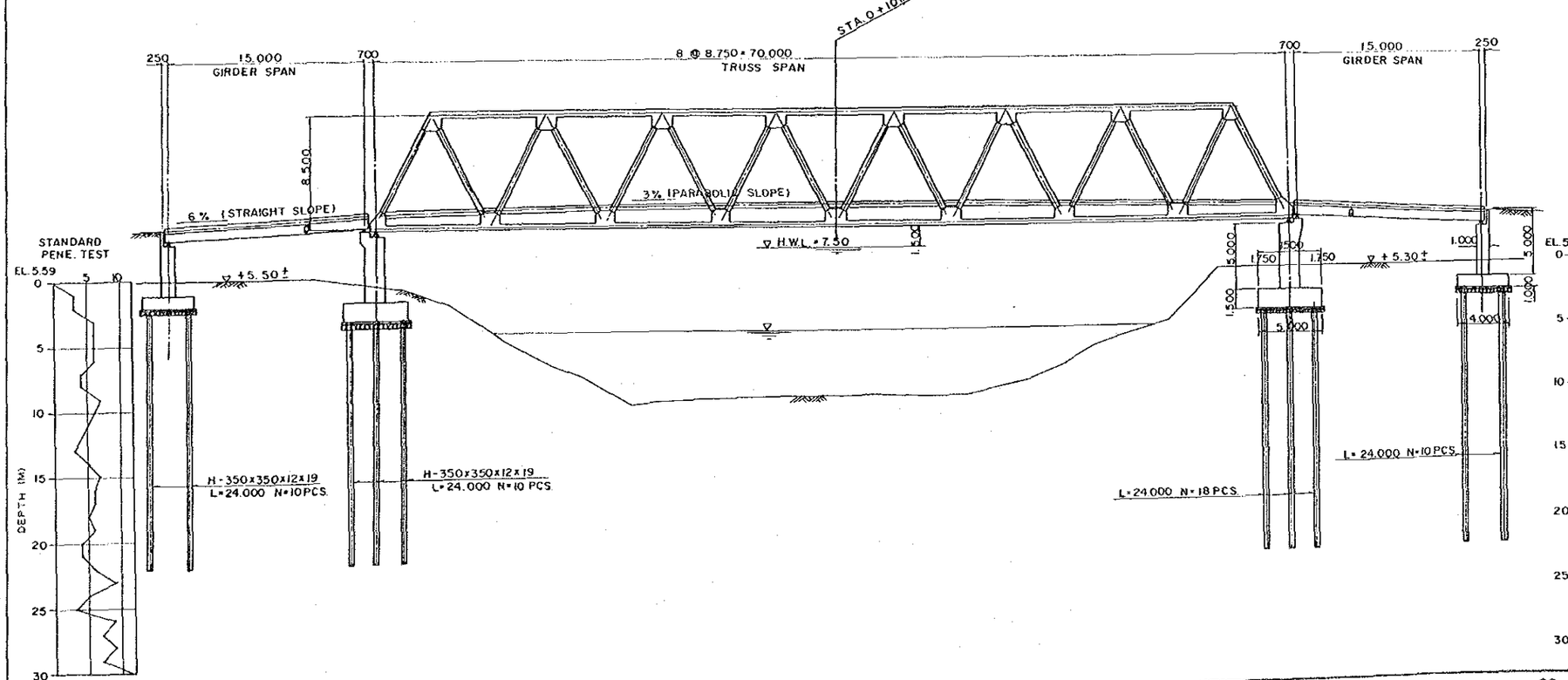
FARM TO MARKET ROAD

LA PAZ BRIDGE

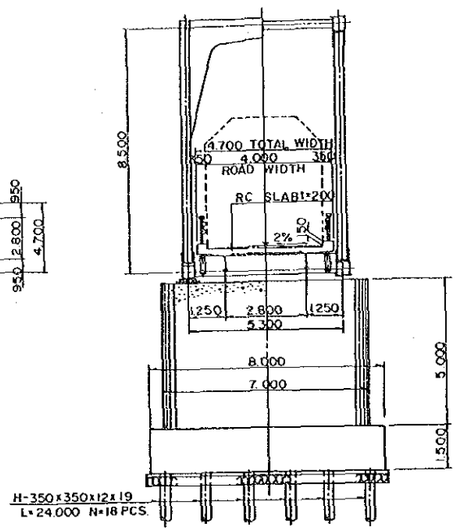
PLAN
S = 1: 200



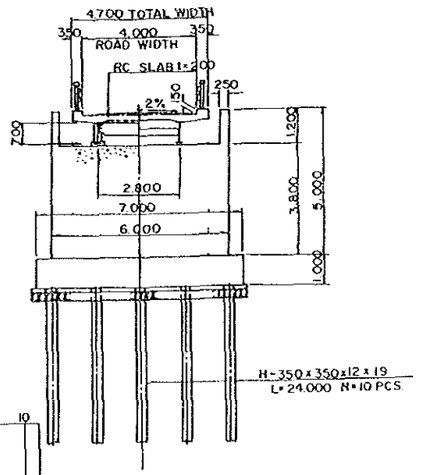
PROFILE
S = 1: 200



GIRDER SPAN
S = 1: 100



TRUSS SPAN
S = 1: 100



SCALE 1: 200

0 5 10 15 20

SCALE 1: 100

0 1 2 3 4 5 10

REPUBLIC OF THE PHILIPPINES
AGRICULTURAL DEVELOPMENT AND PROMOTION PROJECT
IN WESTERN SAMAR
(ADPP)

FARM - TO - MARKET ROAD

LA PAZ BRIDGE

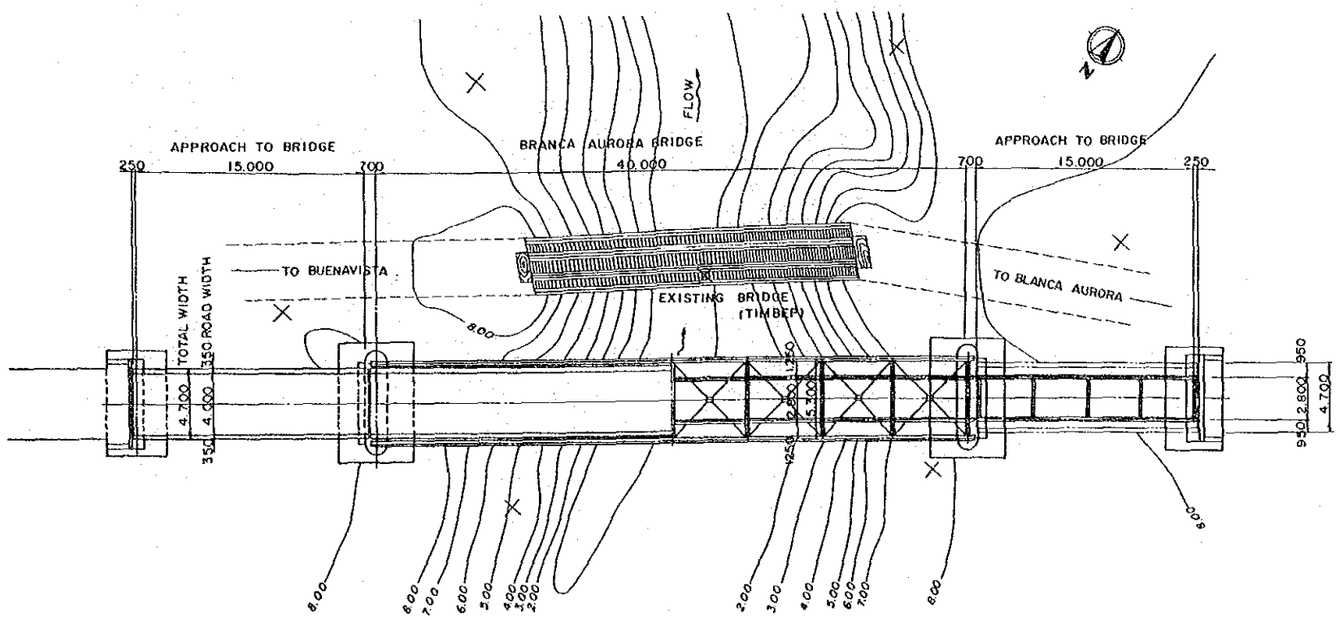
DATE SURVEYED; FEB. 1990	DRAWING NO.
DRAWN BY ;	WS - 009
APPROVED BY ;	

