CHAPTER 9

OPERATION AND MAINTENANCE OF FACILITIES

CHAPTER 9 OPERATION AND MAINTENANCE OF FACILITIES

9.1 General

9.1.1 General Description of Facilities to be Operated and Maintained

Urban Drainage Facilities which are designed in this project are as follows;

Drainage Channels

– river channel (open channel)	Semarang River	L =	7.240 km
	Asin River	L =	1.165 km
	Baru River	L =	1.071 km
– dike raising	L= 4.2 km		
– renovation of inspection road	L= 20 km		
– box culvert	Asin Box Culvert	=	194 m
	Baru Conveyance Channel	=	692 m
	Bandarharjo East Secondary Channel	=	123 m
– secondary open channel	Bandarharjo West Secondary Channel	=	577 m

Asin Pumping Station

– main pump	3 units
– diesel engine	3 units
– auxiliary pump	1 unit
– diesel engine generator	1 unit
– electrical operation system	1 unit
– gate	2 units
– stop log	1 unit

Retarding Pond

– Asin Retarding Pond	Area = 1.6 ha
– Baru Retarding Pond	Area = 0.9 ha

Baru Pumping Station

– main pump	2 units
– diesel engine	2 units
– auxiliary pump	1 unit

- diesel engine generator 1 unit
- electrical operation system 1 unit
- gate 1 unit
- stop log 1 unit

9.1.2 Operation Concept of Pump and Gate Facilities

The drainage pump system will function in both dry and wet seasons. The operation concept of pump and gate facilities are described below.

Dry Season(April to October)

(a) The water level of the retarding pond is to be maintained by an auxiliary pump as the design low water level in order to drain daily waste water from the area.

(b) The gate is closed to protect the area from high tide, and

(c) Operation concept during dry season is shown in Fig. 9.1.1.

Rainy Season (November to March)

(a) During rainy season, the water level of the retarding pond is to be maintained by both the auxiliary pump and a main pump as the design low water level in order to maintain enough storage volume in the pond,

(b) When a storm comes and rain starts, the water level of the retarding pond is to be maintained by main pumps as the design low water level as long as possible,

(c) When inflow discharge of rainfall exceeds the pump capacity and the water level starts rising, the pump shall be operated in full capacity,

(d) The operation of pump shall continue until the storm is over, inflow decreases and the water level in the pond returns to the design low water level,

(e) The gate is to be opened only when the water level in the retarding pond is higher than the water level on the sea side and it is more effective to discharge storm water. In this occasion all pump operation shall be stopped, and

(f) Operation concept during rainy season is shown in Fig. 9.1.2.

9.1.3 Maintenance Concept of Drainage Facilities

(1) Maintenance of Mechanical Facilities

The mechanical facilities in the project is the essence of the pump drainage system, without which the whole urban drainage system will lose its main function. Because

of the low elevation of the whole area, the new system totally relies on mechanical drainage. Therefore, it is absolutely necessary with all effort to maintain the function of the mechanical facilities without termination.

Maintenance activities of the facilities are composed of four components, namely "Observation", "Inspection", "Repair" and "Record". These activities are all equally important to attain proper maintenance of facilities.

(2) Maintenance of Other Facilities

Pump foundation and gate foundation are important civil facilities to maintain the function of mechanical facilities and to be maintained properly. Retarding pond storage volume should be maintained regularly to fulfill the function of storm water retarding. River channel facilities such as channels itself, dike and revetment are to be maintained to attain the function of safe discharge of storm water through the channels.

Land subsidence is one of the important factors affecting the function of civil facilities. The progress of land subsidence should be monitored carefully and to be reflected in effective countermeasures in maintenance works.

9.2 Operation Plan of Asin Pumping Station

9.2.1 Operation Simulation of Pump

Operation of Asin Pumping Station was simulated assuming three storm scales, namely once in two years, once in five years (design storm) and once in ten years.

Assumption of simulation is as follows;

(1) secondary drainage system is perfect and run-off occurs immediately

(2) run-off coefficient is 0.7

(3) tidal water level is the design high water level and the gate is closed

(4) pump is operated according to the operation rule

The result of the simulation is summarized and shown in Figs. 9.2.1. Its shows that;

(1) For two-year storm approximately 9 % of the drainage area is inundated by 20 cm for the duration of 5 hours. The pump operation duration is 16 hours,

(2) For five-year storm, approximately 17 % of the drainage area is inundated by 20 cm for the duration of 9 hours. The pump operation duration is 18 hours, and

(3) For ten-year storm, approximately 27 % of the drainage area is inundated by 20 cm for the duration of 11 hours. The pump operation duration is 21 hours.

As shown in the simulation, temporary storage in the drainage area has a large portion of the storage and even by 2-year rainfall, about 10% of the area is inundated for five hours. The habitual inundation which is happening almost everyday throughout the year will be handled without inundation of the area by the facilities proposed.

9.2.2 Operation Plan of Pump and Gate

(1) Flow Chart of Operation

The operation concept of the pump and gate is expressed in a flowchart in Fig. 9.2.2. The figures show the consequences of operation of pump and gate.

(2) Operation Water Level for Auxiliary Pump

As the auxiliary pump is operated automatically following the water level detector. The water level setting for the operation is arbitrary but it is proposed as follows;

Pump Starting Water Level:

The auxiliary pump should start when the water level exceeds the Design Water Level. The starting level is set to be –0.1 m below the Design Water Level. Here, 0.1m is an allowance of wave or water surface fluctuation.

Pump Stopping Water Level:

It is necessary to maintain the required storage volume in the retarding pond. The stopping level for the auxiliary pump is set to be – 0.5 m below the Design Low Water Level of the pond. Here, 0.5 m is an allowance of operation.

(3) Operation Plan of Gate

Fig. 9.2.3 shows the relationship of the tide level and the design water level in the retarding pond. As the design high water level (EL- 1.0 m) is lower than the lowest tide level (EL –0.7m), the gate should be kept closed as far as the water level in the retarding pond is maintained within the design high water level. However, when the water level in the retarding pond is higher than the design level and the tide level at that time is lower, it is more effective to open the gate rather than operating pump. When the gate is open, operation of gate should be terminated immediately.

9.2.3 Proposed Operation Rule of Asin Pumping Station

Based on the operation plan described above, an operation rule is proposed as below.

General

This operation rule instructs how to operate Asin Pumping Station for the purpose of the mitigation of inundation drainage of the Asin Drainage Area.

Definition of the Asin Drainage Area

The Asin Drainage Area is defined by the secondary and tertiary drainage system. The area of 4.430 km² is surrounded by the left bank of Semarang River to the east, Pemuda Street to the south, some urban roads in Tanah Mas and Pondok Hasanudin Estates to the west, and North Ring Road to the north.

Definition of Dry and Rainy Season

The "Dry Season" is defined as the period between April 1 and October 30. The "Rainy Season" is defined as the period between November 1 and March 31 next year.

Design High Water Level and Design Low Water Level of Asin Retarding Pond

The "Design High Water Level " of Asin Retarding Pond is EL –1.0 m expressed in TTG (Jakarta Harbour System). The "Design Low Water Level" of Asin Retarding Pond is EL – 2.5 m expressed in TTG.

Definition of Administrator and Operator

The "Administrator" is the person in charge of the urban drainage of whole Semarang City. The "Operator" is the person in charge of the operation of the Asin Pumping Station.

Operation of Pump in Dry Season

(1) Operation of Auxiliary Pump

During Dry Season, the Auxiliary Pump should be operated automatically with the water level detector in order to discharge mainly wastewater which flows into Asin Retarding Pond. The start water level is set as 0.1 m below the Design Low Water Level. The stop water level is set as 0.5 m below the Design Low Water Level.

(2) Operation of Main Pump

During Dry Season, the Main Pump should stand by to cope with a storm which may occur. The operation rule of the Main Pump during a storm should follow that of the Rainy Season.

(3) Operation of Gate

During Dry Season, the Asin Pumping Station Gate should be closed in order to prevent sea water intrusion into the Asin Retarding Pond. However, for the purpose of water quality improvement in the Asin Retarding Pond, it can be opened when the water level on the sea side is lower than lowest ground water level (EL –0.2 m in 1997) in the drainage area. In order to operate the gate, the operator should start operating the diesel engine unit first.

Operation in Rainy Season

(1) Operation of Auxiliary Pump

During Rainy Season, the Auxiliary Pump should be operated automatically with the water level detector in order to discharge mainly wastewater which flows into Asin Retarding Pond. The start water level is set as 0.1 m below the Design Low Water Level. The stop water level is set as 0.5 m below the Design Low Water Level.

(2) Operation of Main Pump

During Rainy Season, the Main Pump should be operated as follows;

(a) When a storm is expected the operator should stand by for the main pump operation.

(b) When rainfall starts the operator should observe the water level indicator in the

Pump Operating Building as well as the water level in the intake so that he can start pump immediately when the water level exceed the Design Water Level. The operator should also inspect the intake so that any danger of pump operation is prevented.

(c) When the water level in the Asin Retarding Pond becomes higher than the Design Low Water Level, the operator should start one of the diesel engines and the pump. Upon starting the operation, the Operator should inform the Administrator the fact of pump operation start.

(d) After staring main pump operation, the operator should observe the change of water level in the Asin Retarding Pond.

(e) If the water level is still rising, the operator should start the second diesel engine and the second main pump. Otherwise, the operator should keep watching the pump and the water level.

(f) If the water level is still rising after the operation of the second pump, the operator should start the third diesel engine and the third main pump. Otherwise, the operator should keep watching the pump and the water level.

(g) If the water level is still rising after the operation of the third pump, the operator should continue operation of all three pumps and keep watching the water level in the Asin Retarding Pond.

(h) When the water level in the Asin Retarding Pond exceeds the Design High Water Level the Operator should inform the fact to the administration immediately.

(i) The operator continue full operation of three pumps until the water level in the Asin Retarding Pond starts falling.

(j) When the storm is over and the water level starts falling, the operator should continue full operation of three main pumps until the water level in Asin Retarding Pond becomes as low as the Design Low Water Level.

(k) The operator should keep the Design Low Water Level in Asin Retarding Pond by means of the Auxiliary Pump and the Main Pump to wait for the next storm. Upon termination of main pump operation, the Operator should inform the Administrator the fact of operation of main pump termination.

(3) Operation of Gate

During Rainy Season, the Asin Pumping Station Gate should be closed in order to prevent sea water intrusion into the Asin Retarding Pond. However, when the water level on the sea side is lower than the water level of Asin Retarding Pond and it is expected to be more effective to discharge storm water by gravity, the operator can open the gate by the instruction of the "Administrator".

9.3 Operation Plan of Baru Pumping Station

9.3.1 Operation Simulation of Pump

Operation of Baru Pumping Station was simulated assuming three storm scales, namely once in two years, once in five years (design storm) and once in ten years.

Assumption of simulation is as follows;

(1) secondary drainage system is perfect and the run-off occurs immediately,

(2) run-off coefficient is 0.7,

(3) tidal water level is the design high water level and the gate is closed, and

(4) pump is operated according to the operation rule.

The result of the simulation is summarized and shown in Fig. 9.3.1. It shows that

(1) For two-year storm, approximately 8% of the drainage area is inundated by 20 cm for the duration of 5 hours. The pump operation duration is 15 hours,

(2) For five-year storm, approximately 15 % of the drainage area is inundated by 20 cm for the duration of 8 hours. The pump operation duration is 17 hours, and

(3) For ten-year storm, approximately 26 % of the drainage area is inundated by 20 cm for the duration of 11 hours. The pump operation duration is 20 hours.

As shown in the simulation, temporary storage in the drainage area has a large portion of the storage and even by 2-year rainfall, about 10% of the area is inundated for five hours. The habitual inundation which is happening almost everyday throughout the year will be handled without inundation of the area by the facilities proposed.

9.3.2 Operation Plan of Pump and Gate

(1) Flow Chart of Operation

The operation concept of the pump and gate is expressed in a flowchart in Fig. 9.2.2.

The figures show the consequences of operation of pump and gate.

(2) Operation Water Level for Auxiliary Pump

As the auxiliary pump is operated automatically following the water level detector. The water level setting for the operation is arbitrary but it is proposed as follows;

Pump Starting Water Level:

The auxiliary pump should start when the water level exceeds the Design Water Level. The starting level is set to be –0.1 m below the Design Water Level. Here, 0.1 m is an allowance of wave or water surface fluctuation.

Pump Stopping Water Level:

It is necessary to maintain the required storage volume in the retarding pond. The stopping level for the auxiliary pump is set to be – 0.5 m below the Design Low Water Level of the pond. Here, 0.5 m is an allowance of operation.

During the dry season, it may be possible to raise the water level in the retarding pond as so much storage volume is unnecessary. However, taking safer side, the maintenance water level during dry season is set as the same as during the wet season. The setting could be revised after starting of operation.

(3) Operation Plan of Gate

Fig. 9.3.2 show the relationship of the tide level and the design water level in the Baru River. As the design high water level (EL –0.9 m) is lower than the lowest tide level (EL -0.7 m), the gate should be kept closed as far as the water level in the retarding pond is maintained within the design high water level. However, when the water level in the retarding pond is higher than the design level and the tide level at that time is lowest, it is more effective to open the gate rather than operating pump. When the gate is open, operation of gate should be terminated immediately.

9.3.3 Proposed Operation Rule of Baru Pumping Station

General

This operation rule instructs how to operate Baru Pumping Station for the purpose of the mitigation of inundation of the Baru Drainage Area.

Definition of the Baru Drainage Area

The Baru Drainage Area is defined by the secondary and tertiary drainage system. The area is surrounded by Semarang River to the Southwest, North Ring Road to the north and MT Haryono, Ronggowarsito streets to the east and Agus Salim street to the south. The area is 2.185 km^2.

Definition of Dry and Rainy Season

The "Dry Season" is defined as the period between April 1 and October 30. The "Rainy Season" is defined as the period between November 1 and March 31 next year.

Design High Water Level and Design Low Water Level of Baru River

The "Design High Water Level " of Baru River is EL –0.9 m expressed in TTG(Jakarta Harbour System). The "Design Low Water Level" of Baru River is EL –2.4 m expressed in TTG.

Definition of Administrator and Operator

The "Administrator" is the person in charge the urban drainage of whole Semarang City. The "Operator" is the person in charge of the operation of Baru Pumping Station.

Operation of Pump in Dry Season

(1) Operation of Auxiliary Pump

During Dry Season, the Auxiliary Pump should be operated automatically with the water level detector in order to discharge mainly wastewater flows into Baru River. The start water level is set as 0.1 m below the Design Low Water Level. The stop water level is set as 0.5 m below the Design Low Water Level.

(1) Operation of Main Pump

During Dry Season, the Main Pump should stand by to cope with storm which may occur. The operation rule of the Main Pump during a storm should follow that of the Rainy Season.

(2) Operation of Gate

During Dry Season, the Baru Pumping Station Gate should be closed in order to prevent sea water intrusion into Baru River. However, for the purpose of water

quality improvement in Baru River, it can be opened when the water level on the sea side is lower than lowest ground water level (EL –0.1 m in 1997) in the drainage area. In order to operate the gate, the operator should start operating the diesel engine unit first.

Operation in Rainy Season

(1) Operation of Auxiliary Pump

During Rainy Season, the Auxiliary Pump should be operated automatically with the water level detector in order to discharge mainly wastewater which flows into Baru River. The starting water level is set as the Design Low Water Level. The stopping water level is set as 0.5 m below the Design Low Water Level.

(2) Operation of Main Pump

During Rainy Season, the Main Pump should be operated as follows;

(a) When a storm is expected the operator should stand by for the main pump operation.

(b) When rainfall starts the operator should observe the water level indicator in the Pump Operating Building as well as the water level in the intake so that he can start pump immediately when the water level exceed the Design Water Level. The operator should also inspect the intake so that any danger of pump operation is prevented.

