5-3-4 Structural Design

(1) Basic policy

The construction site is located by the seashore and particular attention will be paid to the selection of materials that do not suffer much influence of damages caused by salt, in connection with the design and construction of the principal structural parts. Furthermore, all materials to be used are assumed to be made in Thailand or available in Thailand and the basic policy in connection with the construction method is to simplify it as much as possible. Next, in connection with the earthquake load and wind load that are the principal elements taken in consideration for the sake of structural design, Thailand is located far off the so-colled Trans-Asiatic seismic zone ranging extending through India-Western Malay Peninsula-Indonesia and the Seismic Zone of the Pacific Rim and therefore it is not necessary to take into consideration the seismic load. On the other hand, as for the wind speed, maximum value of approximately 45 knots (approx. 25m/sec) has been recorded during the monsoon season of June and July according to observation data collected in Rayong, located nearby the construction site, and therefore careful wind-resistant design is required in this case. As for the foundation, the upper layer ground consists of sea sand accumulated in a relatively recent epoch and therefore it is not possible to expect a sufficient bearing capacity for the direct foundation. The use of piling foundation is being planned for the principal structures, but the ultimate decision for the sake of execution design will be after the soil surveying of site.

(2) Design policy

The Bye-Laws of the Bangkok Metropolis is a representative regulation of Thailand regarging structural design. The chapter 6 of the said municipal ordinance contains stipulations about the strength of the materials and loads. The facilities in question will be designed in condormity

with the said ordinance. The principal frames of the structure, such as columns, beams, floor slabs, etc., will be made of reinforced concrete, the walls will be made or concrete blocks or bricks and the roof will be made of wood in order to cut down the weight of the building. The structural outline of each building is described in the followings.

- Laboratory building, dormitory, feed plant and generator house.
  The columns and beams will be interconnected in the form of rigid joints and the roof will consist of wooden truss.

- Workshop
  The columns and large-span beams will be made of concrete truss and the roof will be a wooden structure.

- Overhead water tank
  The tower will consist of rigid joint columns and beams. The foundation will be integrated into the water-receiving tank, in order to cope effectively with falling down.

As for the loads acting on the building, they cosist of the following components.

1) Fixed load

The dead weight of the elements such as structural members, finishing materials, etc., are included in this item. The unit weight of the principal materials are assumed to be as follows for the sake of calculation.

- Reinforced concrete	2.4 t/m^3
- Concrfete blocks and bricks	0.13 t/m^2
- Slate	15 kg/m^2
- Wood	0.7 t/m^3
- Tile roofing	50 kg/m^2

2) Live load

The values of live load stipulated in the municipal ordinance of Bangkok will be used in structures for general purposes. However, these values are considerably large in some cases, and in this case they will be used to design the floor slabs. As for the beams and columns, it is presumed that the values stipulated in the said ordinance can be reduced by taking into consideration the extent of concentration of load and the values stipulated in the Building Standard Law of Japan. On the other hand, in the case of special loads the relevant values will be caluculated in conformity with the actual state of things.

The live loads of the principal rooms are as follows:

- Laboratory building

Laboratories and office:	300 kg/m^2
Lecture room and dining room:	400 kg/m^2
Library and specimen room:	500 kg/m^2

- Dormitory

Bedroom:	200 kg/m^2
Hall:	300 kg/m^2

As for special loads, ten 1-ton tanks to be installed in the mariculture experimental room and the 1 ton hoist crane to be installed in the ceiling beam of the workshop will be taken into consideration for the sake of structural design.

3) Wind load

The value of the maximum wind speed recorded so far and the value stipulated for the rural area of Thailand will be taken into consideration to calculate

the wind speed load q. Buildings with height not exceeding 10 m will be designed by assuming q = 100 kg/m^2. As for the form factor of each part of the buildings, the standards in force in Japan will be used for the sake of reference.

4) Seismic load

The seismic load is not taken into consideration for the sake of structural design.

(3) Structural Materials

1) Concrete

Concrete is normally used as structural material, and the standard strength assumed for the sake of design is F_{28} = 210 kg/cm^2. Cement to be used will be 100% made in Thailand. The specifications of cement are stipulated in TIS (Thai Industrial Standards) 15, and the chemical and physical properties are particularly the same as JISR5210. The stipulated value of the compressive strength (245 kg/cm^2 or more) is low compared with 300 kg/cm^2 of JIS, but in reality the value of the products of domestic manufacturers of Thailand has been stable at approximately 300 kg/cm^2 of late. As for the mixing proportion, the components are weighed and concrete is prepared by taking the concrete mixer to the site. Water to be used to prepare concrete must be free of salt and therefore it will be brought from a place far off the seashore. Self-consistency concrete with 5-15 cm slump is normally used in Thailand, making as a consequence possible to obtain more dense concrete compared with Japan. After placing the concrete, it is necessary to cure the concrete with plenty of water sprinkling in order to protect from high temperature.

2) Reinforcing bars

Round reinforcing bars (SR24) and deformed reinforcing bars (SD30, SD40) are manufactured in Thailand and both kinds of reinforcing bars have sufficient supply capacity. The chemical properties and physical properties of both types of reinforcing bars have practically the same values as JISG3112. SD30 will be used in most of the structures of the buildings to be constructed this time, in addition to SR24 which will be used in some parts. The stress intensity of each kind of reinforcing bar is stipulated in the Bye-Lows of the Bangkok Metropolis.

3) Piles

Square and H-shaped prestressed concrete piles are being manufactured in Thailand. Square-shaped piles are available in sizes ranging from 18 cm to 45 cm. Standard size piles up to 21-25 m are available, and welding joint is also possible.

5-3-5 Facilities Plan

(1) Air-conditioning and Ventilation System

1) Air-conditioning equipment

Air-conditioning will be provided in the principal rooms of the laboratory building. The air-conditioning systems are planned as follows, by taking into consideration such factors as air-conditioning conditions required in each case, reduction of the routine opration, etc., in a collective way. The contents of each system are shown in the following table.

Name of Room	Air Cond. Area (m^2)	Air Cond. condition (°C)	Approx. Air Cond. Load (Kcal/hr)	Air Cond. System	Air Cond. Capacity per unit	of unit
Conference & Lecture Room	111.8	27	29,000	I	15,000	2
Temperature controlled Room	24	20±2	7,200	II	7,200	1
Balance Room	12	25	2,000	III	2,000	1
Chemicals' Room	12	25	2,000	III	2,000	1
Dark Room	10	27	1,400	III	1,600	1
Radio Room	15	27	3,000	III	3,000	1
Computer Room	15	27	3,000	III	3,000	1
Director's Room	43	27	8,000	III	4,000	2

Note : The air-conditioning systems are as follows.

I. Package type air-conditioner — Direct blowing type

II. Package type air-conditioner equipped with dehumidifier and humidifier — Large capacity type

III. Separate type air-conditioner — Wall type

2) Ventilation facilities

Ventilation facilities will be provided in each of the rooms shown in the following table.

Name of room		Ventilation system	Quantity
	Canteen	Ceiling-type 900ø propeller fan, provided with control switch	4
	Kitchen	Duct fan or wall-mounted 300ø exhaust fan	1
		Ceiling-type 900ø	

Lab. building	Information	propeller fan, provided with control switch	1
	Chemical lab.	"	12
		Duct fan or wall-mounted 300ø exhaust fan	7
	Preparation & training room for students	Ceiling-type 900ø propeller fan, provided with control switch	6
		Duct fan or wall-mounted 300ø exhaust fan	2
	Planktology room	Ceiling-type 900ø propeller fan, provided with control switch	3
		Duct fan or wall-mounted 300ø exhaust fan	2
	Ichthyology room	Ceiling-type 900ø propeller fan, provided with control switch	3
		Duct fan or wall-mounted 300ø exhaust fan	2
	Mariculture experimental room	Ceiling-type 900ø propeller fan, provided with control switch	6
		Duct fan or wall-mounted 300ø exhaust fan	3
	Deputy Director's room	Ceiling-type 900ø propeller fan, provided with control switch	2
	Library	"	4
	Copy room	Duct fan or wall-mounted 300ø exhaust fan	1
	Teacher's room	Ceiling-type 900ø propeller fan, provided with control switch	4
	Fishing gear small-scall fisheries development room	"	4
Lab. building	Technician's room	Ceiling-type 900ø propeller fan, provided with control switch	6
	Marine conservation & management room	"	4
	Marine environmental research room	"	4
	Mariculture development room	"	4

Name of room		Ventilation system	Quantity
Dormitary	Kitchen	Duct fan or wall-mounted 300ø exhaust fan	1
	Food storage	"	1
	First-aid room	Ceiling-type 900ø propeller fan, provided with control switch	2
Workshop	Office	"	2

(2) Water Supply, Drainage and Sanitary System

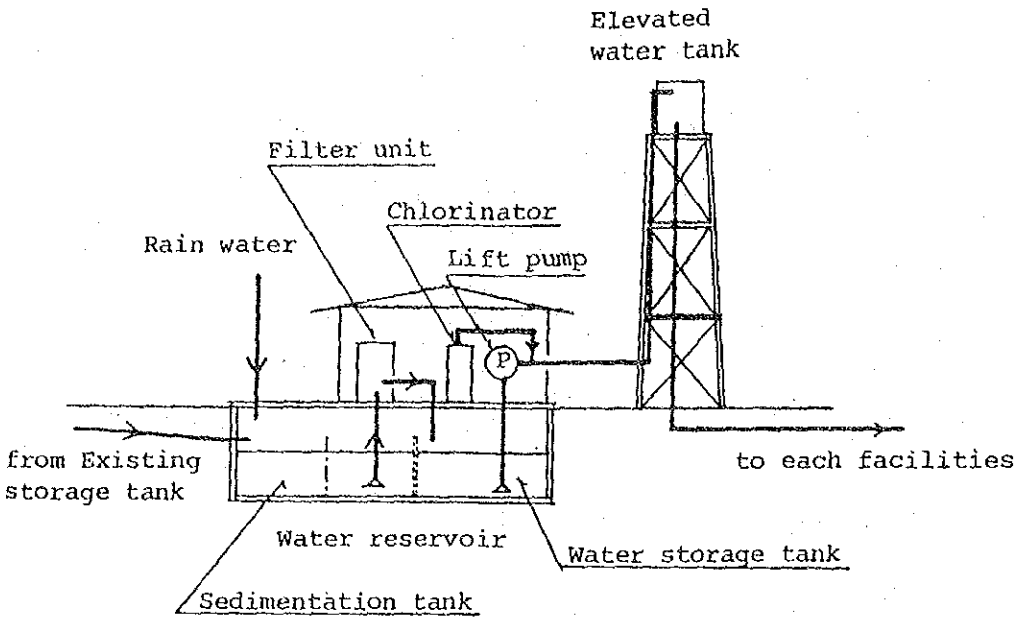
1) Water supply system

There are two types of water supply system. One is the fresh water supply system and the other is the seawater supply system aimed at supplying seawater to the tanks to breed marine fishes and other related facilities. The water distribution system of each type is as follows.

a) Freshwater supply system

In this case water is led gravitationally into the reservoir from the existing storage tank, and stored once in the storage tank after passing through the sand sedimentation tank located in the reservoir and then it is pumped up to the elevated water tank. During the rainy season rain water collected on the roof of each building is led into the sand sedimentation tank by the rain-leader, in order to make the effective use of rain water. Water transferred from the sand sedimentation tank to the storage tank is filterated by means of filter. Furthermore, water is sterilized with chlorine when it is pumped up to the elevated water tank. Water contained in the elevated tank is supplied by gravity to the laboratory building, dormitory, workshop, and so

on. The flowchart of the aforementioned process is as follows.



The approximate volume of water required in these facilities is calculated as follows.

Object of water supply

a. Laboratory building
   Area of laboratory section: 544 m^2
b. Staff of the laboratory building: 80 persons
c. Capacity of the dormitory: 33 persons

Volume of water to be supplied

- Per day
  a. 15 l x 544 m^2 = 8,160 l/day
  b+c. 200 l x 113 persons = 22,600 l/day
  Total = 30,760 l/day

- Average per hour
  a. 8,160 l ÷ 8 hr = 1,020 l/hr
  b+c. 22,600 l ÷ 10 hr = 2,260 l/hr
  Total = 3,280 l/hr

- Maximum per hour
  3,280 l x 2 = 6,560 l/hr

- Maximum per minute
  6,560 l ÷ 60 = 109 l/min

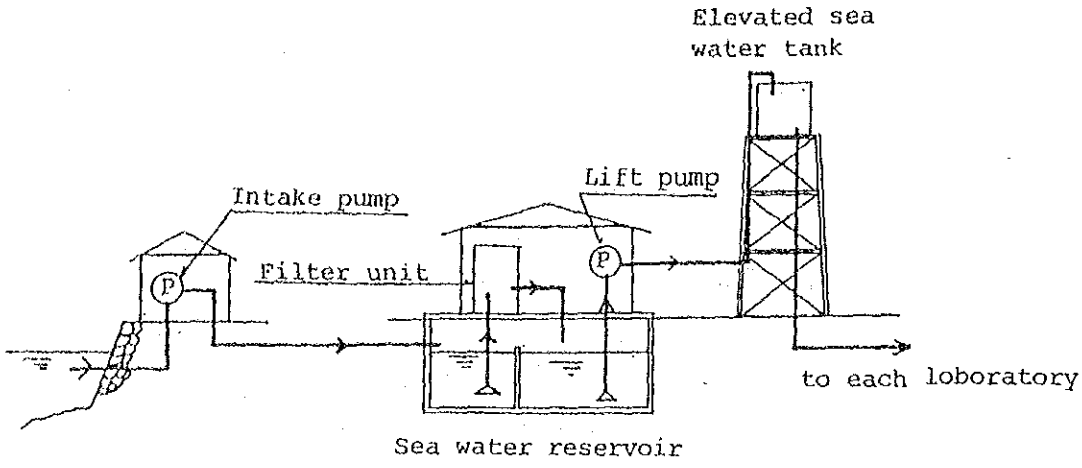
Therefore, the water receiving tank will be designed with a capacity of 50 ton, by taking into consideration the storage of rain water. The elevated water tank with a capacity of 5 ton will be constructed 20 m above the ground level. The lift pump will have a capacity of 120 l/min. or more. Two sets of the pumps will be installed and alternated automatically in operating.

The corrosion of metallic equipment, particularly in the case of outdoor equipment, caused by salt pollution must be taken into consideration. Therefore, the elevated water tank and the piping will be made of vinyl chloride.

b) Sea water supply system

Sea water supply system will be installed with the purpose of supplying seawater to the water tanks of the laboratory building and other parts. Sea water taken from the sea by means of pumps will be pumped to the seawater reservoir installed nearby the laboratory building. Seawater stored in the seawater reservoir will be filtered by means of filters, and sent to the elevated seawater tank by means of lift pump, and then it will be supplied by gravity to each laboratory.

The flowchart of the aforementioned process is as follows.



The volume of seawater required by the facilities to be constructed this time is estimated to be 20 ton at maximum, in view of the capacity of the mariculture experimental tanks. Therefore, the seawater reservoir will be designed with a capacity of 20 ton and the elevated seawater tank will be designed with a capacity of 3 ton. The maximum consumption per minute of water is calculated as follows.

20,000 l x 2 ÷ 8 hr ÷ 60 min = 83 l/min.

Therefore, two sets of lift pumps with a capacity of 100 l/min or more, will be installed and the operation of them will be alternated automatically.

It goes without saying that it is indispensable to take into consideration the corrosion caused by the seawater itself as well as salty wind in connection with the selection of the piping material.

2) Drainage system

The drainage treatment method depends on the types on substances contained therein. Therefore, the drainage is classified in accordance with the

following types, and appropriate treatment methods will be used in each case.

i) Sanitary sewage drainage
ii) Ordinary miscellaneous drainage
iii) Miscellaneous drainage containing chemicals
iv) Seawater drainage

a) Treatment of sanitary sewage drainage

Sanitary sewage discharged from the laboratory building and dormitory will be collected in the drainage treatment tank. The drainage treatment system will be the prolonged aeration type combined treatment system by means of the activated-sludge treatment process, with BOD not exceeding 30 ppm. Treated drainage will be discharged in small rivers or in the sea.

Sanitary sewage generated in the workshop will be treated by the independent septic tank and the treated drainage will be infiltrated into the ground.

b) Treatment of ordinary miscellaneous drainage

Ordinary miscellaneous drainage discharged from the laboratory building and dormitory will be treated by means of the same system as that one used in the case of sanitary sewage, because the treatment tank is combined treatment type.

As for miscellaneous drainage discharged from the workshop, it will be collected directly in the infilteration tank, and infiltrated into the ground.