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

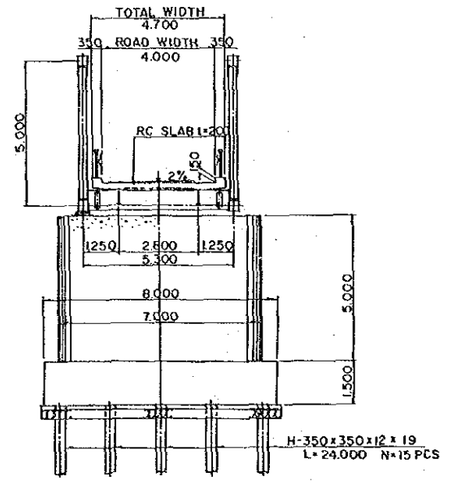
FARM-TO-MARKET ROAD

BLANCA AURORA BRIDGE

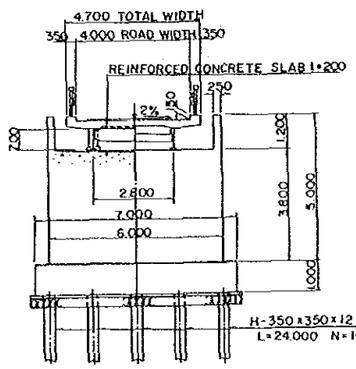
PLAN
S = 1: 200



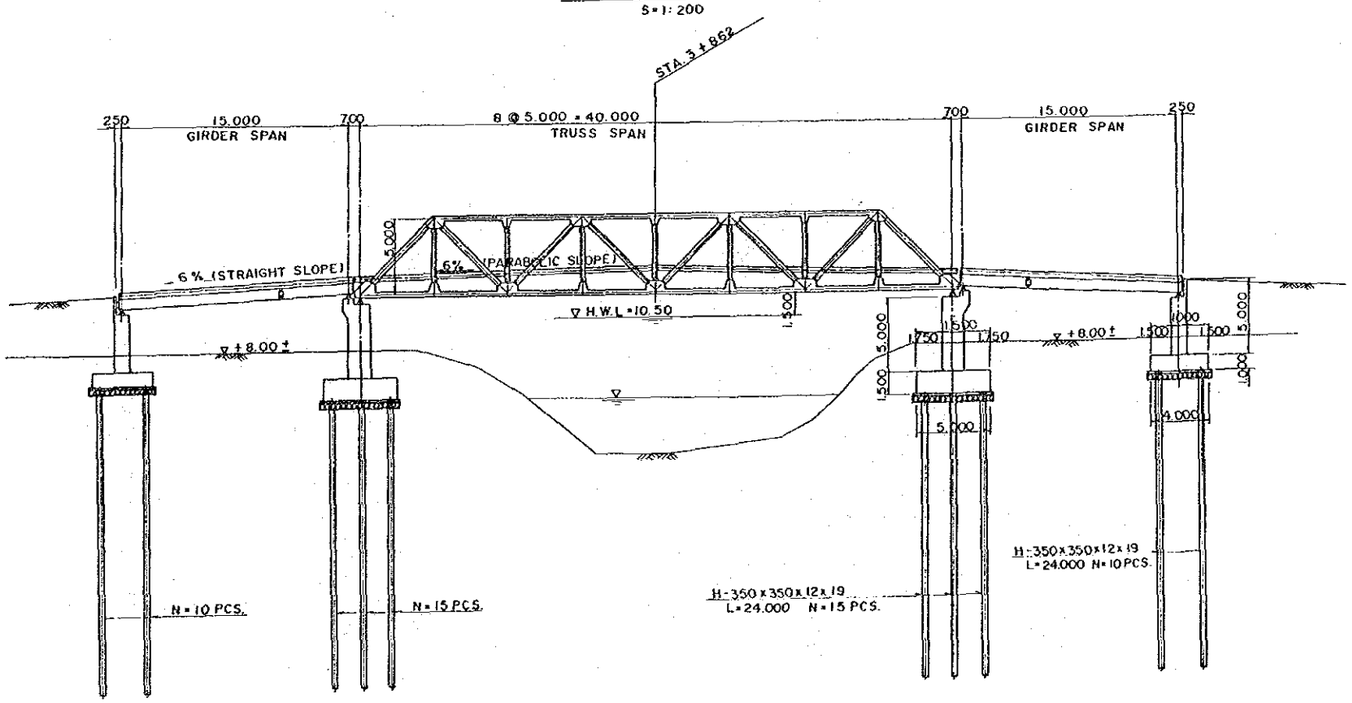
TRUSS SPAN
S = 1: 100



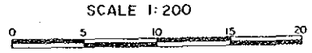
GIRDER SPAN
S = 1: 100



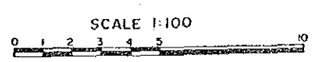
PROFILE
S = 1: 200



SCALE 1: 200



SCALE 1: 100



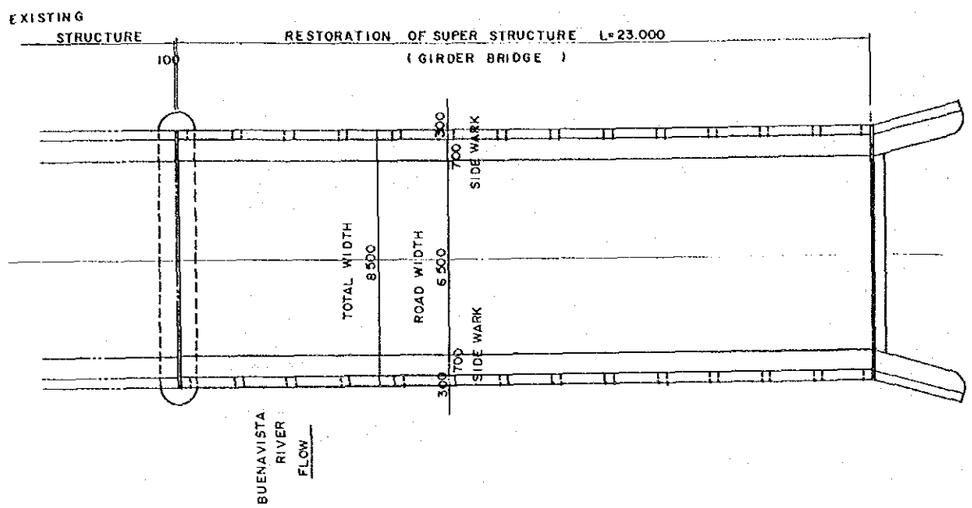
REPUBLIC OF THE PHILIPPINES AGRICULTURAL DEVELOPMENT AND PROMOTION PROJECT IN WESTERN SAMAR (ADPP)	
FARM-TO-MARKET ROAD BLANCA AURORA BRIDGE	
DATE SURVEYED: FEB. 1990	DRAWING NO.
DRAWN BY :	WS-010
APPROVED BY:	
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	

FARM TO MARKET ROAD

RESTORATION OF BUENAVISTA BRIDGE

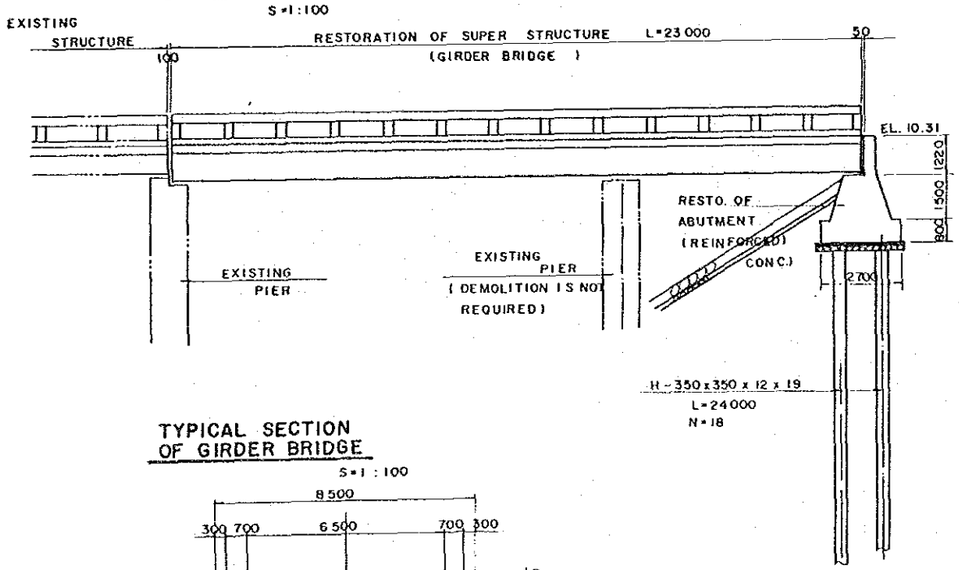
PLAN

S=1:100



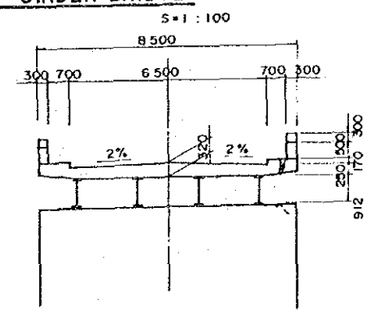
PROFILE

S=1:100



TYPICAL SECTION OF GIRDER BRIDGE

S=1:100



SCALE 1:100

0 1 2 3 4 5 10

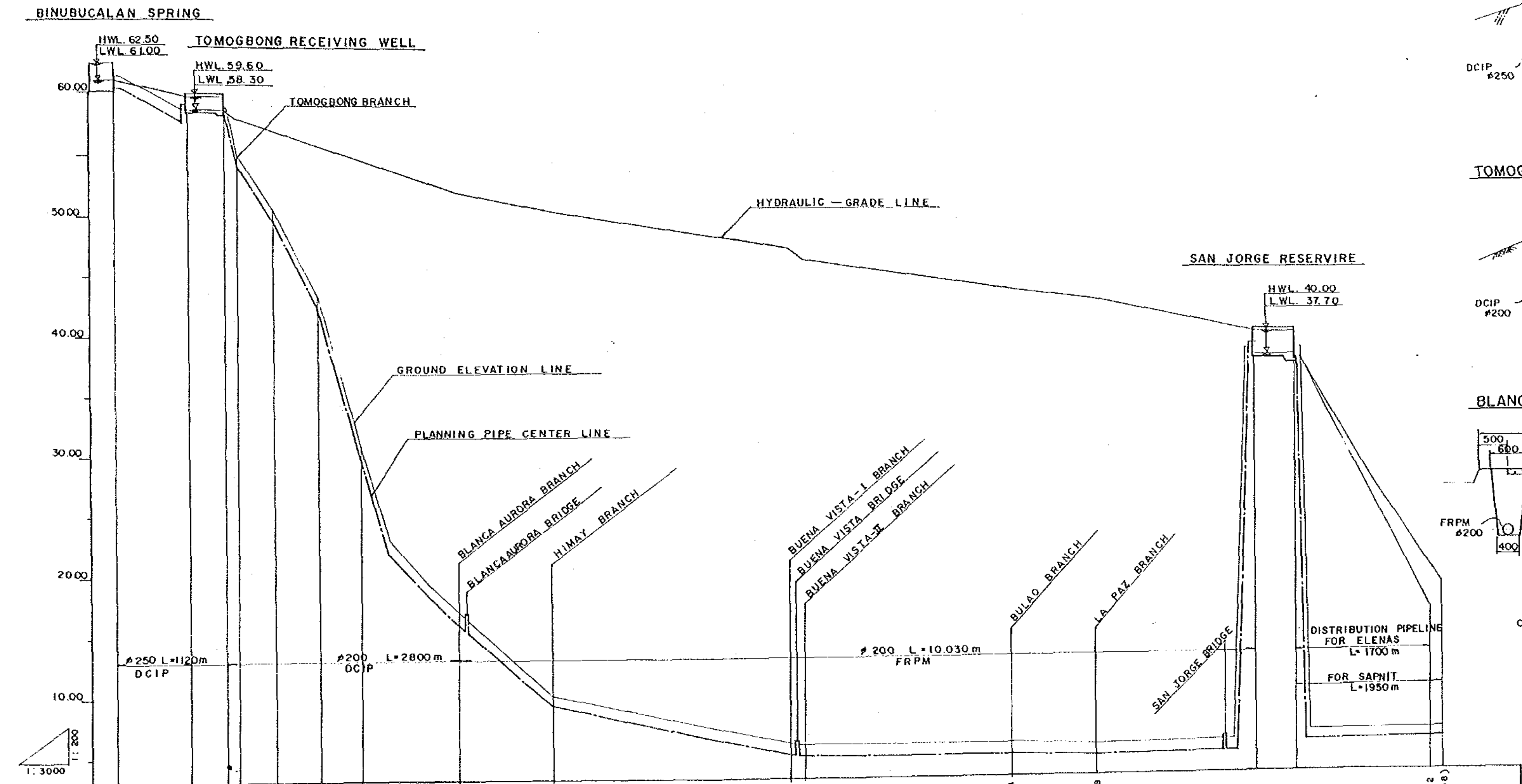
SCALE 1:50

0 1 2 3 4 5

REPUBLIC OF THE PHILIPPINES AGRICULTURAL DEVELOPMENT AND PROMOTION PROJECT IN WESTERN SAMAR (ADPP)	
FARM-TO-MARKET TOAD RESTORATION OF BUENAVISTA BRIDGE	
DATE SURVEYED: FEB. 1990	DRAWING NO.
DRAWN BY :	WS-011
APPROVED BY:	
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	

