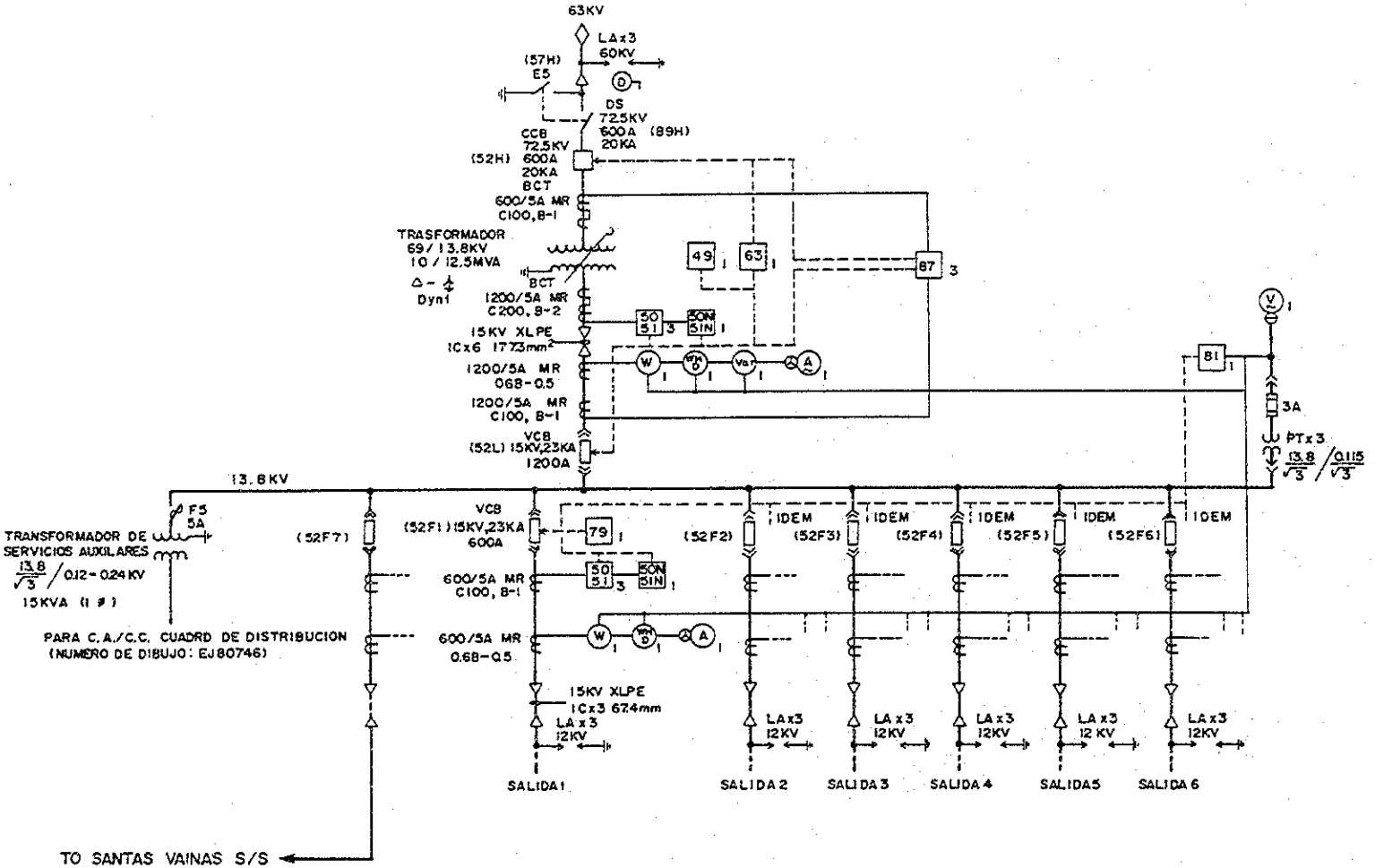
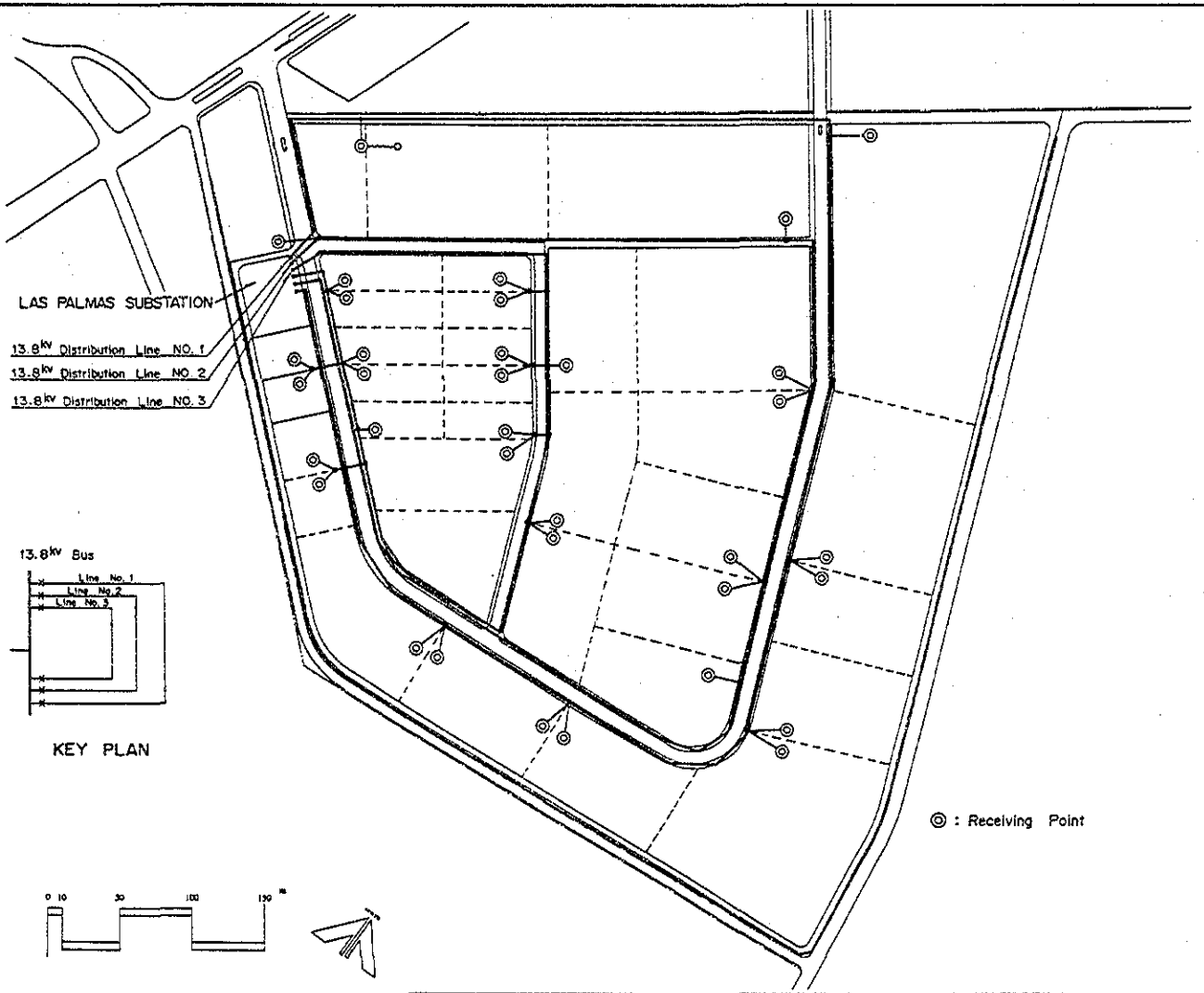
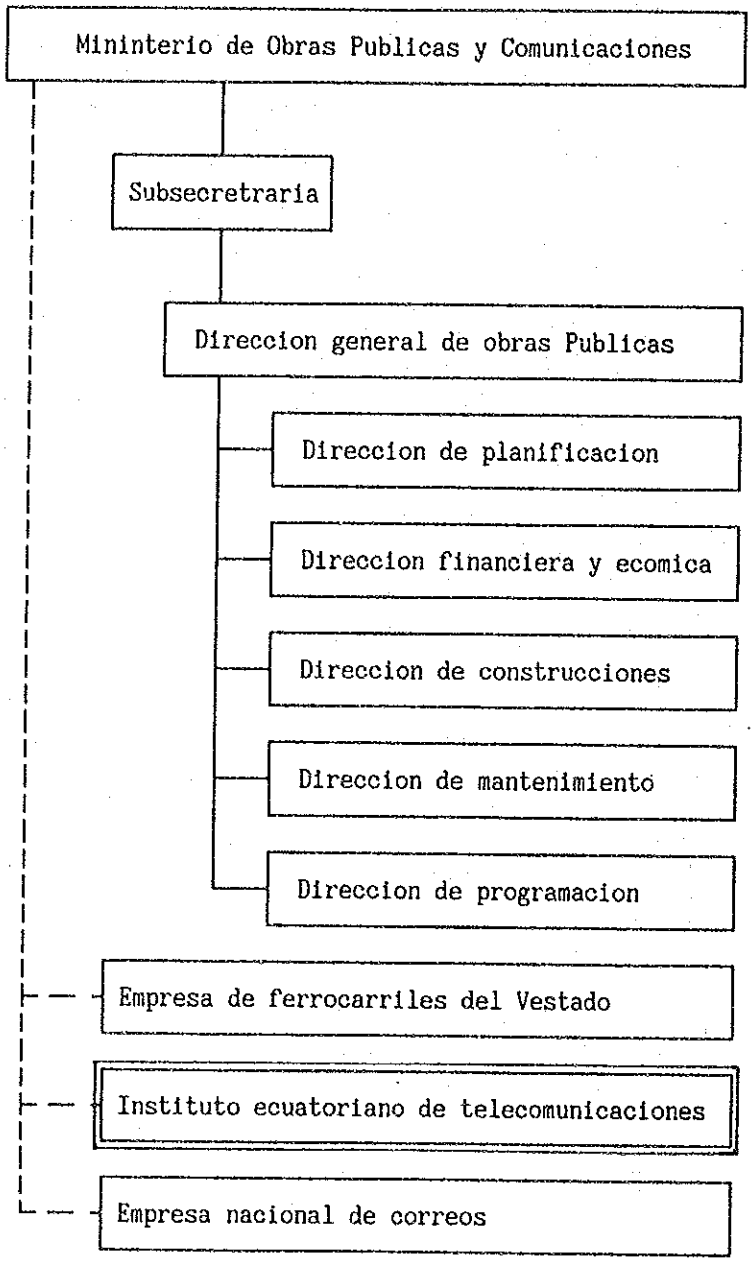