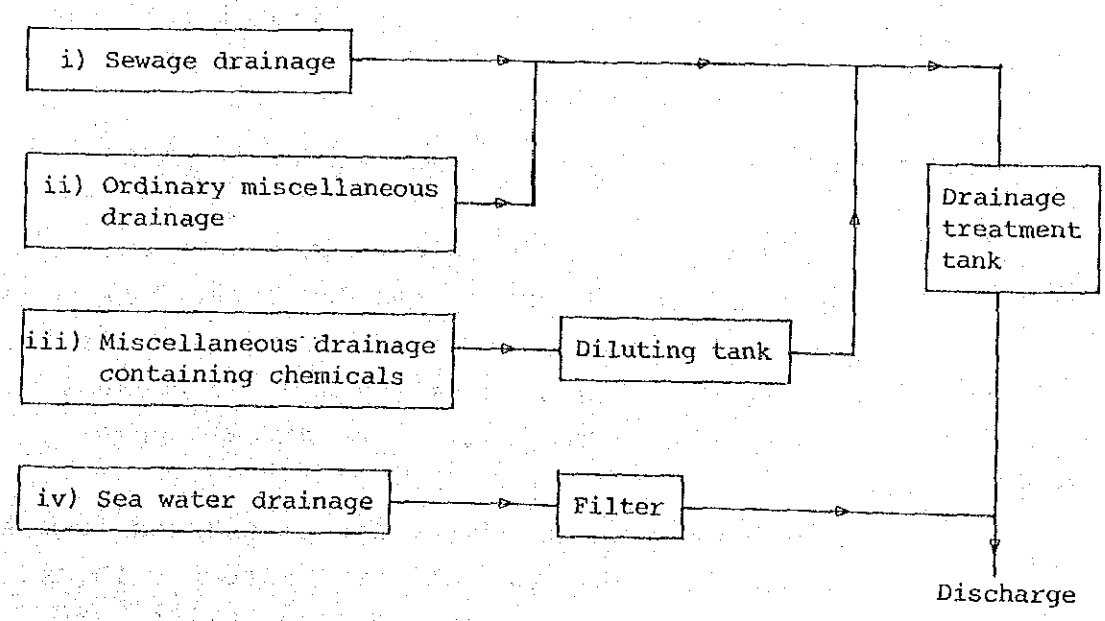
c) Treatment of miscellaneous drainage containing chemicals

Drainage containing chemicals discharged from the laboratories will be collected in the diluting tank and then it will be submitted to the same treatment as ordinary miscellaneous drainage after being duly diluted with water.

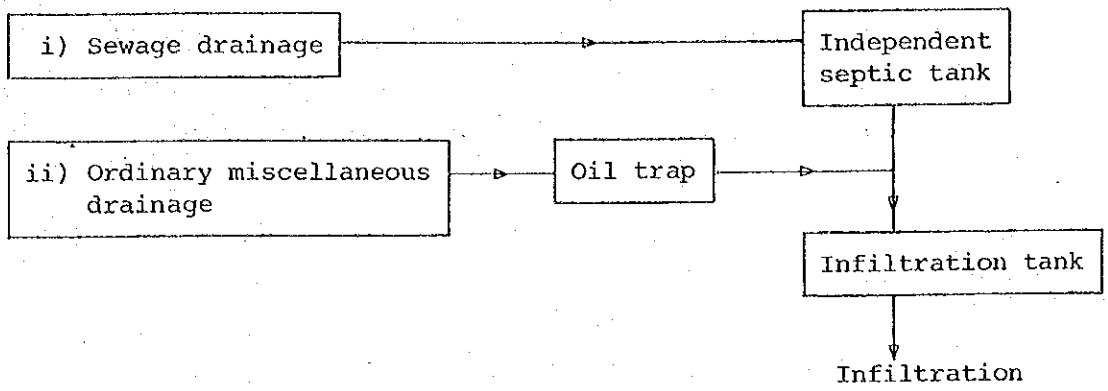
d) Treatment of seawater drainage

Seawater discharged from the laboratories will be poured in small rivers or in the sea, after being filtered.

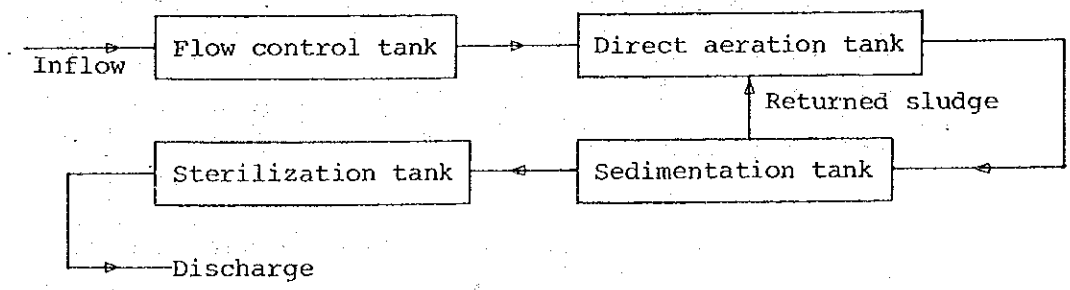
Drainage system of the laboratory building and dormitory.



Drainage system of the workshop



The flowchart of the drainage treatment tank is as follows.



The capacity of this drainage treatment tank will be 30 ton per day at maximum.

3) Hot water supply system

Instantaneous gas water heaters will be installed in the laboratory building and other required places.

4) Sanitary ware

Sanitary ware wil be installed in toilets, lavatories and other required places of each building. Western-style closet bowls will be installed in the laboratory building, while Thai-style ones will be installed in the dormitory and workshop.

(3) Electricity Supply System

1) Power receiving & substation facilities

The station receives 3ø 3W type 22KV 50HZ power from the PEA, and the existing sub-station facilities have a capacity of 250KVA. It is necessary to modify appropriately the existing power reciving and substation facilities, because new electric equipment and facilities will be added concurrently with the expansion plan to be implemented this time. The power receiving and substation facilities will have the following configuration after the modification. Each equipment to the installed anew should be salt-resistant type one.

i) Outdoor-type pole transformer system
(Thai system)

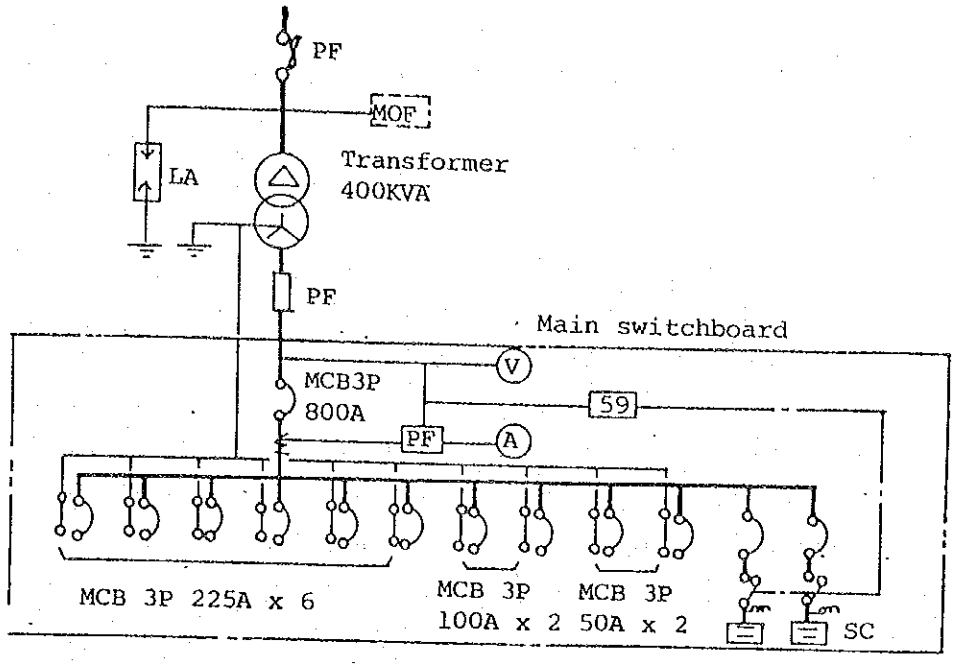
ii) Power receiving voltage: 3ø 3W 22KV 50Hz

iii) Transformer
3ø TR 400 KVA /ΔY (delta star) connection
Primary side 3ø 3W 22KV,
Secondary side 3ø 4W 380V/220V

iv) Main switchboard
1 unit, provided with built-in MCB, SC, SR

v) SC (static condenser), SR
3ø 400V, SC 75KVA x 2, SR 5KVA x 2

The outline of the connection diagram is as follows.



2) Generator equipment

It was reported that the frequency of power stoppage in the area was of the order of once or twice a month. Therefore, an emergency generator equipment will be provided with the purpose of guaranteeing the functions of the various facilities, and will supply power to the lift pumps, walk-in-cooler, drainage treatment tank, various equipment of the laboratory building, radio communication equipment, part of the lighting, and part of the existing facilities. The generator will be an indoortype radiator-colled one with a capacity of 100KVA and the system of 3ø 4W 380V/220V, provided with oil tank for 30-hour operation. In selecting the equipment it is indispensable to take into consideration that the construction site is in the tropicals as well as in the salt pollution area.

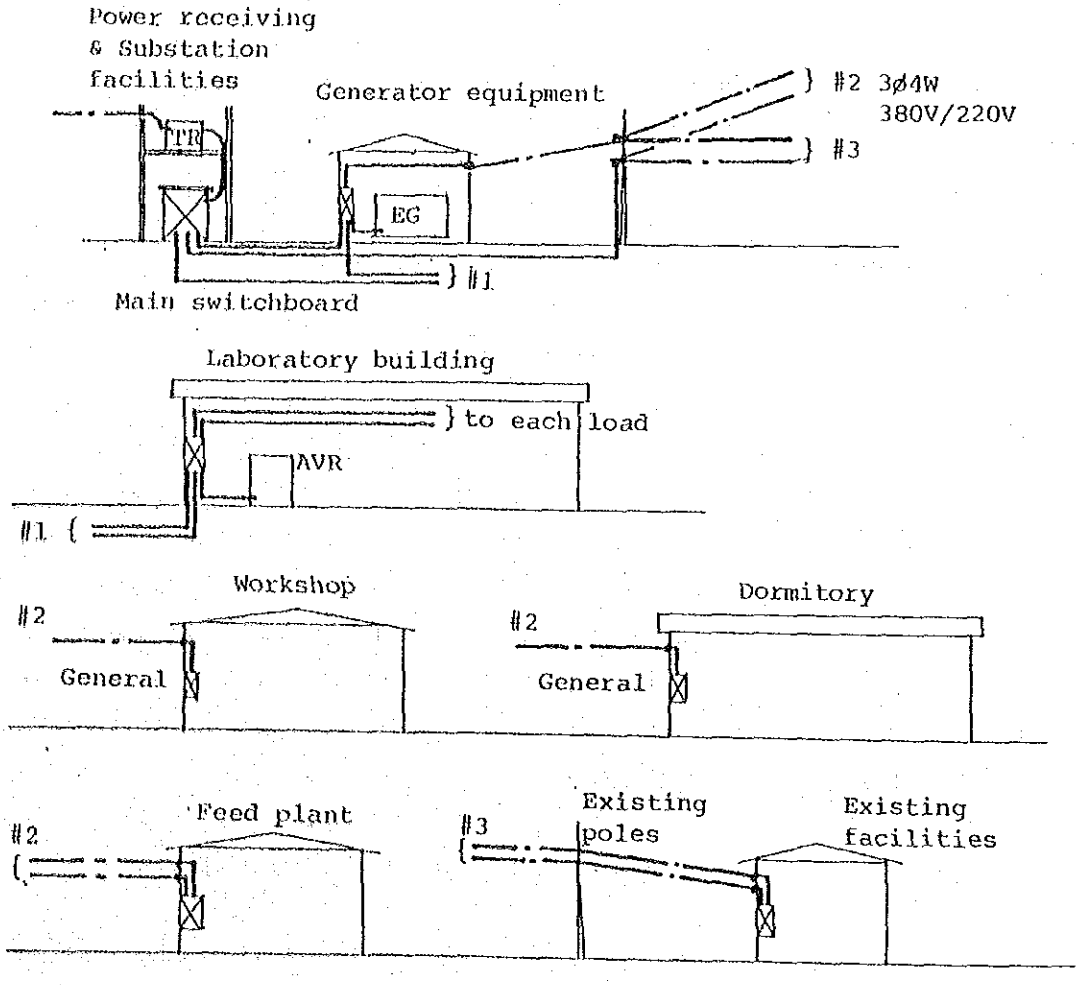
3) Automatic voltage regulator (AVR) equipment

AVR will be installed in the electric system, because some euipment of the laboratory building are

largely influenced by variations of voltage. The AVR to be installed will be a static-type one, with the system of 1ø 2W 200V and a capacity of 50KVA.

4) Feeder facilities

The distribution of electricity from the power receiving & substation facilities and/or generator equipment will be carried out by means of overhead distribution lines. However, the lead-in cable of the laboratory building will be burried under the ground. The existing poles will be used as much as possible for installation of the overhead distribution lines to be provided anew. The outline of the power distribution system is shown schematically in the following figure.



As for the distribution of power to the existing facilities, the existing power distribution facilities will be used without modifications if there is not equipment to be installed anew concurrently with this expansion plan.

The power sources of each type of load are classified as follows.

Type of power source	Ordinary Power Source			Generator Power Source				
Name of load or room	Light-ing	Outlet	Power	Light-ing	Outlet	Power	AVR	
							Outlet	Power
Office system	X	X						
Communication equipment room		X		X			X	
Computer room		X		X			X	
Copy room	X	X	X					
Laboratory system	X			X	X		X	X
Dormitory	X	X						
Workshop	X	X	X					
Feed production	X	X	X					
Walk-in-cooler				X		X		
Water supply system						X		
Drainage treatment system						X		
Existing facilities	X	X	X	X	X	X		

5) Lighting and power outlet facilities

Distribution boards installed in each room of the buildings supply power to the lighting fixtures and power outlet of these rooms. Distributing circuit beakers are used to protect each branch circuits. Leakage circuit brakers are used to the power outlet circuits, located at places where the floor is wet (e.g. mariculture experimental room).

The wiring will be in conformity with the Thai Industrial Standards (T.I.S.), and the wiring work will be executed by means of ordinary methods adopted in Thailand. The types of power sources are those ones mentioned in the former section 4).

The lighting fixtures of the principal rooms will consist of fluorescent lamps, and the standard intensity of illumination for the sake of design will be as follows.

i)	Rooms of the laboratory building	400 Lux
ii)	Lecture rooms, library, etc.	300 Lux
iii)	Dormitory, workshop, feed plant	200 Lux
iv)	Corridors, toilets, etc.	100 Lux

Emergency lighting fixtures provided with built-in battery, aimed at providing illumination in the case of power stoppage, will be installed in the corridors of the laboratory building. Street lamps operated by means of timer will be provided outdoors.
Salt-resistance will be taken into consideration in connection with the lighting fixtures to be installed in the opening space to the outdoor.

6) Telephone and interphone system

Communication with outside of this system is carried out by means of radio communication equipment,

because there is no telephone circuit in the project area. At the present time it is not necessary to provide conduits in advance, because it is very easy to cope with the future installation of telephone in view of the structure of the buildings. Simultaneous call type interphones will be installed in the principal rooms of the laboratory building, dining room of the dormitory, office of the workshop, etc., for internal communication between the various parts of the facilities to be constructed. Furthermore, the new interphone system will be installed in such a way to make possible the communication with the interphone system of the existing facilities.

7) Antenna

Antennae to receive TV and radio broadcasting will be installed, and outlets will be provided in the radio room, director's room and dining room. Radio communication equipment and antenna will not be provided, and only the conduits between them will be installed for the time being.

8) Automatic fire alarm system

Automatic fire alarm system will be installed in the laboratory building. Differential or constant temperature spot type detectors will be installed in each room. The receiver will be installed in the office, and bells, lamps and pushbuttons will be installed in the proper place of the corridor. Only pushbutton and bell will be installed in the dormitory and workshop.

9) Lightning arrester equipment

Lightning arrester will be installed atop the elevated water tank.

(4) Other facilities

1) Gas facilities

LPG will be used in the facilities. Gas cylinders will be installed outdoors, nearby the required places. Central gas supply system will be adopted in the laboratory building.

2) Air supply system

Air blower and piping will be installed for the pourpose of supplying oxigen to the water tanks in the mariculture experimental room. The consumption of oxygen S (l/hr) is calculated as follows, by assuming 12 tons of the volume of water contained in the tanks and 10 kg/ton of the quantity ratio of fish breeded in the tanks.

$$S = 0.2 \times 12 \times 10 = 24 \text{ (l/hr)}$$

and the quantity of oxigen M (l/hr) solubilized in the water is calculated as follows, by assuming that the water surface has an area of 22 m^2.

$$M = 0.8 \times 22 = 17.6 \text{ (l/hr)}$$

Therefore, the volume of air A (l/min) to be supplied is calculated as follows.

$$A = \frac{24 - 17.6}{0.001 \times 0.7 \times 0.2\ 60} = 762 \text{ (l/min)}$$

where:

0.001	Contact efficiency
0.7	Piping loss
0.2	Approximate percedntage of oxygen contained in the air

As can be seen from the aforementioned considerations, the blower will have a capacity of 800 l/min.