(c) When the water level in the Baru River becomes higher than the Design Low Water Level, the operator should start one of the diesel engines and the pump. Upon starting the operation, the Operator should inform the Administrator the fact of pump operation start.

(d) After starting main pump operation, the operator should observe the change of water level in the Baru River.

(e) If the water level is still rising, the operator should start the second diesel engine and the second main pump. Otherwise, the operator should keep watching the pump and the water level.

(f) When the water level in the Baru River exceeds the Design High Water Level the Operator should inform the fact to the administration immediately.

(g) The operator continue full operation of two pumps until the water level in the Baru River starts falling.

(h) When the storm is over and the water level starts falling, the operator should continue full operation of two main pumps until the water level in Baru River

becomes as low as the Design Low Water Level.

(i) The operator should keep the Design Low Water Level in Baru River by means of the Auxiliary Pump and the Main Pump to wait for the next storm. Upon termination of main pump operation, the Operator should inform the Administrator the fact of main pump termination.

(3) Operation of Gate

During Rainy Season, the Baru Pumping Station Gate should be closed in order to prevent sea water intrusion into the Baru River. However, when the water level on the sea side is lower than the water level of Baru River and it is expected to be more effective to discharge storm water, the operator can open the gate by the instruction of the Administrator.

9.4 Maintenance Plan of Drainage Facilities

9.4.1 General

Maintenance activities of facilities are composed of four components, namely "Observation", "Inspection", "Repair" and "Record". These terms are defined as follows;

Observation

Observation is checking of the equipment mainly by human eyes. It includes observation of the machines while they are operated and periodical checking of facilities by human eyes.

Inspection

Inspection is direct checking of facilities by means of simple tools, testers and measuring instruments. Inspection is performed monthly, annually or spontaneously after emergency events like an earthquake or a large storm. As for mechanical and electrical equipment, periodical (annual) inspection by engineers from manufacturer is necessary.

Repair

Repair includes cleaning, painting, oiling, replacement of parts, repair and performance test of facilities by using special tools for repair.

Record

Record include information on design (as built drawings and deign note), operation and maintenance manual prepared by the contractor, records of periodical checking and any information of renovation and reconstruction.

These four components are to be properly composed in order to accomplish proper maintenance of facilities. In order to attain this, the administrator of facilities should prepare a "Maintenance Plan" of the facilities.

Maintenance Plan states the basic idea how the maintenance activities should be done, including organization, time schedule and method of maintenance.

In case of mechanical equipment, the manufacturer should be involved in "Repair", while the in house engineers of the administrator can do "Observation" and "Inspection". In the contract of the construction, the contractor is responsible for all the facilities in the contract for two years after the hand over the facilities. After expiring of the term, it is preferable to make a new contract with the manufacturer on periodical checking and repair of the equipment.

The time schedule of "Observation", "Inspection" and "Repair" is proposed as follows;

Facilities	Observation	Inspection	Repair
Civil Structures	Monthly	Annually	Required Time
Main Pump	Daily during wet season	Weekly during wet season Monthly during dry season Annual Inspection by Manufacturer	Annually (painting once in five years)
Auxiliary Pump	Daily	Weekly Annual Inspection by Manufacturer	Annually
Gate	Monthly	Annually Annual Inspection by Manufacturer	Annually (painting once in five years)
Electrical Equipment	Daily	Monthly Annual Inspection by Manufacturer	Annually

The complete record including as-built drawing, operation and maintenance manual and operation record should be well preserved in the "Management Office" in the Pumping Station Complex as well as in the main office of the administrator. For the daily operation, simplified operation manual should be prepared for operation personnel.

9.4.2 Maintenance of Pump

(1) Screw

Detailed maintenance manual shall be prepared a the manufacturer of the pump and periodical inspection and maintenance is absolutely necessary to maintain the

function of the pump. During the "Inspection", all the pump system should be test operated with close watching of the performance of the system including screw, engine and gear box.

As the pumping station is near the sea and sea water intrusion is expected, the screw body is always exposed to sea water. Therefore it is necessary to maintain a periodical painting of the screw body in order to prevent corrosion. The frequency of painting should be once in five (5) years.

Greasing of the top and the bottom bearing of the screw is necessary in order to attain smooth rotation of the equipment. The amount of grease should be checked periodically to sustain lubrication of the system.

(3) Gear Box

During weekly "Inspection", belt tension should be checked.

(4) Diesel Engine

In order to obtain optimum work performance, careful handling is a prerequisite and proper periodic inspection and maintenance are most important. Test operation in the dry season is necessary once a month.

Engine oil

It is necessary to check oil level daily and change the oil every 100-150 operating hours.

Fuel system

Constant amount of fuel in the fuel tank should be maintained.

Fan belt and generator belt

The fan and generator belt tension should be checked periodically and should be replaced if fraying is detected during daily check.

(5) Auxiliary Pump

As Auxiliary pump will be operated throughout a year, it is necessary to maintain the equipment by daily observation of the performance. Daily observation targets

performance of the equipment, garbage accumulation around the pump and sedimentation around the pump. In weekly inspection, the pump should be taken out from under the water and appearance and performance should be checked. Annual repair, any required repair should be done.

(6) Electrical Equipment

Daily "Observation" includes checking of water level detector, control panel and performance of the cable. Monthly "Inspection" includes precise performance test using test tools.

9.4.3 Maintenance of Gate

(1) Gate Leaf

Detailed maintenance manual shall be prepared by a manufacturer of the pump and periodical inspection and maintenance is absolutely necessary to maintain the function of the gate. Monthly observation and inspection target appearance (corrosion), painting, water tightness and any obstacles near the gate.

The girder of the gate leaf should be periodically painted once in 5 years in order to prevent corrosion. Painting of skin plate is unnecessary as the material is stainless steel.

(2) Hoist

During "Observation", motor, local control panel, sieve and wire rope should be observed to detect any malfunction. Leakage of lubricant should be checked as well. During the periodical "Inspection", any deflection, wearing out or any abnormality should be measured and detected. During "Inspection", test operation of gate is necessary to insure the proper performance of gate system.

9.4.4 Maintenance of Civil Structures

(1) Dike and Revetment

As mentioned before, a rapid land subsidence is anticipated and it is necessary to maintain the function of dike and revetment with the progress of the land subsidence.

During the monthly "Observation", appearance of dikes and revetment should be checked, in terms of any deflection, cracks or wearing out of concrete or mortar.

(2) Pumping Station

As the pumping station and gate are supported by deep foundation sustained by hard clay, no uneven subsidence is anticipated. However, the hard clay layer itself is shrinking by a few centimeters annually. Therefore, it is necessary to observe the performance of the civil structure carefully so that any deflection could be detected.

During the monthly "Observation", appearance of dikes and revetment should be checked, in terms of any deflection, cracks or wearing out of concrete or mortar.

9.5 Land Subsidence

9.5.1 General

As described in Chapter 2, land subsidence is continuing in the Central Semarang Area. This phenomenon is mainly caused by excess extraction of groundwater through deep wells and the process will continue unless groundwater extraction is prohibited.

In the design of the pumping station, 40 cm of subsidence of alluvium layer is taken into account. For the design of dike raising, additional raising in the future is anticipated and the top width of the dike is as wide as forty (40) cm for additional dike raising.

As there is not accurate data of land subsidence, the estimation may not be accurate. Therefore, it is necessary to measure the development of the land subsidence periodically and assess the estimation to take action required in the maintenance process.

9.5.2 Measurement Plan

Direct measurement by survey is the most accurate method for land subsidence measurement. As target marks are distributed in the Study and initial measurement has been done in the JICA Study in 1997 and 1998. The standard bench mark for the survey should be TTG 447 which has little influence of land subsidence.

It is necessary to continue this periodical measurement in the area and watch the development of the phenomenon.

9.5.3 Dike Raising Plan

Dike along Semarang River should be raised in accordance with the subsidence of the structure with the ground. Although freeboard from the design high water level is 60 cm in the lower reaches and 40 cm in the upper reaches (boundary is No.90), it is necessary to assess the function and the height should be raised in the future.

9.5.4 Effect on Function of Pump and Gate

The High Water Level in the retarding pond is designed taking into account future land subsidence by 40 cm. Therefore, further 40 cm of land subsidence of alluvium layer is tolerable for the retarding pond to take in rainwater from the lowest point in the drainage area. When the land subsidence continue further, the original design capacity of the pump drainage system is gradually lowered. The lowest location in the drainage area will suffer from insufficient-drainage during storms.

The shoot point of the outlet of pump is set as EL 1.2m, which is 80 cm higher than the design water level on the sea side. It means it allows the subside of fluvial layer by 80 cm before its function is hindered. If land subsidence continues further the water backflow during high tide.

The gate structure has 60 cm and 40 cm of freeboard for Asin and Baru rivers respectively. So they can cope with the 40 cm of fluvial layer subsidence.

It is necessary to follow up the behavior of the pumping station with the development of the land subsidence.

9.6 Sedimentation

9.6.1 General

As mentioned in Chapter 2, the improvement of the present Semarang river channel was completed in 1990 by SSUDP project. Since then as much as 100,000 m^3 of sediment accumulated in the Semarang river channel. As the most of the excavation volume from Semarang River is from the sedimentation between the year 1990 and 1997, approximately 15,000 m^3 (100,000/7=14,290≒15,000) of sedimentation is anticipated in the area.

So it is necessary to remove 15, 000 m^3 of sediment from river channels and retarding ponds in order to maintain the function of the drainage system.

9.6.2 Measurement Plan

Periodical topographical survey of channel sections as well as pond sections are required in order to grasp the degree of sedimentation which will affect the function of the river and function of the pump system.

9.6.3 Dredging Plan

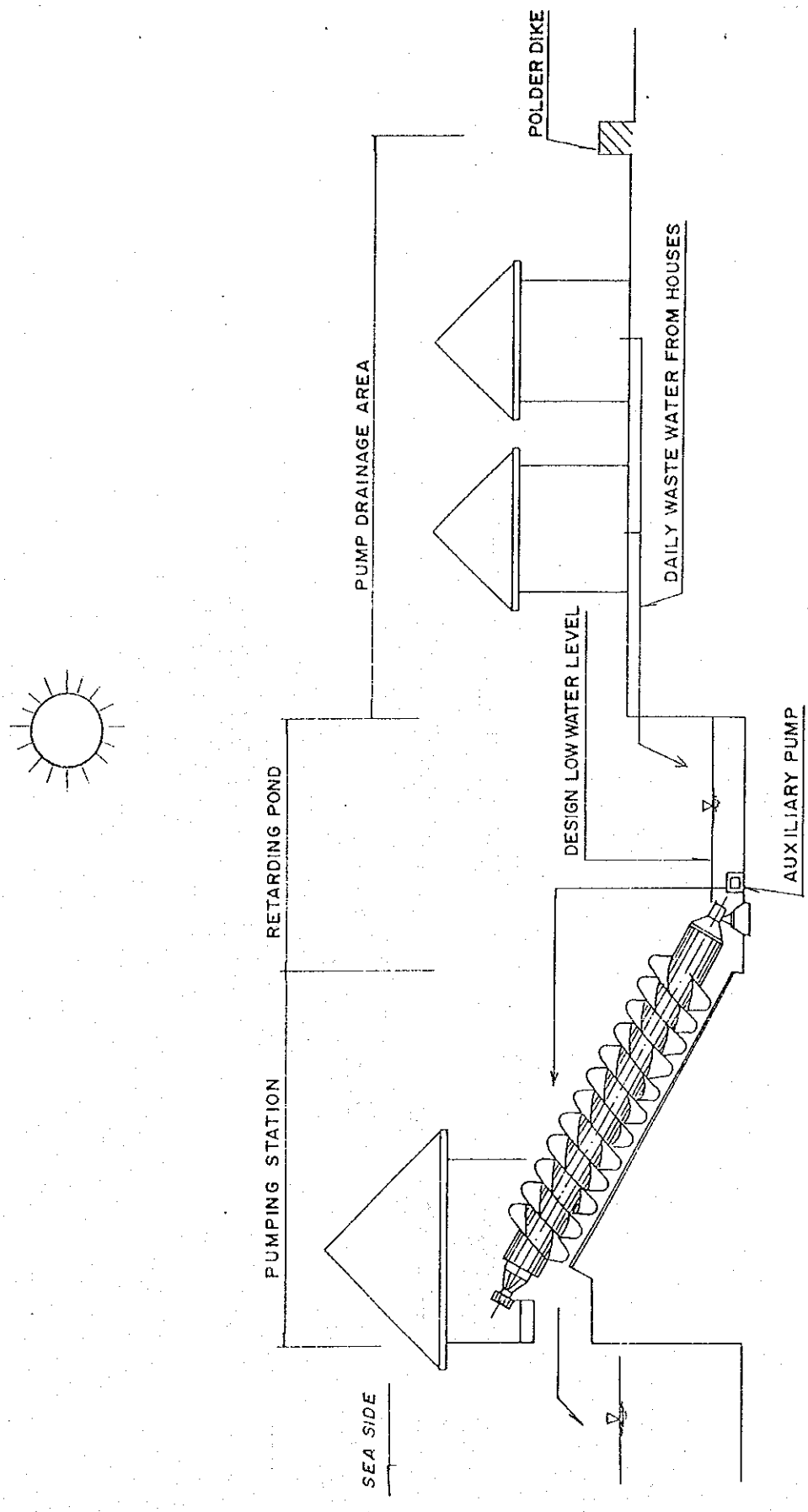
Periodical dredging is necessary for Semarang, Asin, Baru rivers, and Asin and Baru retarding ponds. Dredging of secondary and tertiary channels are also necessary to complete the whole system.

For Semarang river dredging, excavation from below water level is necessary. For the channels and ponds in the pump drainage system, it is possible to lower the water level by pump operation in dry season and enhance the excavation operation. Baru retarding pond is equipped with entrance path to the bottom for heavy machines.

The excavated soil from the channels may still be contaminated with heavy metals as described in Chapter 2. Therefore, it is necessary to test leaching heavy metals from the soil and to take responsible measure to prevent groundwater contamination in a spoil bank.