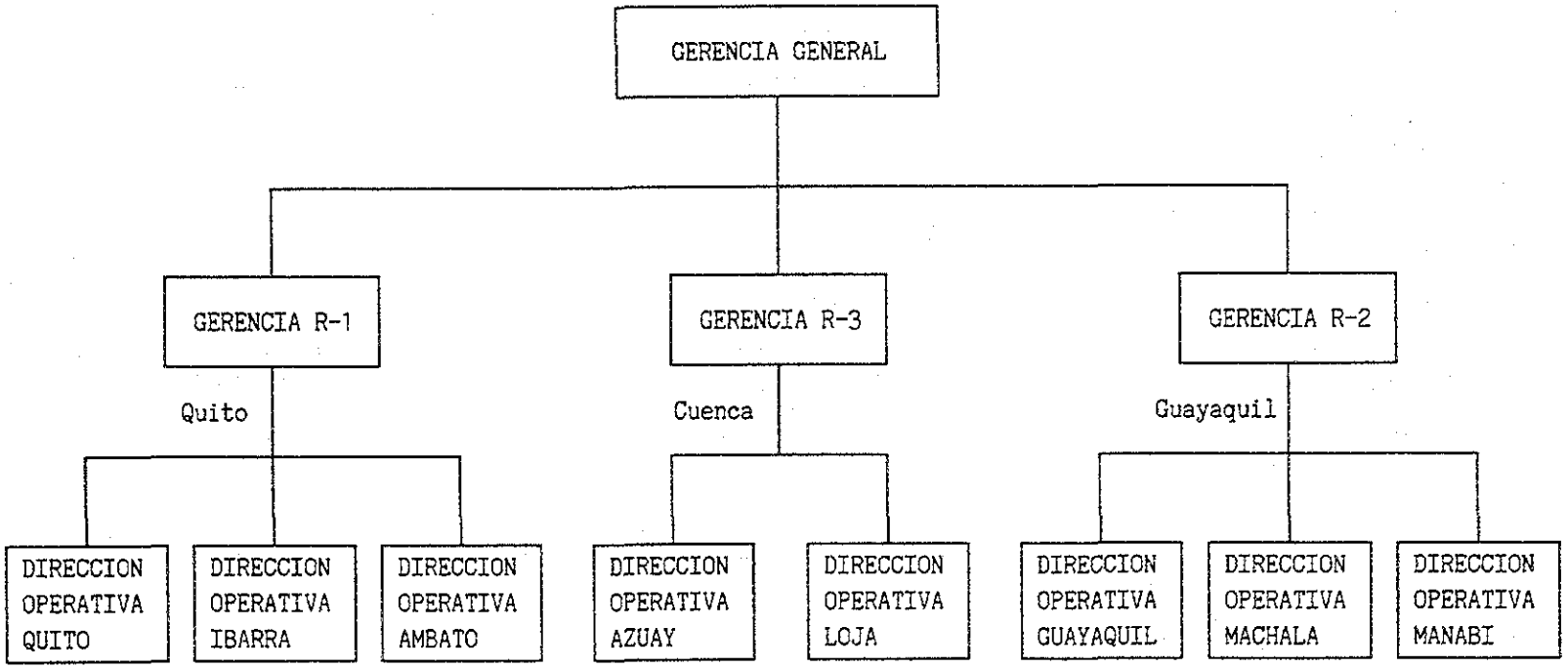
ESMERALDAS EXPORT PROCESSING ZONE DEVELOPMENT PROJECT	Fig. I-12 Single Line Diagram of Las Palmas Substation
JAPAN INTERNATIONAL COOPERATION AGENCY	