5-3-6 Improvement Plan for Existing Facilities

(1) Mariculture Development Unit

Activities of the Mariculture Development Unit of the Center include studies on seed production, rearing techniques and artificial feed for economically important marine fishes.

The objective species cover red snapper (Lutyanus argentimaculatus), greasy grouper (Epinephelus tauvina), green tiger prawn (Penaeus semisulcatus) and swimming blue crab (Portunus pelagicus) with the following present targets of production for the first three years.

Species	1st year	2nd year	3rd year
Red snapper	200,000	200,000	300,000
Greasy grouper	-	200,000	300,000
Green tiger prawn	-	200,000	200,000
Swimming blue crab	400,000	400,000	300,000

These species are highly marketable in both foreign and local markets, and are possible to produce but not tried by Brackishwater Fisheries Division. Although the spawning and hatching of these species had already been succeeded on experimenntal basis, further research are required for achieving the mass-production system. The above-shown production targets are rather low and more efforts should be made to reach mass-production level.

Larvae of green tiger prawn and swimming blue crab will be released into the sea, while fingerings of red snapper and greasy grouper will be utilized for the experiment at the Center. Some of the fingerlings will be distributed to the private farmers to be utilized in their fish culture performance under technical guidance of the Center.

As for the crab larvae, the Station produces some million pieces of megalopa stage presently, and releases them to natural water. However, the survival rate was low due to weekness of the larva at the stage. Under this Project, the crab larvae will be reared at least upto 10 mm in carapace length before the releasing so as to expect higher survival rate and recruitement effect to the resources. By the same reason, red snapper and greasy grouper will be also reared upto the size of about 25 mm in body length.

Research on mariculture technology will be carried out basically for other economic species such as grouper (Epinephelus marabaricus), rabbit fish (Siganus guttanus), spinefoot fish (Siganus oramin), pearl oyster (Pinctada martensii), and western pink prawn (Penaeus latisulcatus), in addition to the four species mentioned. The basic research includes the studies on rearing condition, stocking density, induced spawning, feeding, disease and parasite.

(2) Improvement Plan

There is so few data and information on the target species that estimation of the scale of facilities is impossible. Based on the performances achieved on the similar species by now, the existing mariculture facilities would be sufficient to carry out the planned activities without new construction, if the existing facilities achieved highest efficiency through some improvement and supplement.

The improvement of facilities under the Project were designed as follows.

1) Upgrading of Seawater Intake Capacity

At present, existing two seawater intake pumps (5.5 kw and 7.5 kw) are capable of supplying

seawater of about 150 ton/day by the alternate operation. These pumps , however, are heavily damaged of seawater corrosion and the efficiencies are too low to supply enough seawater to the Station. In order to make sufficient and constant supply of water required for the Center's activities, these pumps will be replaced by new ones and seawater supply piping system will be also newly installed under the Project. The volume of seawater supply to be required under the Project is as follows.

Name of tank	Tank Capacity	Rate of Water Exchange (%/day)	Required Seawater
Hatchery & Rearing Tank	340 ton	50	170 ton (filtered)
Medium size Concrete Tank (2 units for broodstock)	530	20	110
Earthen Rearing Pond (3 units)	2,400	5	120
New Laboratory Building			20 (filtered)

Seawater volume to be supplied per day

filtered seawater	190 tons
un-filtered seawater	230 tons
Total	420 tons

Seawater Intake Pump 2 units (alternate use)

Capacity : Approx. 60 tons/hr., 11kw

Material : Seawater resistant material

Power Source : 380 V, 50 Hz

Equipped with the automatic seawater level control pparatus.

2) Upgrading of Aeration Capacity

Three existing air compressor (1-2 hp) are quite old. One of the three is out of order and is now under repairing. The aeration capacity is not sufficient to supply enough air to all tanks. Therefore, new air compressor (approx. 5.5 kw) will be supplied to replace the existing ones.

3) Supply of FRP Tank

Due to the heavy water leakage, the existing rectangular concrete hatching & rearing tanks are hardly used at present. These tanks should be repaired or replaced by FRP tanks. For the later case 50 tanks of same capacity as concrete tank will be required.

4) Supply of Floating Net Cages

Although the team examined the possibility for utilization of the eastern earthen large seawater reservoir by dividing into small sections for broodstock and fingerling production, this reservoir seemed to be inadequate for rearing marine fishes in respect of water exchange and depth.

The Sub-Station at Ko Samet island located 2 mile off Ban Pe would be best suited for rearing marine fishes if floating cage nets are provided.

Size and number of the net cages required on basis of the optimum stocking density are as follows.

B.L. of fishes	Stocking Density	Scale of Cage	No. of units
30-50 mm	30,000 pcs.	5mL x 5mW x 3mD	8
50-70	18,000	"	12
over 70	1,500	10mL x 10mW x 3mD	3
broodstock	800	"	2

5) Construction of New Laboratory

In order to conduct water quality analysis, micro-organism culture, feed analysis, biological observation and fish disease study, the existing laboratory is not sufficient in respect of space and facilities. The new laboratory building will be designed to satisfy these requirements.

6) Improvement of Water Gate

As mentioned above, the earthen large reservoir has problems on water exchange and depth so as not to be utilized for marine fish culture by dividing into small sections. This reservoir had better be used as an emergency reservoir which supplies seawater to the Center's facilities tentatively in the case that seawater supply from open sea should be stopped supplying due to its water quality problems such as red tide. To perform this function as a reservoir, seawater exchange rate should be raised to stock seawater of adequate quality and quantity.

The water gate is located at the southeast end of this reservoir and presently seawater is exchanged by tidal fluctuation therethrough. The function of the water gate is not fully performed due to imcomplete opening and closing of the gate. The improvement of water gate, therefore, is required to make the gate operation complete as well as to raise water exchange rate. A seawater pump will be also installed to supply seawater to adjacent earthen rearing ponds and to the indoor tanks in emergency cases by taking water from that reservoir.

5-3-7 Basic Plan for Fisheries Research Vessel

(1) Basic Plan

The fisheries research vessel will play an important role on execution of the Center's activities. In consideration of scope of the activities, the fisheries research vessel is designed as follows.

1) Objectives

The fisheries research vessel, which will belong to the Center, will be operated to carry out various investigations under the administration of Fisheries Resource Conservation & Management Unit and Marine Environment Research Unit. Major activities related to this vessel are as follows.

- Fisheries resource investigation : Fishing ground and the demersal fish resource will be investigated by mainly trawl fishing.
- Experimental operation : Various experimental fishing operation will be carried out for improvement of fishing gear and selection of optimum mesh size of trawl net.
- Fisheries extension : Extension services such as the demonstration of new fishing gears and methods, and training of local fishermen will be provided on the vessel.
- Marine environment investigation : In order to monitor the marine environment, various environmental parameters such as temperature, salinity, DO, depth, water color, transparency and water current will be observed at selected points. Sampling of seawater, bottom soil and aquatic organisms will be also performed concurrently.
- Other work related to resource management : Seed releasing, fish apartment launching, etc.

2) Operational Area

The objective area of activities of this vessel is generally limitted in the eastern region of the upper Gulf of Thailand, 90 miles from north to south and 130 miles from east to west, enclosed by coastline between Chabang, Cholburi Province and Head Leck, Tred Province, and by latitude 11°-39"N and longitude 100°-49"e. However, in order to perform cooperative research and investigation with the upper section of Marine Fisheries Division and other relevant goverment organizations, the vessel will be designed to equip enough capacity to carry out operation in all over the Gulf of Thailand.

3) The Gulf of Thailand is dominated by the southwest monsoon during April to Octorber and the southeast monsoon during November to March. High waves rise in the eastern region of the Gulf of Thailand for several days during the southwest monsoon season. The vessel, therfore will have adequate seaworthness and stability.

4) The total number of crew is 12 including on-deck researchers and assistants, and navigation days per trip is 10 days for fisheries investigation and marine observation.

5) In order to conduct on-deck work such as experimental fishing and marine observation, the vessel will have high steering ability and maneuverability.

6) The deck is single-floor on which work deck is located aft so as to make space for the research work as wide as available. The upper constructions such as the bridge and accommodation area located as fore as possible.

7) Since the climate of the operational area of the vessel is hot and humid, the ventilation as well as

lightning of the vessel will be considered for maintenance of equipment and improvement of living condition, in the designig.

8) The equipment to be attached to the vesel will be selected based on easy operation and maintenance.

9) The coast of the Gulf of Thailand is generally shallow with sandy-mud bottom. Since the operational area of the vessel includes such shallow water and the pier for the vessel is situated over only 3.5 m deep water at the low tide, draught of the vessel is designed at not more than 3 m. In addition, the adjacent part of rudder will be strengthened by thick and reinforced material.

10) Although majority of Thai fishing vessels are wooden-made, the hull of the new vessel will be made of FRP in consideration of the following merits.

- The FRP hull is lighter than wooden one. Higher speed of the vessel can be obtained. Also, the main engine can be minimized to economize the fuel consumption.
- FRP is more durable and free of corrision and boring which are oftenly seen on wooden hull.
- Reparing work is easy on slipway with repairing materials. FRP resin and glass fiber are available in Thailand. There are 6 shipyards (for construction and repairing of wooden boats) in Rayong Province, and it is possible to utilize those slipways for repair of the new vessel. In addition, there is a shipyard for construction of small FRP boat in Bangkok so as to have no problem on the hull repairing and maintenance.
- Demonstration effect for FRP is expected.

11) This research vessel will be constructed in accordance with SENPAKU ANZEN HOU (Japanese ship's

construction regurations), KOGATA GYOSEN TOKUSHU KITEI (Japanese small fishing vessel special regulations), and FRP SEN TOKUSHU KITJUN (Construction standerd for FRP vessels). Furthermoer, the vessel will pass the Japanese Export Survey for Ships.

(2) Preliminary Specifications

Based on the basic plan, the preliminary specifications of the vessel were designed as follows.

1)	Vessel Type	: Single decker, fore brigde, single chine hull
2)	Hull Materials	: FRP
3)	Principle Dimension	:
	Length (overall)	approx. 23.0 m
	Breadth	approx. 5.8 m
	Depth	approx. 2.3 m
4)	Gross Tonnage	: approx. 50 tons (according to the Japanese Ships Tonnage Measurment, 1969)
5)	Main Engine	: approx. 400 ps, diesel engine
6)	Sea Speed	: approx. 9 knots (service speed)
7)	Navigation Range	: approx. 1,500 nautical mile
8)	Tank Capacity	:
	for fuel	approx. 15 m^3
	for freshwater	approx. 6 m^3
9)	Fish Tank Capacity	: approx. 12 m^3 (equipped with insulation and refrigeration appratus)
10)	Complement	: 12 persons
11)	Deck Machinery	:

Capacity (for deck) 1 ton x 15 m
Trawl winch (net winch) 3 ton x 50 m
Net/line hauler
Winch for marine research, etc.
* All machinary mentioned above are driven by hydraulic motor.

12) Navigation Equipment :

NNSS
Rader
Fish finder
Doppler speed log, etc.

13) Wireless Equipment :

S.S.B.
V.H.F.

14) Research Equipment :

Reversable thermometer, Secki disk,
Nansen bottle, Plankton & larva net,
Smith & MacIntyre type bottom sampler,
Current meter, etc.

15) Tender :

FRP boat with out-board engine	1 unit
Length	approx. 5 m
Capacity of out-bord engine	approx. 30 ps.

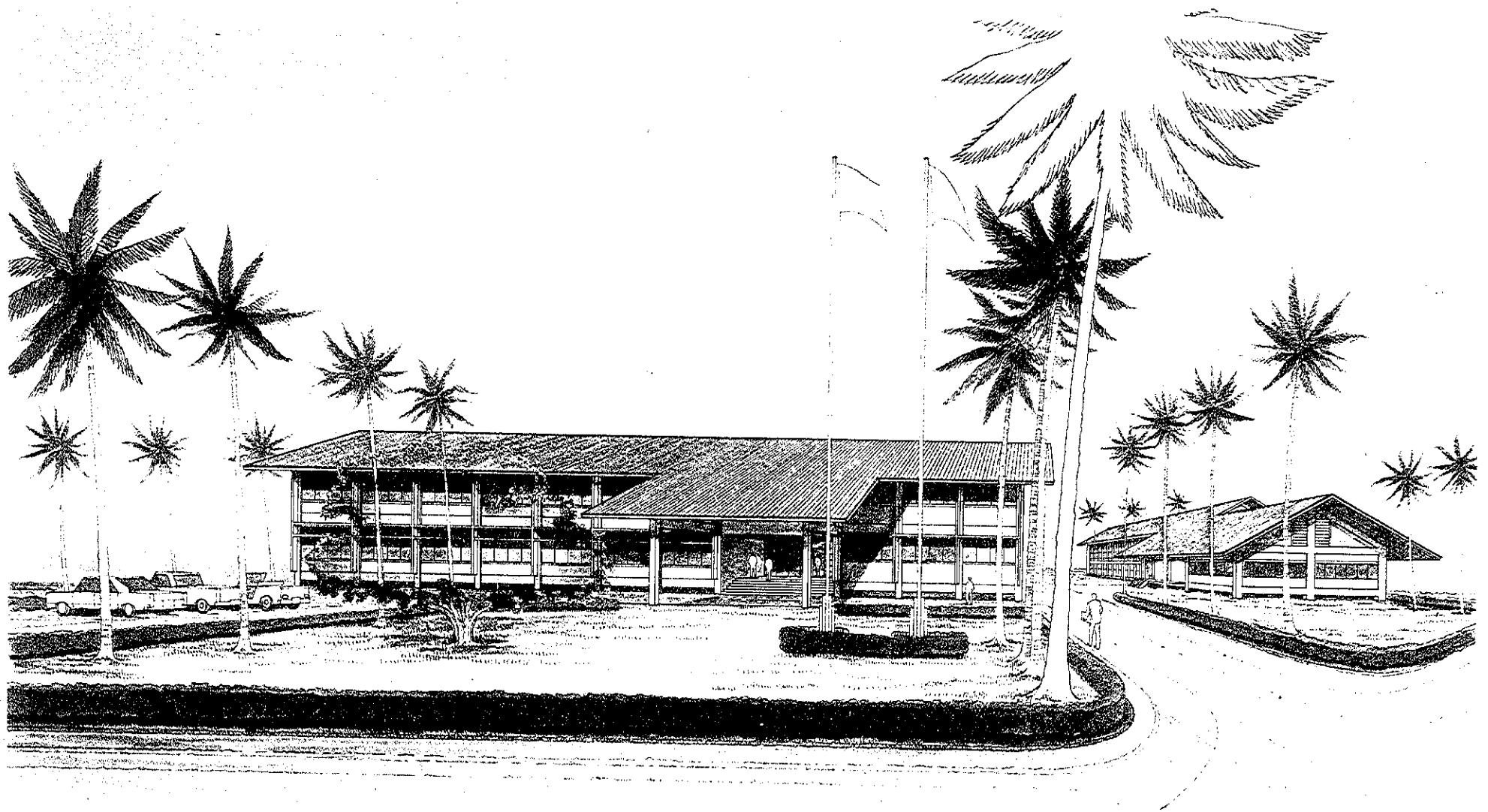
(3) Fishing Equipment

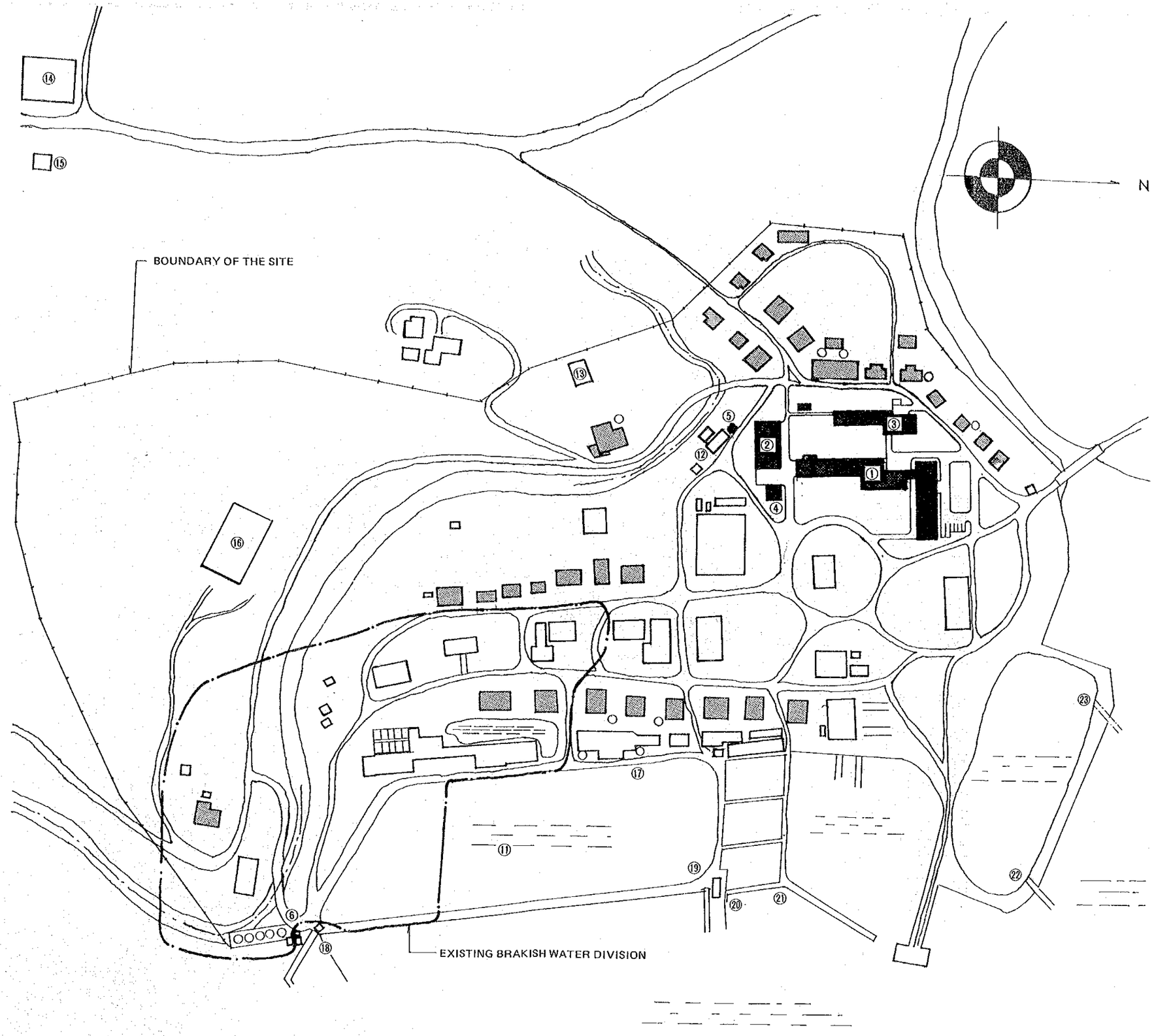
The following fishing equipment will be furnished.