FIGURES

CHAPTER 9
OPERATION AND MAINTENANCE OF FACILITIES

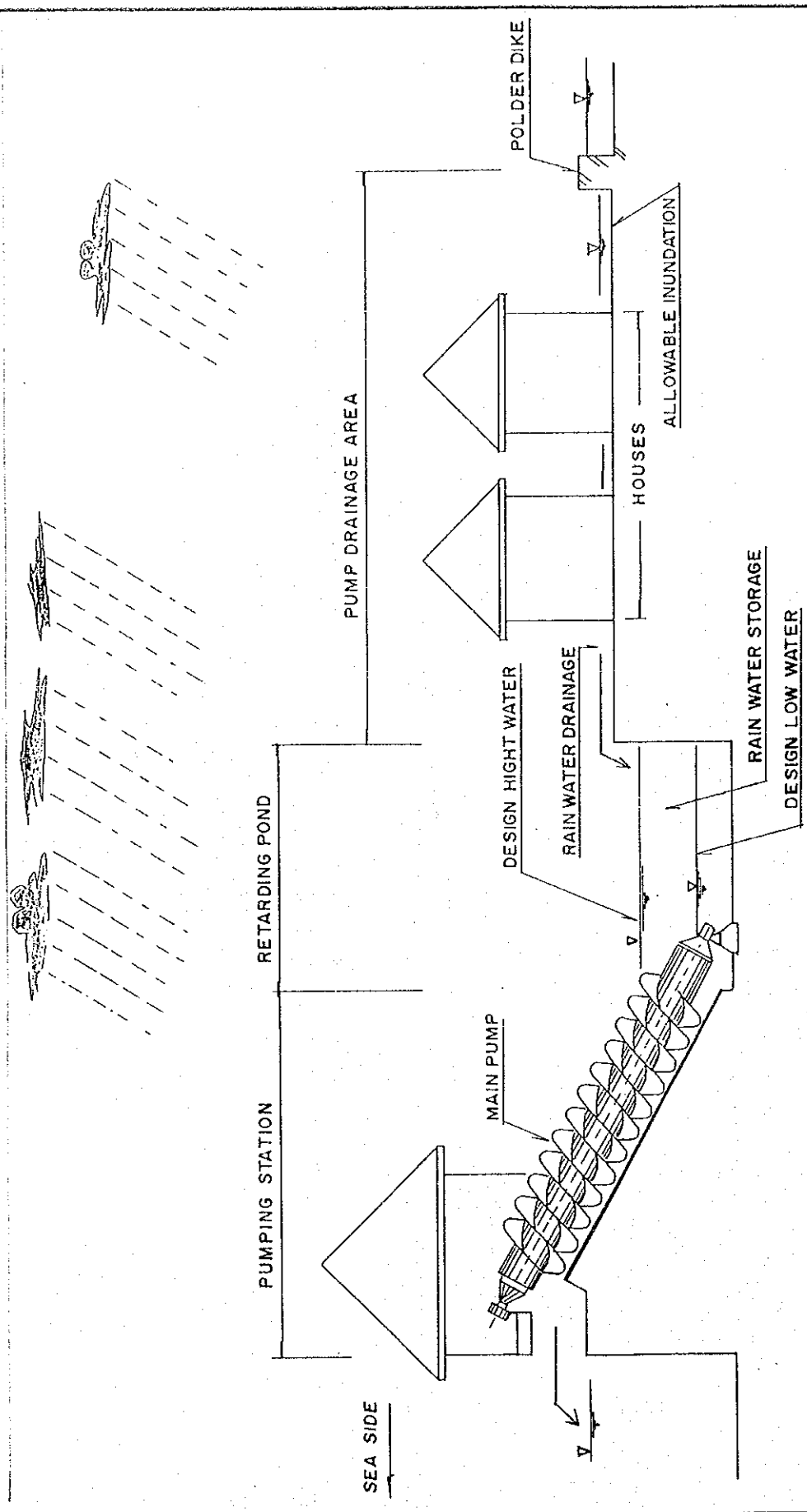


THE DETAILED DESIGN OF FLOOD CONTROL, URBAN DRAINAGE AND WATER RESOURCES DEVELOPMENT IN SEMARANG IN THE REPUBLIC OF INDONESIA

JAPAN INTERNATIONAL COOPERATION AGENCY

Fig. 9.1.1

THE OPERATION CONCEPT DURING DRY SEASON

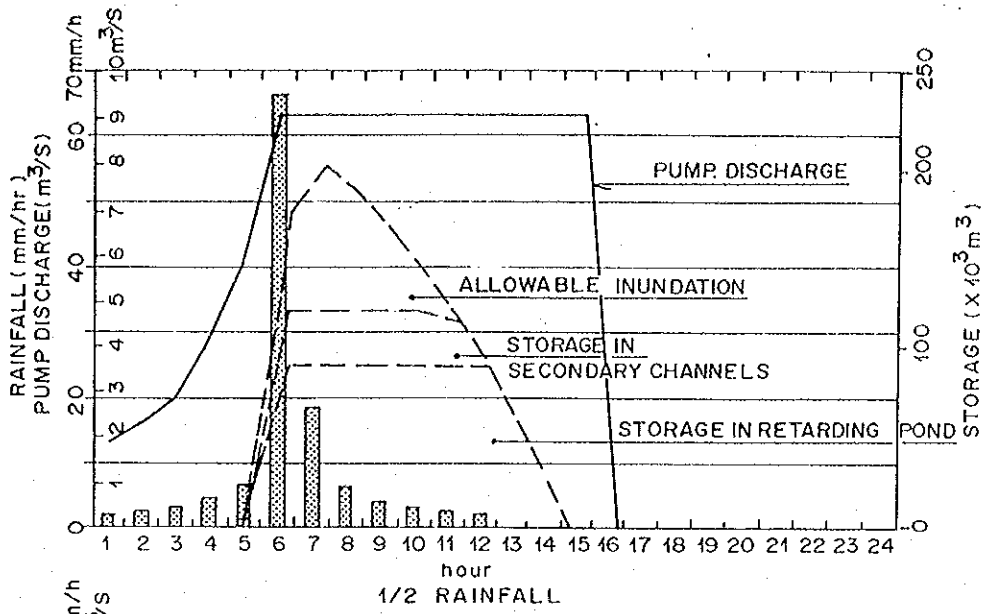


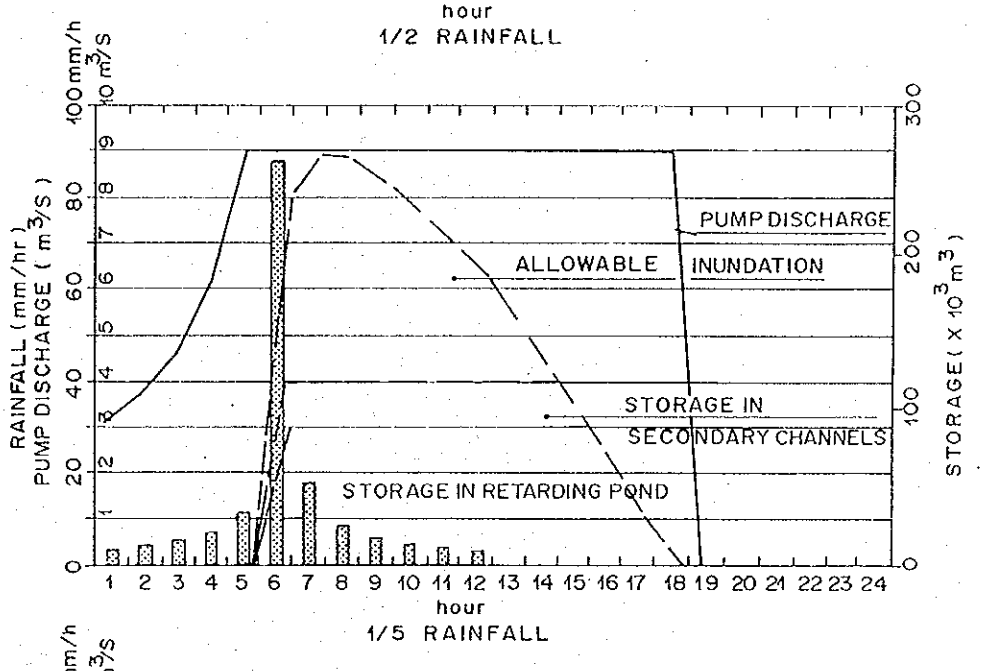
THE DETAILED DESIGN OF FLOOD CONTROL, URBAN DRAINAGE AND WATER RESOURCES DEVELOPMENT IN SEMARANG IN THE REPUBLIC OF INDONESIA

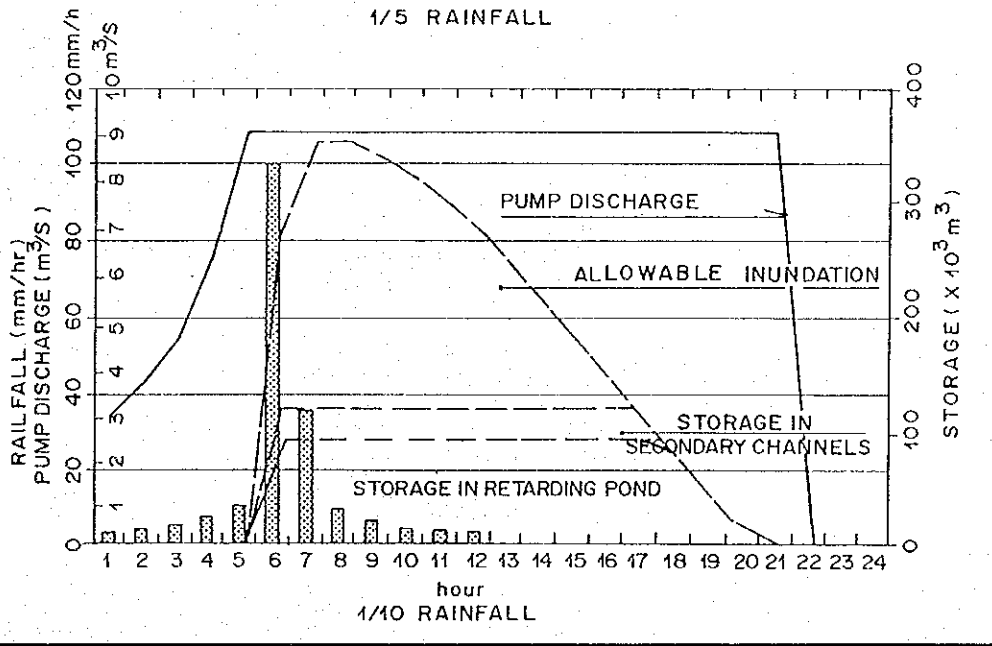
JAPAN INTERNATIONAL COOPERATION AGENCY

Fig. 9.1.2

THE OPERATION CONCEPT DURING RAINY SEASON







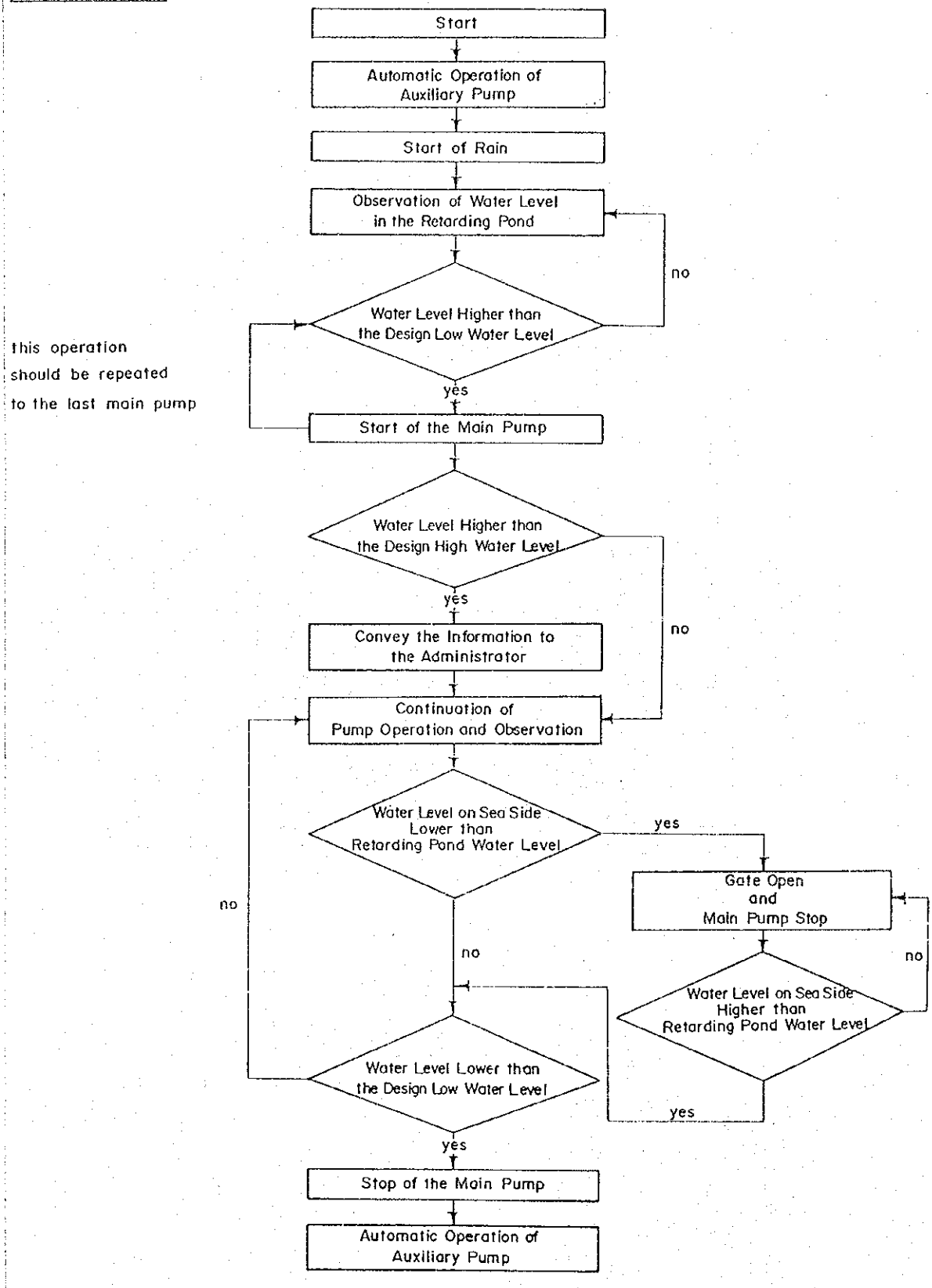
THE DETAILED DESIGN OF FLOOD CONTROL, URBAN DRAINAGE AND WATER RESOURCES DEVELOPMENT IN SEMARANG IN THE REPUBLIC OF INDONESIA

JAPAN INTERNATIONAL COOPERATION AGENCY

Fig. 9.2.1

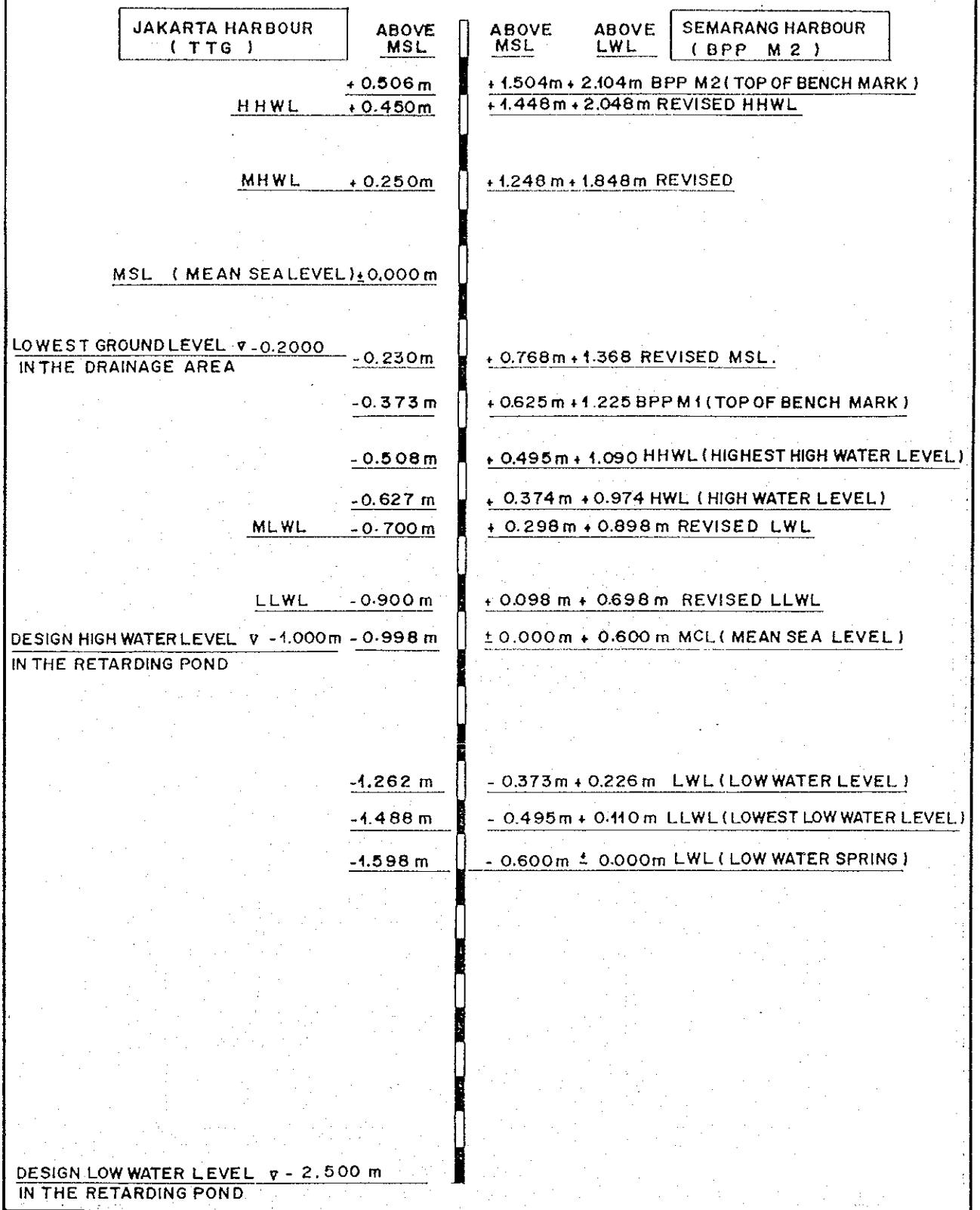
SIMULATION RESULT OF OPERATION OF ASIN PUMPING STATION

Rainy Season



THE DETAILED DESIGN OF FLOOD CONTROL, URBAN DRAINAGE AND WATER RESOURCES DEVELOPMENT IN SEMARANG IN THE REPUBLIC OF INDONESIA	Fig. 9.2.2 FLOWCHART OF THE OPERATION CONCEPT OF PUMP AND GATE.
JAPAN INTERNATIONAL COOPERATION AGENCY	