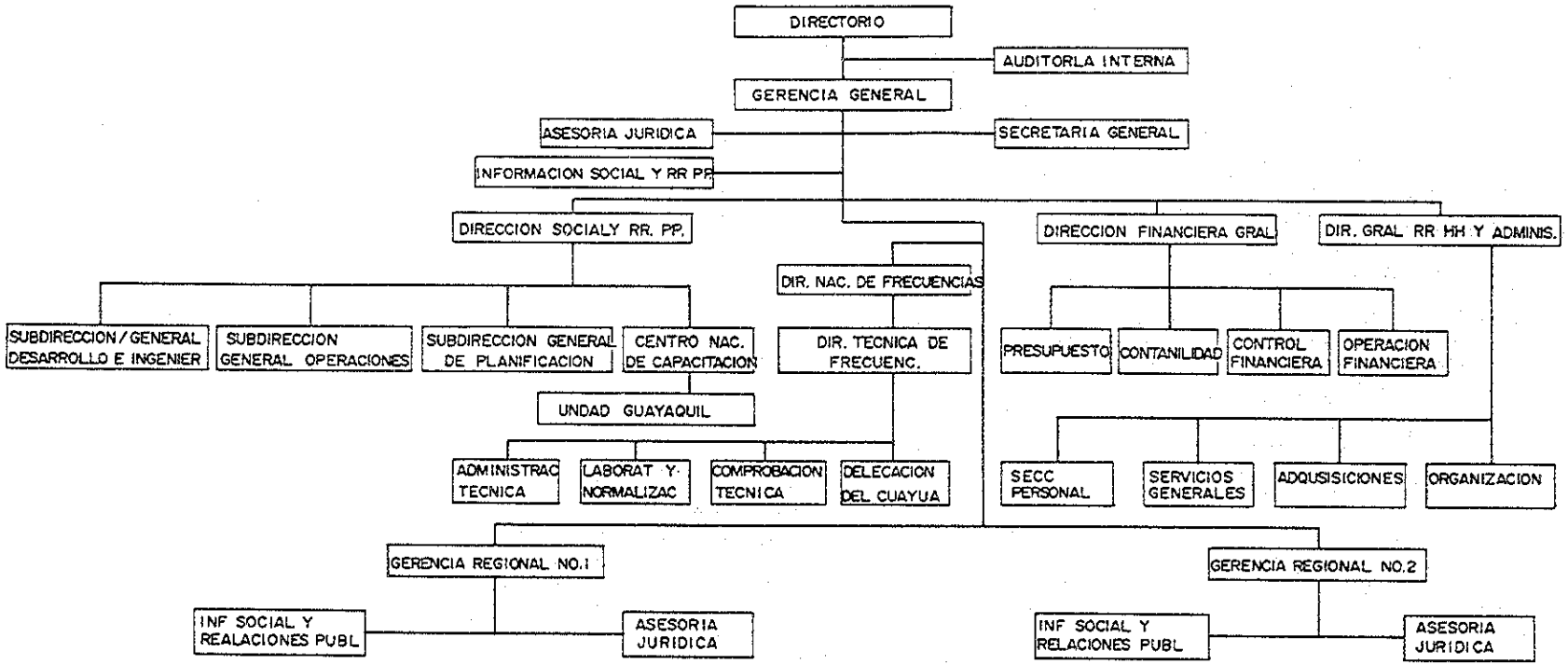
ESMERALDAS EXPORT PROCESSING ZONE DEVELOPMENT PROJECT	Fig. I-13
JAPAN INTERNATIONAL COOPERATION AGENCY	Route Map of 13.8 kV Distribution Lines



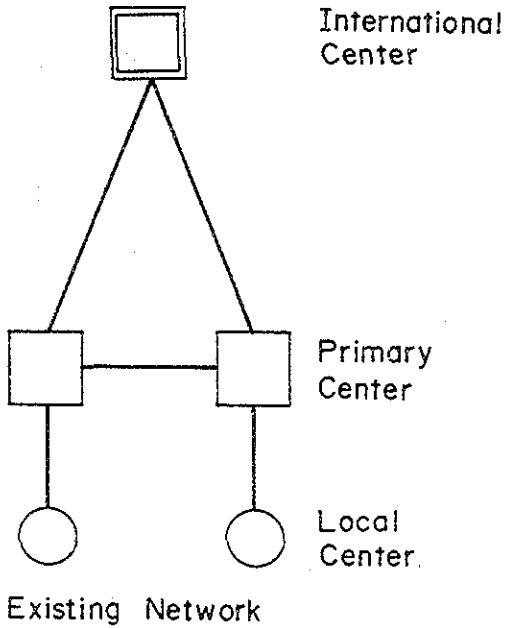
	ESMERALDAS EXPORT PROCESSING ZONE DEVELOPMENT PROJECT
	Fig. I-14 Institution of Ecuadorian Telecommunications
	JAPAN INTERNATIONAL COOPERATION AGENCY



ESMERALDAS EXPORT PROCESSING ZONE DEVELOPMENT PROJECT	Fig. I-15 Administrative Structure of Telecommunications Sector
JAPAN INTERNATIONAL COOPERATION AGENCY	