1) Trawl Fishing Net	
Two panels construction (used in Thailand)	2 sets
Four panels construction (newly introduced)	2 sets
2) Gill Net	
Floating gill net	20 sets
Bottom gill net	20 sets
3) Bottom long line	20 sets
4) Collapsible fish cage	20 sets
5) Materials for repair of the above listed fishing gear	1 set

5-4 Basic design drawings

01.	Site plan	1/2500
02.	Plot plan	1/500
03.	1st floor plan for laboratory	1/300
04.	2nd floor plan for laboratory building	1/300
05.	Elevation and section for laboratory building	1/300
06.	1st and 2nd floor plan for dormitory	1/300
07.	Elevation and section for dormitory	1/300
08.	Floor plan, elevation and section for workshop, feed plant, laboratory building and generator house	1/300
09.	Electric power supply system (1)	1/2500
10.	Electric power supply system (2)	1/500
11.	Sea water intake and distrbution system	1/2500
12.	Water supply system	1/500
13.	Sewage system (1)	1/2500
14.	Sewage system (2)	1/500
15.	Improvement of the water gate	1/200
16.	Fishery research vessel	





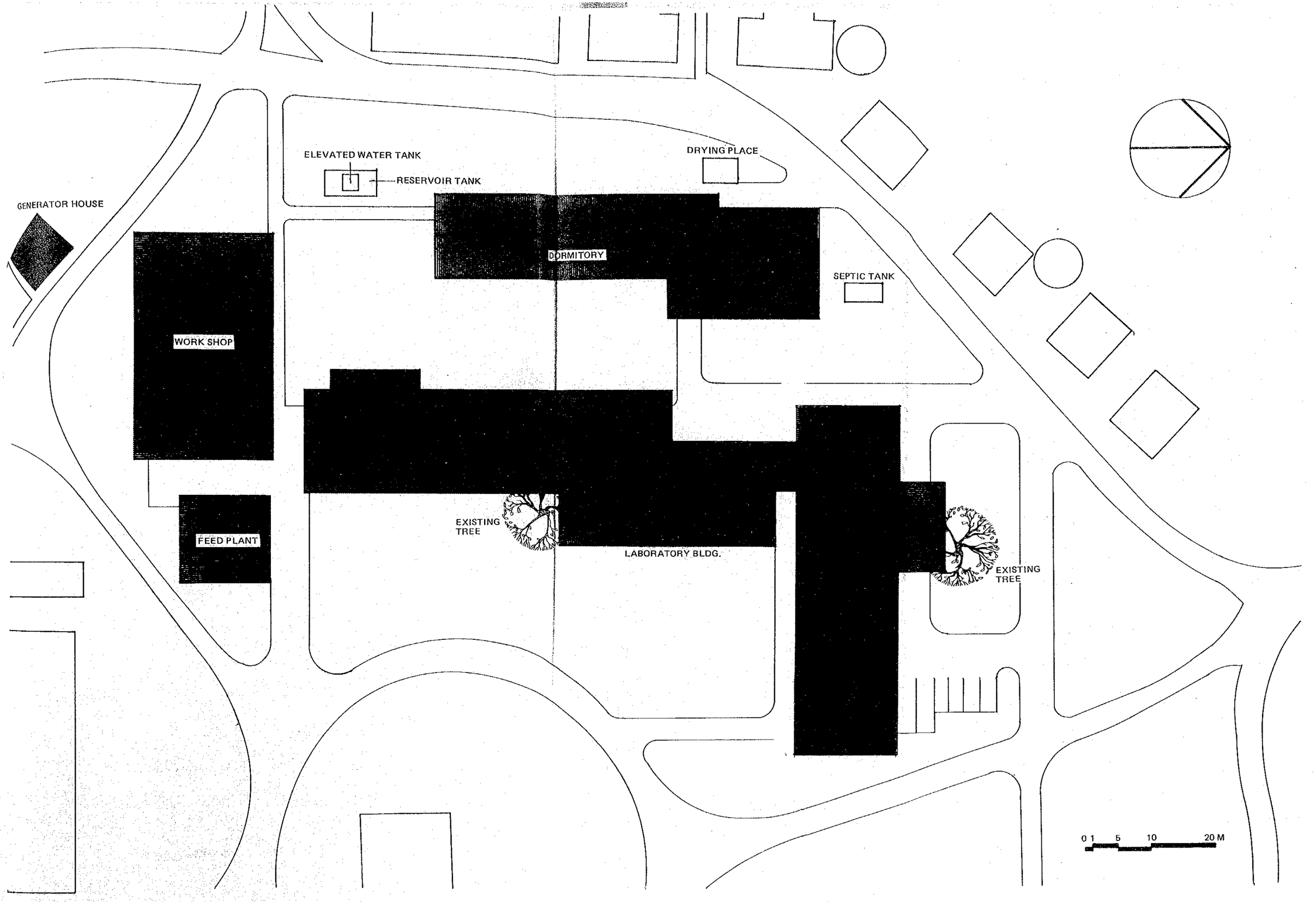
NEW BUILDING

① LABORATORY BUILDING
② WORK SHOP
③ DORMITORY
④ FEED PRODUCT UNIT
⑤ GENERATOR HOUSE
⑥ PUMP STATION
⑦ ELEVATED WATER TANK

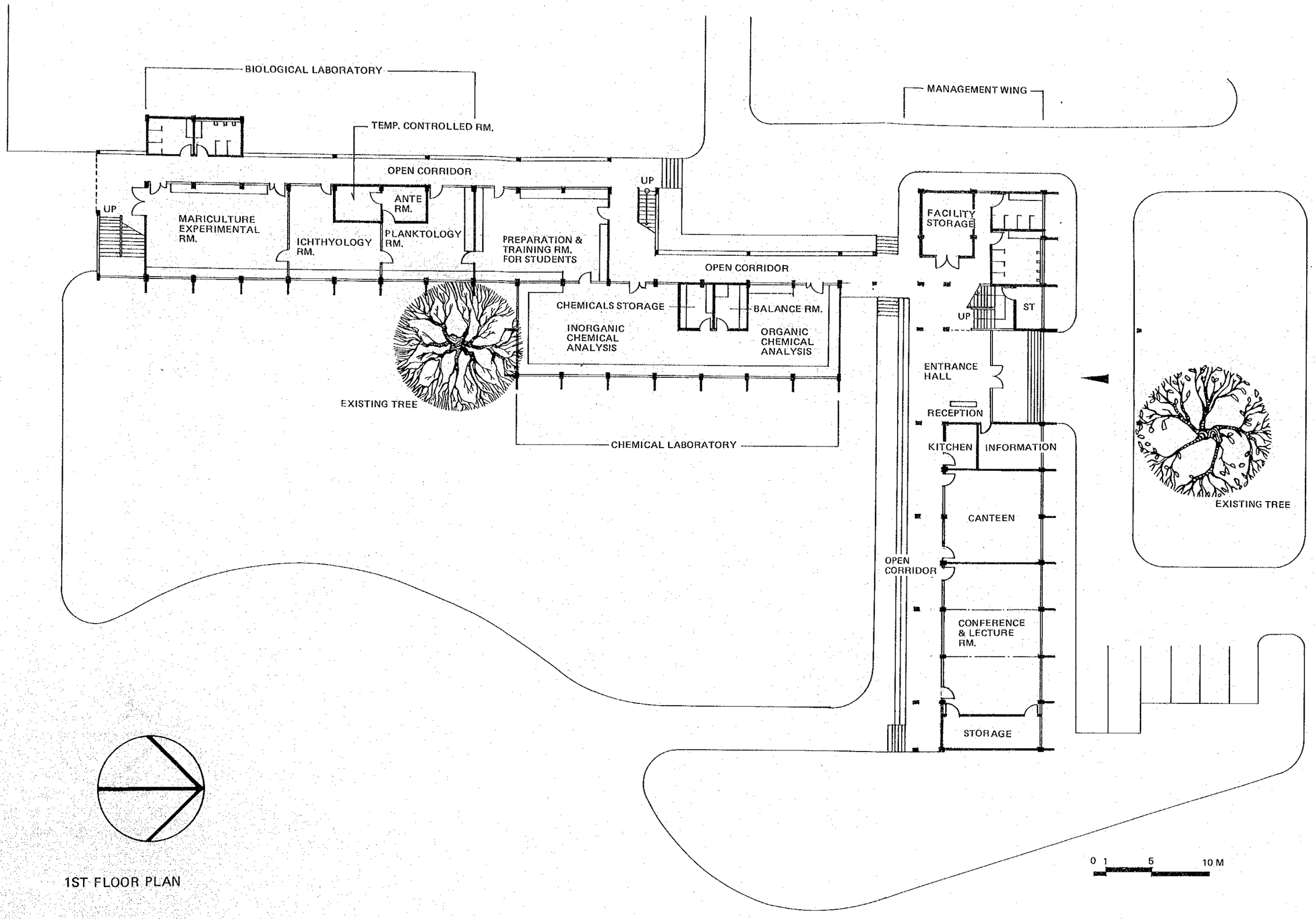
EXISTING FACILITY

⑪ POND
⑫ GENERATOR HOUSE
⑬ FRESHWATER TANK
⑭ RESERVOIR
⑮ PUMP HOUSE
⑯ RESERVOIR
⑰ TENTATIVE PIER
⑱ SEA WATER GATE 1
⑲ SEA WATER GATE 2
⑳ SEA WATER GATE 3
㉑ SEA WATER GATE 4
㉒ SEA WATER GATE 5
㉓ SEA WATER GATE 6

SITE PLAN 1/2500 01

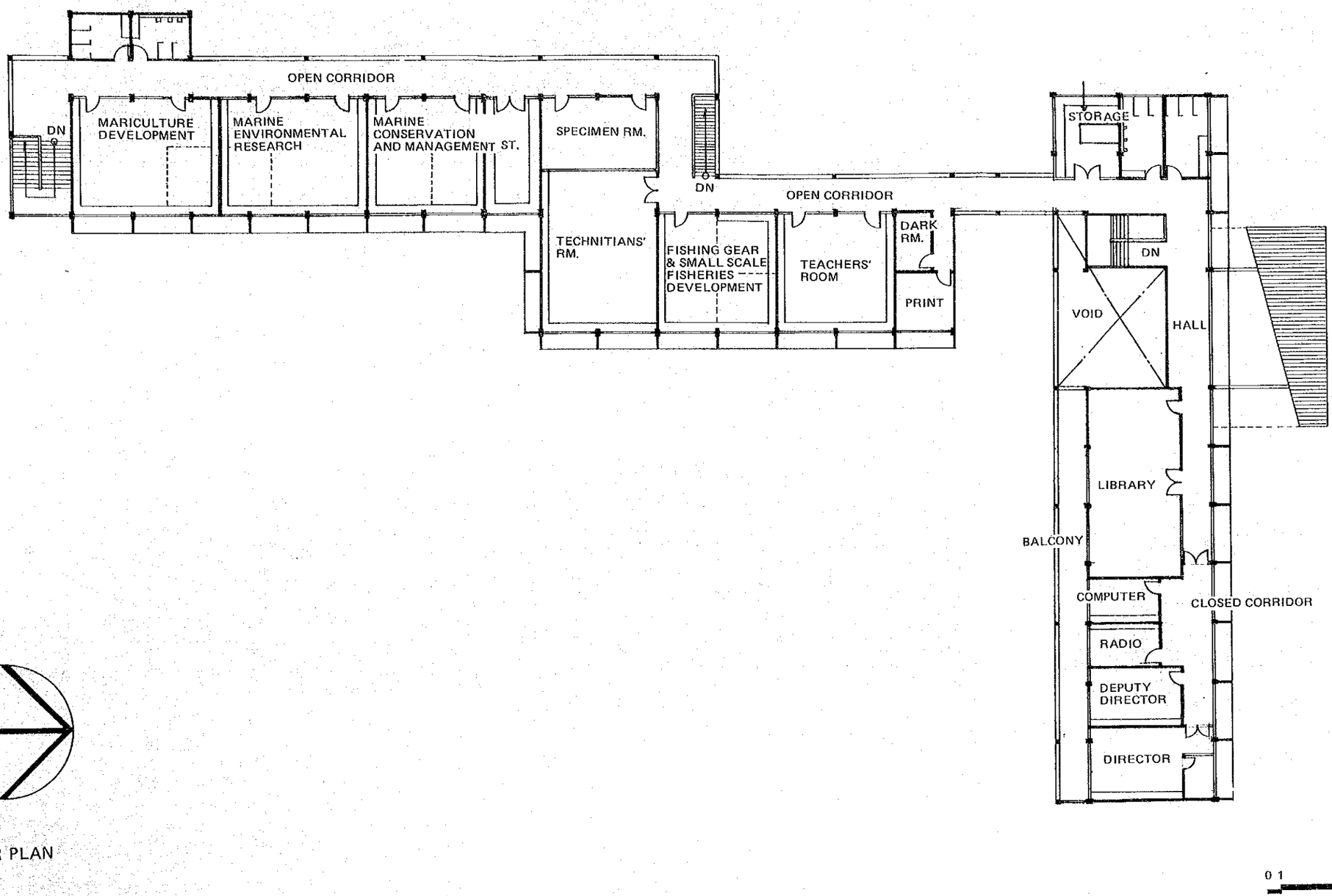


PLOT PLAN 1/500 02



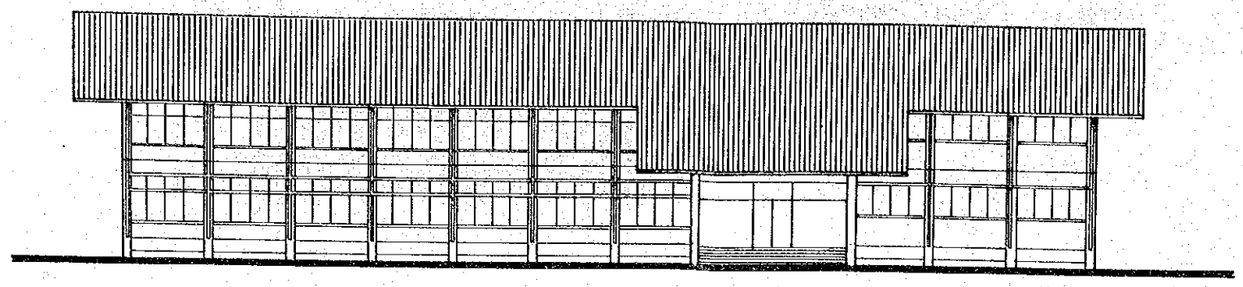
1ST FLOOR PLAN

1ST FLOOR PLAN FOR LABORATORY 1/300 03

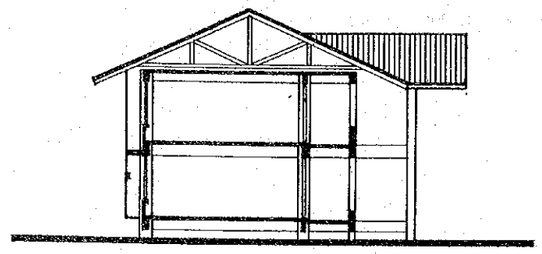


2ND FLOOR PLAN

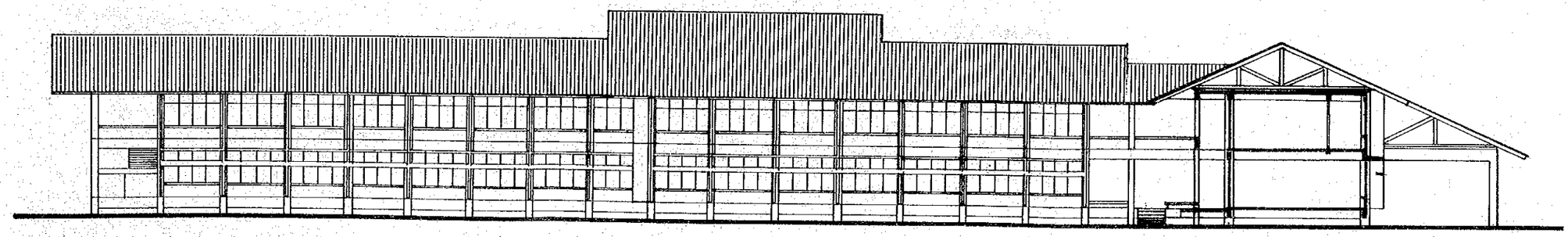
2ND FLOOR PLAN FOR LABORATORY BUILDING 1/300 04