(ASIN)

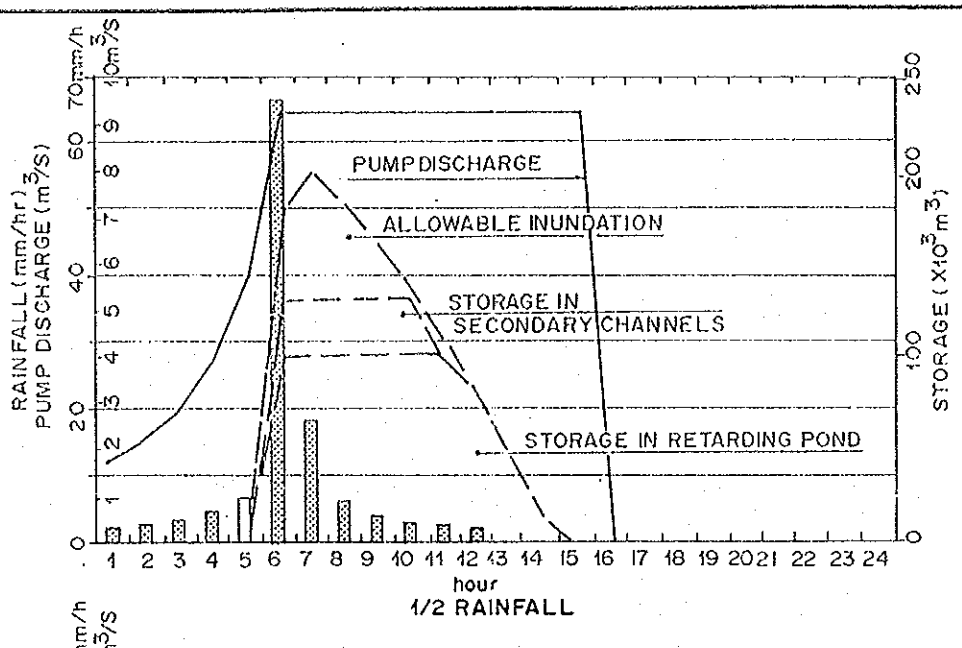


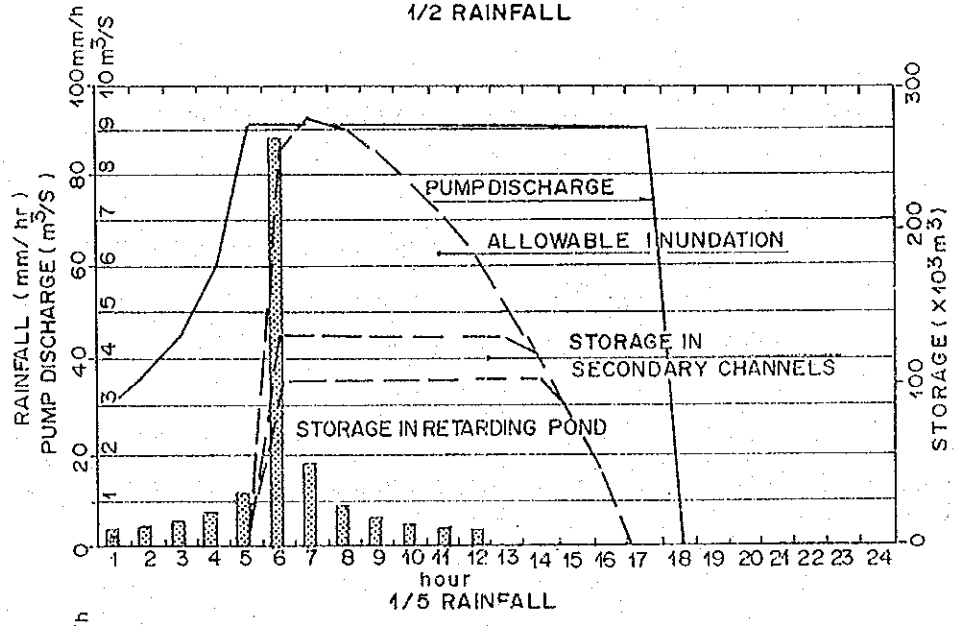
THE DETAILED DESIGN OF FLOOD CONTROL, URBAN DRAINAGE AND WATER RESOURCES DEVELOPMENT IN SEMARANG IN THE REPUBLIC OF INDONESIA

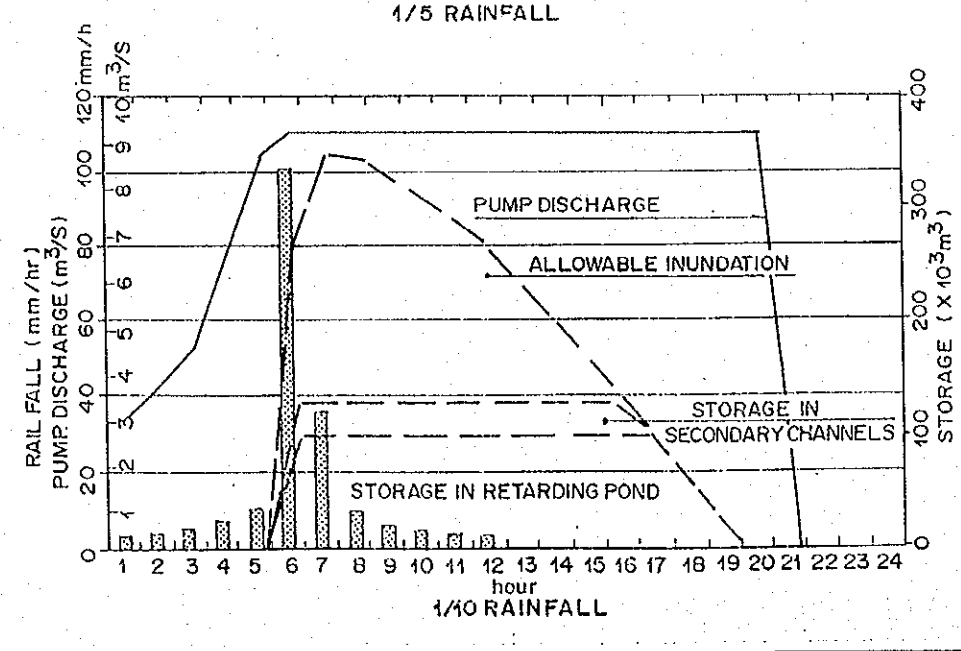
JAPAN INTERNATIONAL COOPERATION AGENCY

Fig. 9.2.3

THE RELATIONSHIP OF THE TIDE LEVEL AND THE DESIGN WATER LEVEL IN THE RETARDING POND (ASIN)

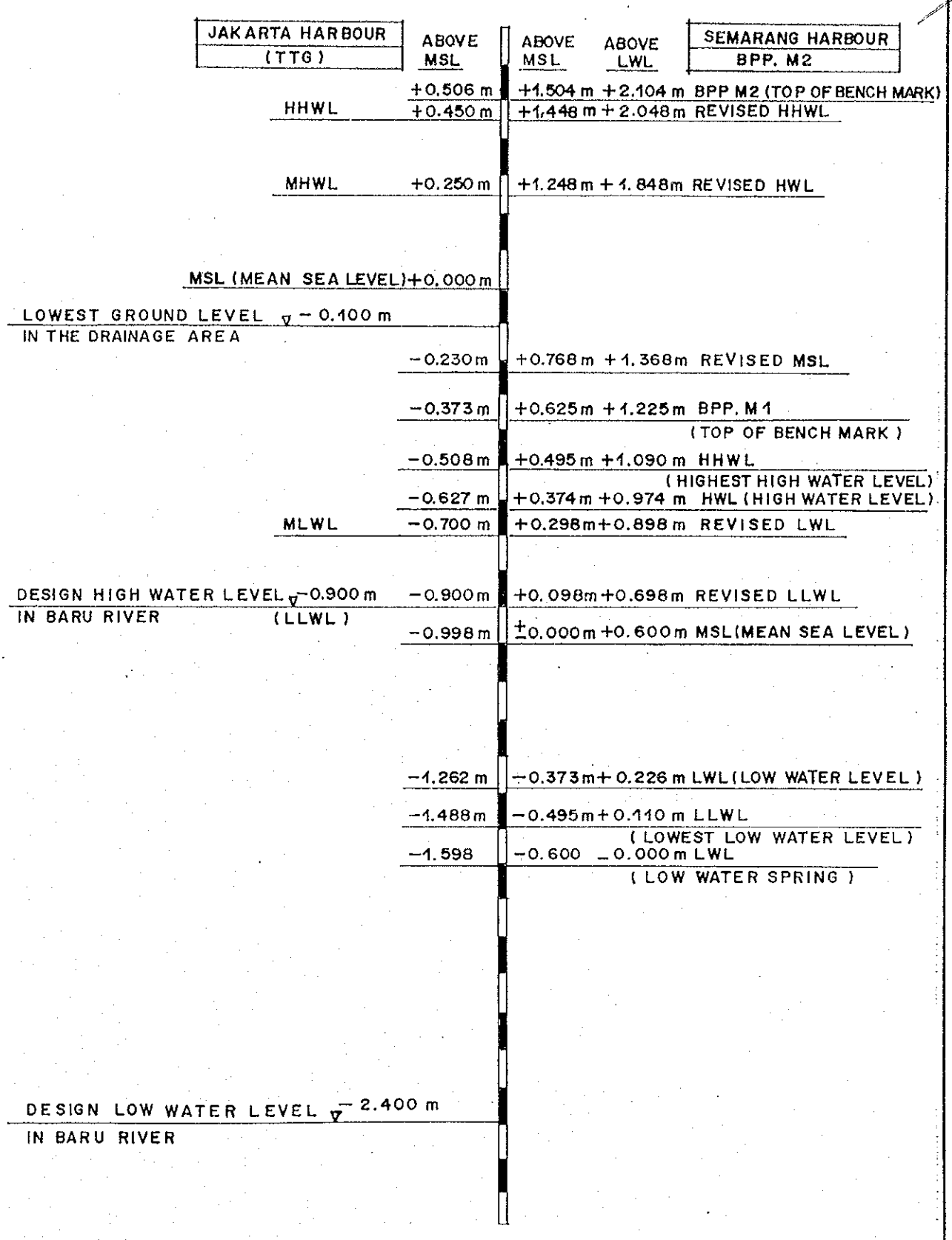






THE DETAILED DESIGN OF FLOOD CONTROL, URBAN DRAINAGE AND WATER RESOURCES DEVELOPMENT IN SEMARANG IN THE REPUBLIC OF INDONESIA	Fig. 9.3.1 SIMULATION RESULT OF OPERATION OF BARU PUMPING STATION
JAPAN INTERNATIONAL COOPERATION AGENCY	

(BARU)



THE DETAILED DESIGN OF FLOOD CONTROL, URBAN DRAINAGE AND WATER RESOURCES DEVELOPMENT IN SEMARANG IN THE REPUBLIC OF INDONESIA

JAPAN INTERNATIONAL COOPERATION AGENCY

Fig. 9.3.2
THE RELATIONSHIP OF THE TIDE LEVEL AND THE DESIGN WATER LEVEL IN THE RETARDING POND (BARU)

CHAPTER 10

ORGANIZATION AND INSTITUTION FOR OPERATION AND MAINTENANCE OF THE DRAINAGE FACILITIES

CHAPTER 10 ORGANIZATION AND INSTITUTION FOR OPERATION AND MAINTENANCE OF THE DESIGNED FACILITIES

10.1 Regional Government System in Indonesia

The new Autonomy Law (No. 22/1999) was enforced in May 1999. But the regulations for its implementation are not enacted yet. Thus, the present regional government system is in a transition period, awaiting the promulgation and implementation of the new regional regulation on the organization and procedures based on the new Law.

In this Chapter, italic words show Indonesian terms.

10.1.1 Structure and Powers of Regional Governments

Regional Governments are categorized into two levels, namely, Level I and Level II. Level I Regional Governments are composed of Provinces (*Propinsi*) and Level II Regional Governments are Regencies (*Kabupaten*) or Municipalities (*Kotamadya*). Regencies are governments in rural areas and Municipalities are in urban areas. Thus, Semarang Municipality (*Kotamadya Semarang*) is a Level II Regional Government in an urban area.

Regencies/Municipalities are the basic units of regional government system. Matters which affect over one Regency/Municipality are assumed by Provinces while those over one Province are assumed by the Central Government. Ministries of the Central Government have Regional Representative Offices (*KANWIL: Kantor Wilayah*). Regional Representative Offices make technical guidance to or technical coordination with Regional Government Services in the related field. Some Ministries including Education, Religion etc. have them for both Regional Government Level I and II. Ministry of Public Works has them only for Level I.

Regional Parliaments (*DPRD: Dewan Perwakilan Rakyat Daerah*) are established at each Level of Regional Government. Approval by the Regional Parliaments is necessary for making a budget and regional regulation, and for implementing regulations. In addition, each Regional Parliament elects candidate(s) of the regional government's head. Governor (*Gubernur*), the head of Province is appointed by the President, and Regent (*Bupati*), the head of Regency and Mayors (*Walikota*), the head of Municipality are appointed by the Governor.

Structure of regional government offices are similar both for Level I and Level II. Under the head of the regional government, established are Vice Head, such as Vice Governor (*Wakil Gubernur*), Vice Regent (*Wakil Bupati*) and Vice Mayor (*Wakil Walikota*), Secretariat (*Sekretariat Daerah*), Regional Development Planning Board (*BAPPEDA: Badan Perencanaan Pembangunan Daerah*), Inspectorate (*Inspektorat*) which reports to the head of the regional government, and Services (*Dinas*).

Vice Head assists the Region's Head, coordinates the activities of the Regional Government institutions and is responsible to the Region's Head.

Secretariat supports the Region's Head, collects and analyze information on regional administration.

Services are offices for implementation of government services in respective fields. They execute implementation procedures of services, guidance, planning, licensing and supervision/administration of implementation. Each Service has Secretariat, Sub-Service and Branch Offices under the Head of Service.

BAPPEDA draws up a development plan and financial plan, coordinates government services between the Services in dealing with problems on development.

Refer to Fig. 10.1.1 for the structure of the Regional Governments.

Sub-Regional Governments

Under Regencies/Municipalities, there are Sub-Regional Governments. Their characteristics are summarized as follows:

Sub-Regional Governments

Name	Status	Function	Description
Sub-District (*Kecamatan*)	Under Regency / Municipality	Coordinate Village Administrations in its jurisdiction.	Head (*Camat*) is appointed by and reports to Regent/Mayor. No parliament.
Village-administration (*Kelurahan*)	Under Sub-District in Urban Areas	A government office in direct contact with the public.	Head (*Lurah*) is appointed by and reports to Regent/Mayor. No parliament.
Village (*Desa*)	Under Sub-District in Rural Areas	A government office in direct contact with the public. Can make village internal Regulations by the proposal and/or approval of the Village Consultative Assembly (*Musyawarah Desa*).	Head (*Kepala Desa*) is elected directly by the Village residents and appointed by and reports to Regent/Mayor.