VILLAGE WATER SUPPLY

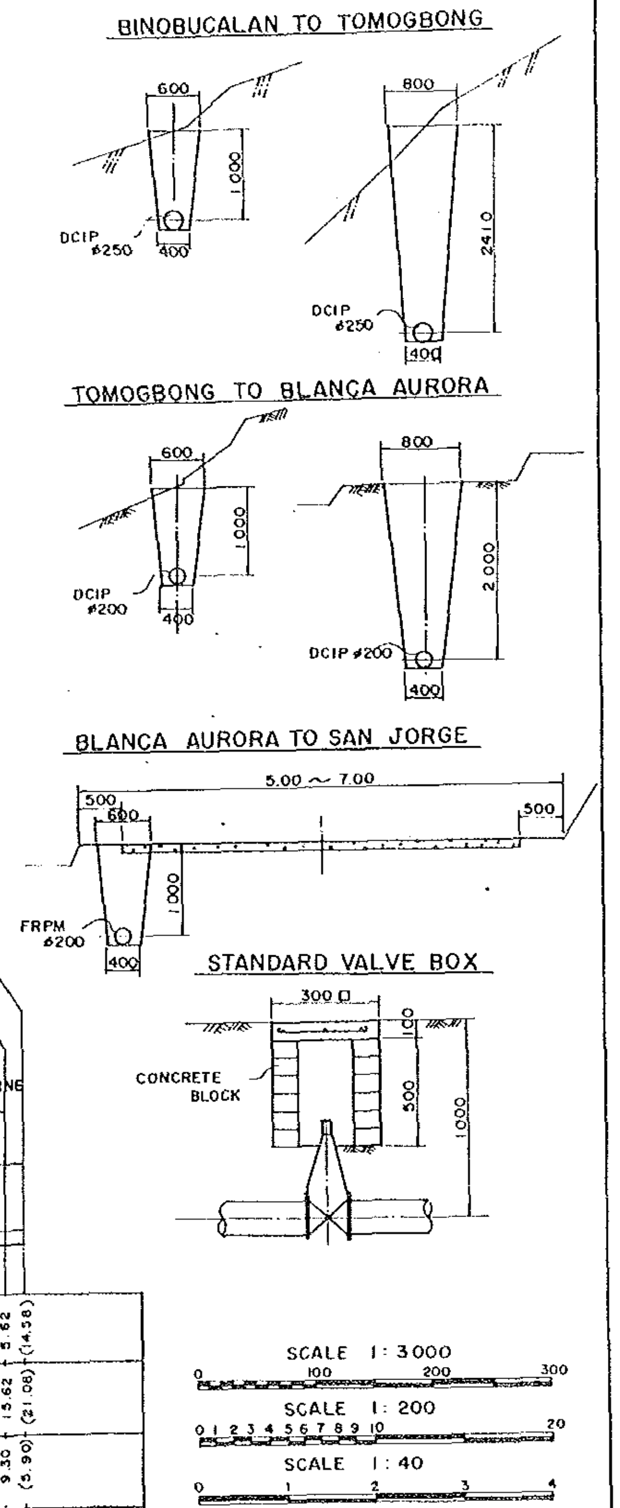
GENERAL PROFILE OF WATER TRANSMISSION PIPELINE



DYNAMIC WATER PRESSURE			3.08				34.68	40.32	40.26	39.64	37.44	37.58			5.62	(14.58)
HYDRAULIC LEVEL	(HWL) 62.50 61.00 (LWL)	(HWL) 59.60 58.30 (LWL)	57.89			54.49	51.76	50.41	46.96	46.00	43.64	42.78	HWL 40.00 LWL 37.70		15.62	(21.08)
PLANNING PIPE CENTER	59.70	58.30	51.70				15.88	8.89	5.50	5.16	5.00	4.00	36.80	36.80	9.30	(5.90)
GROUND ELEVATION	62.33	58.30	58.30 52.78	50.33	43.39	30.96	17.08	10.09	6.70	6.36	6.20	5.20	38.00	38.00	10.00	(6.50)
DISTANCE	0.00	1,120	0 100.0	500.	500	500	1,200	1,150	2,950	170	2,600	1,100	2,060	0.00	1700	(1950)
ACCUMULATIVE DISTANCE	0	1,120	0 100.0		1,100	1600	2,800	3,950	6,900	7,070	9,670	10,770	12,830	0.00	1700	(1950)
NAME OF BARANGAY	BINUBUCALAN SPRING	TOMOGBONG RECEIVING WELL	TOMOGBONG				BLANCA AURORA	HIMAY	BUENA VISTA I	BUENA VISTA II	BULAO	LA PAZ BRANCH	SAN JORGE	RESER VOIR	ERENAS	SAPNIT

TYPICAL CROSS SECTION OF PIPELINE

S=1:40



REPUBLIC OF THE PHILIPPINES
AGRICULTURAL DEVELOPMENT AND PROMOTION PROJECT IN WESTERN SAMAR
(ADPP)

VILLAGE WATER SUPPLY
GENERAL LAYOUT OF WATER TRANSMISSION PIPELINE

DATE SURVEYED; FEB. 1990	DRAWING NO.
DRAWN BY ;	WS-012
APPROVED BY;	
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	

VILLAGE WATER SUPPLY

BINUBUKALAN INTAKE

GENERAL PLAN
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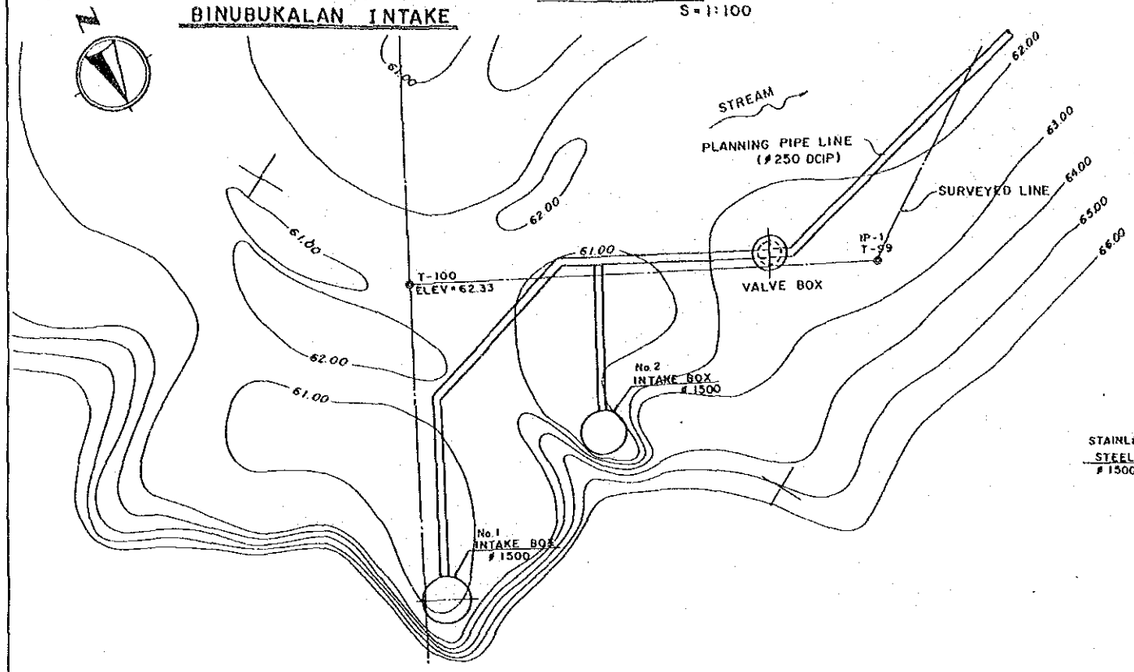

LONGITUDINAL CROSS SECTION
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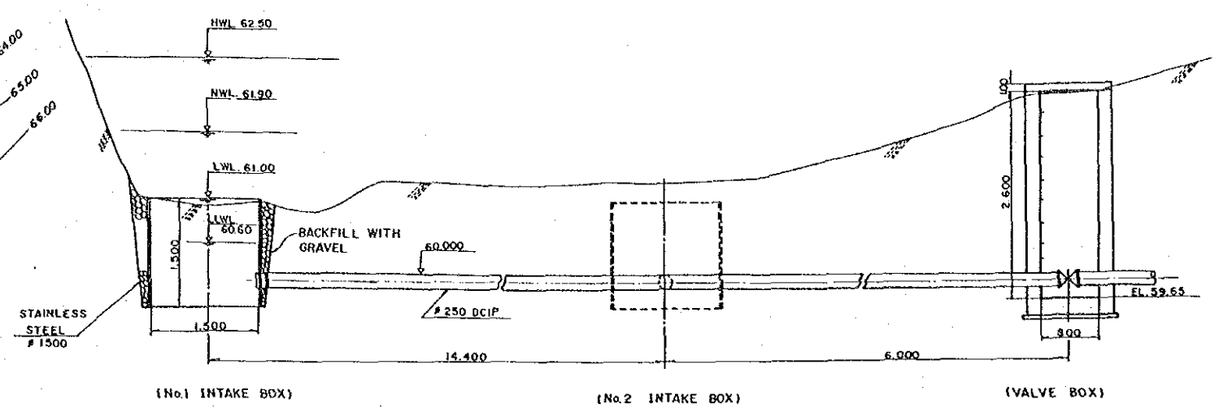

TOMOGBONG RECEIVING WELL

GENERAL PLAN
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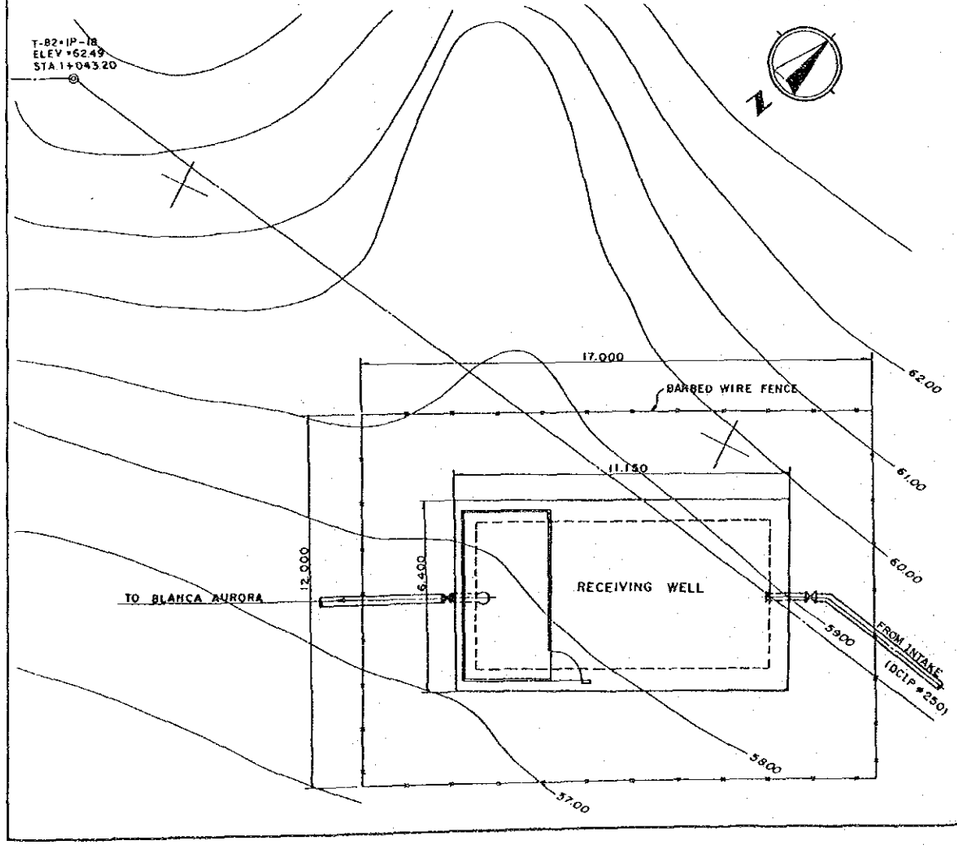