NORTH SIDE ELEVATION



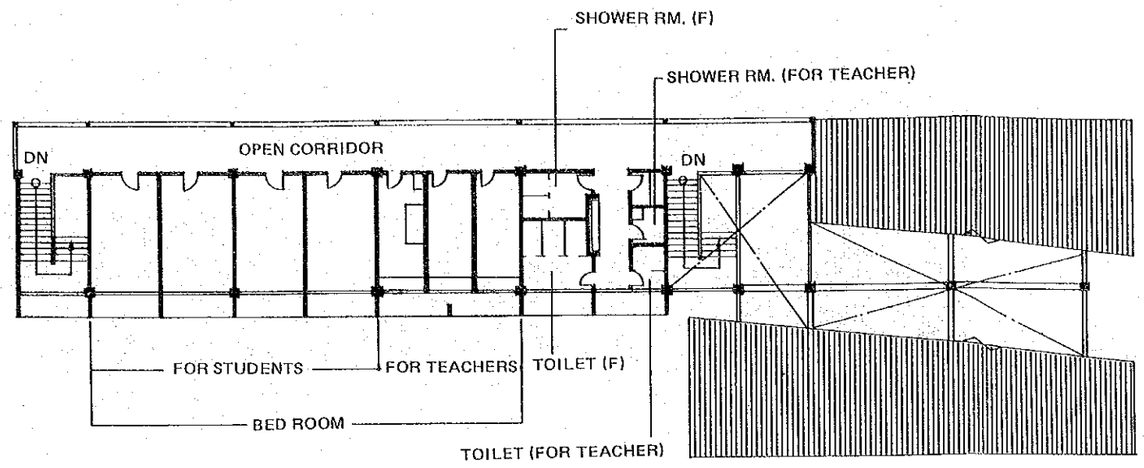
SECTION



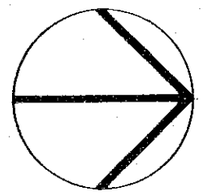
EAST SIDE ELEVATION & SECTION

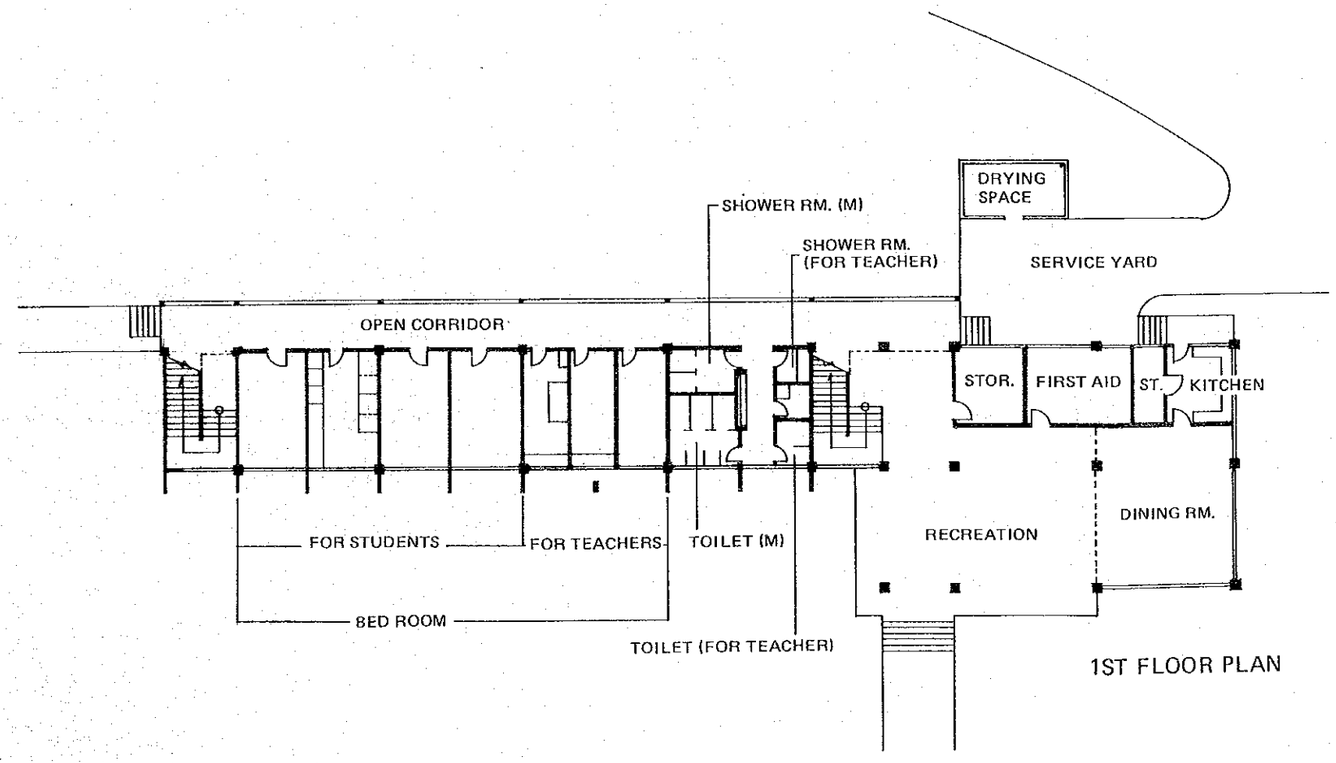
0 1 5 10 M

ELEVATIONS AND SECTIONS FOR LABORATORY BUILDING 1/300 05



2ND FLOOR PLAN

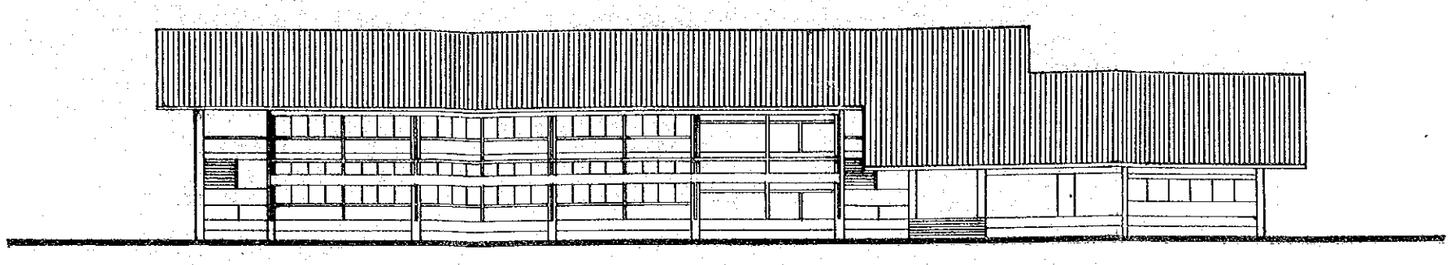




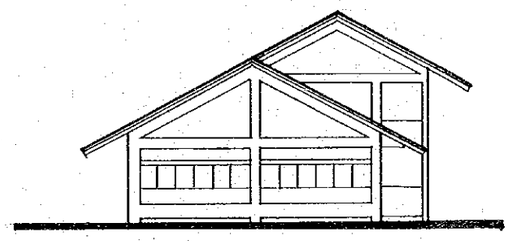
1ST FLOOR PLAN

0 1 5 10 M

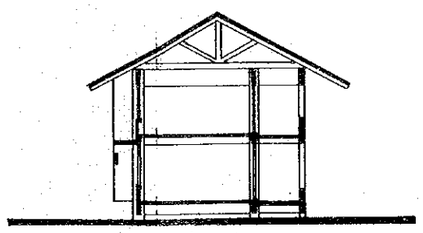
1ST AND 2ND FLOOR PLAN FOR DORMITORY 1/300 06



EAST SIDE ELEVATION



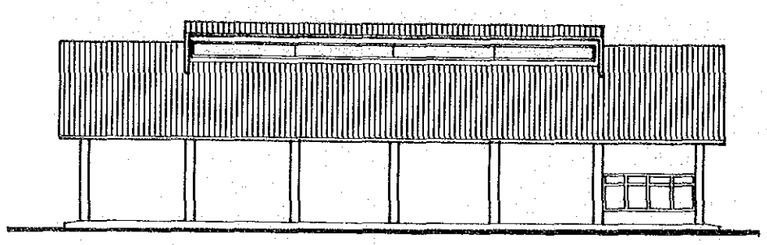
NORTH SIDE ELEVATION



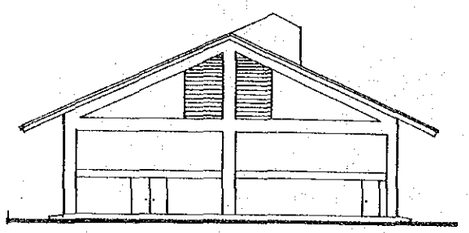
SECTION

0 1 5 10 M

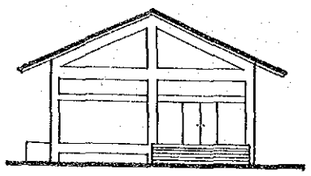
ELEVATIONS AND SECTION FOR DORMITORY 1/300 07



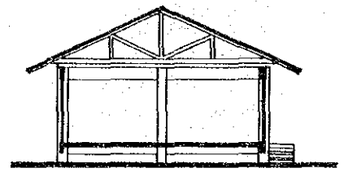
NORTH SIDE ELEVATION



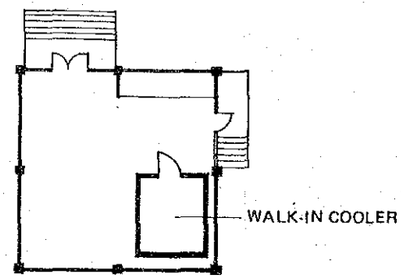
EAST SIDE ELEVATION



WEST SIDE ELEVATION

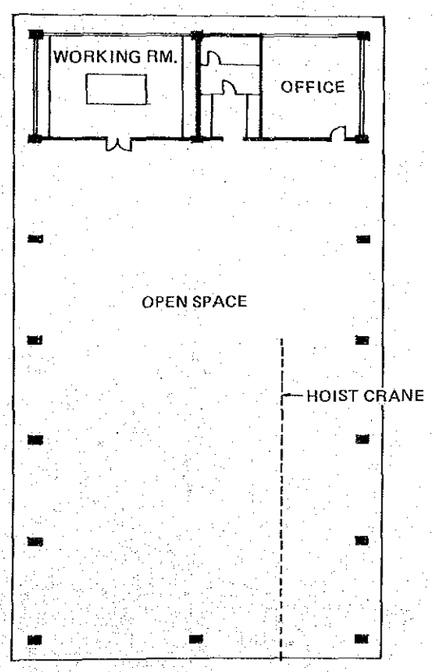


SECTION



PLAN

FEED PLANT



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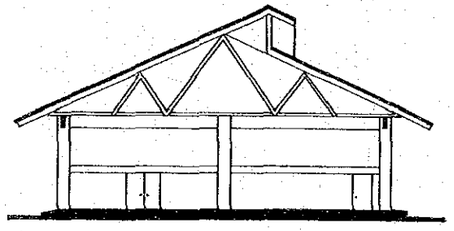

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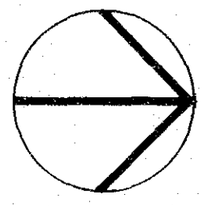
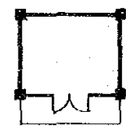
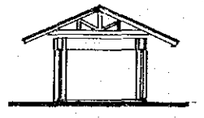


WORK SHOP



PLAN



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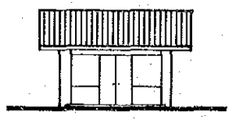
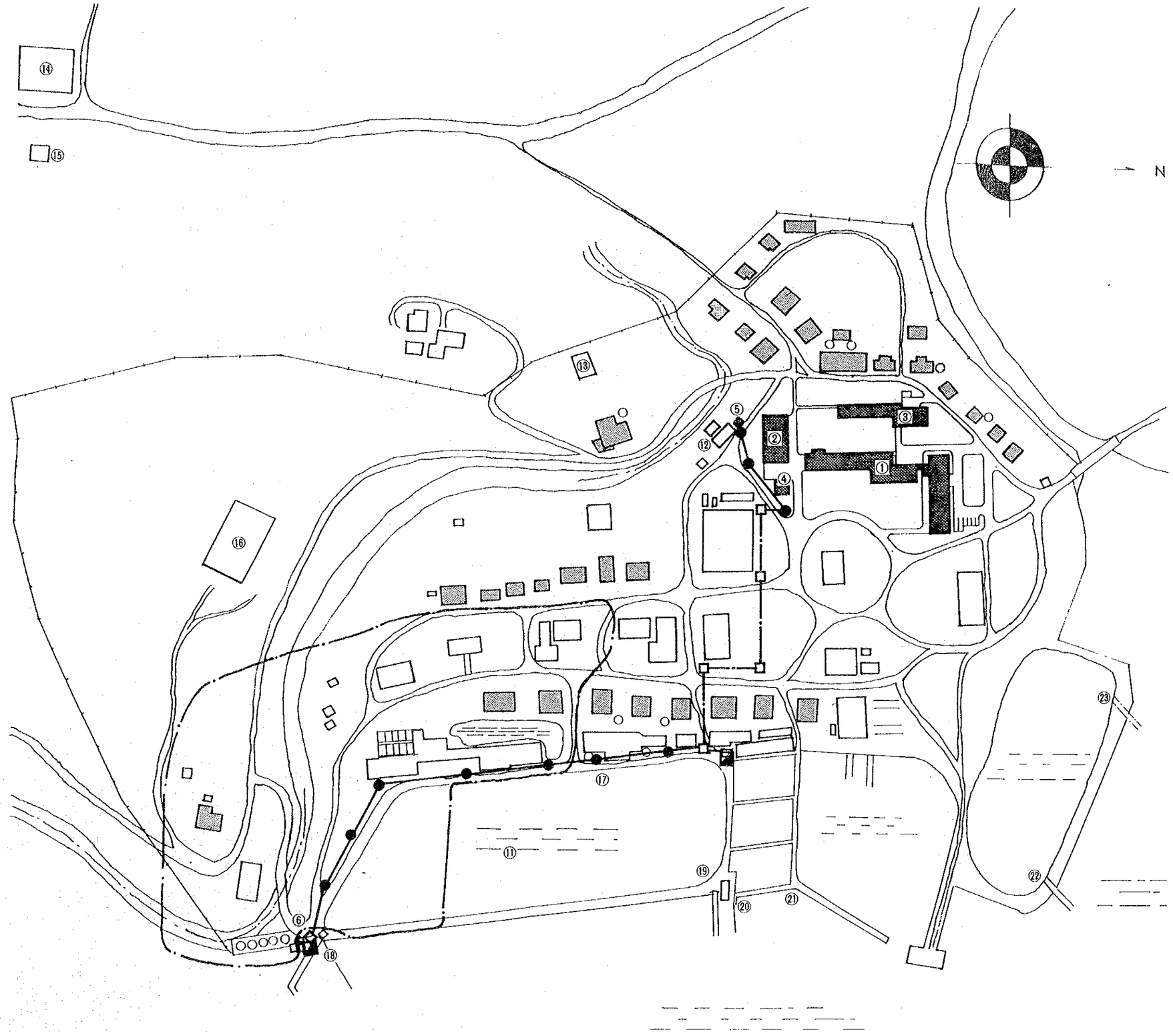