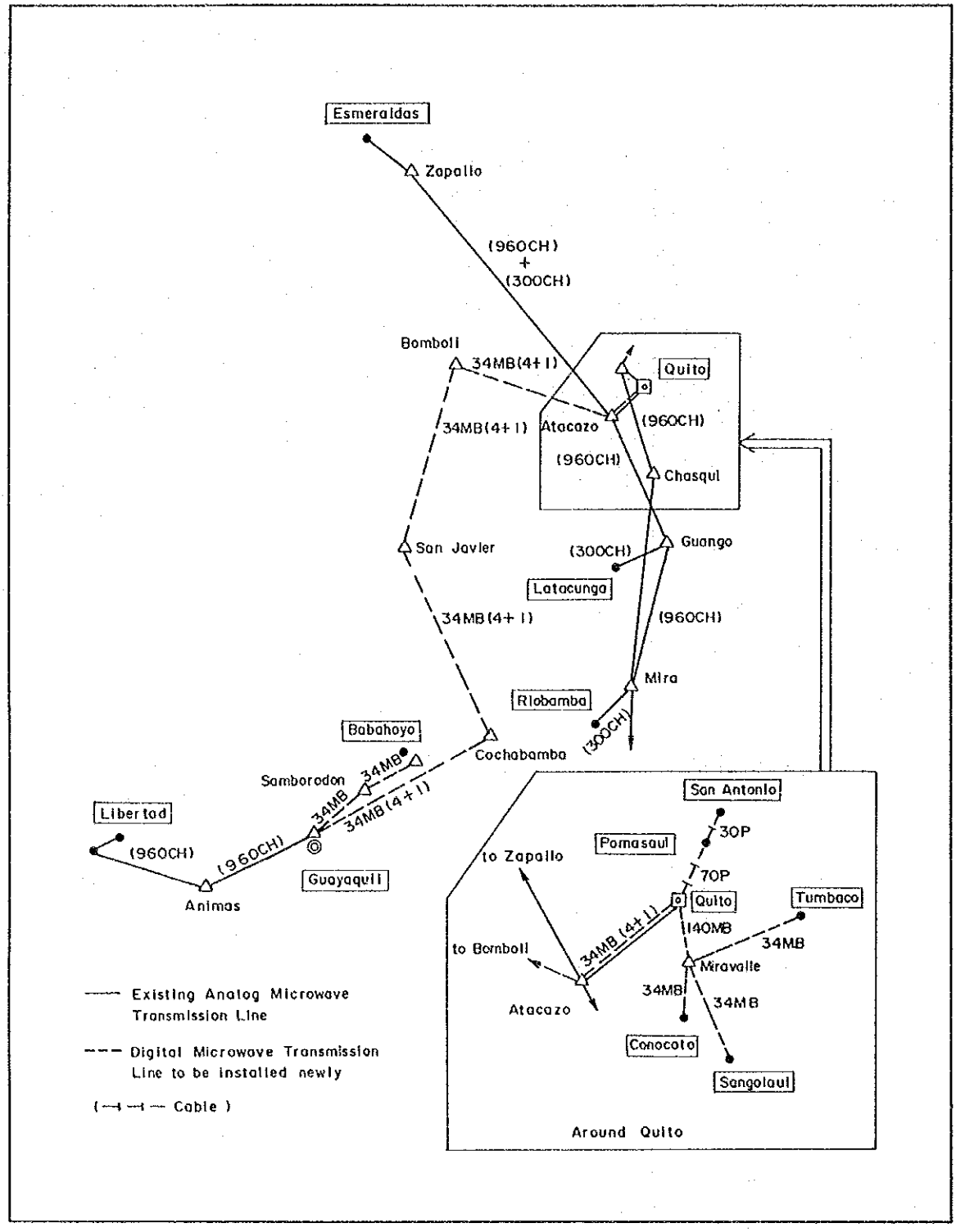


ESMERALDAS EXPORT PROCESSING ZONE DEVELOPMENT PROJECT	Fig. I-16
JAPAN INTERNATIONAL COOPERATION AGENCY	Organization of IETEL

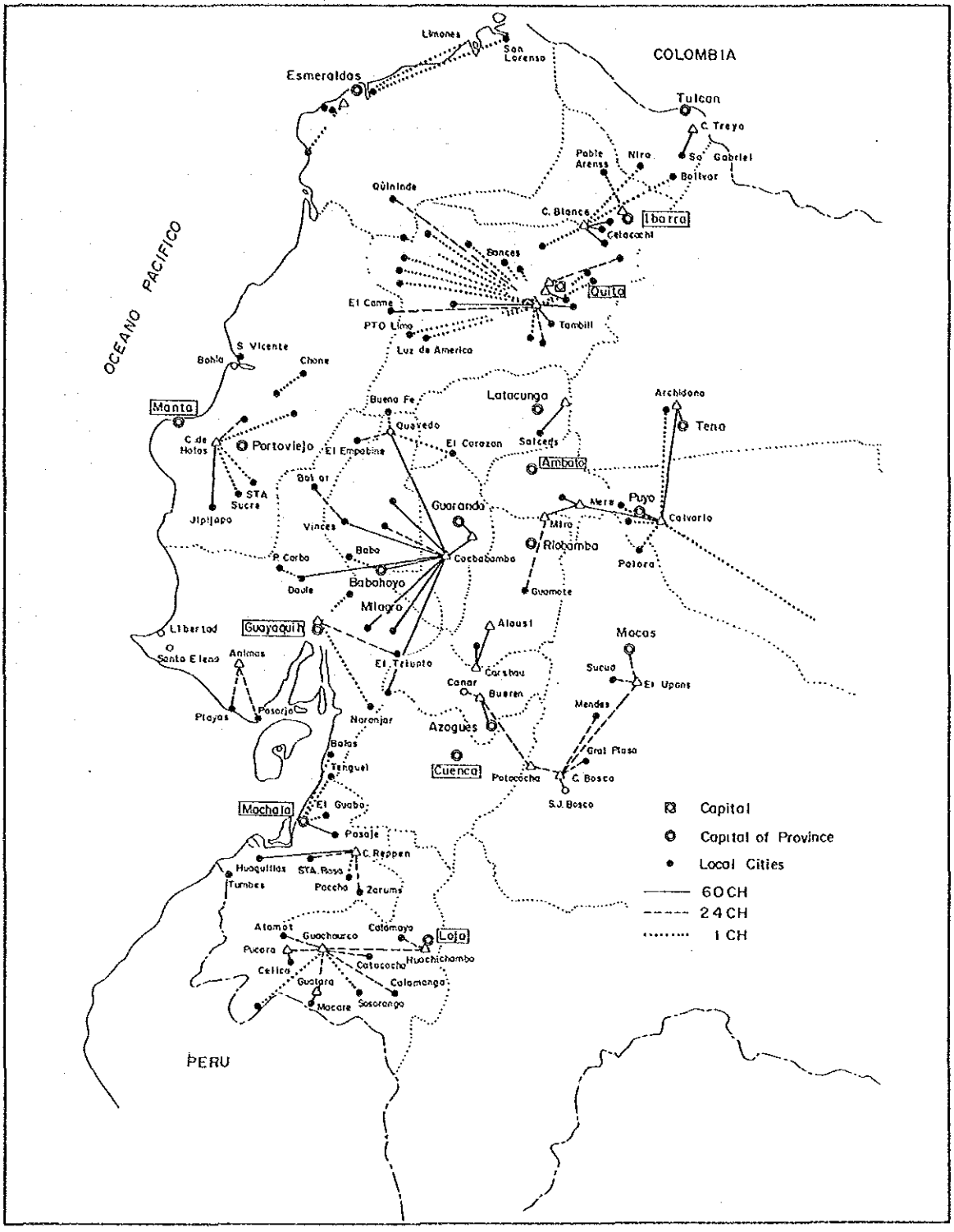


	At Present	
	Number of Offices	Name of Office
International Center	1	Quito
Secondary Center	--	--
Primary Center	3	Quito Guayaquil Cuenca

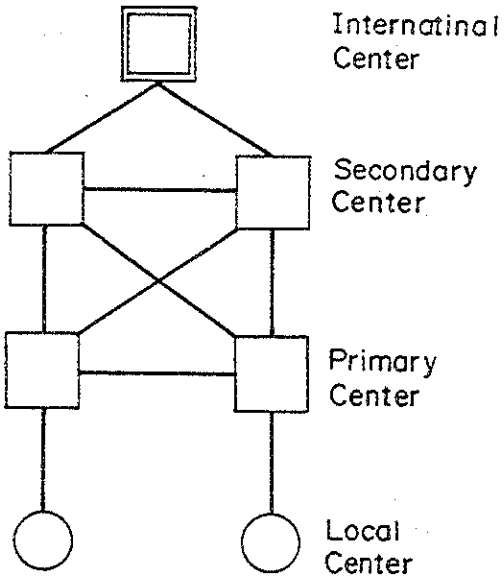
ESMERALDAS EXPORT PROCESSING ZONE DEVELOPMENT PROJECT	Fig. I-17 Existing Switching Hierarchy of Telephone Network
JAPAN INTERNATIONAL COOPERATION AGENCY	