PLAN OF RECEIVING WELL
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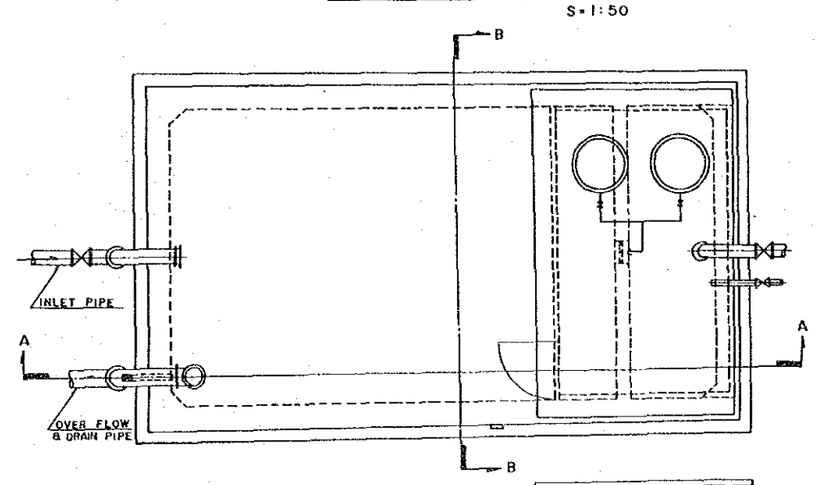
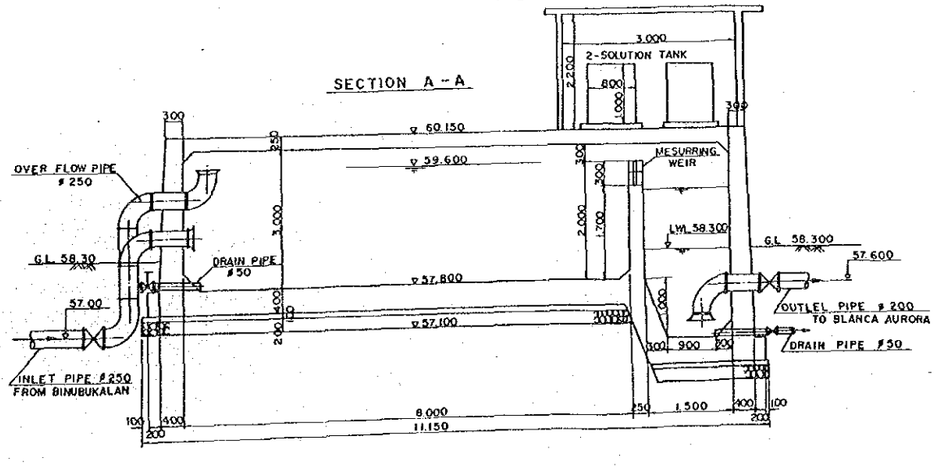
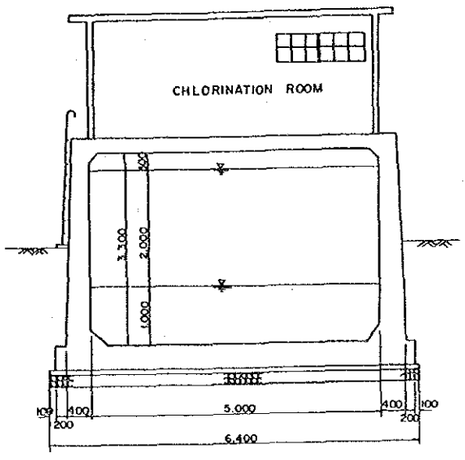


SECTION A - A



SECTION B - B



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SCALE 1:50
0 10 20 30 40 50

SCALE 1:40
0 10 20 30 40

REPUBLIC OF THE PHILIPPINES
AGRICULTURAL DEVELOPMENT AND PROMOTION PROJECT
IN WESTERN SAMAR
(ADPP)

VILLAGE WATER SUPPLY
BINUBUCALAN INTAKE & TOMOGBONG
RECEIVING WELL

DATE SURVEYED: FEB. 1990	DRAWING NO.
DRAWN BY :	WS-013
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JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	

VILLAGE WATER SUPPLY

SAN JORGE RESERVOIR
GENERAL PLAN
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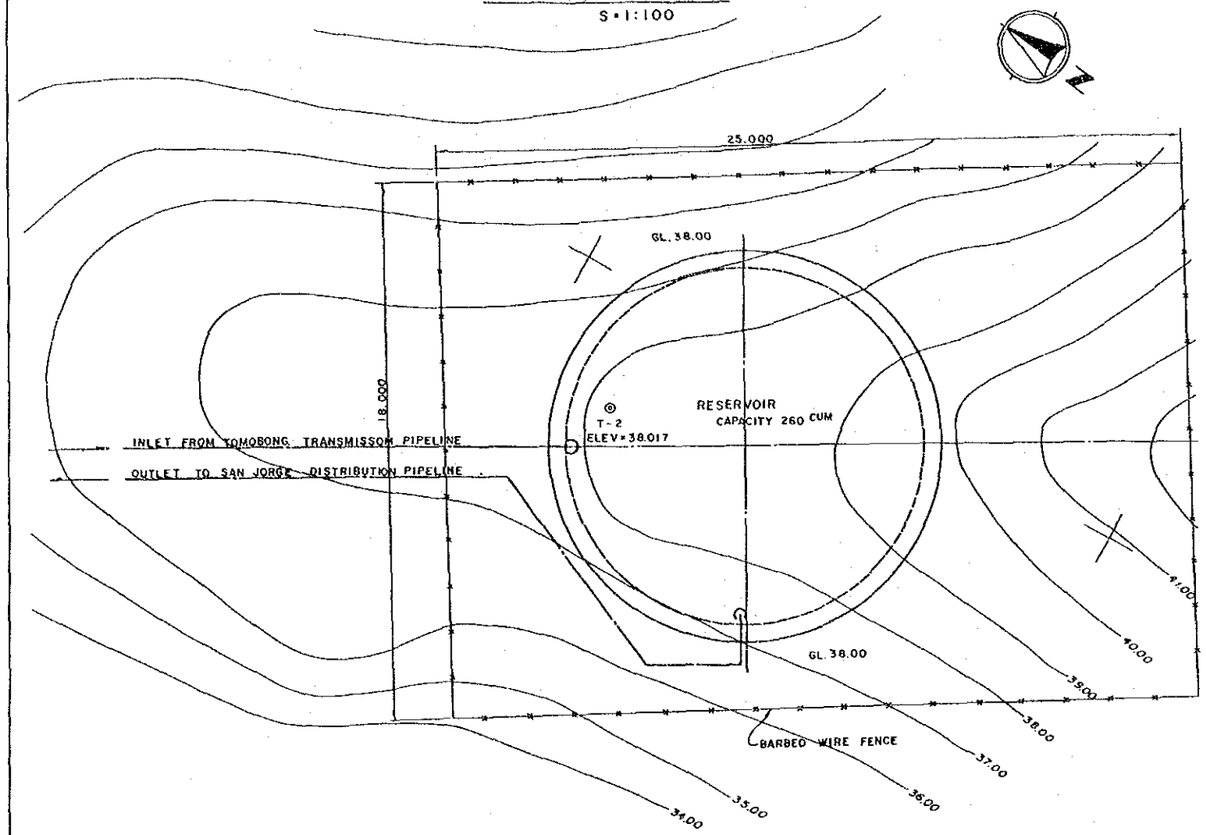
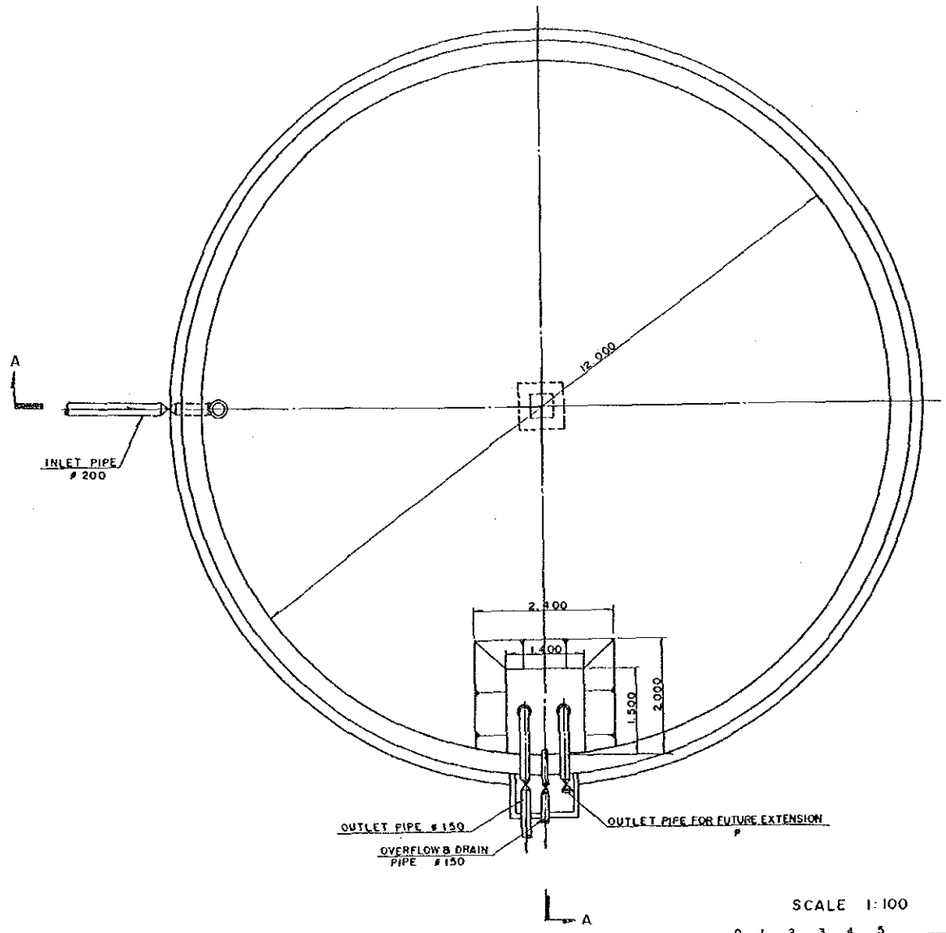