ELEVATION

GENERATOR HOUSE

0 1 5 10 M

WORK SHOP, FEED PLANT AND GENERATOR HOUSE 1/300 08



NEW BUILDING

① LABORATORY BUILDING
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⑪ POND
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⑮ PUMP HOUSE
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⑰ TENTATIVE PIER
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⑲ SEA WATER GATE 2
⑳ SEA WATER GATE 3
㉑ SEA WATER GATE 4
㉒ SEA WATER GATE 5
㉓ SEA WATER GATE 6

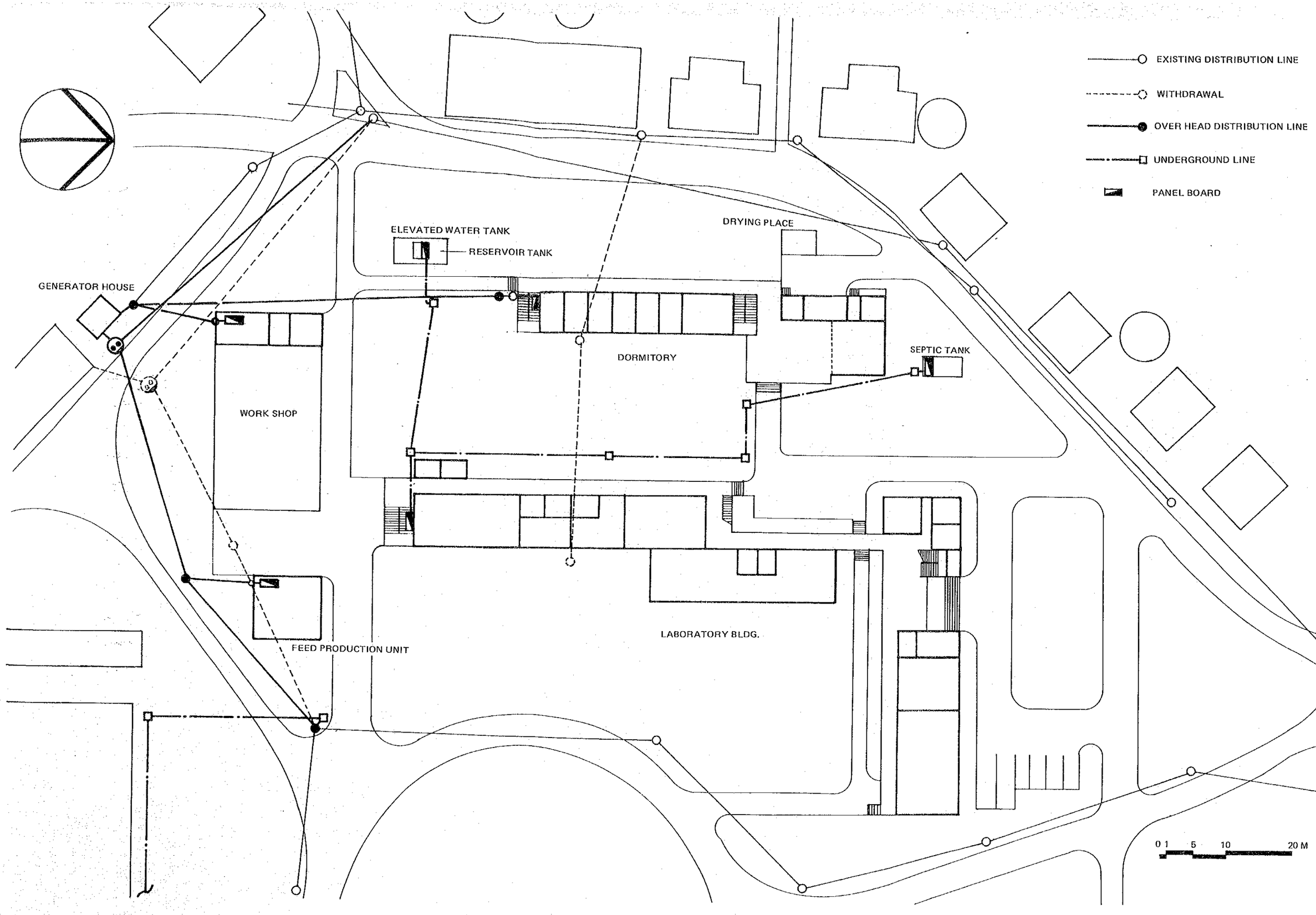
OVER HEAD DISTRIBUTION LINE

UNDERGROUND DISTRIBUTION LINE

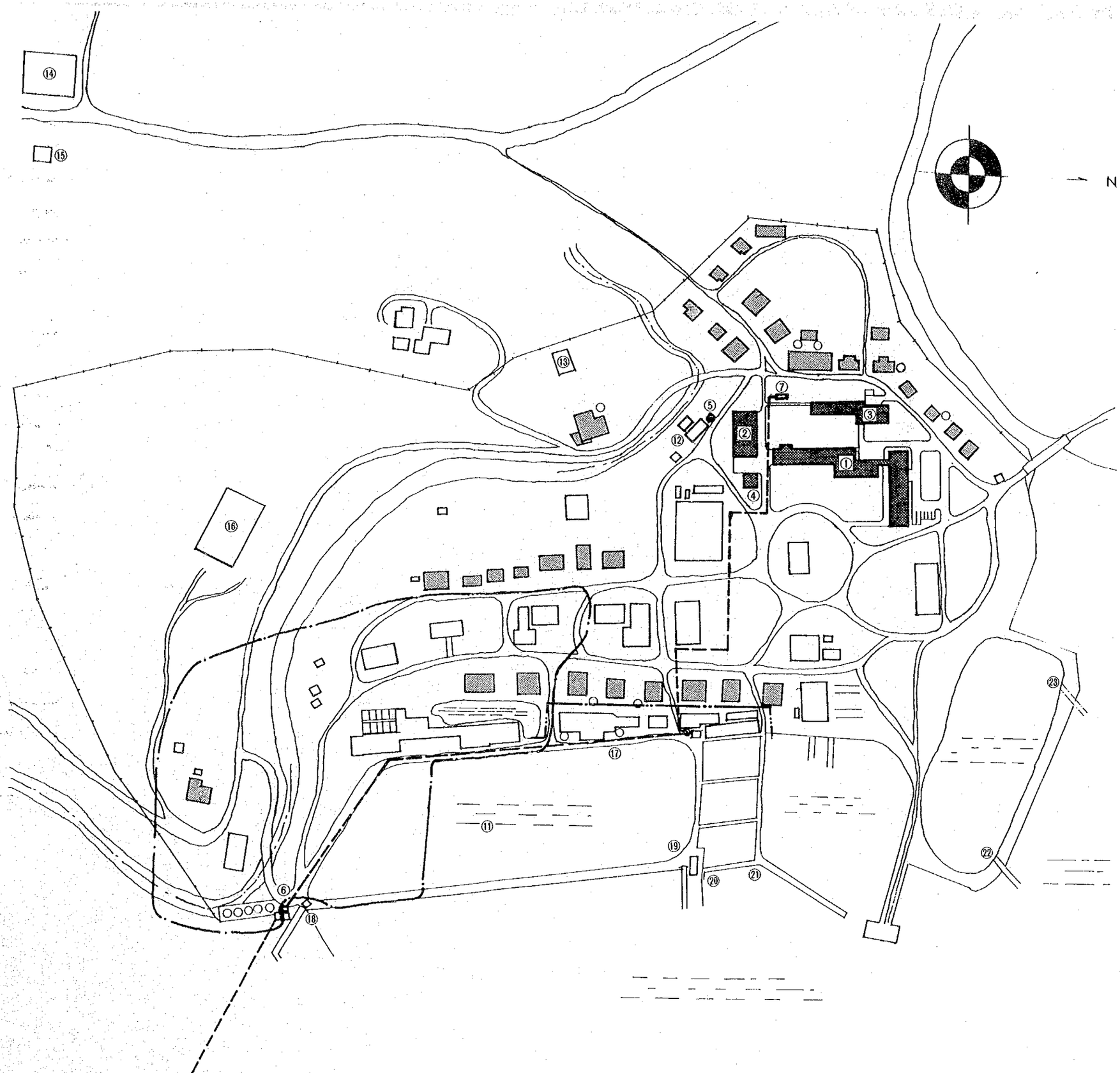
PUMP

0 10 50 100 M

ELECTRIC POWER SUPPLY SYSTEM (1) 1/2500 09



ELECTRIC POWER SUPPLY SYSTEM (2) 1/500 10



NEW BUILDING

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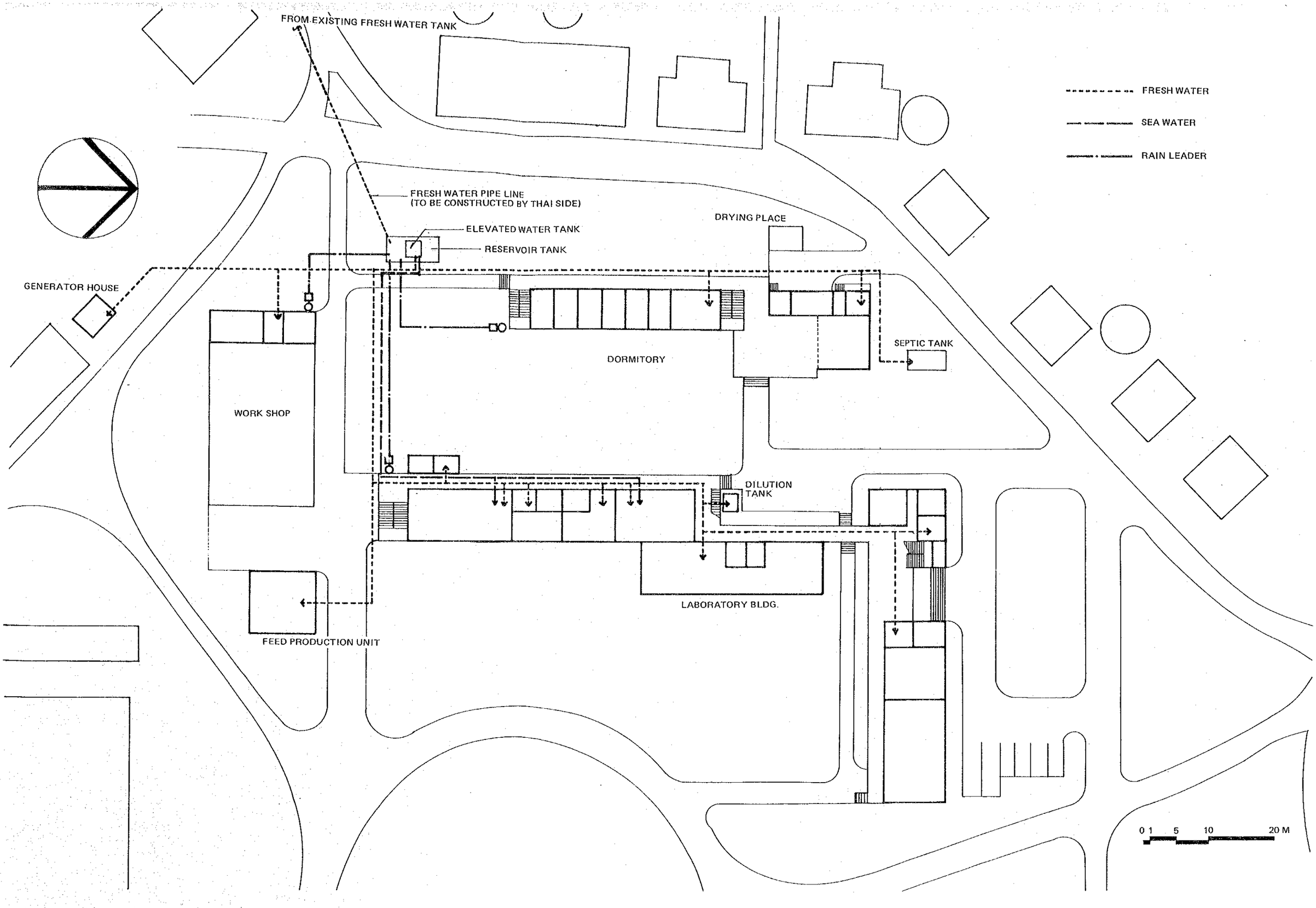
⑳ SEA WATER GATE 3
㉑ SEA WATER GATE 4
㉒ SEA WATER GATE 5
㉓ SEA WATER GATE 6