The Points of the New Autonomy Law (No. 22/1999)

The points of new Autonomy Law can be summarized briefly in the following three points:

(1) Authorities of the higher level of the Governments have been transferred to Regencies/Municipalities. Matters related only in one Regency/Municipality are managed by the Regency/Municipality.

(2) Regent/Mayor is directly responsible to the Regional Parliament not to the Central Government. The only one candidate of Regent/Mayor is elected by the Regional Parliament and appointed by the Governor.

(3) A Vice Head in a Regional Government is established under the Region's Head to reduce the burden of the Region's Head. Thus, the Region's Head is released from routine work and can devote oneself into policy matters.

10.1.2 Finance of Regional Governments

The execution of Regional Government's tasks and the Regional Parliament shall be financed from and borne by the Regional budget. The execution of the Central Government's tasks in the Region shall be financed from and borne by the Central Government's budget.

The sources of revenue in the implementation of Regional Government's tasks are:

(1) Regional original revenue;

(2) Proportion Funds;

(3) Regional loans; and

(4) Other legal regional revenues.

Sources of Regional original revenue consist of:

(1) Regional tax collection;

(2) Regional retribution collection;

(3) Income of the region owned enterprises, from the management of separated Region's assets; and

(4) Other legal regional original revenue.

The Proportion Funds consists of:

(1) Region's proportion from Land and Building Tax revenue, Land and Building Acquisition Duty and revenues from natural resources;

(2) General Allocation Funds; and

(3) Special Allocation Funds.

Certain percentage of the Proportion Funds are paid to Regional Governments. The proportion between the Central Government and the Regional Government is as follows:

Proportion Funds

Source	Central Government	Regional Government
Land and Building Tax	10%	90%
Land and Building Acquisition Duty	20%	80%
Natural Resources (Forestry, General Mining & Fishery)	20%	80%
Oil Mining	85%	15%
Natural Gas Mining	70%	30%
General Allocation Funds	It is stipulated at least 25% from the domestic revenue stipulated in the State's Budget. 10% of the Fund is allocated to Level I and 90% for Level II.	
Special Allocation Funds	It is transferred from the State Budget to certain Regions to assist financing special needs, observing the availability of funds in the State Budget.	
Reforestation Funds	60%	40% for producing Regions as Special Allocation Funds

Proportions between Level I and Level II will be decided in the new Regional regulations except that of General Allocation Funds.

The total revenue is Rp. 1,325 billion for the Central Java Province and Rp. 117 billion for Semarang Municipality in 1995/1996. The latter amounts to 8.8% of the former. Subsidies amount to 73.6% in the total revenue for Central Java Province while only 30% for Semarang Municipality, which shows a clear contrast in the revenue structure. It means that Semarang Municipality has relatively abundant in its own financial sources.

Issuing bonds by Regional Governments is very limited because it is strongly restricted by the Central Government which is very cautious about budgetary deficit as well as the market is not developed yet for the Regional Government bonds. Loans to Regional Governments

are mainly those underwritten by the Central Government. In 1995/1996 budget, Central Java Province borrowed no loans while Semarang Municipality borrowed Rp. 20 billion.

Expenses are divided into two: one is the routine budget and the other is the development budget. The routine budget is allocated to current expenditures and the development budget is spent on the project bases. The total expenditure is Rp. 1,261 billion for the Central Java Province and Rp. 103 billion for Semarang Municipality in 1995/1996. In Central Java Province, the ratio between the routine budget and the development budget is 85.8% to 14.2% while in Semarang Municipality 48.3% to 51.7%. The largest items in the routine budget is salaries (85.6% in the Province and 36.5% in the Municipality). Concerning the development budget, relatively larger portion is allocated to the transportation sector (19.9% in the Province and 33.5% in the Municipality).

10.2 Present Situations of Organization and Institution for Operation and Maintenance

10.2.1 Related Laws and Regulations

The basic law on rivers in Indonesia is the Government Regulation No. 35/1991. This Regulation is enacted for the implementation regulation of the Law No. 11/1976 on Water Resources Development, under which the Government Regulation No. 22/1982 on Water Management, the Government Regulation No. 23/1982 on Irrigation, the Government Regulation No. 20/1990 on Control of Water Pollution and the Government Regulation No.27/1991 on Swamps are also promulgated.

The background of the enactment of these Regulations is that the increase of water demand due to growth of population and industrial development as well as the deterioration of water quality and decrease of water resources necessitate the implementation of Regulations.

Law No. 11/1974 on Water Resources Development

The State has the responsibility for control, development and management of water resources. Priority is put on water uses for drinking, irrigation and energy in water planning and allocation. Direct beneficiaries are to participate in the operation and maintenance with the Central or Regional Government assuming the operation and maintenance responsibility.

Government Regulation No.22/1982 on Water Management

This Regulation sets up the basis for river basin management including the requirement for a comprehensive water resources plan for each basin which is to be incorporated in a National Water Plan as part of the National Development Plan. Except for domestic use, all water use requires license from the Provincial Government, including groundwater extraction.

Government Regulation No. 35/1991 on River

It declares that rivers have multi-purpose uses and delegates responsibility for their development and management to either Central or Regional Government in accordance with a classification of their economic importance. Construction of river structure with the aim for public welfare and safety shall be made by the Government or a state-owned corporation. In addition, operation of river and river facilities shall be made by the Government or a state-owned corporation.

10.2.2 Related Authorities

(1) *JRATUNSELUNA* Master Project Office

JRATUNSELUNA stands for the names of five river basins (Jragung, Tuntang, Serang, Lusi and Juana) which the office covers in a part of the Central Java Province. It manages the projects for water resources development falling in the scope of Region Level I within the said river basins including Semarang Project Area. The General Manager of the Master Project Office makes guidance to such projects from the viewpoint of policy matters, under the supervision of the Ministry of Public Works. On the other hand, those projects are also guided by Head of Water Resources Development Unit of the Central Java Province in terms of technical matters. Under the General Manager, there are three implementation units for projects (refer to Fig. 10.2.1).

The implementation unit for Irrigation is now abolished because the World Bank loan for the irrigation project has finished. The implementation unit of *PKSDA* (*Proyek Konservasi Sumber Daya Air* or Water Resources Conservation Project) has changed to *PPKSA* (*Proyek Pengembangan dan Konservasi Sumber Air* or Water Sources Development & Conservation Project).

The budget by each project implementation unit is as follows:

Budget by Project Implementation Unit of *JRATUNSELUNA*

Unit: Rp. 1,000

Fiscal Year	Water Resources Management & Flood Control Project		Water Source Development & Conservation Project		Raw Water Supply Project	
	Allocation	Realization	Allocation	Realization	Allocation	Realization
1996/1997	21,128,841	8,234,024	7,161,257	6,956,324	5,210,147	5,205,387
1997/1998	20,903,308	8,080,109	3,137,309	2,986,313	11,042,967	11,039,432
1998/1999	43,384,725	25,713,950	10,742,070	10,669,398	16,413,856	4,454,778

Usually, *JRATUNSELUNA* does O&M services for two years after the construction of facilities. The same implementation unit will take in charge of the O&M services. The budget allocated for the O&M of facilities is very small. It is not proper to show the budgets of previous years for the purpose of the study of the financial capacity with the following reasons:

(a) Budget of *JRATUNSELUNA* is made on the project basis. Thus, the actual budget allocated for the facility cannot be estimated until the project is really started.

(b) The budget allocated for the O&M of facilities is very small. The amount of budget was decided with no reasonable calculation.

(c) Presently, the government system in Indonesia is changing drastically, such as restructuring of Ministries, decentralization of power, clean up of corruption, etc. *JRATUNSELUNA* is also planned to change in the near future.

It is presently planned that *PPSAPB* coordinates with Housing Facilities Improvement Project Office (*P2P*) under Directorate General of Human Settlement (*Directorat Jenderal Cipta Karya*) for the construction of Urban Drainage Facilities. No new organization is planned to be established for the Project Facilities.

(2) Public Works Service of Semarang Municipality (*Dinas Pekerjaan Umum Kotamadya Semarang*)

Public Works Service of Semarang Municipality is characterized as follows:

Purpose: To enhance the execution of Government and development efficiently in particular in the field of operation and maintenance of the construction of roads, bridges, and city channels.

Status: an implementation unit of the public works in the Municipality.

Tasks/Duties: Assisting the Head of Public Works Service in the execution of Government services in the field of the construction of roads, bridges, city channels, water supply facilities and buildings.

Functions are itemized as follows:

(a) Coordinates the implementation and maintenance of the construction of roads, bridges, city channels, water supply facilities and buildings owned by the Regional Government in its working area which are financed by the Level II Regional Budget Funds, Subsidy of Level I Budget and Subsidy of the National Budget;

(b) Reporting on the result of the implementation of the works in its working area to the Head of Public Works Service;

(c) Submitting technical considerations to the Head of Public Works Service; and

(d) Implementing other works provided by the Head of the Public Works Service.

The **Organization** of Public Works Service consists of the Head of the Service, Administration Sub-Service, and five Sections, (refer to Fig. 10.2.2).

The budget of the O&M for urban drainage is Rp. 1,062,394,000 in 1998/1999 and Rp. 991,000,000 in 1999/2000, which is categorized as Project Budget.

(3) Other Related Authorities

Other related authorities concerning water resources development are summarized as follows:

Other Related Authorities Concerning Water Resources Development

Abbreviation	Indonesian Name	English Trans.	Main Tasks & Responsibilities
DGWRD (MPW)	Direktorat Jenderal Pengairan	Directorate General of Water Resources Development (M. of Public Works)	Responsible for planning, development and management of water resources in the nation excluding ground water. Responsible for all river works and flood control in rural and urban areas and for drainage works in urban areas.
DPU Cipta Karya	Directorat Jenderal Cipta Karya, Dep. Pekerjaan Umum	Directorate General of Human Settlements (M. of Public Works)	Responsible for planning, development of human settlement in rural and urban areas.
DPE	Departemen Pertambangan dan Energi	Ministry of Mining and Energy	Gives technical advice to provincial government Gives approval of groundwater exploitation Overseas PT PLN activities in coordination with DGWRD which controls water licensing for hydro use.
DISTAMB	Dinas Pertambangan Daerah Propinsi Dati.I Jateng	Provincial Mining Service, Central Java	Determines the allocation and extraction schedules after getting approval of DPE
BAPEDAL	Badan Pengendalian Dampak Lingkungan	Environment Impact Management Agency	To assist the President in managing environmental impacts including prevention of and control over pollution and environmental damage To assist the President in rehabilitating environmental quality.
BAPEDALDA	BAPEDAL Daerah Propinsi Dati.I Jateng	Provincial Agency for Environment Impact Management	Responsible for monitoring inspecting and controlling quality of water, air and soil. Coordinating for environmental damages.
Dinas Penyehatan	Dinas Penyehatan TK I Jawa Tengah	Sanitation Services, Central Java	Responsible for clean water demand in Central Java Province
DDN	Departemen Dalam Negeri	Ministry of Home Affairs	Responsible for implementation of public services in Indonesia
PT PLN	Perseroan Terbatas Perusahaan Listrik Negara	State Electric Power Company	Responsible for power generation, transmission and distribution of electricity Responsible for planning, construction and operation of power supply facilities
PDAM Semarang	Perusahaan Daerah Air Minum	Regional Drinking Water Supply Company (Semarang)	Responsible for providing municipal and industrial water Surface water of the K. Garang is withdrawn for Semarang mainly groundwater is pumped up for other areas than these two.
Dam Safety Unit	Balai Keamanan Bendungan	Dam Safety Unit	Responsible for preventing negative impact of dams in Indonesia

10.3 Proposed Organizations for Operation and Maintenance

Usually, *JRATUNSELUNA* does O&M services for two years after the construction of facilities. The same implementation unit will take in charge of the O&M services. After that, O&M responsibilities will be transferred to respective Regional Governments according to the Regional Regulation on the organization and procedures.

10.3.1 Proposed Organization

Several meetings were held between the Study Team and Semarang Municipal Office how to establish an organization and an institution for maintenance and operation of drainage facilities which would be constructed in the Project. Based on these discussions, the following proposals on new organization and new institution of cost sharing by beneficiaries are made.

Although this idea of cost sharing by beneficiaries is working in Thanah Mas Estate , where comparatively wealthy people live, it needs a lot of efforts to realize it by Semarang Municipal Office. As mentioned in Chapter 4, five (5) small pumps have been installed through Sector Program Loan(SPL) of JBIC. The operation and maintenance of those small pumps by Semarang City Office will be a crucial mile stone for realization of operation and maintenance of a larger system.

JICA Jakarta Office expressed their strong support in monitoring the maintenance and operation performance of those small pumps by Semarang Municipal Office. A JICA Expert in Jakarta will be assigned to coordinate the monitoring program as one of his official activities.

According to the Municipal Regulation on the organization and procedures, **Settlement Environment Sub-Section** under Drainage and Sanitation Technology Section of Municipal Public Works Service is in charge of operation and maintenance of the proposed drainage system. In order to reduce the financial burden of the Municipal Government and secure daily operation and maintenance, a part of operation and maintenance costs is shared by the beneficiaries of the proposed pumping system since the budget for the operation and maintenance is limited in the Municipality. Refer to Fig. 10.3.1 for the area covered by the pumping system.

For collecting contributions from the beneficiaries and control the payment, a

resident association is established. Here "resident" means not only person who lives in but also person who owns a factory, storehouse or office building which located in the pumping area. The resident association should be the cooperatives which is a legal body or a corporation. The reasons are as follows:

(a) A legal body still exist after the members of it are changed.

(b) A legal body can bring a case before the court when it gets in some legal trouble.

(c) The Cooperative Law stipulates the organization and procedures of the cooperatives. Thus, when a resident cooperative is established, it is enough in legal viewpoint that the residents follow the Cooperative Law.

(d) A cooperative can hold more than one purpose. Thus, the resident cooperative can manage other than operation and maintenance cost of pumping, such as waste cleaning in the area by the decision of the members.

As it is considered that the main cause of the land subsidence is excessive exploitation of groundwater, the operation and maintenance cost of urban drainage facilities should be shared with the users of groundwater. However, it is not yet possible now to verify the cause and result relationship between land subsidence and groundwater with concrete data. So it is proposed here that the cost is to be shared only with beneficiaries. This may be a controversial problem and Semarang Municipal Office should make it clear the legal aspect of the fund collection system from beneficiaries.

The legal status of the money paid for the part of O&M costs is an "assistance" or "donation" to the government. The part of O&M costs include the maintenance cost for equipment/tools, electricity and fuel cost, and over-time salaries of the O&M staff since they are necessary for the daily operation and maintenance. Staff salaries for regular time cannot be paid by the cooperative according to the Government Employees Laws and Legislation.

The organization plan is formulated mainly with the following consideration.

(a) The contribution collected from the residents should be separated from the budget of Municipality;

(b) It should be secured that the contribution collected should be used only for the O&M of the pumping system; and

(c) The Regional Government should avoid receiving the money directly from the residents.

The organization plan is outlined as follows:

Structure and Functions of Resident Cooperatives (refer to Fig. 10.3.2)

(a) A Resident Cooperative is organized at each *Kelurahan* in the pumping area.

(b) Resident Cooperatives in *Kelurahan* level organize a secondary cooperative, the Resident Cooperative Federation. It is composed of the Management Body and the General Assembly. The General Assembly appoints the members of the Management Body, which reports to the General Assembly in turn.

(c) The resident cooperatives have a hierarchical structure as a whole along to the sub-Regional Government System because it is easy to establish and control.

(d) Resident Cooperatives at *Kelurahan* level collect contribution for operation and maintenance of the proposed drainage system.