PLAN OF RESERVOIR
S = 1: 50



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SECTION A - A
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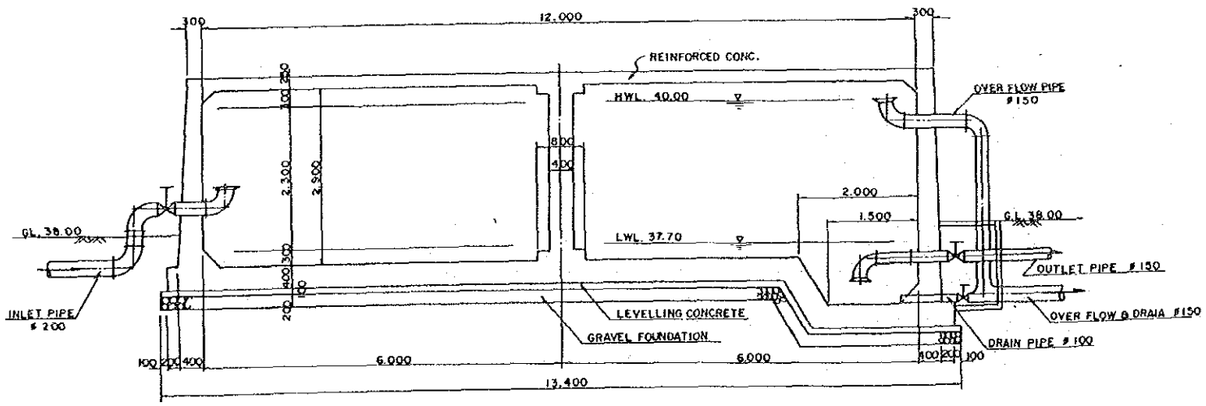
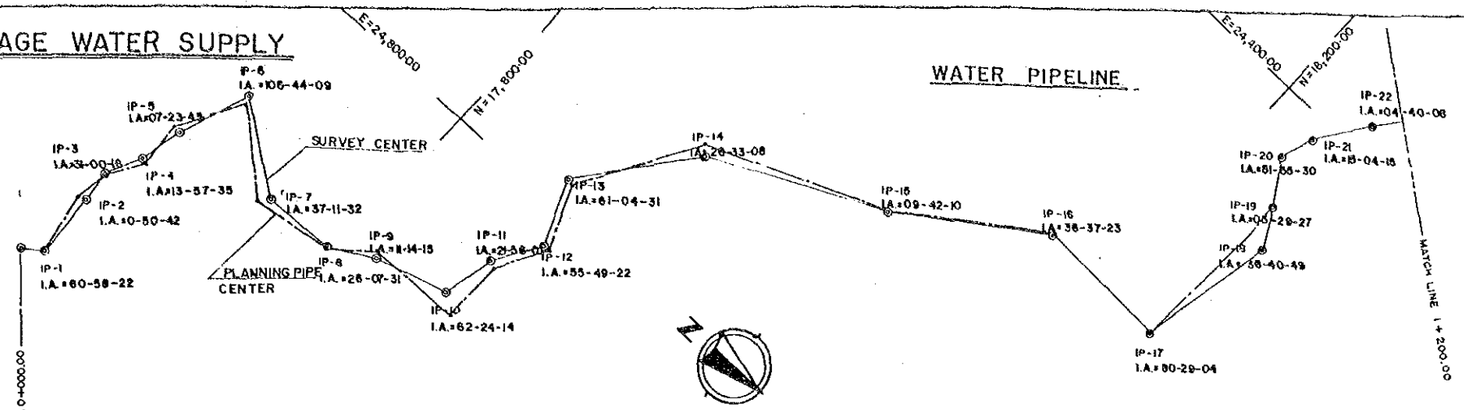
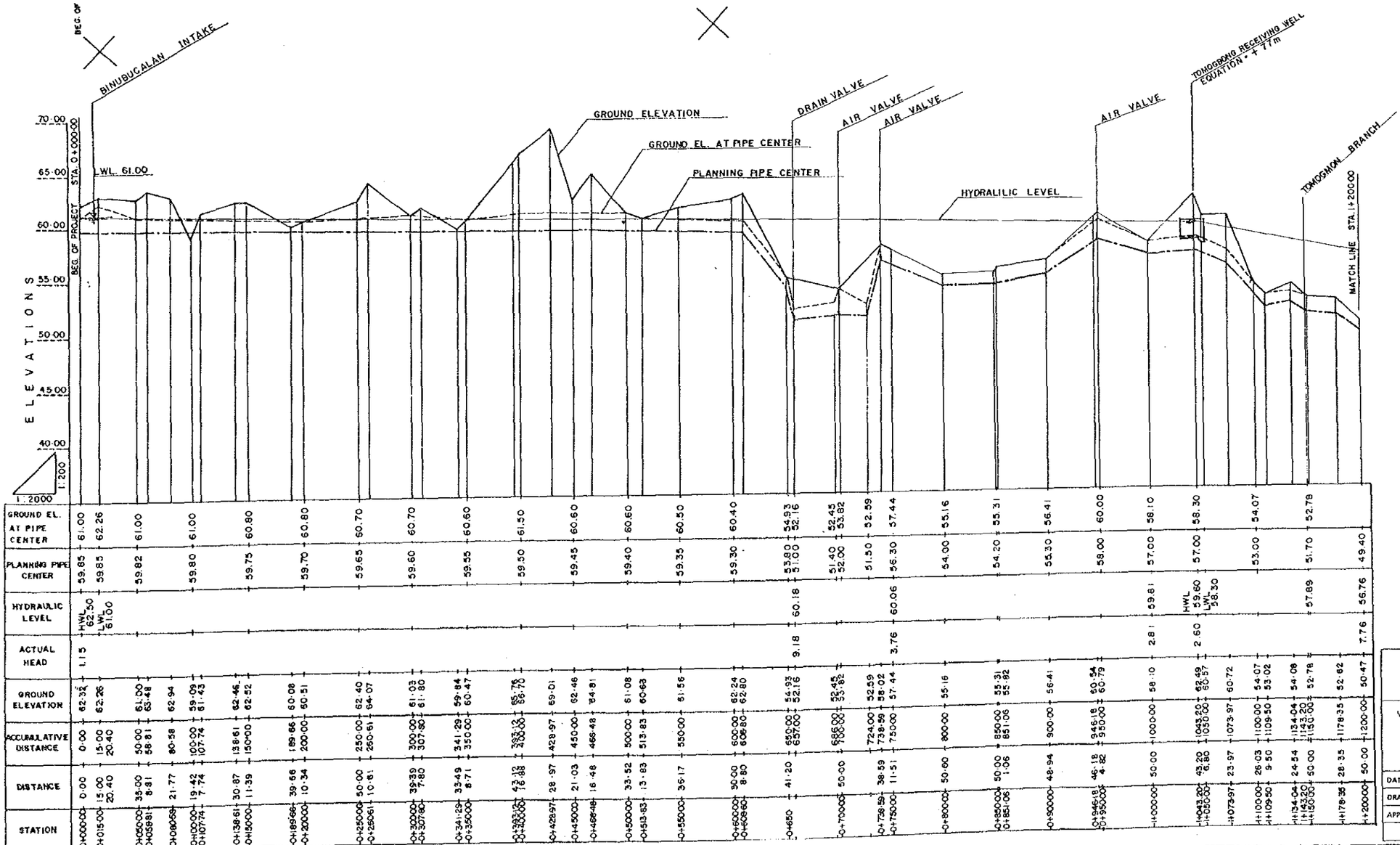


REPUBLIC OF THE PHILIPPINES AGRICULTURAL DEVELOPMENT AND PROMOTION PROJECT IN WESTERN SAMAR (ADPP)	
VILLAGE WATER SUPPLY SAN JORGE DISTRIBUTION RESERVOIR	
DATE SURVEYED; FEB. 1990	DRAWING NO.
DRAWN BY ;	WS-014
APPROVED BY;	
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	

VILLAGE WATER SUPPLY

WATER PIPELINE





STATION	DISTANCE	ACCUMULATIVE DISTANCE	GROUND ELEVATION	ACTUAL HEAD	HYDRAULIC LEVEL	PLANNING PIPE CENTER	GROUND EL. AT PIPE CENTER
0+000.00	0.00	0.00	62.26	1.15	HWL 62.50	59.85	61.00
0+015.00	15.00	15.00	62.26		LWL 61.00	59.85	62.26
	20.40	20.40					
0+050.00	35.00	50.00	61.00			59.82	61.00
0+058.81	8.81	58.81	63.48				
0+080.58	21.77	80.58	62.94			59.80	61.00
0+100.00	19.42	100.00	59.09				
0+107.74	7.74	107.74	61.43				
0+138.61	30.87	138.61	62.46			59.75	60.80
0+150.00	11.39	150.00	62.52				
0+189.66	39.66	189.66	60.08			59.70	60.80
0+200.00	10.34	200.00	60.51				
0+250.00	50.00	250.00	62.40			59.65	60.70
0+260.61	10.61	260.61	64.07				
0+300.00	39.39	300.00	61.03			59.60	60.70
0+307.80	7.80	307.80	61.80				
0+341.29	33.49	341.29	59.84			59.55	60.60
0+350.00	8.71	350.00	60.47				
0+393.13	43.13	393.13	60.78			59.50	61.50
0+400.00	16.88	400.00	60.70				
0+428.97	28.97	428.97	59.01			59.45	60.60
0+450.00	21.03	450.00	62.46				
0+468.48	18.48	466.48	64.81			59.40	60.60
0+500.00	33.52	500.00	61.08				
0+513.83	13.83	513.83	60.63			59.35	60.50
0+550.00	36.17	550.00	61.56			59.30	60.40
0+600.00	50.00	600.00	62.24			55.80	54.93
0+608.80	8.80	608.80	62.80			51.00	52.16
0+650	41.20	650.00	54.93	9.18	60.18	51.40	52.45
0+700.00	50.00	657.00	52.16			52.00	53.82
		666.00	52.45			51.50	52.59
		700.00	53.82				
0+738.59	38.59	724.00	52.59	3.76	60.06	56.30	57.44
0+750.00	11.41	738.59	58.02				
		750.00	57.44				
0+800.00	50.00	800.00	55.16			54.00	55.16
0+850.00	50.00	850.00	55.31			54.20	55.31
0+851.06	1.06	851.06	55.82				
0+900.00	48.94	900.00	56.41			55.30	56.41
0+946.18	46.18	946.18	60.54			58.00	60.00
0+950.00	4.82	950.00	60.79				
1+000.00	50.00	1000.00	58.10	2.81	59.81	57.00	58.10
1+043.20	43.20	1043.20	62.49	2.60	HWL 59.60 LWL 58.30	57.00	58.30
1+050.00	6.80	1050.00	60.57				
1+073.97	23.97	1073.97	60.72				
1+100.00	26.03	1100.00	54.07			53.00	54.07
1+109.50	9.50	1109.50	53.02				
1+134.04	24.54	1134.04	54.08		57.89	51.70	52.78
1+150.00	15.96	1150.00	52.78				
1+178.35	28.35	1178.35	52.62				
1+200.00	50.00	1200.00	50.47	7.76	56.76	49.40	