SEA WATER SUPPLY

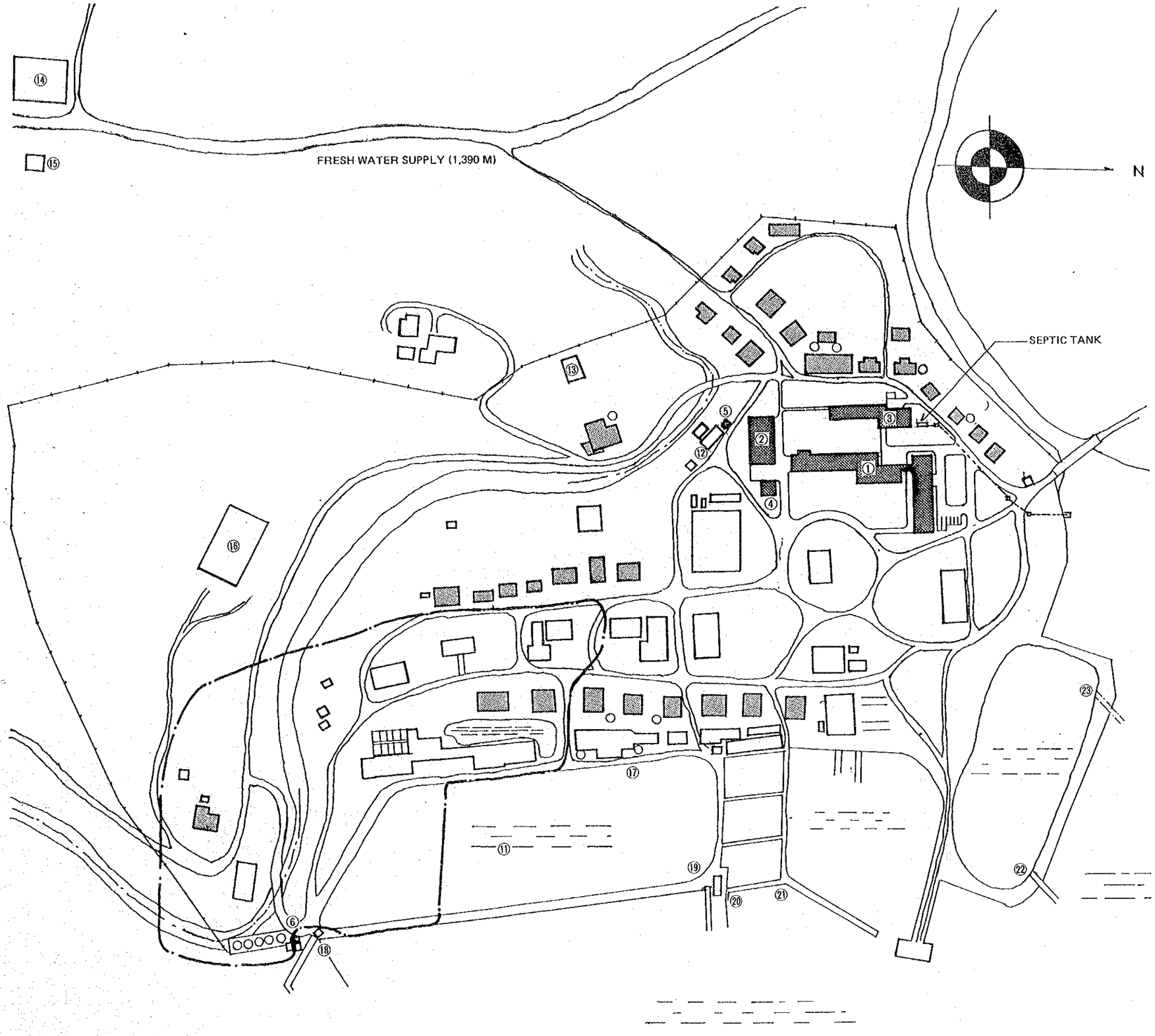
SEA WATER DRAIN

0 10 50 100 M

SEA WATER INTAKE AND TRANSPORTATION SYSTEM 1/2500 11



WATER SUPPLY SYSTEM 1/500 12



NEW BUILDING

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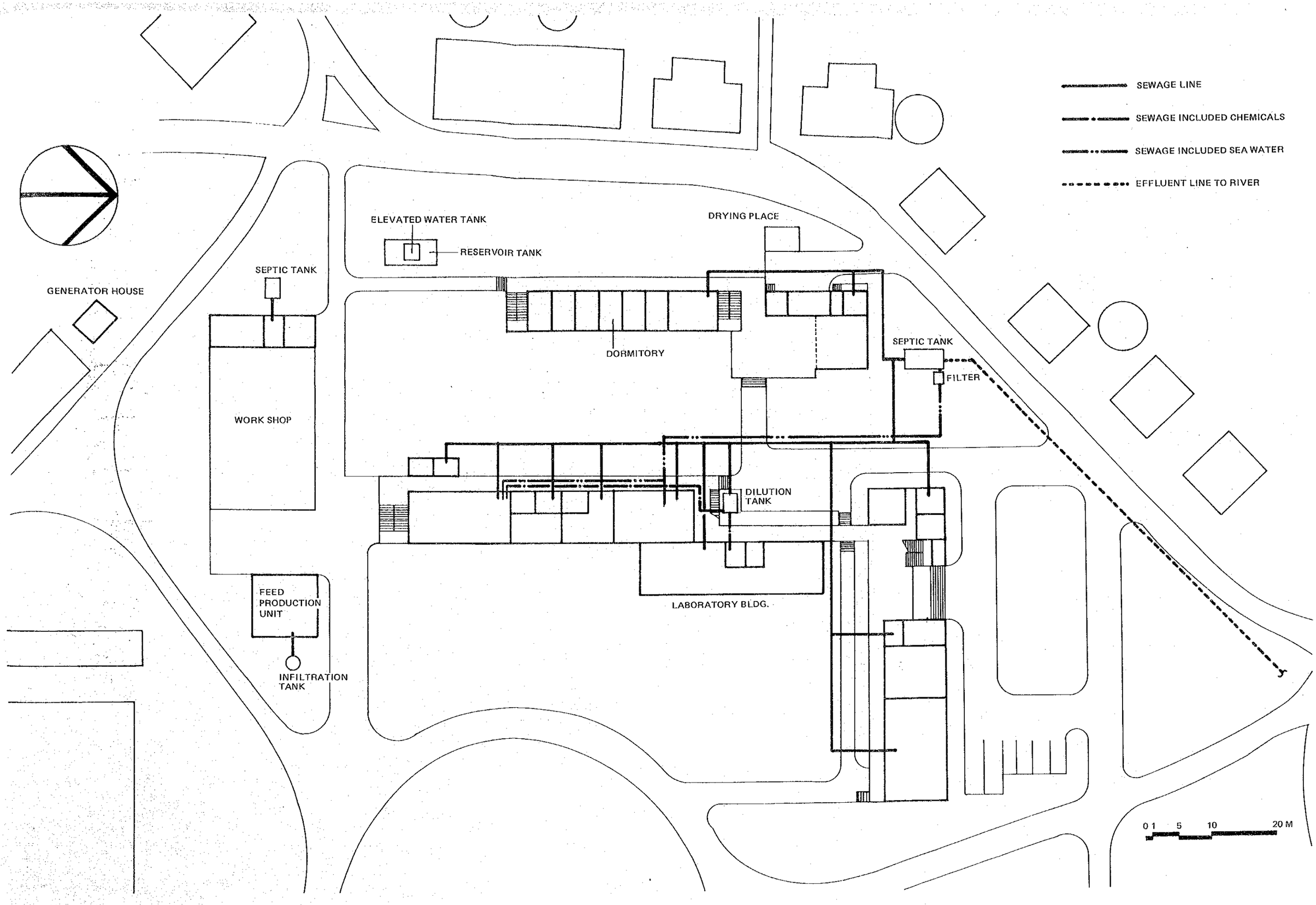
⑲ SEA WATER GATE 2
⑳ SEA WATER GATE 3
㉑ SEA WATER GATE 4
㉒ SEA WATER GATE 5
㉓ SEA WATER GATE 6

SEWAGE LINE

0 10 50 100 M

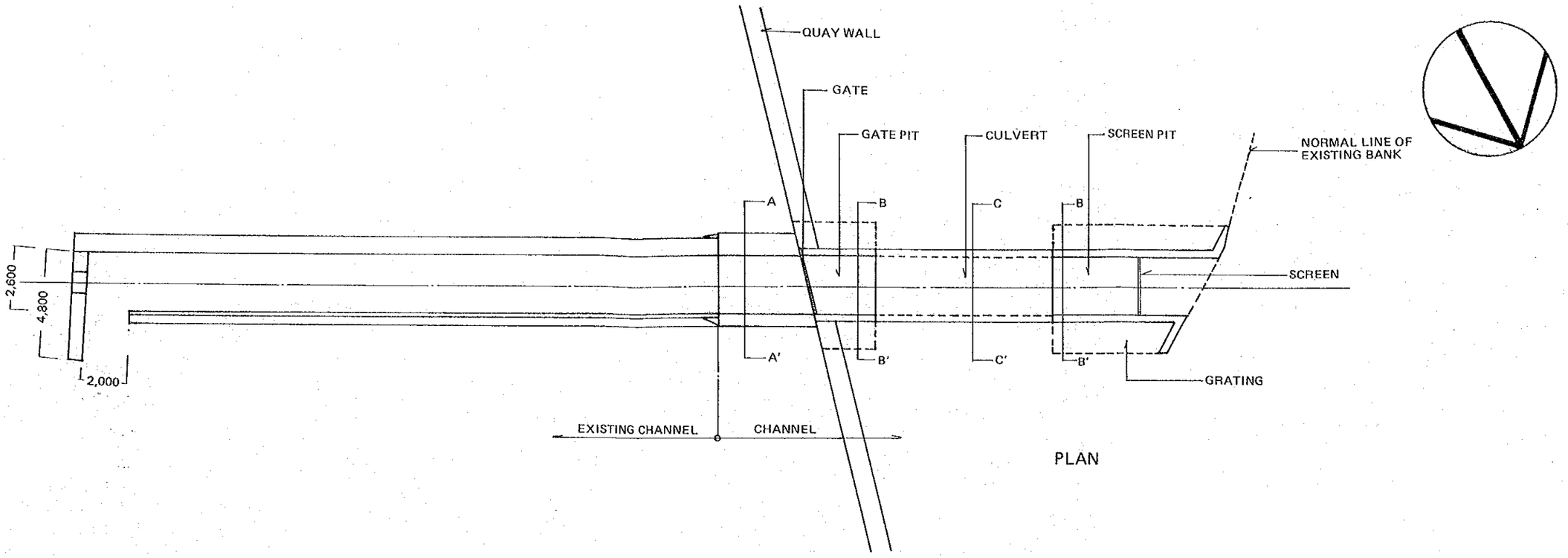
SEA WATER INTAKE PIPE LINE

SEWAGE SYSTEM (1) 1/2500 13



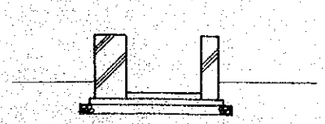
SEWAGE SYSTEM (2) 1/500

14



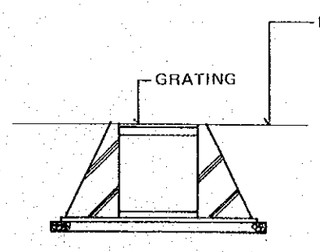
PLAN

0 1 5 10 M



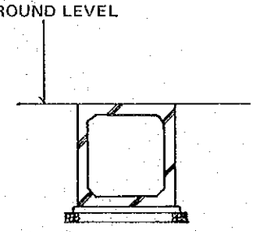
SECTION -- A-A'

TYPICAL SECTION OF CHANNEL



SECTION -- B-B'

TYPICAL SECTION OF RETAINING WALL

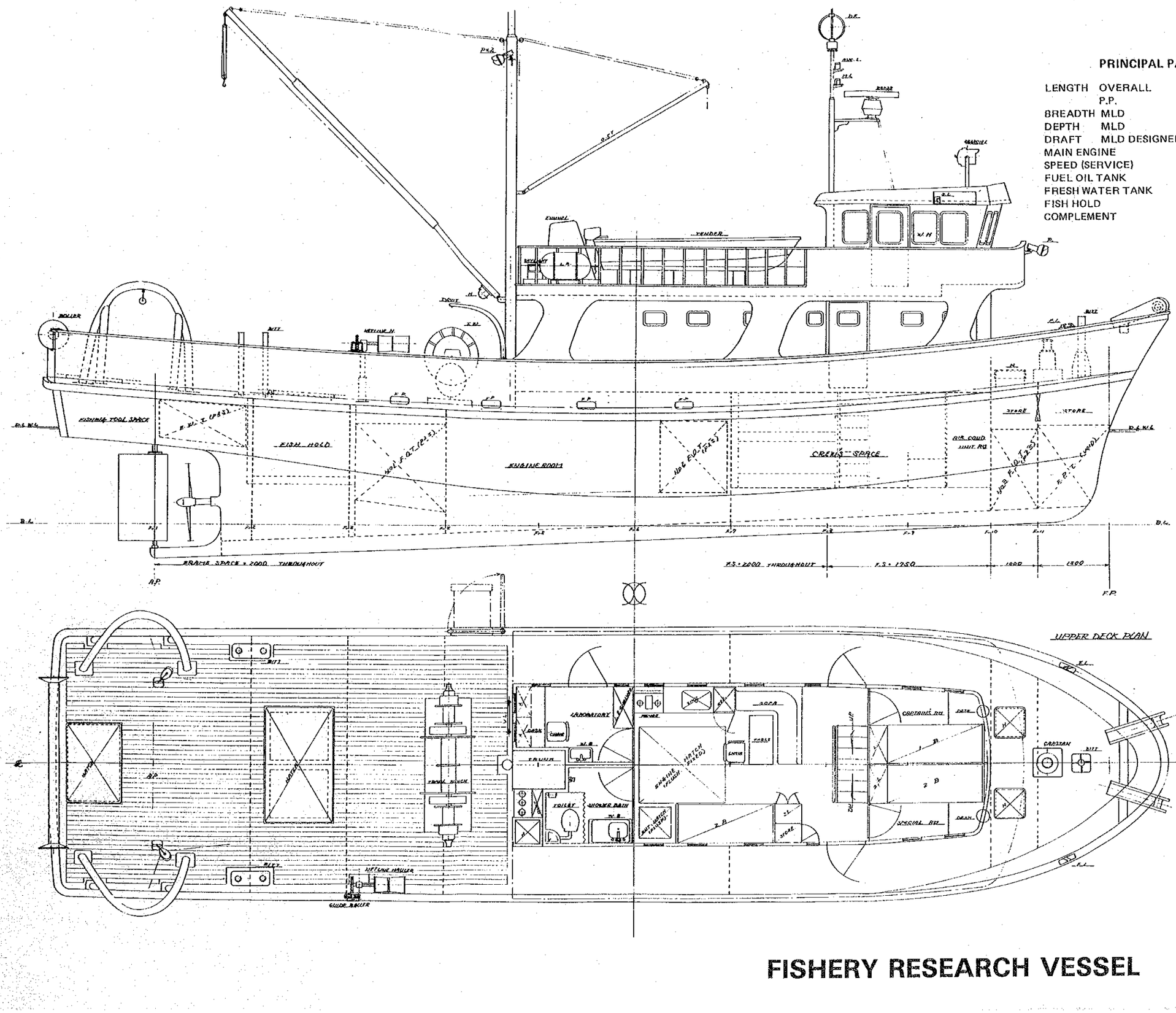


SECTION -- C-C'

TYPICAL SECTION OF CULVERT

PRINCIPAL PARTICULARS

LENGTH	OVERALL	Approx. 23.45 m
	P.P.	Approx. 20.00 m
BREADTH	MLD	Approx. 5.80 m
DEPTH	MLD	Approx. 2.35 m
DRAFT	MLD DESIGNED	Approx. 2.00 m
MAIN ENGINE		Approx. 400 PS x 1 set
SPEED (SERVICE)		Approx. 9 kt
FUEL OIL TANK		Approx. 15 m³
FRESH WATER TANK		Approx. 5 m³
FISH HOLD		Approx. 12 m³
COMPLEMENT		12 P



FISHERY RESEARCH VESSEL

6. PROJECT IMPLEMENTATION

6-1 Implementation Plan

6-1-1 Role of Executing Agency

The Department of Fisheries, Ministry of Agriculture and Cooperaives bears responsibilities of the implementation of this project. Marine Fisheries Division of the Department of Fisheries will have charge of every work of actual business level regarding the implementation of this project. In other words, it shoud make every effort for the promotion of the Project providing such work as preliminary preparations required the facilitie planning and detailed design of this station, excution of the business matters required for progress of the construction work, and atteinment of budget beared by the Goiverment of Thailand for the Project.

6-1-2 Implementation System

The preparation of the tender documents and the supervision of the construction work of this project should be carried out by a Japanese Consultant. Accordingly, the construction work should be carried out by a Japanese firm in conformity with the general contracting system, and local sub-contractor firms of Thailand should be in charge of the actual construction work. On the other hand, the construction of the fishery research vessel and the manufacturing and procurement of materials and equipment should be carried out by specialized Japanese firms. The consultant will and start the work related to the detailed design after the E/N between the goverments of the Kingdom of Thailand and Japan about the grant for the implementation of this project. The term required for that detailed design will be 2 months, and be carried out holding the necessary consultations with the Thai authorities concerned.

The contractor should be selected by tender to be carried out by the owner after the completion of the tender documents.

The successful bidder should be examined the breakdown of the offered price for the approval, and then it will sign the contract agreement with DOF after the confirmation of the appropriateness of the said price breakdown. It is expected that the tender procedure will require approximately 1 month.

6-1-3 Implementation schedule

The construction work will be started after the signature of the contract agreement between the Government of Thailand and the successful bidder, with due verification of the Government of Japan. It is expected that approximately 5 months will be required from the E/N to the start of the construction work.

The term of works is expected to total 10 months, consisting of 1 month for preparatory works, 8 months for construction works as well as manufacturing and ocean transportation of the materials and equipment and 1 month for installation, test and adjustment, taking into account delays caused by the rain condition.

After the signature of the contact between the Government of Thailand and the contractor, the consultant will send to the project site the chief architect and the field supervisor of this project that will take charge of the following duties.

- To give the contractor every instruction related to the work.
- To hold consultations and to confirm details about the working schedules.
- To carry out the required formalities.

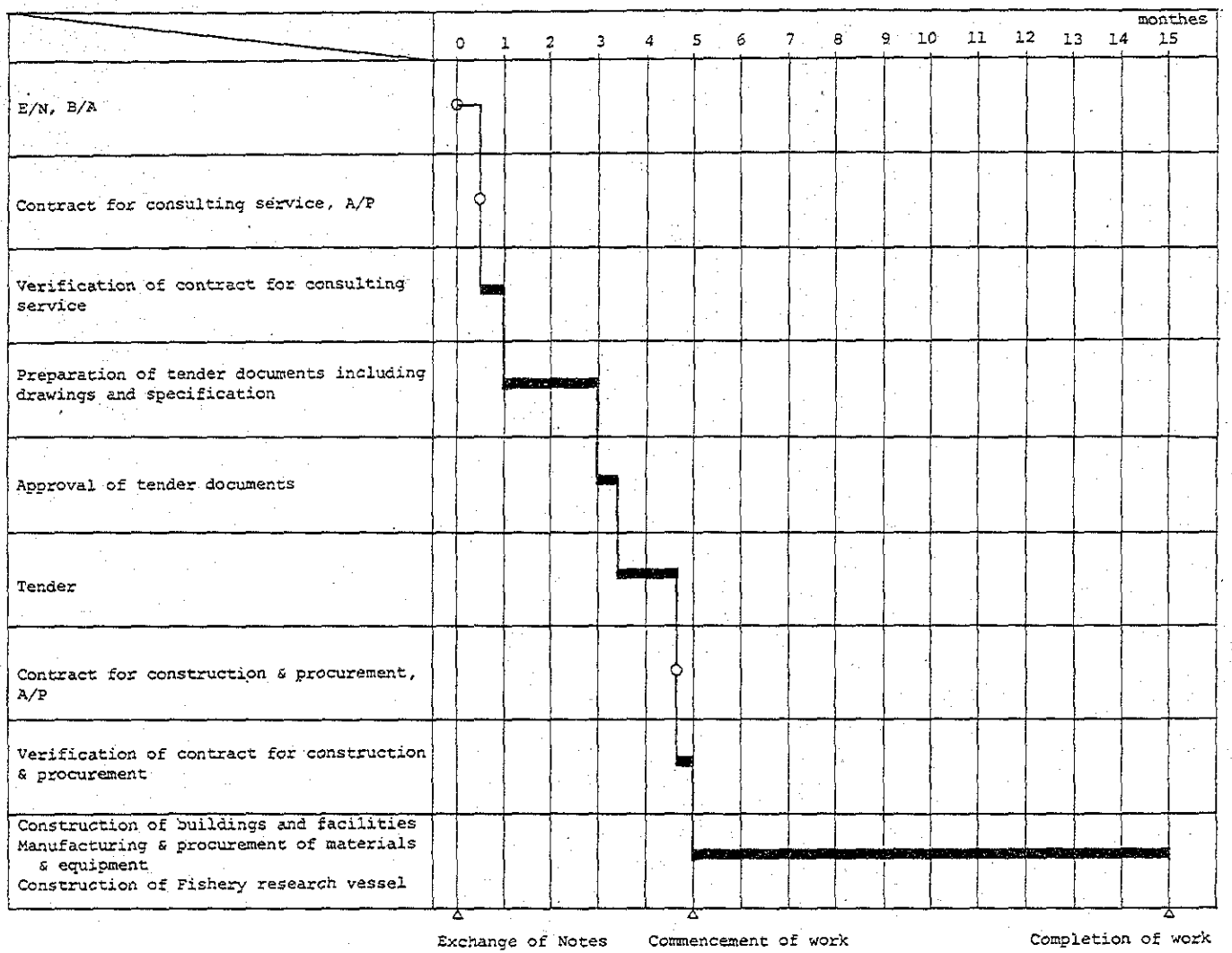
Once started the work, the resident field supervisor will stay in Thailand until the completion of the work, taking charge of the following duties.