(e) The Resident Cooperative Federation keeps the contribution collected by each Resident Cooperative and pay them to suppliers of O&M goods/services directly on the request of the Settlement Environmental Sub-Section of Public Works Services, which is in charge of O&M of the proposed drainage system.

(f) Contribution collected from the residents and kept by the Cooperative Federation should NOT spend for other than O&M costs of the proposed drainage system.

(g) Independent auditor is organized, which should be appointed by the General Assembly of the Resident Cooperative Federation. It audits the accounting of the Management Body.

(h) Members of the independent auditor consists of a certified public accountant, members of NGOs, representatives of the residents, etc. by the decision of the General Assembly.

(i) Independent auditor reports to the Head of Public Works Service of Semarang Municipality and the General Assembly of the Resident Cooperative

Federation periodically.

Note: Presently, no secondary cooperatives are planned to be made at Kecamatan level. It is for the reason that the number of *Kecamatan* in the pumping area is two. In this case only two member cooperatives have to organize the Resident Cooperative Federation. But member cooperatives should be at least three according to the Cooperative Law. In the future when the pumping area is expanded and the number of *Kecamatan* is increased, it would be necessary to organize secondary cooperatives at *Kecamatan* level under the Resident Cooperative Federation.

New Assignments and Functions in the Public Works Service (refer to Fig.10.3.3)

(a) New jobs are assigned to Settlement Environment Sub-Section for the proposed drainage system because there should be no organization under Sub-Sections.

(b) New assignments include Maintenance of Primary Channels (Asin River, Baru River and Semarang River), O&M of Pumping Stations, Resident Cooperative Affairs and Drainage System Accounting.

(c) Settlement Environment Sub-Section manages the operation and maintenance of the proposed drainage facilities/equipment and control the new pumping stations.

(d) Head of Settlement Environment Sub-Section request the payment for the maintenance cost for equipment/tools, electricity and fuel cost, and over-time salaries of O&M staff to the Management Body of the Resident Cooperative Federation.

Detailed tasks and responsibilities of the new assigned staff is shown in Table 10.3.1.

10.3.2 Necessary Cost

Necessary yearly costs of the operation and maintenance for the proposed facilities are Rp. 621,867,000 for the urban drainage system as shown in the table below.

Required Annual Operation & Maintenance Cost for Urban Drainage

Description	Yearly Cost (Rp)
1. Salary for Staff	57,000,000
2. Maintenance Cost for Equipment/Tools	16,800,000
3. Electricity and Fuel Cost	74,400,000
4. Repair Cost of Pump, Gate, Hoist, Electrical/ Mechanical Equipment, Office building and Civil works	218,667,000
5. Dredging of Channels (15,000 m3)	255,000,000
TOTAL	621,867,000

The amount to be paid by the beneficiaries are Rp. 91,200,000, total of item 2 to item 5, excluding over-time salaries. Refer to Table 10.3.2 for the details.

10.3.3 Monthly Contribution from the Beneficiaries

The pumping area contains Factory & Storehouse, Business & Commercial, Public (Government Office, Hospital & School), and Residential Areas. Area size and share of each category is as follows:

Land Use in the Area Covered by the Pumping System

Land Use of Drainage Area	m^2	Area Share
Factory & Storehouse	403,000	12.9%
Business & Commercial	439,500	14.0%
Public	155,750	5.0%
Residential	2,134,750	68.1%
Total	3,133,000	100.0%

In order to differentiate the burden of the costs by reducing that of residential and increasing that of Business and Industry, the cost share is adjusted, and monthly contribution per m^2 is calculated as follows only for reference on the assumption that Factory and Business Area share 40% of the required cost and the rest of sectors share 60% of the rest.

Monthly Contribution after Share Adjustment

Land Use of Drainage Area	Cost Share	Yearly Shared Cost (Rp)	Monthly Contribution per m^2 (Rp)
Factory & Storehouse	19.0%	107,224,730	266.3
Business & Commercial	21.0%	118,622,030	269.9
Public	5.0%	28,243,250	181.3
Resident & Small Shop	55.0%	310,676,850	145.5
Total	100.0%	564,867,000	-

Since the number of households is estimated approximately at 26,000, the average monthly contribution for household is Rp. 3,082, taking the following assumptions into consideration.

(a) Cooperative participation rate of the residents: 70%

(b) Contribution collection rate: 60%

(c) Administrative cost of the Cooperatives: 30% of the calculated amount

Since the median of monthly expenses by a household is estimated at Rp. 340,915.3, Rp. 3,082 is only 0.90% thereof. Refer to Table 10.3.3 for the detailed list of assumptions for the above calculation.

10.4 Groundwater Intake Regulation

10.4.1 Background

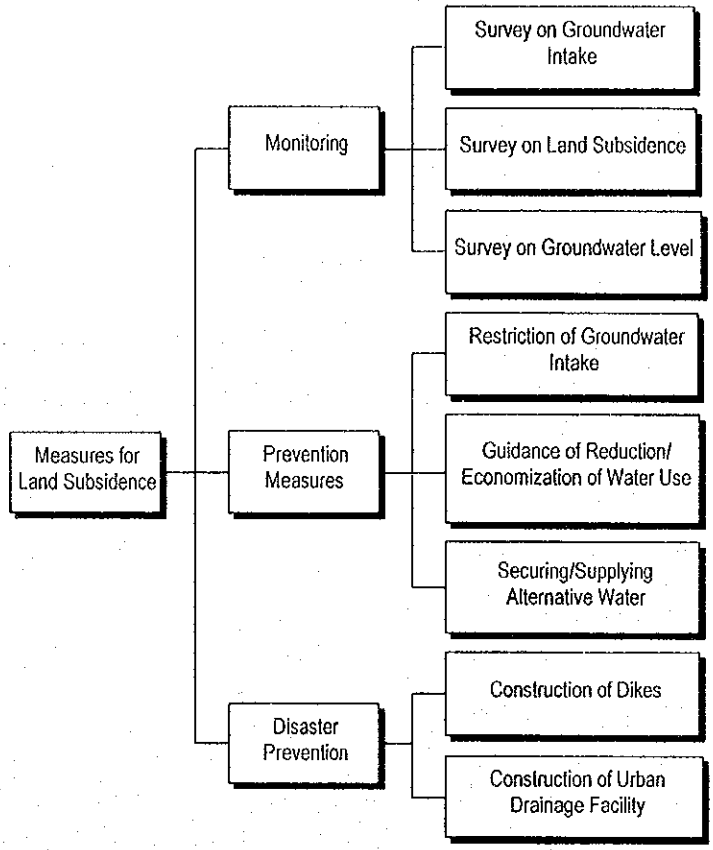
(1) Present Conditions

In the past decade, land subsidence was caused in the coastal area of Semarang Municipality due to the excess exploitation of groundwater by the industrial sector. As a result of the leveling survey done in August 1997 and 1998, all of the eight (8) bench marks were found to be subsided 4.0cm on an average with the range of 1.2 cm to 10.0 cm annually.

(2) Measures against Land Subsidence

Since the groundwater is relatively low cost and its use is widely ranged from domestic to industrial, on the other hand groundwater intake is the cause of land subsidence which makes huge loses of activities of the people, its regulation should be planned carefully and comprehensively. Measures against land subsidence can be categorized to (1) Monitoring, (2) Prevention Measures and (3) Disaster Prevention as follows:

Measures against Land Subsidence



Monitoring includes surveys on land subsidence, amount of groundwater intake and groundwater levels. Prevention measures should include not only restriction of groundwater intake but also plans of groundwater reduction/economization and alternative water supply for the effective conversion of water sources. Finally, disaster measures are construction works whose designs are in progress in this Study.

Comprehensive measures against land subsidence require comprehensive legal system of water resource management both for groundwater and surface water. It takes long time, however, to develop the comprehensive legal system. Thus, regulation of groundwater pumping should be developed urgently.

10.4.2 Present Regulations and Issues

(1) Present Regulations

Provincial Regulation No. 5/1985 on Groundwater Intake requires the license of the Provincial Government for groundwater drilling and/or use for any purpose. Article 24 of the Regulation provides that Groundwater intake without license results

in "violation" in terms of **General Provisions of Penal Code**, which stipulates a maximum of six months in prison. **The Letter of the Governor of the Central Java Province (No. 546.2/029618, dated: October 6th 1993) on Closing of Part of Semarang Municipality and Demak Regency for New Groundwater Intake/Drilling** prohibits issuing new licenses as well as renewal of licenses in almost all the area near the coast in Semarang Municipality except for the purpose of drinking and domestic use. Thus, after the term of all existing licenses are expired (three years), no groundwater intake is permitted except for drinking and domestic use.

The Decision of the Governor of the Central Java Province (No. 546.2/108/1992) on Establishment of Groundwater Control and Supervision Committee stipulates the establishment of organization for the control and supervision of groundwater intake. The Committee consists of Heads of related Services of the Province. The Executive Chairman is the Head of Mining Service, which is in charge of groundwater affairs.

On the other hand, **the Decision of the Mayor of Semarang Municipality (No. 546.2/148/1994) on Obligation to Make Absorption Well** requires new buildings to be equipped with absorption wells, which leads rain water into the groundwater layer. The reason is as follows. If we consider the supply side of groundwater, the development of hilly areas reduces the groundwater supply since construction of buildings in the area reduces the absorption capacity of rain water into the groundwater layer. Although the City Planning Law prohibits disordered development, the City Planning Section finally accepted illegal buildings because proper land for buildings is scarce now in Semarang.

(2) Issues of the Regulations

(a) Surveys

Surveys on groundwater in the Study area have been carried out so far. They include:

(i) Groundwater Conservation Survey in the Area of Semarang, Kendal and Demak in Central Java, Directorate of Environmental Planning of Geology, Directorate General of Geology and Mineral Resources,

Ministry of Mines & Energy, 1994 (Indonesian);

(ii) Assessment of Groundwater Management System in Semarang Basin (Groundwater Data Base Phase I), Water Resources Assessment and Management Project, BPPT, 1995 (Indonesian);

(iii) Report on Absorption Area Observation Study in Garang River Basin, Semarang - Central Java, Mining Service of Central Java Province 1995 (Indonesian);

(iv) Study Report on the Observation of the Garang River Basin Absorption Area in Collaboration between Directorate of Environmental Planning of Ministry of Mining and Energy and Mining Service of Central Java Province, 1995 (Indonesian);

(v) Final Report of Works on Measurement of Estimated Level of the Groundwater Intake Prohibition Area in the Semarang Municipality, Mining Service of Central Java Province and Gajahmada University, 1997 (Indonesian); and

(vi) Groundwater Monitoring & Control Project, BAPPEDAL - DFID, 1998 (English).

There are no written programs for implementation of surveys on groundwater intake. Continuous surveys from the viewpoint of groundwater intake restriction are required in terms of land subsidence prevention. Further, surveys on land subsidence itself have not been practiced except that by the JICA Study Team from 1997 to 1998. Such land level surveys are very important not only to get data on present conditions but also to know how effectively the regulations are implemented.

(b) Detection of Violations

Presently, Mining Service of the Province, which is in charge of groundwater regulation, has designated no special staff for the detection of regulation violation. In addition, no records are kept concerning the violations. Thus, no one knows that the Regulation is observed actually.

(c) Sanctions against Violations

The Regulation stipulates no special sanctions against the violation except one stipulated in the Penal Code, which shall be decided by the Judges of the Court only if the case is brought before the Court of Justice. The Regional Government has no direct sanctions against the violators for securing the implementation of the Regulation.

(d) Water Source Conversion Plan

For the effective implementation of groundwater restriction, conversion of water sources to river water is indispensable. People cannot stop using groundwater unless alternative water source is provided. In addition, since the reduction and economization of water use is limited to some extent, additional water sources should be secured by the Regional Government. Presently, the Regional Government has not formulated comprehensive water balance management plan for the implementation of groundwater restriction.

10.4.3 Recommendation for Groundwater Intake Regulations

Considering the issues on the present regulations for groundwater intake mentioned above, the following are recommended for the effective implementation of the regulations.

(1) Researches/Studies for Land Subsidence Prevention

The following should be promoted from the view point of land subsidence prevention: researches/studies including land subsidence, groundwater level, ground level, investigation of subsidence mechanism, moderating groundwater abstraction, fostering groundwater, monitoring including land level survey and groundwater level survey. Responsibilities of related authorities for researches, studies and surveys should be clarified.

(2) Allocation of Personnel and Budget to Violation Detection

Necessary staff for detection of violations should be designated in Exploitation Supervision Section of Mining Supervision Sub-Service in Provincial Mining Service. At the same time enough budget for the detection should be allocated. A part of such budget can be financed by creating new fines for the violation, which is

not stipulated in the Regulation (explained below).

(3) Effective Sanctions against Violations

Additional suctions should be stipulated in the Regulation in order to implement the Regulation effectively and timely. Examples are as follows:

Fine: Groundwater is used mainly because it is cheaper than surface water which should be processed. Fine should be high enough to make the violation costly and users convert to the surface water. In addition, the budget necessary to implement the Regulation can partially financed by the revenue from the fine.

Publication of Violators: Sometimes fines are not enough to prevent violations. Names of recidivists or extreme/repeating violators should be published. Bad reputation is sometimes very costly for those who does not care the fine.

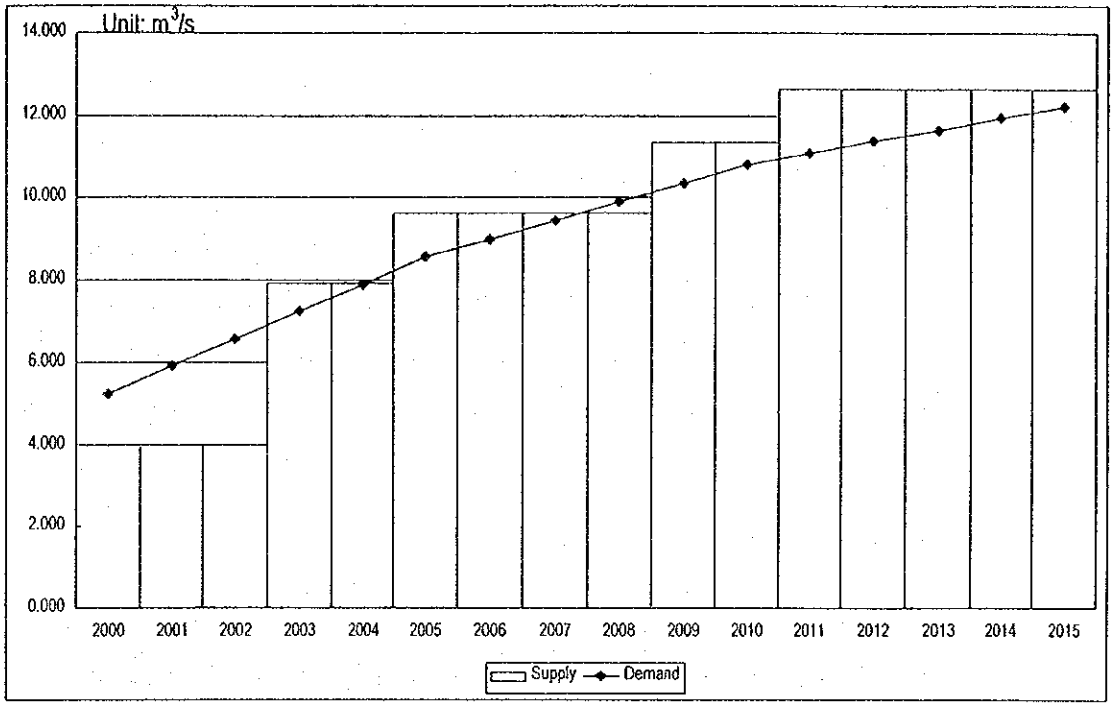
Closing of Wells: New well drilling can be detected easily. But intake from existing wells in secret is very difficult to be found. Thus, wells should be closed or sealed not to be used after the expiration of licenses.