	ESMERALDAS EXPORT PROCESSING ZONE DEVELOPMENT PROJECT
	Fig. I-18 Transmission Route of Microwave System
	JAPAN INTERNATIONAL COOPERATION AGENCY



	ESMERALDAS EXPORT PROCESSING ZONE DEVELOPMENT PROJECT
	Fig. I-19 Transmission Route of UHF/VHF/HF System
	JAPAN INTERNATIONAL COOPERATION AGENCY

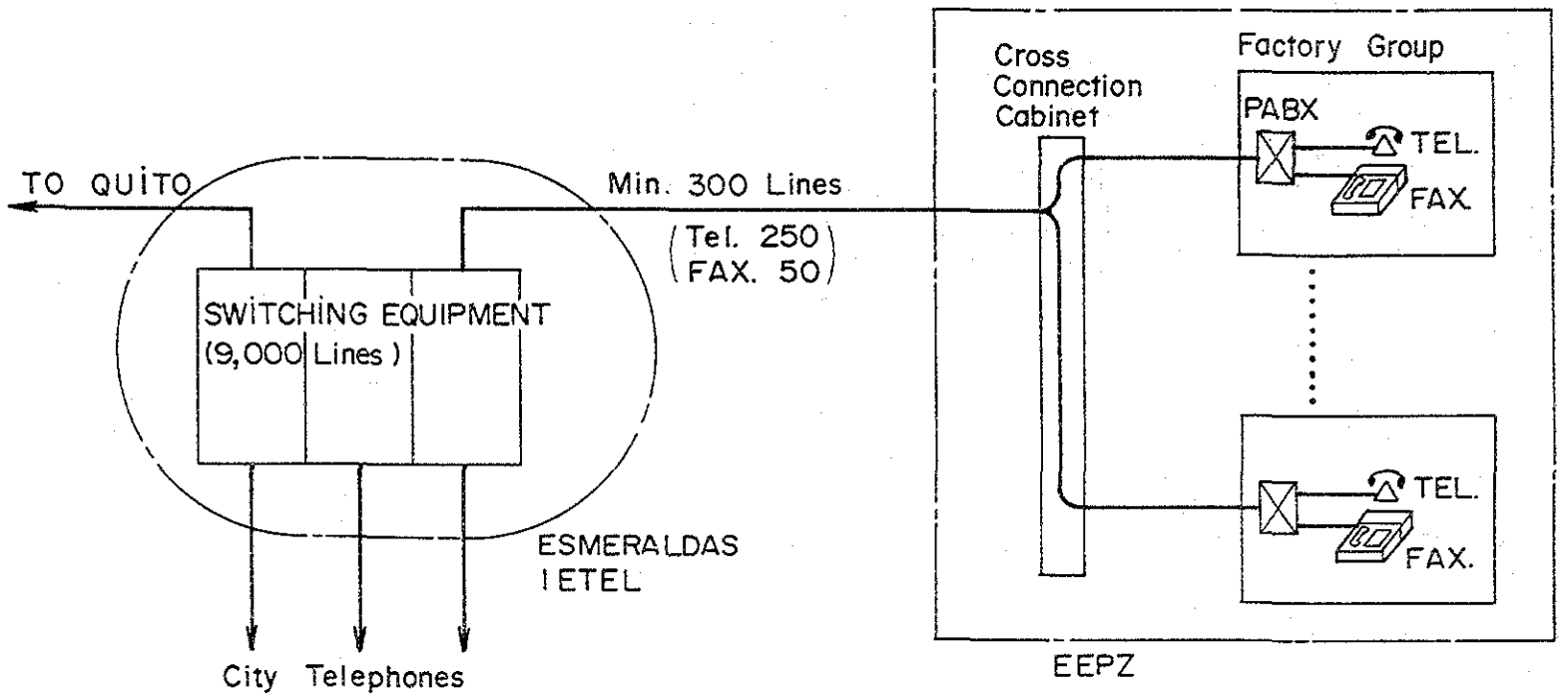


Future Network

	At the completion of 5-Year expansion plan	
	Number of Offices	Name of Office
International Center	1	Quito
Secondary Center	2	Quito Guayaquil
Primary Center	8	Quito Guayaquil Cuenca Ibarra Ambato Manta Machala Loja

Office Rank and Main Exchange Office

ESMERALDAS EXPORT PROCESSING ZONE DEVELOPMENT PROJECT	Fig. I-20 Network Structure of Three Level Hierarchy
JAPAN INTERNATIONAL COOPERATION AGENCY	



ESMERALDAS EXPORT PROCESSING ZONE DEVELOPMENT PROJECT	Fig. I-21 System Interconnection Diagram
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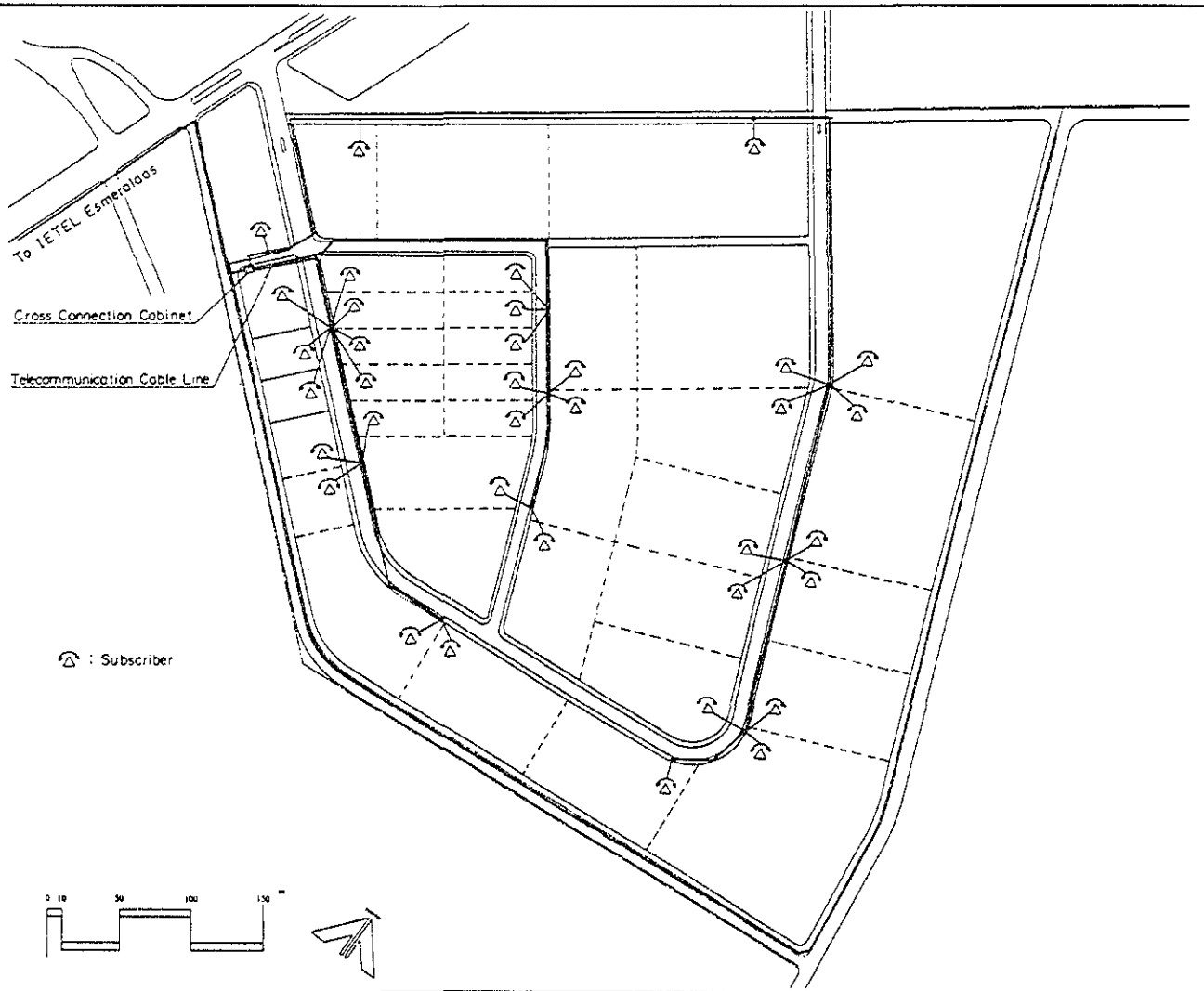