- Supervision of the construction work.
- Delivery of the facilities, materials and equipment to the owner and execution of other relevant formalities required until the completion of the work.

The chief architect and the engineers as well as the engineers in charge of the structure, equipment and materials will fly to Thailand as occasion demands concurrently with the progress of the work, to carry out supervision on the spot and inspections of the critical jobs.

The construction work will start 5 months after the aforementioned E/N and the term of works is 10 months. Therefore, 15 months will be required after the E/N until the completion of construction work and delivery of the project to the owner. The said schedule is schematically shown in the following chart.

Implementation Schedule



6-1-4 Scope of work

The scope of each item of work to be borne by Japan and Thailand are shown in the following table.

		Japan	Thailand
Basic work	Preliminary preparation	Roads, parking lots, street lamps and drying places in the blocks of the buildings to be provided by Japan	Ground levelling, felling and unrooting should be finished before the start of the work, in accordance with the ground levelling plan prepared in Japan. Construction of the road accesssing the existing facilities.
	Water supply	Construction of the water receiving tank, pumping facilities and elevated tank, as well as installation of water supply facilities up to the buildings to be provided by Japan.	Laying work of water supply main pipe up to the water receiving tank to be constructed by Japan and extension of the water supply main pipe up to each one of the facilities to be constructed by Thailand.
	Drainage	Drainage facilities of all buildings to be provided by Japan, i.e., laying work of drainage main pipes to discharge miscellaneous drainage and sanitary sewage in the small rivers, via primary treatment chamber located at the vicinity of each building and final treatment chamber.	Drainage system of each facility to be constructed by Thailand.
	Power	Power receiving & subsequent transmission systems up to each facility to be provided by Japan.	Lead-up to the power receiving and substation facilities, cost of the required formalities, and supply of power to the facilities borne by Thailand. Formalities with the Thai authorities regarding power receiving and substation and sharing of lead-in cost.

	Japan	Thailand
Building	16 buildings mentioned in "5-2 Basic Planning".	
Reinforcement of facilities related to marine cultivation and ploriferation	Water gate, sea water intake, drainage and transportation of sea water to the laboratory building.	
Outdoor facilities	Roads, parking lots, street lamps and drying place at the vicinity of the buildings to be provided by Japan.	Improvement of roads accessing the existing facilities.
Furnitures and equipment		Carpets, desks, chair, other office furnitures and equipment. Chemicals and other items for each laboratory.
Equipment and materials of various kinds	Transportation and installation of equipment and materials to be provided by Japan.	Transportation and installation of required materials and equipment besides those mentioned at left.
Fishery research vessel and observation materials and equipment	Research vessel and accompanying observation equipment and materials mentioned in section 5-2-7 of this chapter.	Arrangement to use the jetty of the Ban Pae Cold Storage Organization as mooring and supply wharf.
Transportation of materials and equipment	Packing, insurance, shipping, ocean transportation, landing in the port of Bangkok and land transportation of the equipment to be supplied by Japan. Delivery trip of the research vessel.	Custom clearance on the occasion of the landing, tax exemption measures and concurrent costs.

6-1-5 Cost beared by the Government of Thailand

1) Site Preparation and External Work		
1. Site preparation & existing road improvement		฿300,000.-
2. Gardening		฿200,000.-
	(Sub-total	฿500,000.-)
2) Basic Service Work		
1. Electric Power supply to the generation house (Electricity extension cost, etc.)		฿135,000.-
2. Installation of Antenna for Radio		฿80,000.-
3. Water Supply System to the site (already arranged the budget at Thai side)		(฿1,160,000.-)
	(Sub-total	฿215,000.-)
3) Furniture and Fixture		
1. Laboratory Materials		฿100,000.-
2. Furniture & Fittings		฿600,000.-
	(Sub-total	฿700,000.-)
4) Others		
1. Charges for application		฿50,000.-)
	(Sub-total	฿50,000.-)
	Total	฿1,465,000.-

6-2 Management Plan

6-2-1 Organization and Staffing

(1) Marine Fisheries Division is responsible for management of the Center, in accordance with policies and guidelines set force by Department of Fisheries (DOF), Thailand.

The operational results including data and information obtained through the investigation and research will be reported to the Division, and be utilized for

examination and formulation of the fisheries policies by Marine Fisheries Division, DOF.

The Center will carry out the activities in collaboration with relevant governmental organizations such as DOF's other research sections, provincial governments, National Environment Board and National Research Council. In addition, the Center will keep close contact and cooperation with private fisheries related organizations to execute the Project effectively.

(2) Following personnel will be required for carrying out various activities of the Center (Annex 8).

Name of Unit	No. of Staffs
1) Marine Resource Conservation & Management Unit	4 Fishery Biologists 6 Technicians
2) Marine Environment Research Unit	3 Fishery Biologists 2 Marine Chemist 1 Physical Oceanographer 4 Technicians
3) Fishing Gear Development Unit	1 fishing Gear Expert 1 Fishery Biologist 4 Technicians
4) Small-scale Fisheries Development Unit	2 Fishery Biologist 6 Technicians
5) Mariculture Development Unit	8 Fishery Biologist 8 Technicians
6) Management Unit (Training programme will be prepared and executed in this unit, in collaboration with other units. (See Annex 9))	5 Fishery Biologist
7) Fisheries Research Vessel	7 Crew (captain, chief engineer and five deck-hands.)
8) Others	Seasonal laborers will be employed on occasion.

Presently, there are 6 fishery researchers (3 biologists and 3 fishing gear experts), 6 technicians and 67 laborers in Rayong Marine Fisheries Station. These existing staffs will be consequently assigned to the Center. In addition, 18 fisheries researchers from each field covering fishery resource, marine environment, chemical analysis and mariculture will be transferred to the Center from Marine Fisheries Division in Bangkok. All researchers to be stationed to the Center should have sufficient knowledge and experiences in each field.

6-2-2 Maintenance Plan

The aforementioned staffs will take charge of the actual business of maintenance and management of this center. As for the maintenance and management of research equipment and materials of various kinds, the respective staffs will be responsible for them, and a statisfactory management is expected in this connection in view of the research record attained so far in this station.

As for special equipment and apparatuses, they will be selected in conformity with the criteria of minimum trouble and easy repair. In connection with items whose maintenance by the personnel of this Center is impossible, the problem can solved by asking for help of specialized firms from outside as occasion demands.

6-2-3 Operational Cost

The accessary cost for the Center's operation was estimated as described below. All operational cost will be borne by the budget of Department of Fisheries (DOF), Thailand. For the implementation of thie Project, DOF submitted the proposal for the Project to the National Economic and Social Development Board (NESDB) and is making an effort to obtain a budget through approval by the cabinet.

This Project was formulated in accordance with the reginal developmennt policy set forth in the National Development Plan. In this aspect, the Government of Thailand has a positive intension to the budget arrangement for this Project.

Based on the data obtained through the field survey, the annual operation and management cost was estimated as follows.

1) Salaries

฿7,910 x 7 persons x 12 months	฿664,440.-
฿4,400 x 18 persons x 12 months	฿950,400.-
฿2,440 x 55 persons x 12 months	฿1,610,400.-
Total	฿3,225,240.-

2) Maintenance

a) Initial year construction cost x 0.2 %	฿124,650.-
b) Subsequent years construction cost x 0.5 %	(฿311,620.-)
Subtotal for the initial year	฿124,650.-
Subtotal for the subsequent years	(฿311,620.-)

3) Electricity & Fuel

a) Electricity	
฿97,600/month x 12 months	฿1,171,200.-
b) Gas	
฿10/m^3 x 15 m^3/day x 300 days	฿45,000.-
c) General oil	
฿5/L x 17 L/hr x 240 hrs	฿20,400.-
Total	฿1,236,600.-

4) Operational Cost for Fisheries Research Vessel

This research vessel will be operated for about 7 days each month to conduct monthly marine observations at selected points for carrying out marine resource investigation and environmental research.

peration cost

a) Fuel & lubricant oil — ฿680,000.-/year

Operation hours

Main engine: 16h/d x 7 ds/mon = 112h/mon

Auxilliary engine: 24h/d x 3 ds/mon + 16h/d x 4 ds/mon = 136h/mon

Fuel consumption

Main engine: 170g/ps/h x 400ps x 0.8 x 1/0.85 x 112h/mon x 1l = 78,850 l

Auxilliary engine: 175g/ps/h x 60ps x 0.8 x 1/0.85 x 136h/mon x 1l = 14,790 l

Fuel cost

(78,850 + 14,790) x ฿7/l = ฿655,480/year

Lubricant oil

Main engine: 1g/ps/h x 400ps x 0.8 x 1/0.85 x 112h/mon x 1l = 464 l

Auxilliary engine: 1.5g/ps/h x 60ps x 0.8 x 1/0.85 x 136h/mon x 1l = 34 l

Lubricant oil cost

(464 + 34) x ฿43/l = ฿21,420/year

Other oil: hydraulic oil, etc. ฿3,000/year

b) Personnel — ฿348,000.-/year

Salaries for captain x 1 = 4,000

for chief eng. x 1 = 3,700

for crew x 5 = 12,500

20,200/month

x 12 = ฿242,400/year

Food ฿80/head/d x 12 x 10 d x 1l = ฿105,600/year

c) Consumable expenses

ice, vessel requisites, etc. ฿50,000.-/year

d) Maintenance cost ฿400,000.-/year

Total ฿1,478,000.-/year

5) Operation cost for vehicles etc.

a) Fuel ฿301,000.-

Vehicle

A: 4h x 50km/h x 60 day x 1/3 x ฿9/1 x 1

B: 4 x 80 x100 x 1/6 x 9 x 2

C: 4 x 80 x 30 x 1/3 x 9 x 1

D: 5 x 80 x 50 x 1/6 x 9 x 1

FRP boat

0.4l/hp/h x 55 hp x 2h x 100 day x ฿12 x 2

b) Repair ฿50,000.-

Total ฿351,000.-

6) Consumable Expense

a) Glassware ฿20,000.-

b) Reagent

c) Medical goods ฿10,000.-

d) Office materials ฿120,000.-

e) Miscellaneous ฿30,000.-

Total ฿180,000.-

Grand Total ฿7,305,490.-/year

(¥76,269,000.-)

7. PROJECT EVALUATION

Department of Fisheries (DOF), Thailand, launched the Marine Fisheries Development Plan, based on fisheries resource conservation and effective utilization, in order to meet the underlying problems on marine fishery. This Project was formulated as first step for realizing the Plan. Although the marine resource investigation in the Gulf of Thailand has been carried out by the research unit attached to Marine Fisheries Division in Bangkok, all area of the Gulf of Thailand cannot be covered by this unit alone due to the limited research equipment and the superannurated research vessels. In addition, since the laboratory of the Division in Bangkok is located distantly from the survey field, smooth data collection and analysis are difficult to be undertaken. By the successful implementation of this Project, the first regional marine fisheries development center having sufficient functions for the resource conservation and its utilization, will be established on the seaside of the Gulf of Thailand. Therefore, the establishment of the Center is desired for the promotion of marine fisheries development in Thailand.

The objective area under this Project is the eastern region of Thailand that is one of the integrated development region designated under the Fifth Five-Year National Socio-Economic Plan, and therefore, environmental contamination is expected in this region. The research function to be added anew to the Center will enable the assessment of the natural environment, and together with the experimental and extention functions the result will contribute to formurate the prompt and adequate countermeasure. In this respect, it is considered reasonable that the Project site is selected in the very region where rapid change in natural environment is expected.

The Project utilizes the existing facilities to attain the maximum efficiency with the minimum budget. This

utilization not only reduces the construction budget but also saves manpower employments by transferring the experienced researchers from Marine Fisheries Division, Bangkok. This effort for economization and effective project excution should be highly appreciated.

This Project is expected to generate the following direct benefits.

(1) Analysis of resource condition such as spawning season & ground and migration route, standing stock, potential productivity, and MSY, in the eastern region of the Gulf of Thailand, will be carried out with higher accurancy through more detailed research and data collection.

(2) The change of marine environment will be assessed more closely through regular and constant observation of marine environment in this region so as to take more prompt countermeasure. This aspect is especially effective for the prevension of water contamination in the adjacent area of industrial zone.

(3) The mariculture technonoly will be developed and extended to fishermen. New fisheries technology with mariculture is expected to develop and substitute the catch-only fishery.

(4) In cooperation with the resource investigation, mariculture development will enable more positive management of the resource.

(5) Through the educational services on fishery management and resource conservation to fishermen, their recognition for the future fishery will be improved. Furthermore, the Center's education services will contribute to the generation of leading personnels of Thai fishery.

Furthermore, the above bnefits will generate the following secondary benefits in cooperation with the upper governmental agencies.

(1) Data and informations on fisheries resources and marine environment will be further examined joitly by Marine Fisheries Division in Bangkok. These data and information will contribute to the formulation of appropriate measures for effective fisheries management in relation with resource management, and will also contribute to the formulation and execution of the industrial drain restriction and marine environmental standard by relevant organizations such as National Environmental Board and National Research Council.

(2) The systematic fisheries activities in the eastern coastal region in the Gulf of Thailand will be established under the appropriate fishery administration.

The fisheries of Thailand had achieved rapid development toward the increase of fish production. However, the fisheries resources were over-exploited due to the excessive fishing operation. In this situation, provision of the adequate fisheries resource management is urgently required. This Project which aims at fishery development in harmonization with environmental conservation was formulated timely, and has great significance for future development of Thai marine fisheries.

8. CONCLUSION AND RECOMMENDATION

The fishery of Thailand, which plays an important role not only on nutrient supply to the Thai people but also on the national economy, is required to achieve further development in the future.

Thai marine fisheries, however, is facing the problems on the exhaustion of the resources caused by the unlimited expansion of fishing efforts in the Gulf of Thailand and the reduction of fishing grounds caused by the establishment of 200 mile exclusive economic zone (EEZ) by neighboring countries. For further development of the marine fisheries sector, adequate resource management and its effective utilization are the major target to be achieved.

Department of Fisheries launched the Marine Fisheries Development Plan for achieving this target, and formulated this Project as the first step for the execution. This Project is in accordance with the policies of regional development, which is one of the objective of the National Socio-Economic Development Plan. Since all activities planned in this Project has been its sprouts in the present fishery sector in Thailand and the existing facilities is effectively utilized, the Project will have no particular problem on its implementation.

As shown in the PROJECT EVALUATION, the excution of this Project will generate the effects and benefits necessary for the further marine fisheries development in Thailand. Therefore, the economic assistance by the Japanese Government in the form of a grant to the Project will greatly contribute to the development of Thai marine fisheries.

For the effective implementation of the Project, the followings are recommended.

(1) Budgetary allocation required for the Project implementation should be confirmed. All the facilities and equipment to be provided should be effectively operated and maintained with careful manner.

(2) Coastal fisheries development should be promoted in close collaboration with local fishermen. The Center should positively keep communication with local fishermen for achievement of the Center's objectives such as the establishment of systematic fishing operation, the recovery of resources and the development of mariculture.

(3) Achievement of the benefits expected through the Center's activities requires accumulation of persistent effort of the relevant personnels as well as the relevant organizations. Their cooperation should be made.

(4) Appropriate fisheries resource management requires the basic innovation of fisheries system itself and execution of appropriate regulations on fishing operation in Thailand. The achievement of this target, therefore, is anticipated to cause a strained relation between fishermen and administrations. In order to achieve the real benefits through research activities of the Center, therefore, the positive support and strong administrative guidance by relevant upper governmental agencies are strongly recommended.