(4) Securing/Supplying Alternative Water and Economizing Water Use

New water resources should be developed to secure stable supply of alternative water, and efficient use of groundwater should be promoted to appropriate excess water to alternative use.

According to the estimation of future water demand and proposed water supply plan by JICA Study Team in 1993, the water supply and demand in the future could be balanced without counting in the groundwater intake in the urban area. See the Graph below.

Future Water Supply Plan and Demand Forecast



Note: Since the water demand forecast was made in 1993, it should be revised to lower considering the recent economic down turn in Indonesia.

Details of the proposed water supplies are as follows:

Water Supply Plan

Water Source	Additional Capacity (m^3/s)	Cumulative (m^3/s)	Year
Existing	1.486	1.486	1996
Water transfer from Klambu to Kudus	2.500	3.986	1998
Jatibarang Reservoir	1.460	5.446	2003
Dolok Reservoir	0.750	6.196	2003
Tuntang Jragung Regulation Tunnel	1.750	7.946	2003
Mundingan Reservoir	1.020	8.966	2005
Interbasin Transfer	0.680	9.646	2005
Kedung Suren Reservoir	1.700	11.346	2009
Babon Reservoir	1.300	12.646	2011

Note: Water source "Existing" includes Garang River, Babon River, springs and deep wells around Mt. Ungaran.

The latest plan concerning future water demand up to target year 2015 have been arranged in "SFCP Final Project Preparation" Report in 1996. According to that report, future water demand in three areas (Eastern, Western, and Upper areas) of

Semarang City in target year 2015 is 12.218 m^3/s.

In order to realize the balance of water supply and demand and keep it, the following measures should be implemented by the Regional Government.

(a) Economizing Non-groundwater Use

Necessary measures should be taken to secure alternative water sources to groundwater. The users should be instructed to take measures for economizing water use according to the standard of water use economization (explained below), and to take necessary measures to appropriate excess water to alternatives to groundwater.

(b) Securing Alternative Water Sources

Necessary measures should be taken to secure river water as the alternative to groundwater in the water supply with high priority if the economization of water use can not fulfill the demand of alternative water.

(c) Economization of Groundwater Use

Those who are licensed to intake groundwater should be advised to take necessary measures to economize groundwater use in accordance with the standard of water use economization (explained below).

(d) Standard of Water Use Economization

Technical standards of water use economization should be enacted for each water use category in order to promote reduction and reuse of water.

(e) Assistance for Convert to Alternative Water

The Province should consider the establishment of a fund or tax reduction for financing the remodeling of facilities for conversion to alternative water use, economization of water use, water reuse, etc. as well as to offer other assistance.

TABLES

CHAPTER 10
ORGANIZATION AND INSTITUTION FOR OPERATION AND MAINTENANCE OF THE DRAINAGE FACILITIES

Table 10.3.1 NEW ASSIGNED STAFF FOR THE O&M OF PROPOSED URBAN DRAINAGE SYSTEM

Assignment of Staff	Number	Tasks and Responsibility	Remarks
Chief Civil Engineer	2	- Management and administration - Supervision of O&M works - Instructions to the Operator for periodical inspection, maintenance and repair - Request of budget	Periodical and emergency case (to be assigned for 6 months in a year)
Electrical/Mechanical Engineer	2	- Assistance to Chief/Civil Engineer - Supervision of Operator - Periodical inspection, maintenance and repair of electrical/mechanical equipment	Periodical and emergency case (to be assigned for 6 months in a year)
Operator	4	- Daily operation of sediment flush gates and intake gates - Operation of flood discharge gates in flooding event - Daily inspection, maintenance and repair of gate and hoist	Permanently stationed (in the staff house at site)
Heavy Equipment Operator	2	- Operation of heavy equipment (Backhoe, Dump Truck, Boat)	Periodical and in emergency case
Worker	5	- Maintenance/Repair work at the site	Periodical and in emergency case
Staff of Cooperative Affairs	1	- Management and administration of cooperative affairs - Budget request	Permanent
Staff of Drainage System Accounting	1	- Daily book keeping of the O&M cost requested to the Resident Cooperative Federation - Budget request procedures	Permanent
Assistant on Cooperative Affairs	13	- Explain the new drainage system and its benefit to the residents	Part-time until the Cooperatives are established

Table 10.3.2 REQUIRED ANNUAL OPERATION & MAINTENANCE COST FOR URBAN DRAINAGE

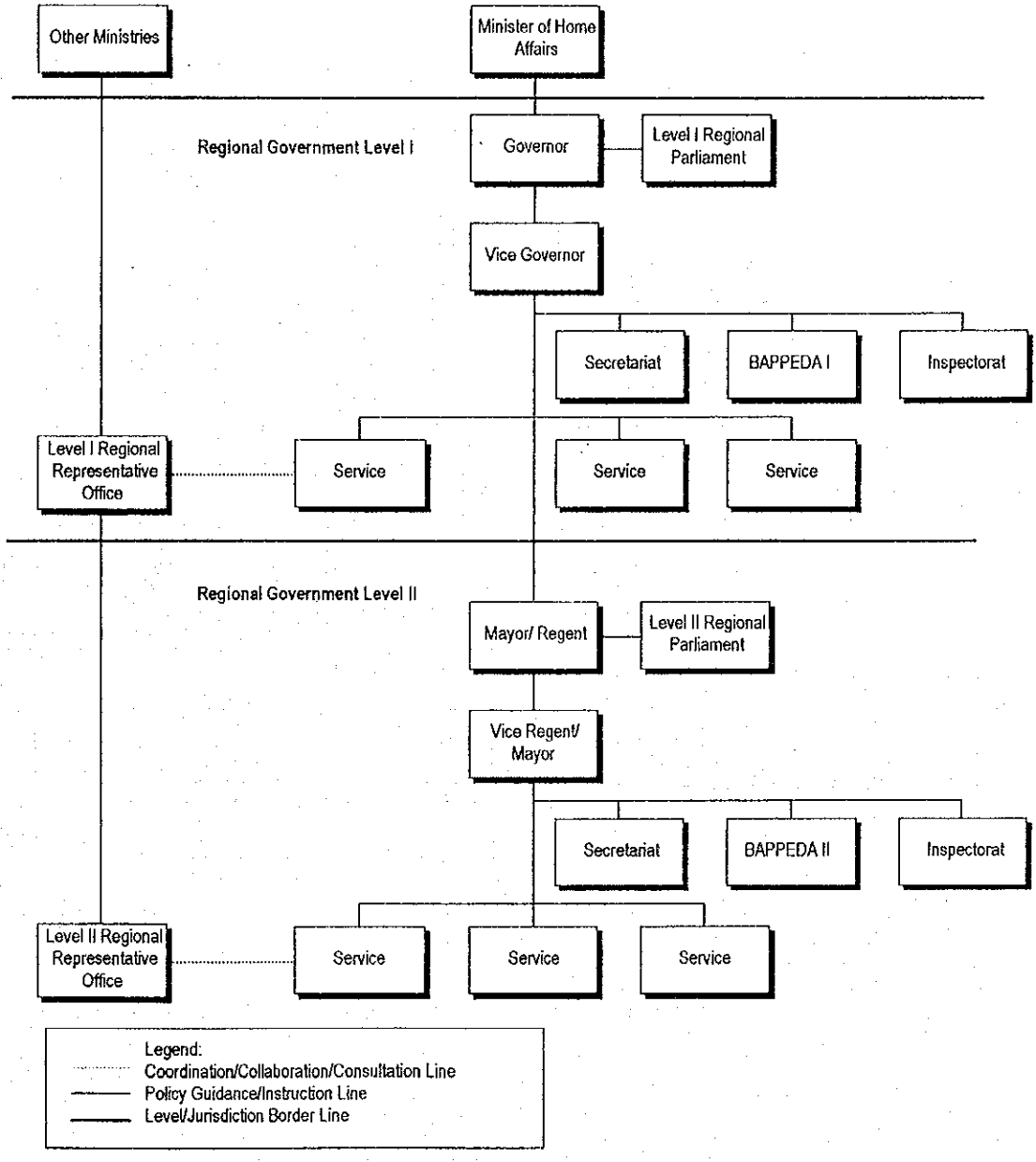
Description	Unit	Yearly Quantity	Unit Cost (Rp)	Yearly Cost (Rp)
1. Salary for Staff				
Chief/ Civil Engineer (2 x 6 = 12)	M/M	12	600,000	7,200,000
Electrical/Mechanical Eng. (2 x 6 = 12)	M/M	12	450,000	5,400,000
Operator (4 x12 = 48)	M/M	48	400,000	19,200,000
Heavy Equipment Operator (2 x 6 = 12)	M/M	12	350,000	4,200,000
Worker (5 x 6 = 30)	M/M	30	300,000	9,000,000
Cooperative Affairs (1 x12 = 12)	M/M	12	500,000	6,000,000
Accountant (1 x12 = 12)	M/M	12	500,000	6,000,000
Subtotal				57,000,000
2. Maintenance Cost for Equipment/Tools				
Car (with fuel and oil)	month	12	350,000	4,200,000
Backhoe(with fuel and oil)	month	12	350,000	4,200,000
Dump Truck(with fuel and oil)	month	12	350,000	4,200,000
Boat(with fuel and oil)	month	12	350,000	4,200,000
Subtotal				16,800,000
3. Electricity and Fuel Cost				
Electricity Charge (auxiliary pump)	hr	7,300	3,000	21,900,000
Fuel Charge(main pumps and generators)	hr	1,750	30,000	52,500,000
Subtotal				74,400,000
4. Repair Cost of Pump, Gate, Hoist, Electrical/Mechanical Equipment, Office building and Civil works				
Electrical/Mechanical Equipment	L.S.	-	-	104,000,000
Civil/Architectural Works	L.S.	-	-	114,667,000
Subtotal				218,667,000
5. Dredging of Channels (15,000 m3)	L.S.	-	-	255,000,000
TOTAL				621,867,000

Table 10.3.3 ASSUMPTIONS AND RESULTS OF H OUSEHOLD CONTRIBUTION CALCULATION

Population Density (person/km2)	16,000
Pumping Area (km2)	6.6
Population in Pumping Area	105,600
Average Number of Family Members	4
Family Number of Pumping Area	26,000
Residential and Small Shop Area (m2)	2,134,750
Average Family Area (m2)	82.1
Cost Shared by Resident & Small Shop (Rp/year)	310,676,850
Participation Rate	70%
Collection Rate	60%
Monthly Average Fee Per Family (Rp)	2,371
Administrative Cost of Cooperative (30%)	711
Total Monthly Average Fee Per Family (Rp)	3,082
Monthly Famiy Expenditure (50% Level)	340,915
Percentage of Total Fee to Expenditure (50% Level)	0.90%

FIGURES

CHAPTER 10
ORGANIZATION AND INSTITUTION FOROPERATION AND MAINTENANCE OF THE DRAINAGE FACILITIES

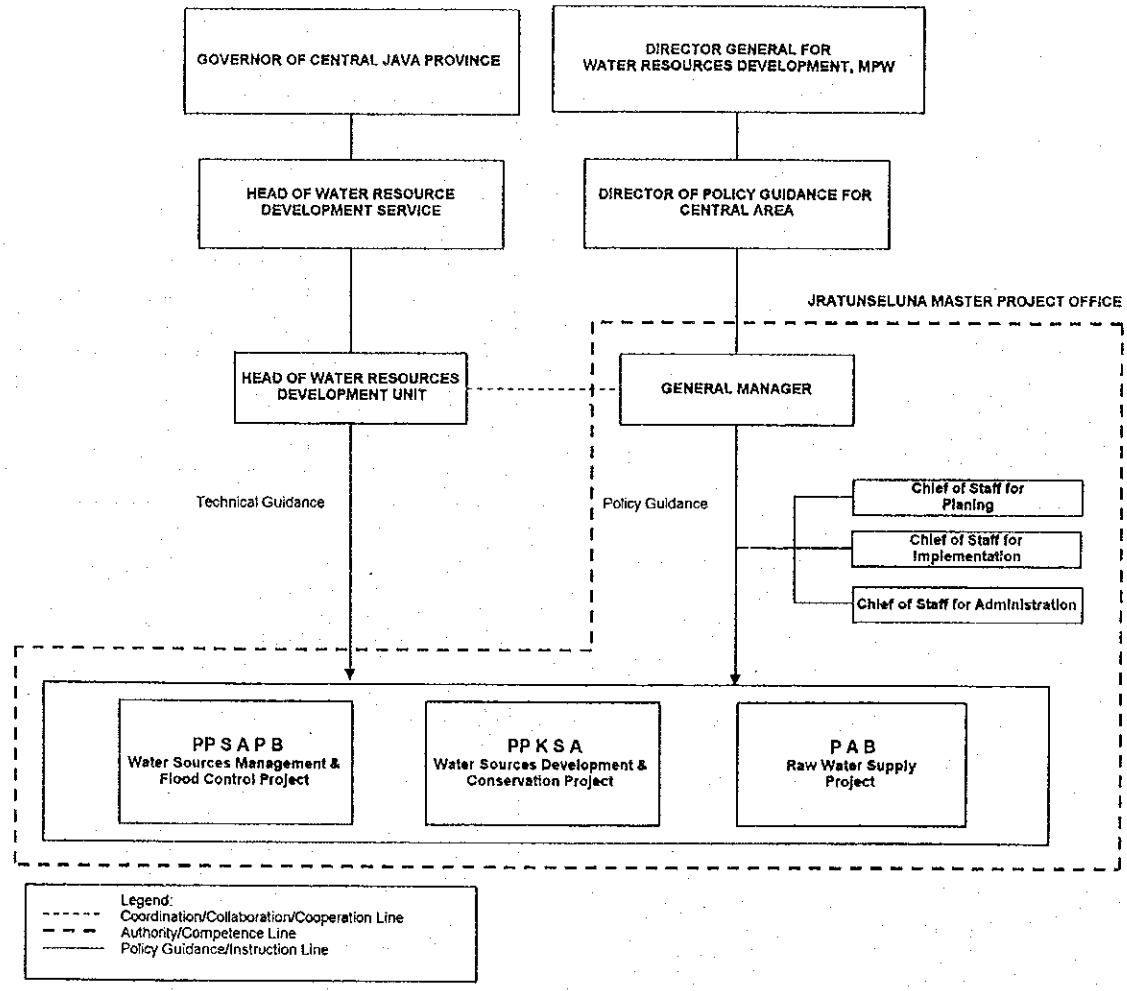


THE DETAILED DESIGN OF FLOOD CONTROL, URBAN DRAINAGE AND WATER RESOURCES DEVELOPMENT IN SEMARANG IN THE REPUBLIC OF INDONESIA