SCALE 1:2000
0 100 200

SCALE 1:200
0 5 10 15 20

REPUBLIC OF THE PHILIPPINES
AGRICULTURAL DEVELOPMENT AND PROMOTION PROJECT
IN WESTERN SAMAR
(ADPP)

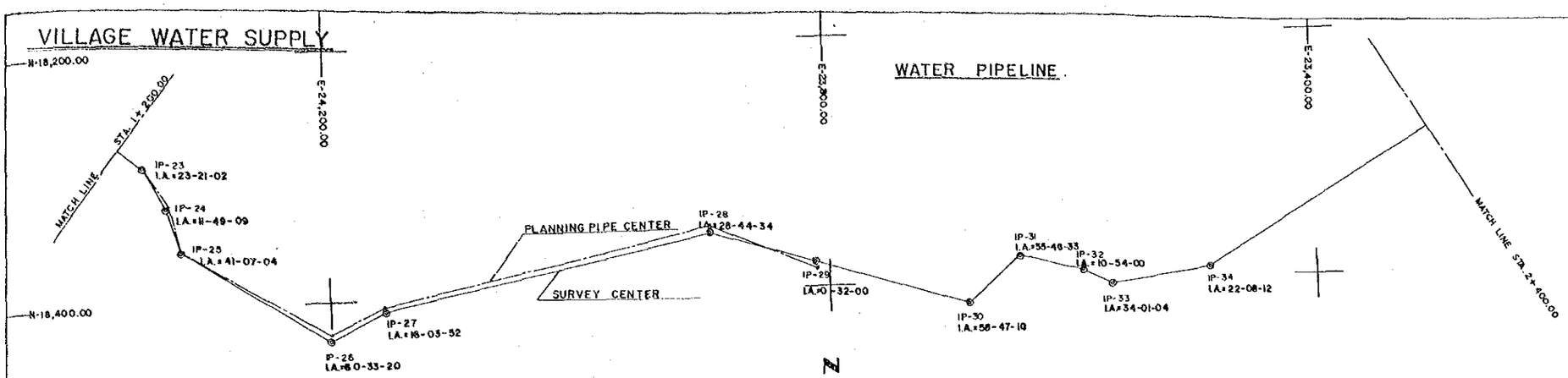
VILLAGE WATER SUPPLY
LONGITUDINAL PROFILE OF PIPELINE-1
(BINUBUCALAN TO TOMOGBONG)

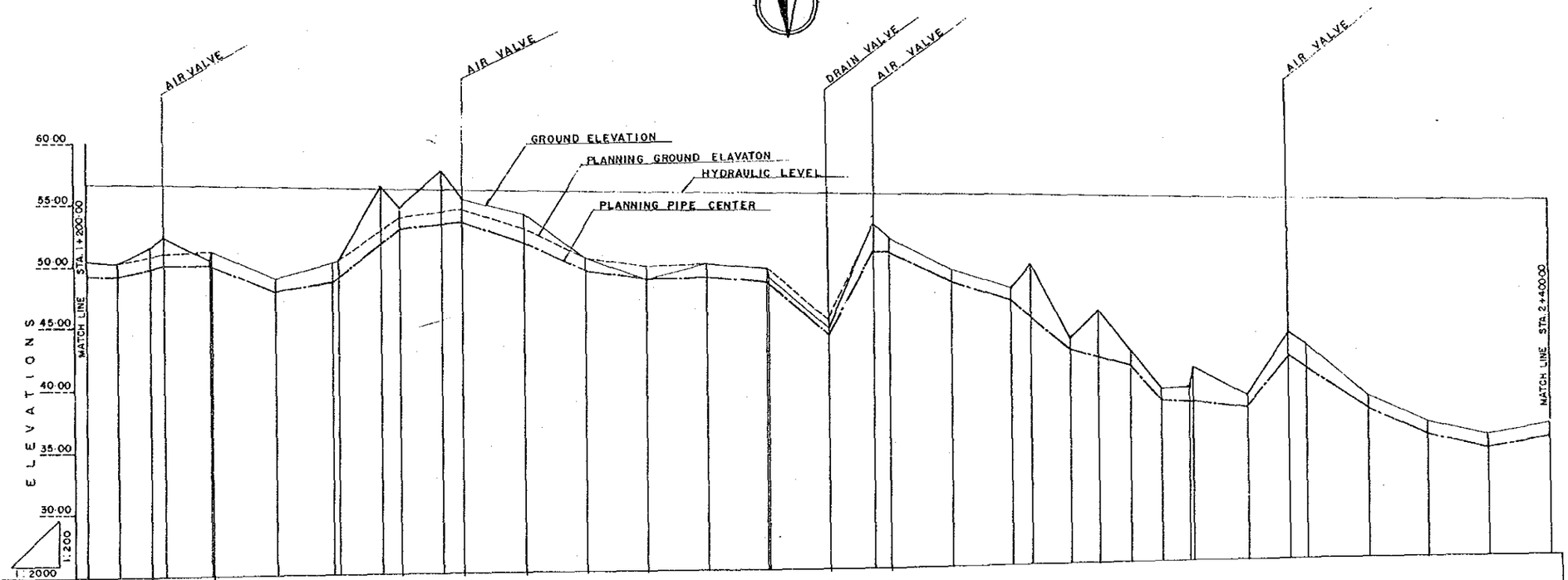
DATE SURVEYED: FEB. 1990	DRAWING NO.
DRAWN BY :	WS-015
APPROVED BY :	

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

VILLAGE WATER SUPPLY

WATER PIPELINE





STATION	DISTANCE	ACCUMULATIVE DISTANCE	GROUND ELEVATION	ACTUAL HEAD	HYDRAULIC LEVEL	PLANNING PIPE CENTER	PLANNING GROUND ELEVATION
1+200.00	50.00	1200.00	50.47	7.76	56.76	49.40	50.00
1+224.10	24.10	1224.10	50.20			49.20	
1+250.00	25.90	1250.00	51.52				
1+260.39	10.39	1260.39	52.93				
1+297.59	27.20	1297.59	54.36				
1+300.00	2.41	1300.00	51.12			50.00	
1+350.00	50.00	1350.00	48.90			47.80	
1+387.93		1387.93	48.63			47.80	
1+400.00	50.00	1400.00	50.31			48.90	
1+434.69	34.69	1434.69	56.32			52.90	54.00
1+445.00	15.31	1445.00	54.58			52.80	53.80
1+457.10		1457.10					
1+483.00	33.00	1483.00	57.54			52.80	53.80
1+500.00	17.00	1500.00	55.20	3.28	56.08		
1+550.00	50.00	1550.00	53.94			51.90	53.00
1+600.00	50.00	1600.00	50.33			49.20	50.33
1+650.00	50.00	1650.00	48.59			48.40	49.50
1+700.00	50.00	1700.00	49.80			48.70	
1+748.13	48.13	1748.13	49.27			48.10	
1+750.00	1.87	1750.00	48.59				
1+800.00	50.00	1800.00	44.47	11.40	55.40	44.00	45.00
1+837.65	37.65	1837.65	52.81	5.49	55.29	49.80	51.00
1+850.00	12.35	1850.00	51.70				
1+900.00	50.00	1900.00	49.00			46.40	
1+950.00	50.00	1950.00	47.52			42.30	
1+966.95	16.95	1966.95	49.28			41.30	
2+000.00	33.05	2000.00	43.39			38.10	
2+023.56	23.56	2023.56	45.61			37.40	
2+050.00	26.44	2050.00	42.34			42.60	
2+076.34	26.34	2076.34	39.13			41.60	
2+100.00	23.66	2100.00	38.37				
2+103.16	3.16	2103.16	40.35				
2+150.00	46.84	2150.00	38.93			37.20	
2+184.46	34.46	2184.46	43.60			35.10	
2+200.00	15.54	2200.00	42.66			34.00	
2+250.00	50.00	2250.00	38.33			34.80	
2+300.00	50.00	2300.00	36.21				
2+350.00	50.00	2350.00	35.00				
2+400.00	50.00	2400.00	35.89	19.24	54.04		