ESMERALDAS EXPORT PROCESSING ZONE DEVELOPMENT PROJECT	Fig. I-22 Cable Route Arrangement for Esmeraldas EPZ
JAPAN INTERNATIONAL COOPERATION AGENCY	

ANNEX J

WATER SUPPLY, SEWERAGE, DRAINAGE AND SOLID WASTE DISPOSAL

ANNEX-J

WATER SUPPLY, SEWERAGE, DRAINAGE AND SOLID WASTE DISPOSAL

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J.1 GENERAL

This Annex-J presents the result of study and planning on such infrastructures as water supply, sewerage, drainage and solid waste disposal to be required for the establishment of the Esmeraldas EPZ.

Since the area and scale of development of the Esmeraldas EPZ are relatively small, and the EPZ is located close to Esmeraldas city, it has been envisaged that the available facilities in the city, existing and planned, would be utilized to the maximum extent and that a harmonious relation with the city would be maintained through the establishment of the EPZ and the related infrastructures. The harmonious development of the infrastructures in the EPZ would enhance the amenity in the urban development in Esmeraldas.

In the first place, the water supply system to the Esmeraldas EPZ is studied in the context of the New Regional Water Supply System which is under construction in Esmeraldas city and peripheral areas. On the basis of estimate of water demand in the Esmeraldas EPZ, a preliminary design of water supply facilities for the EPZ will be worked out.

Secondly, the sewerage system in the EPZ is studied to maintain the wastewater quality to the appropriate standard in the EPZ. Wastewater treatment facilities, as well as pipe system, will be designed preliminarily in this context.

Thirdly, the drainage system of rainfall in the EPZ is studied to effectively drain water from the EPZ. Drain pipes and other related structures will be designed preliminarily.

Finally, the system of solid waste disposal from the EPZ is studied and its operation system will be proposed to efficiently operate the Esmeraldas EPZ.

J.2 WATER SUPPLY SYSTEM

J.2.1 Present Water Supply System in Esmeraldas

Present water supply system in Esmeraldas city was initially designed and constructed through 1962 to 1965. The system was designed for the target year 1985, and it comprised 3 reservation tanks of 2,500 m^3 each and distribution networks. Water demand per capita in the initial design was 140 l/h/d (liter per head per day) for the population of 36,000. The design capacity was estimated to increase to 203 l/h/d with an annual increase rate of 3 l/h/d towards 1985.

Capacity of the existing treatment plant is 800 m3. However, the present rate of paid-water is reported to be approximately 60%, and the rest (40%) is counted to be non-paid water. 60% out of the non-paid water is assumed to be irrational pipe connections and the rest is leakage in the distribution networks.

Water source of the system is the wells with a depth of 40 m on an average located on the sands in Esmeraldas river. At present only 6 out of 12 wells are in operation, because of trouble of the wells and break down of the appurtenant facilities. Consequently, water supply capacity is presently insufficient and water is partly sold privately by the tank lorry. The "Water Supply Enterprise" of Esmeraldas had a plan to construct 3 additional wells by the finance of BEDE (Banko Ecuatoriano de Desarrollo). The construction was scheduled to commence in May 1991.

Presently, there are 5 water distribution tanks at 3 locations on top of the hills in Esmeraldas city, having capacities of 1,000 m^3, 500 m^3 and 2,500 m^3 at respective locations.

For the improvement of water distribution system in Esmeraldas city, 800 million sucres were financed by BEDE. During the past three years, 500 million sucres were invested for the improvement of distribution system and approximately 70% of the improvement works has been completed by mid 1991.

Quality of water from the existing wells has much contents of Mn (Manganese) and Fe (Iron). In the treatment plant, efforts have been made to remove Mn and Fe contents by the aeration and chlorination, but the removal has not been so effective.

Major problems of the existing water supply system are, 1) deficit in water quantity, 2) water quality problems of the high contents of manganese and iron, and 3) irrational pipe connections and leakage.

Present water supply system in Esmeraldas city is managed by Water Supply Enterprise with the water tariff as follows:

a)	Domestic use	58 sucres/m^3 + (15 to 20%) for O&M cost
b)	Commercial use	80 sucres/m^3 + (15 to 20%) for O&M cost
c)	Industrial use	120 sucres/m^3 + (15 to 20%) for O&M cost

J.2.2 Future Plan of Water Supply System in Esmeraldas

IEOS (Instituto Ecuatoriano de Obras Sanitarias) planned to work out a "New Regional Water Supply System" for Esmeraldas city and peripheral areas. With the completion of the design for this new system, IEOS started construction work in 1988. It is scheduled to be completed by the end of 1992. This new project aims at improvement and development of the water supply system quantitatively and qualitatively.

Under the new system, water is taken from Esmeraldas river at San. Mateo village. The main structures for the system are intake facility, treatment plant, pump station, conduction pipes, pipeline network and reservation tanks. The construction of these structures has been completed for more than 80% as of March 1990.

The capacities and dimensions of the facilities under the new system are summarized as follows:

a)	Intake	2,236 l/s
b)	Conduction Pipe	2,050 l/s
c)	Treatment Plant	2,050 l/s
d)	Intake Pipeline	D = 1,200 mm
e)	Pipeline (San. Mateo - junction)	D = 900 mm
f)	Pipeline (junction - Esmeraldas)	D = 900 mm
g)	Discharge (junction - Esmeraldas)	Q = 1.1 m^3/s
h)	Length (T/P - Tank in Esmeraldas)	L = 1.4 km
i)	Tank in Esmeraldas (3 tanks)	2,000 m^3, 500 m^3, 500 m^3

The construction work is financed by CAF and the Ecuadorian Government (US$8.5 million and 7,500 million sucres respectively) for the treatment plant and appurtenant facilities.