JAPAN INTERNATIONAL COOPERATION AGENCY

Fig. 10.1.1

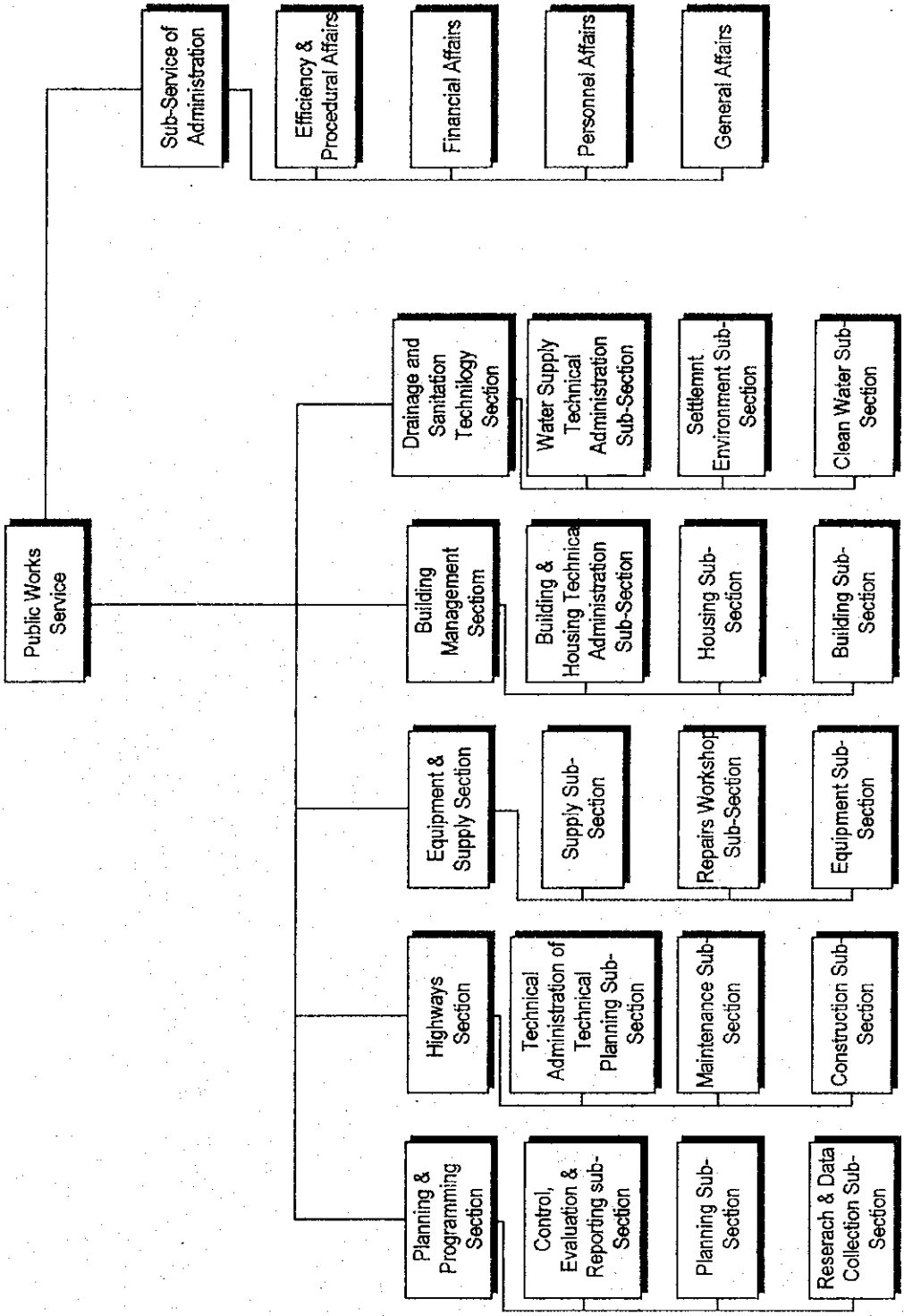
STRUCTURE OF REGIONAL GOVERNMENT



THE DETAILED DESIGN OF FLOOD CONTROL, URBAN DRAINAGE AND WATER RESOURCES DEVELOPMENT IN SEMARANG IN THE REPUBLIC OF INDONESIA

JAPAN INTERNATIONAL COOPERATION AGENCY

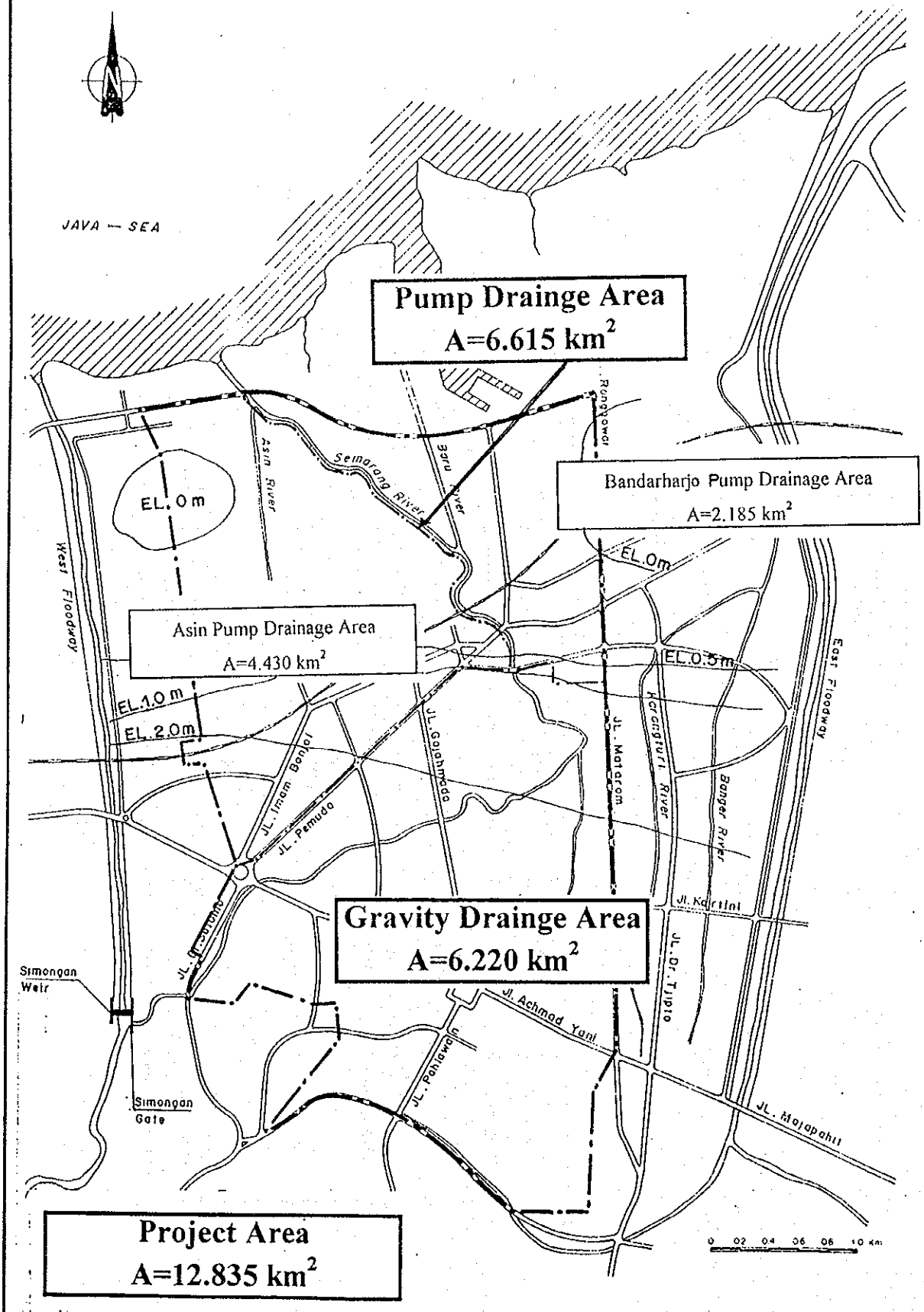
Fig. 10.2.1
ORGANISATION OF JRATUNSELUNA MASTER PROJECT OFFICE AND ITS RELATED AUTHORITIES



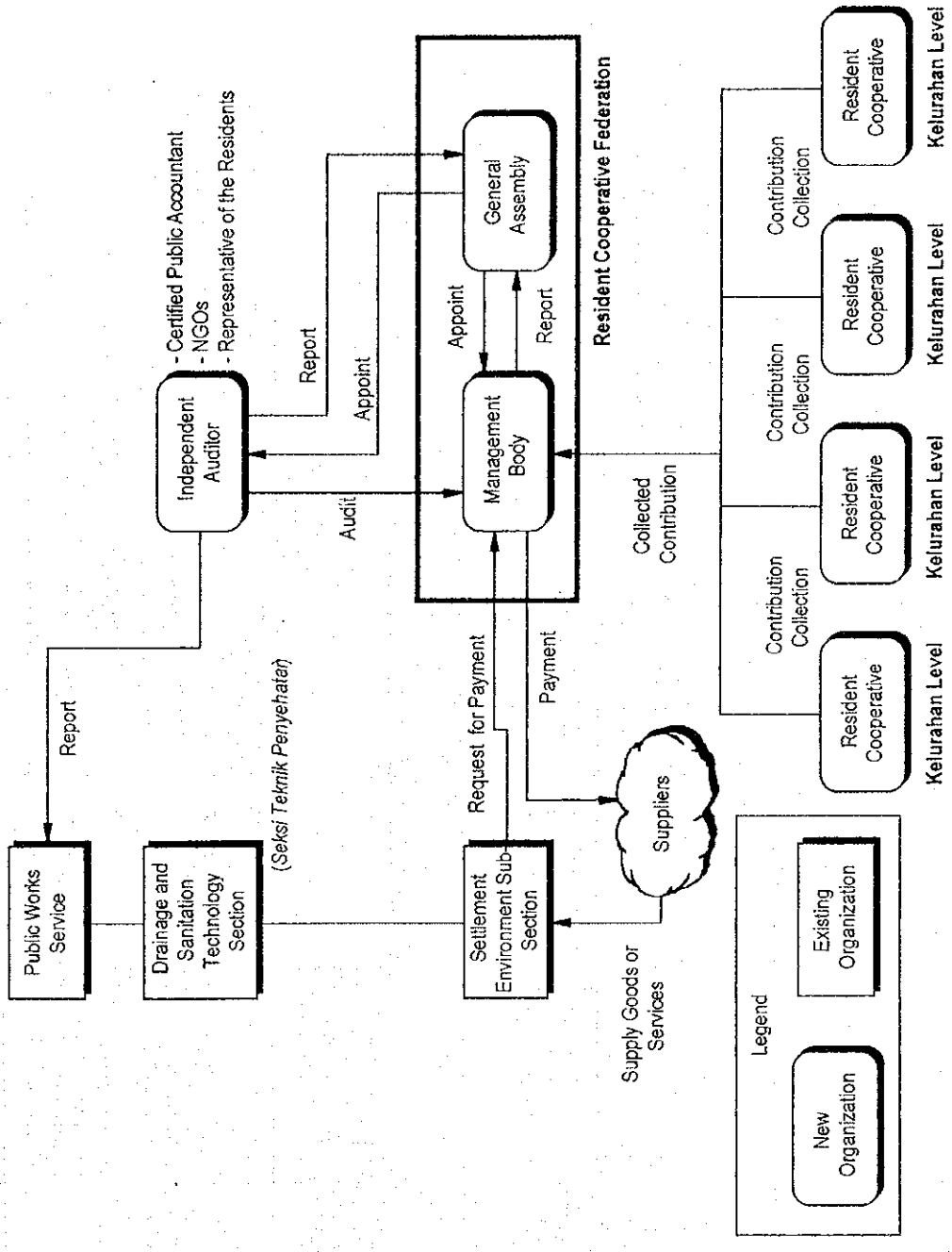
THE DETAILED DESIGN OF FLOOD CONTROL, URBAN DRAINAGE AND WATER RESOURCES DEVELOPMENT IN SEMARANG IN THE REPUBLIC OF INDONESIA

JAPAN INTERNATIONAL COOPERATION AGENCY

Fig. 10.2.2
ORGANISATION OF PUBLIC WORKS SERVICE OF SEMARANG MUNICIPALITY



THE DETAILED DESIGN OF FLOOD CONTROL, URBAN DRAINAGE AND WATER RESOURCES DEVELOPMENT IN SEMARANG IN THE REPUBLIC OF INDONESIA	Fig. 10.3.1 PUMP DRAINAGE AREAS
JAPAN INTERNATIONAL COOPERATION AGENCY	

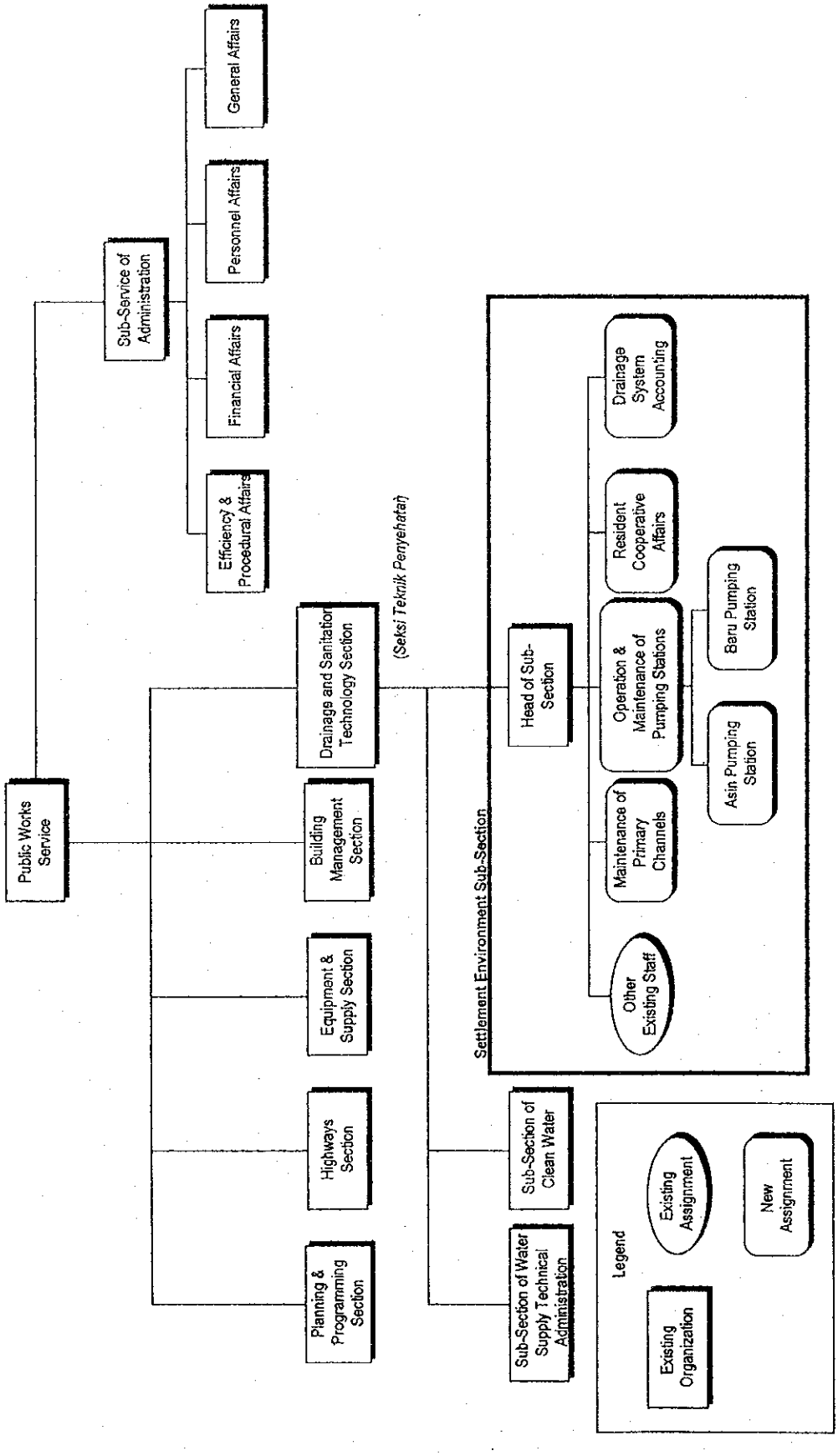


THE DETAILED DESIGN OF FLOOD CONTROL, URBAN DRAINAGE AND WATER RESOURCES DEVELOPMENT IN SEMARANG IN THE REPUBLIC OF INDONESIA

JAPAN INTERNATIONAL COOPERATION AGENCY

Fig. 10.3.2

STRUCTURE AND FUNCTIONS OF RESIDENT COOPERATIVES



THE DETAILED DESIGN OF FLOOD CONTROL, URBAN DRAINAGE AND WATER RESOURCES DEVELOPMENT IN SEMARANG IN THE REPUBLIC OF INDONESIA	Fig. 10.3.3
JAPAN INTERNATIONAL COOPERATION AGENCY	ORGANISATION OF PUBLIC WORK SERVICE AND URBAN DRAINAGE SYSTEM