SCALE 1: 2000
0 100 200

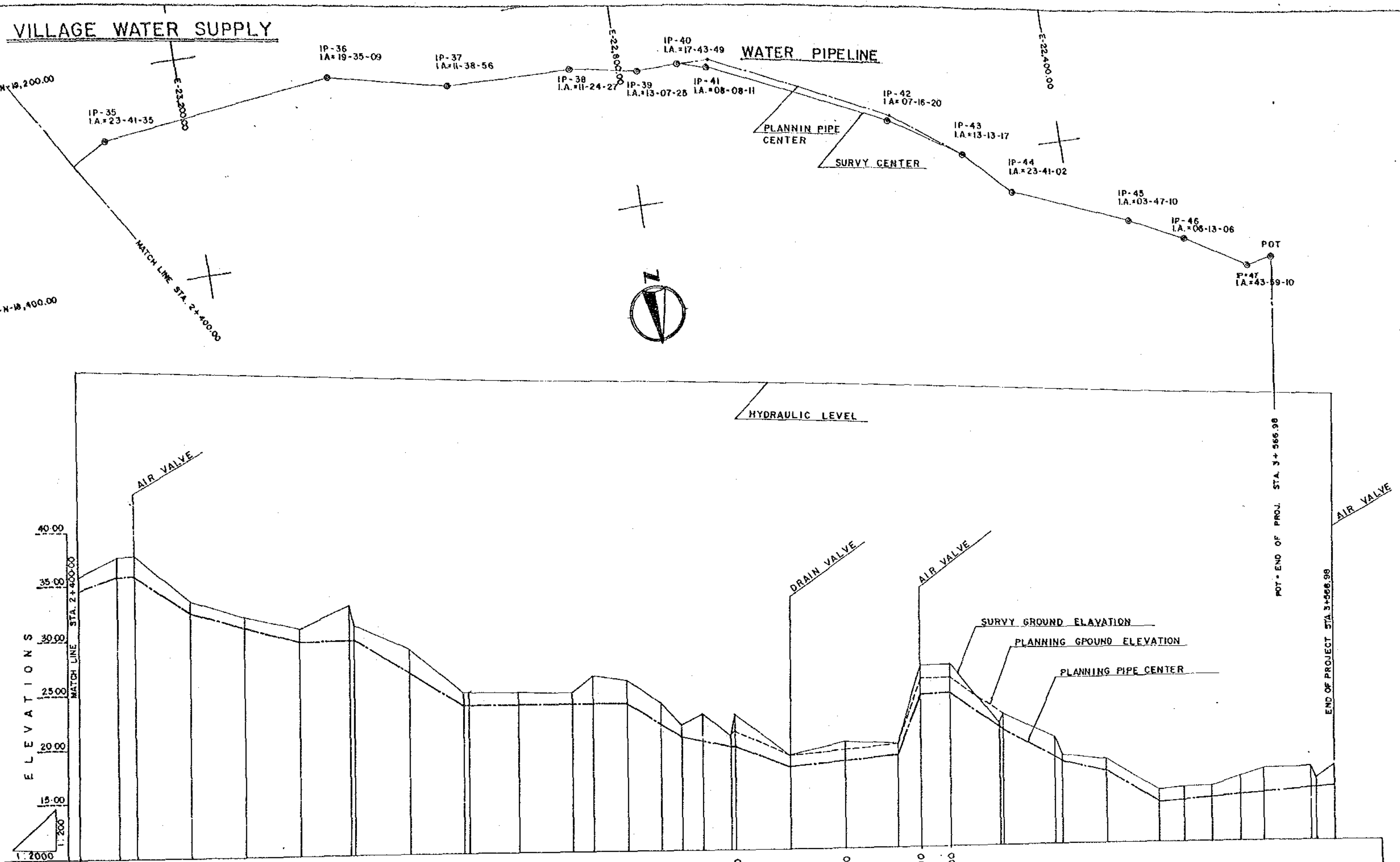
SCALE 1: 200
0 5 10 15 20

REPUBLIC OF THE PHILIPPINES
AGRICULTURAL DEVELOPMENT AND PROMOTION PROJECT
IN WESTERN SAMAR
(ADPP)

VILLAGE WATER SUPPLY
LONGITUDINAL PROFILE OF PIPELINE-2
(TOMOGBONG TO STA-2 + 400)

DATE SURVEYED: FEB. 1990	DRAWING NO.
DRAWN BY :	WS-016
APPROVED BY:	

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)



STATION	PLANNIN GROUND ELEVATION	PLANNING PIPE CENTER	HYDRAULIC LEVEL	ACTUAL HEAD	GROUND ELEVATION	ACCUMULATIVE DISTANCE	DISTANCE
2+400.00		34.80	54.04	19.24	35.89	2400.00	50.00
2+436.40		36.00			37.73	2436.40	36.40
2+450.00		36.00			37.83	2450.00	13.60
2+500.00					33.73	2500.00	50.00
2+550.00		35.00			36.11	2550.00	50.00
2+600.00		28.90	54.49	25.59	30.96	2600.00	50.00
2+646.91		28.80			33.11	2646.91	46.91
2+650.00					31.22	2650.00	3.09
2+700.00		27.50			28.94	2700.00	50.00
2+750.00		23.80			24.90	2750.00	50.00
2+755.87		23.80			24.91	2755.87	5.87
2+800.00		23.80			24.86	2800.00	44.13
2+850.00		23.50			24.65	2850.00	50.00
2+869.24		23.50			26.25	2869.24	19.24
2+900.00		23.50			25.79	2900.00	30.76
2+930.77					23.72	2930.77	30.77
2+950.00		20.40			21.56	2950.00	10.23
2+969.50					22.69	2969.50	19.50
2+996.60	21.00	19.50			20.63	2996.60	27.10
3+000.00		19.30			22.57	3000.00	3.40
3+050.00		17.50			18.54	3050.00	50.00
3+100.00	19.00	17.95			19.74	3100.00	50.00
3+150.00		18.40			19.54	3150.00	50.00
3+171.67	26.00	24.50			26.90	3171.67	21.67
3+200.00	26.00	24.50			26.88	3200.00	28.33
3+248.83		21.00			21.45	3248.83	49.83
3+250.00					22.13	3250.00	1.47
3+300.00		18.80			19.92	3300.00	50.00
3+307.46					18.31	3307.46	7.46
3+350.00		16.60			17.78	3350.00	50.00
3+400.00		13.70			14.72	3400.00	50.00
3+423.69					15.16	3423.69	23.69
3+450.00		14.04			15.04	3450.00	26.31
3+477.46					16.19	3477.46	27.46
3+500.00		15.66			16.66	3500.00	22.54
3+544.30					17.01	3544.30	44.30
3+550.00					15.72	3550.00	5.70
3+566.98		15.88	51.76	34.68	17.08	3566.98	16.98

SCALE 1: 2000
0 100 200

SCALE 1: 200
0 5 10 15 20

REPUBLIC OF THE PHILIPPINES
AGRICULTURAL DEVELOPMENT AND PROMOTION PROJECT
IN WESTERN SAMAR
(ADPP)

VILLAGE WATER SUPPLY
LONGITUDINAL PROFILE OF PIPELINE-3
(STA. 2 + 400 TO BULANCA AURORA)

DATE SURVEYED; FEB. 1990	DRAWING NO.
DRAWN BY	WS-017
APPROVED BY;	

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

4-4. IMPLEMENTATION PLAN

4-4-1. Construction Condition

(1) Physical Condition

In the Project area, it rains throughout the year, and there is no dry season as said in general. The rain is shower in the type and very seldom lasting over the day. However, when the area is affected by typhoon, the flood take place with high frequency. Thereby, it is absolutely essential to take care to control the construction progress and daily works as well as in the construction of bridge and washing out of embanked materials. As a matter of fact, from a statistic data of damages, the month so often suffered from the flood is November.

(2) Socio-economic Condition

The purchase of construction materials is commonly made by cash. Seeing that the materials is sometimes in short supply, the procurement shall be scheduled with enough stocks before the construction. In this schedule, the floor area of warehouse and stock capacity of fuel tank may be increased. It is unavoidable to procure the parts of construction equipment and major materials from Manila.

The condition of electric supply, water supply, transportation and telecommunication are insufficient in the Project area so that the related facilities, such as generator, well, radio communication, enough number of vehicles, etc., will be required.

4-4-2. Implementation Plan

(1) Mode of Construction and Procurement

The construction of various project component included in the integrated area development project in the Philippines have formerly been executed for each project component by the agencies related to their field of works, respectively. The integrated area development project offices have coordinated and monitored the progress of each component works and managed overall project implementation. However, the construction works of proposed project shall be implemented by one contract work, taking into account system of the Grant Aid Program and

facility of the progress control. On the other hand, the works undertaken by the Government of the Philippine will be implemented under the management of NIA for the construction of on-farm facilities and DPWH for the communal faucets of village water supply, if required.

The construction of facilities and procurement of equipment, which are undertaken by the Japanese Government, will be made by the open competitive bidding among the Japanese general contractors and commercial firm, respectively to afford an opportunity of bidding fairly and evenly. For claiming the reasonable and secure construction and procurement, the pre-qualification of bidder will be conducted before bidding.

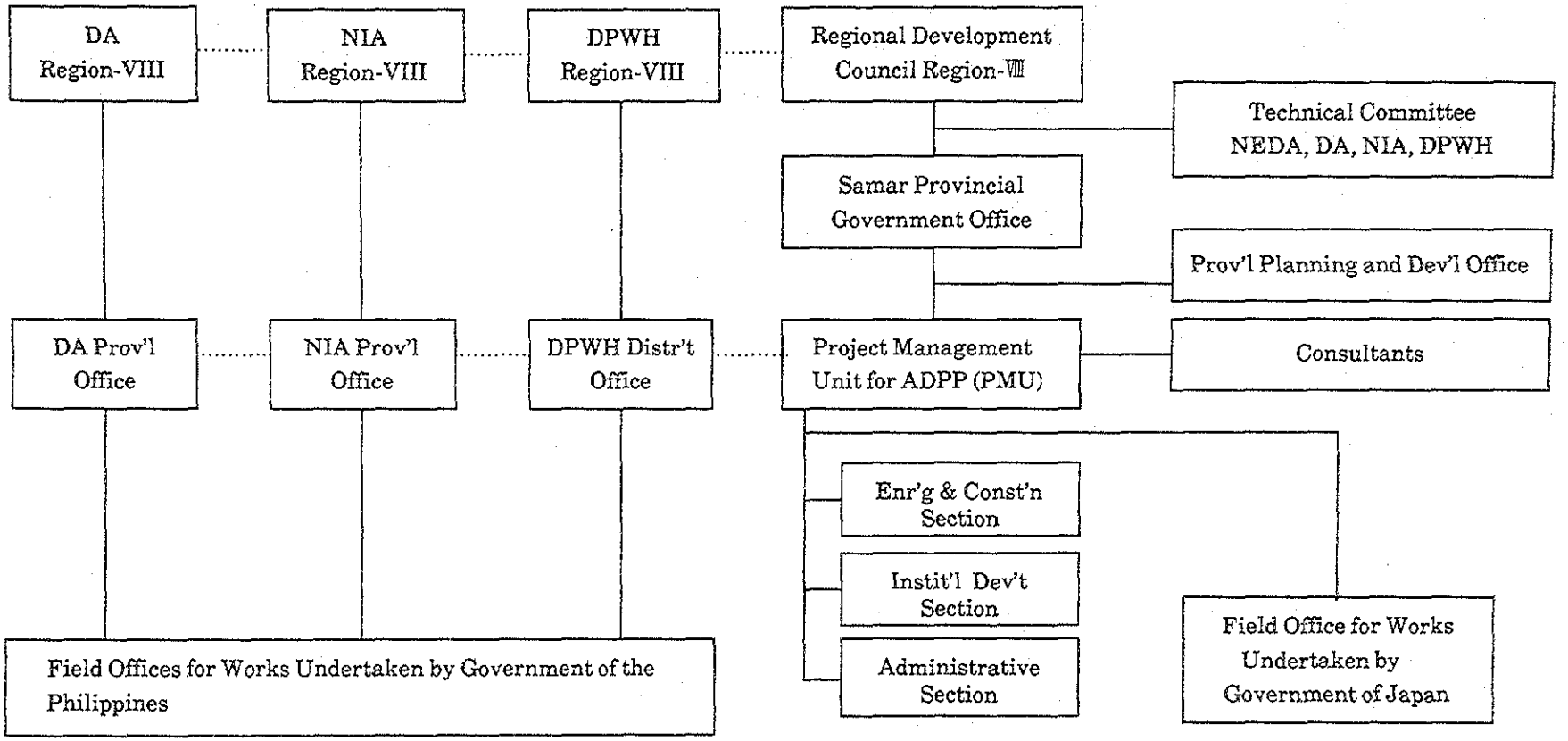
(2) Organization and Management

The executing agency for the implementation of the Project is the Provincial Government Office of Samar. However, for this Project implementation, the new organization will be established because of large scope of works and several implementing agencies involved. Therefore, the Project Management Unit (PMU) for the Agricultural Development and Promotion Project in Western Samar will be placed under Samar provincial government office, which will be directly responsible for day-to-day works in the Project site.