J.2.3 Water Supply System Proposed for Esmeraldas EPZ

Water supply system for the Esmeraldas EPZ has been planned, starting with the analysis and estimate of water demand for industrial and other uses. On the basis of the demand forecast, the water storage tank and water supply pipe systems for the EPZ have been worked out.

1) Water demand

Daily Water Demand

Industrial water demand has been calculated by the unit water demand per day per hectare by each category of industries, as shown in Table J-1. It is estimated that the industrial water demand will amount to approximately 2,460 m^3/day. This volume of water can be conducted through the existing pipelines of 150 mm and 200 mm in diameter located in the vicinity of the Esmeraldas EPZ area.

As for the water for public utility use, 10 m^3/day will be required, judging from the records on the past water demand in Ecuador. For domestic water use, 13 m^3/day will be required on the basis of 100 liter per head per working time of 10 hours as an unit water demand.

Meanwhile, water demand for fire extinguish has been estimated to be 30 m^3, on the basis of 30 minutes for fire fighting by using 1.0 m^3/min from a fire hydrant.

Total water demand at the Esmeraldas EPZ is summarized hereunder. This water demand will be defined as the maximum daily water demand.

Water Demand in Esmeraldas EPZ

Water Use	Volume (m^3/day)
Industrial Use	2,464
Public Utility, Domestic Use, and Others	23
Fire Extinguish	30
Total	2,517

Maximum Hourly Rate of Supply

Maximum hourly rate of supply has been calculated in the following manner:

$$(2{,}464\ m^3/d + 23\ m^3/d) / 10\ hrs = 248.6\ m^3/hr$$
$$248.6\ m^3/hr \times 1.3 + 30\ m^3 = 353.2\ m^3/hr$$
$$= 0.098\ m^3/sec$$

where,
Time fluctuation = 1.3
Fire extinguish = $30\ m^3$

2) Water supply facilities

Water Supply Pipes

Minimum water pressure at the end of the supply network should be 1.5 kg/cm^2 in view of the case of fire occurrence. Through computation by means of "Hardy-Cross" method, pipe size of the network should be 150 mm in diameter on an average for main pipes along the road. The branch pipes from the main pipe to each factory will be set at 75 mm. Plan of water supply network, together with valves and hydrants, is shown in Figure J-1.

With respect to the pipe material, Ductile iron pipe and PVC pipe have been compared. In view of the facts that PVC pipes are not commonly used for larger pipe size (150 mm in diameter, as proposed above) for reason of durability against stress, that Ductile pipes are generally used in Esmeraldas, and that electric corrosion will not occur in the project area, Ductile iron pipe will be proposed to be applied for the water supply system.

Water Storage Tank

The water from the "New Regional Water Supply System", which is scheduled to complete by the end of 1992, will be supplied to the Esmeraldas EPZ. The water storage is to be constructed in EPZ to secure water supply to industries. The capacity for water storage is estimated on the basis of 5 to 6 hours retention time, which is practical and economical for industrial parks and/or free zones. Consequently, the capacity of storage tank will be determined to be 2,000 m^3. In the event that a certain industry requires a larger volume of water, the industry should additionally install its proper storage tank of smaller size depending on the requirement.

Water storage tank of 2,000 m^3 is proposed to be constructed at one time (without phasing out into 1,000 m^3 x 2 units), in view of the facts that the phased-out construction cost would be much higher and that the water could be supplied directly from the city in the case of

emergency and maintenance work.

Two alternative systems of storage tank have been compared: pressure tank or water tower. The pressure tank will satisfactorily give pressure of at least 1.5 kg/cm^2 at the end of pipe network. On the other hand, construction of water tower (about 20~25 m in height) will be much more costly due to geotechnical conditions as noted in Annex G.3-G.5, as well as to the pumps to be installed at the foot of the tower. Consequently, it is proposed to construct pressure tank for the Esmeraldas EPZ.

Appurtenant facilities at the storage tank, such as pumps and pressure tank, will be required in the following manner:

Pump	125 mm x 18.5 kW x 3 units
Pressure tank	12 m^3

J.3 SEWERAGE SYSTEM

J.3.1 Present Sewerage System in Esmeraldas

Existing sewerage system in Esmeraldas City was constructed in the period from 1965 to 1978 as an "separate system". Since then, minor extension and rehabilitation works have been executed gradually. Nevertheless, the system has been actually functioning as the "combined system". It is because many pipes have been irrationally connected due to insufficient provision of facilities and lack of proper maintenance works.

At present, the rate of service of the sewerage system is reported to be approximately 60%. However, it is reported that the wastewater for more than 50% of the city has been directly discharged into the Esmeraldas river due to irrational connection of the sewer pipes to the drainage pipes.

The existing sewage system in the Esmeraldas city is provided with the pipes of 200 to 1,000 mm. The pumping station is located near the port area at the west end of the city, to discharge wastewater to the sea through a submarine pipe. The submarine pipe extends approximately 1.5 km offshore.

At the pumping station, 4 pumps of 500 mm in diameter, including one extra pump, have been installed. The pump has a discharge rate of 240 l/s and a pump head of 24 m. Present discharge rate from the city to the pumping station is assumed to be 760 l/sec.

Capacity of the chamber in the pumping station is 65 m^3. This capacity holds retention time for more than 2 hours in the dry season, and reportedly 5 to 10 minutes in the wet season due to the flow of a large volume of rain water into the pipes.

The major problems of the sewerage system in Esmeraldas, at present, are:

a) Insufficient provision of pipes in the area, both drainage and sewage pipes, in addition to the irrational connection of the pipes,

b) Deficient capacity and maintenance work of the pumping station, together with lack of facilities,

c) Deficient maintenance work, pipes being stuck with sand conducted by rain water, and

d) Irrational discharge of more than 50% of the domestic wastewater and rain water into the Esmeraldas river, creating water pollution in the river.

There is no future improvement plan scheduled for the sewerage system in Esmeraldas city. However, in view of the present condition that the wastewater is discharged directly into the Esmeraldas river and the sea, it will be necessary to rehabilitate and expand the present sewerage system. The requirement for improvement will be more acute as the increased water supply under the New Regional Water Supply System will bring about larger quantity of wastewater to the city.

J.3.2 Wastewater System Proposed for Esmeraldas EPZ

Wastewater system for the Esmeraldas EPZ has been planned, starting with the analysis of quantity and quality of wastewater. On the basis of the analysis and estimate, the wastewater treatment facilities have been proposed for the EPZ.

1) Quantity of wastewater

Industrial Wastewater

Mean daily water use in the Esmeraldas EPZ has been estimated to be 2,464 m^3/day. Wastewater discharge rate is computed to be 2,217 m^3/day on the basis of the industrial wastewater discharge rate of 0.9. On the other hand, mean daily water use by weighted average is 148 m^3/day/ha, and then mean daily wastewater discharge rate becomes 133 m^3/day/ha. The maximum hourly wastewater discharge rate will be 0.004802 m^3/sec/ha on the basis of the time fluctuation factor of 1.3. The daily water use and pollutant load at the Esmeraldas EPZ is estimated as shown in Table J-2.