PMU for ADPP in Western Samar will be organized with technical staff dispatched from the related agencies under the Project Manager and responsible for carrying out land acquisition, construction supervision of Grant Aid Project, coordination and monitoring of the works undertaken by the implementing agencies, preparation of operation and maintenance manual and others related to the Project. The works undertaken by the implementing agencies will be dealt with by the respective provincial offices. (See Fig. 4-4)

In addition, for the purpose of strengthening administrative and technical aspect of provincial office, the technical committee composed of representatives of the line agencies in Region-VIII will also be organized to make recommendation to the Governor in regard to the Project implementation and management on the technical aspects. The line agencies will involve NEDA, DPWH, DA and NIA.

FIGURE 4-4 ORGANIZATION CHART FOR IMPLEMENTATION FOR AGRICULTURAL DEVELOPMENT PROMOTION PROJECT IN WESTERN SAMAR



4-4-3. Construction and Supervisory Plan

(1) Detail Design Engineering

The scope of works for detail design engineering services includes the detailed design of canals, roads, pipeline and those related structures, preparation of contract documents, specification and drawings and assistance staff of the executing agency in the pre-qualification, bidding, bid evaluation and contracting.

The services will be undertaken mainly by Japanese consultants due to the time constraint though the local consultants are available and active in the Philippines. The engineers and experts may be required in Team leader/agricultural development, design engineers for canals, roads, pipelines, general structures, water supply structures, and steel bridges, experts/specialists for the preparation of contract documents and specifications for civil works, steel bridges and equipment. In addition, the route surveys for irrigation and drainage canals, farm-to-market roads and water supply pipeline, and topographic surveys for major structures, and geological exploration for the foundation of major structures and roads, are necessary for preparing the detailed design of the facilities/structures.

(2) Construction Supervision

The Japanese consulting engineers will be employed for the construction progress, quality and quantity control, and certification of payment for the accomplished works and coordination of progress between the works undertaken by the Philippine Government and under Japan's Grant Aid Program during the construction period. The team leader/chief supervisor will be assigned through out the construction period.

4-4-4. Procurement Plan

The major materials such as cement, steel bar and others manufactured, are available in Manila but limited in the kind, quality and quantity in the Project site. Therefore, the major materials and parts of equipment, except special materials, such as major pipes for

the water supply, shaped steel materials, special purpose equipment etc., which those will be procured from Japan, will be brought in from Manila. Thereof, the equipment/materials, which may be in lower quality and/or high price, such as valves, pumps, engine, electric apparatus, etc., will be also brought into the Philippines from Japan.

The parts of equipment and materials, which may be required for the operation and maintenance of the facilities completed under the Project, will be available in Manila but may take time for the procurement because of distance away. Therefore, it may as well procure the parts of equipment good for about five(5) years operation at the time when bidding those equipment.

4-4-5. Implementation Schedule

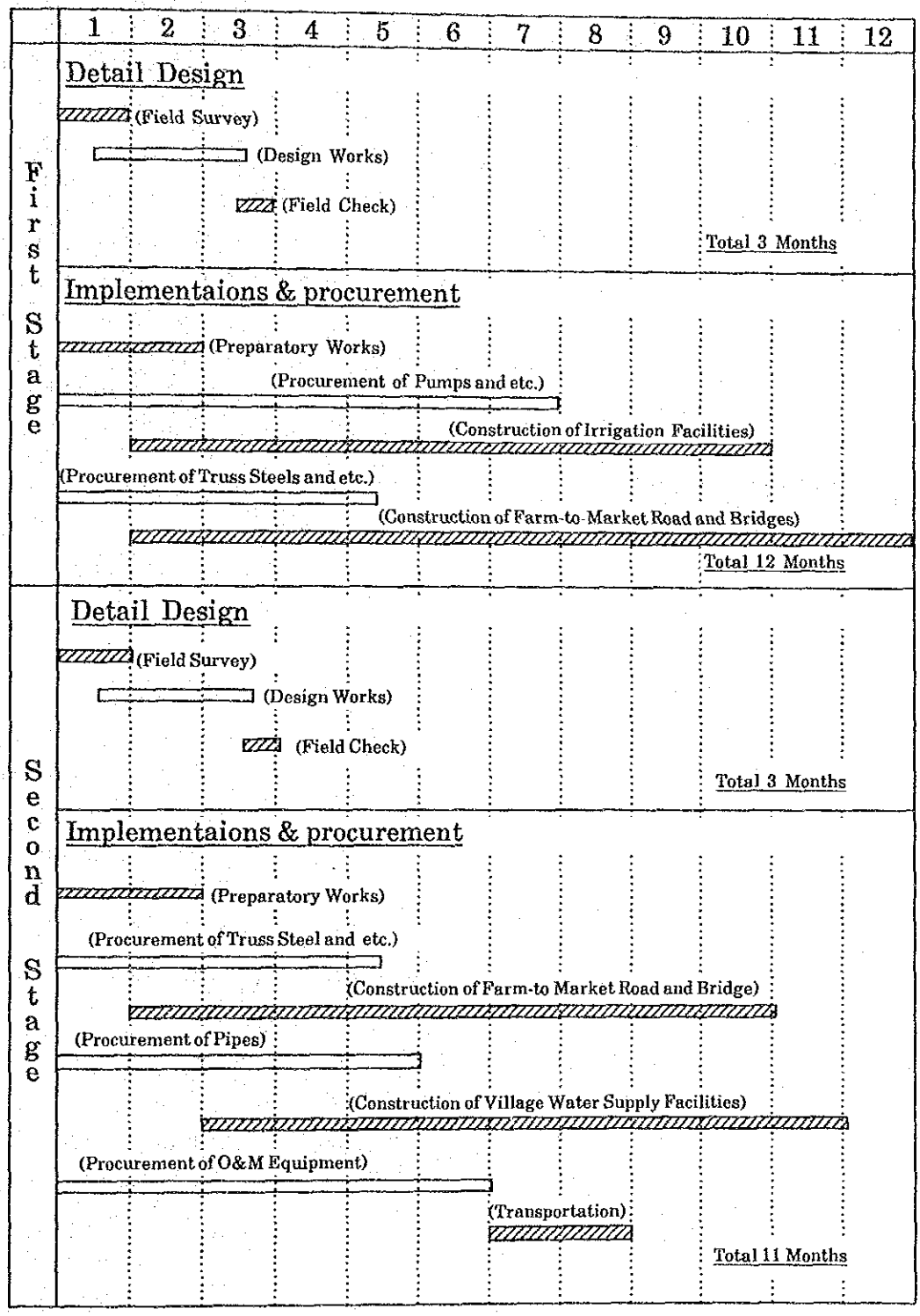
The maximum period required for the detailed design and pre-construction works, including contracting consulting services, detailed design engineering services, pre-qualification, pre-bidding arrangement, bidding, evaluation of bid and contracting of construction works, after the effects of Exchange of Notes between both the governments will be only six(6) months. Thereafter, the construction period will be allowed within 12 months, as one fiscal year's project.

The project, however, had better implement over two (2) fiscal years, taking into account the sequence of installing two (2) Truss steel bridges, repair of Buenavista bridge to make it passable for the construction equipment and land acquisition to be secure for the construction of new road, between Quezon and Cantaguic. Those project works programmed for two stages and the implementation schedule including engineering service are illustrated in summarizd in Table 4-1 and Fig. 4-5, respectively

TABLE 4-1. PROJECT WORKS PROGRAMMED FOR TWO STAGES

Item	Project works		
	Total	1st stage	2nd stage
1. Irrigation Facilities			
(1) Quezon Area	1 - diversion dam	1 - diversion dam	—
(22ha)	1,090 m - Irr. canal	1,090 m - Irr. canal	—
(2) Auroa Area	1 - divers,ion dam	1 - divers,ion dam	—
(18ha)	1,655 m - Irri. canal	1,655 m - Irri. canal	—
(3) Bulao Area	1 - pump stations	1 - pump stations	—
(130ha)	4,720 m - Irr. canal	4,720 m - Irr. canal	—
	1,110 m - drain. canal	1,110 m - drain. canal	—
(4) Bulao South Area	8 - pump stations	8 - pump stations	—
(120ha)	5,260 m - Irr. canal	5,260 m - Irr. canal	—
2. Farm - to - maket Roads			
(1) Bulao ~ La Paz	0.5 km - road length	0.5 km - road length	—
(to be constructed)	1 - bridge (New)	1 - bridge (New)	—
(2) Quezon~Cantaguic	6.1 km - road length	—	6.1 km - road length
(to be constructed)			
(3) Blanca Aurora~	4.1 km - road length	—	4.1 km - road length
Buenavista	1 - bridge (New)	—	1 - bridge (New)
(To be improved)	1 - bridge (Repair)	1 - bridge (Repair)	—
(4) San Agustin~Pologon	3.7 km - road length	3.7 km - road length	
(To be improved)			
3. Village Water Supply	1 - intake facility	—	1 - intake facilities
	13.9 km - Pipeline	—	13.9 km - Pipeline
	1 - Reservoir	1 - Reservoir	
4. O & M Equipment			
(1) For Irrigation	1 - package	—	1 - package
(2) For Roads	1 - package	—	1 - package

FIGURE 4-5 TENTATIVE PROJECT IMPLEMENTATION SCHEDULE



4-4-6. Scope of Work

(1) The Works Undertaken by the Government of Japan

1) Construction and improvement of four (4) irrigation systems covering an area of some 290 ha in the total
2) Construction and improvement of four (4) lines of farm-to-market roads totaling about 14.4 km in the length
3) Provision of village water supply facilities along the Gandara river from the water source of Binubucalan spring to San Jorge reservoir
4) Procurement of O & M equipment for the irrigation systems and farm-to-market roads

(2) The Works Undertaken by the Government of the Philippines

1) Land acquisition and compensation of right-of-way for the construction of irrigation facilities, farm-to-market roads and village water supply facilities, costing about 3.99 million pesos
2) Construction of on-farm-facilities in the irrigation systems and minor works, costing about 0.47 million pesos
3) Construction of communal faucets, as required, costing about 5.26 million
4) Payment of commission fee for banking services and duty, tax etc. under the system of Japan's Grant Aid Program, costing about 1.17 million pesos
5) Construction of access roads for the structures of village water supply component, costing about 1.59 million pesos
6) Construction of fence, gates, etc. for the pumping station, costing about 0.54 million pesos
7) 16.27 million in the total pesos including contingencies shall be prepared for the subject works

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Note : The import tax and other charges for the equipment and materials to be procured for the Project are not included in the total costs.