Ground Water

Ground water intrusion, in accordance with the criteria applied by IEOS, is assumed to be 14 m^3/day/ha (0.000162 m3/sec/ha), or 234 m^3/day. This value appears to be considerably large. However, in view of the location of EPZ beside the sea and sewage pipes to be install predominantly below the ground water level in the area, this volume has been taken in estimating the ground water intrusion.

Domestic Wastewater

Domestic wastewater is defined as the wastewater generated by office workers in administration and service building, excluding the workers in the factories. Domestic wastewater is estimated to be 9 m^3/day on the basis of 100 l/head/10 hrs as an unit water demand, 130 office workers in total and 70% of discharge rate.

Wastewater by Other Water Use

Wastewater by other water use is defined as the wastewater generated by temporal visitors, public use, fire extinguish and unaccounted water use. It is estimated to be 7 m^3/day or 70% of 10 m^3/day water supply for other water use.

Total Wastewater Quantity

On the basis of the above estimate, the total wastewater in the Esmeraldas EPZ is estimated to be 2,467 m^3/day as summarized hereunder. In designing the facilities for wastewater treatment, this volume will be set as the maximum daily wastewater, because there is little difference between mean daily wastewater and maximum daily wastewater in quantity.

Wastewater in Esmeraldas EPZ

	Volume (m^3/day)
Industrial wastewater	2,217
Groundwater	234
Domestic wastewater	9
Wastewater of other water use	7
Total	2,467

2) Quality of wastewater

On the basis of the unit pollutant load show in Table J-2, pollutant loads by BOD and SS are estimated as follows:

16,000 l x 180 mg/l x 10^(-6) = 2.88 kg/day (3 kg/day)
3 kg/day + 1,362 kg/day = 1,365 kg/day (BOD)

16,000 l x 160 mg/l x 10^(-6) = 2.56 kg/day (3 kg/day)
3 kg/day + 764 kg/day = 767 kg/day (SS)

Average BOD and SS concentrations of affluent water are estimated to be 553 mg/l and 311 mg/l, respectively. These values are comparatively similar to the concentration of the wastewater in the existing pumping station. However, existing method of wastewater disposal is the direct discharge to the sea and additional pollutant load will certainly worsen the

water environment in the sea. Consequently, the wastewater will be treated in the Esmeraldas EPZ. It is proposed that the effluent water quality will be set at 55 mg/l and 70 mg/l for BOD and SS, respectively, in the light of the treatment efficiency of the standard activated sludge method as described hereinafter.

It is noted additionally that the treatment of toxic materials and heavy metals should be executed by each factory that generates such materials.

3) Wastewater facilities

Treatment Plant

In the selection of treatment method, i) oxidation pond method, ii) oxidation ditch method and iii) standard activated sludge method have been comparatively studied as alternative treatment methods. Consequently, the activated sludge method is adopted as the most appropriate method, mainly for reason that the other two systems world require larger area within the restricted area. By adopting the standard activated sludge method, it is estimated that approximately 1,200 m^2 of land will be required for the construction site of the wastewater treatment plan.

It should be noted that there are some limitations in adopting this activated sludge method, including:

i) Toxic materials and heavy metals generated by factories should be treated by each factory.

ii) The treatment plant will basically treat biological substances including some facilities for chlorination, pH control, etc.

iii) Dewatering will not be taken into consideration in the treatment system. Condensed sludge should be transported by vacuum car to the sludge disposal site to be located apart from the EPZ.

In the proposed system, affluent water quantity should be controlled by the equalization tank against fluctuation. This tank will also be effective for the control of effluent water quantity.

The layout of the proposed treatment plant at the Esmeraldas EPZ is schematically illustrated in Figure J-2.

Condensed slurry by the thickner will be carried by a vacuum car to a disposal site to be prepared for this project near the disposal site in San Mateo or at other appropriate site.

Pipes and Manholes

Pipes for wastewater disposal to be laid in the Esmeraldas EPZ are proposed in the plan and profile in Figure J-3 to J-7. The pipes to be installed are 250 mm and 300 mm in diameter. The pipe material will be reinforced concrete pipe taking the durability into account. The maximum earth covering in the down stream will be 3.5 m and it is below the groundwater level (GL-2.5 m). Consequently, firm foundation will inevitably be necessary. In this design, concrete foundation will be designed throughout the pipe line extension.

With respect to the discharge rate of the sewage pipe, it is not computable at this stage when the type and location of industries are yet unknown. However, according to IEOS design criteria, the minimum water velocity should be more than 0.6 m/s, and the proposed sewage pipe will satisfy this requirement. The proposed reinforced concrete pipe of 250 mm in diameter is the minimum size defined under IEOS design criteria.

Transportation of Treated Water

Treated water from the treatment plant will be conducted to the existing pumping station located behind the Port Authority office, through the reinforced concrete pipe of 250 mm in diameter, and will be discharged to the sea together with domestic wastewater from Esmeraldas city. The chamber of the existing pumping station has a capacity of approximately 270 m^3 and is available to receive this additional wastewater from the treatment plant.

The profiles of the pipes are shown in Figure J-8.

Use of Existing Pumping Station

The treated water from the treatment plant is 2,467 m^3/day (or 37 l/sec as a maximum with 24 hours detention), and it is much smaller than the existing maximum discharge rate from the city of 760 l/sec. On the basis of the study on the pumping capacity and the chamber capacity, it is obvious that there is no problem in discharging this additional wastewater from the Esmeraldas EPZ.

J.4 DRAINAGE SYSTEM

J.4.1 Present Drainage System in Esmeraldas

As noted previously, the present drainage system is operated practically as a "Combined System". Drainage pipes are provided for approximately two thirds of the city area.

Many of the drainage pipes in the city are stuck with sand due to heavy rain and subsequent discharge of muddy water runoff from the mountain behind the city.

The drain water from the pipes are discharged directly into the Esmeraldas river, including some sewage water, bringing about high turbidity in the river water.

J.4.2 Drainage System Proposed for Esmeraldas EPZ

1) Runoff discharge

Estimate of runoff discharge has been conducted by means of the rational formula as shown below:

$$Q = 1/360 * C * I * A$$

where,

C	=	Coefficient of discharge = 0.7	(non dimension)
I	=	Rainfall intensity	(mm/hour)
A	=	Area	(hectare)
Q	=	Runoff discharge	(m^3/sec)

By referring to the IEOS data, following parameter will be used in the estimate:

$$I = a / (t + b)$$

where,

a	=	3817	(constant parameter)
b	=	41.11	(constant parameter)
t	=	15 (min)	(rainfall duration)

For the calculation of velocity, Manning formula will be adopted, and it is estimated as follows:

$$Q = A * V$$
$$V = 1/n * R^{(2/3)} * I^{(1/2)}$$

where,

n	=	0.014	(coefficient of roughness)
R	=	Hydraulic radius	(m)
I	=	Gradient of water surface	(= gradient of pipes)

Minimum velocity will be 0.8 m/sec for 80% water depth and 0.6 m/sec for less water quantity. The results of estimate is summarized in Table J-3.

2) Drainage facilities

Drainage Pipes

Drainage pipes will be a closed conduit, and concrete pipes are preferable economically. However, invert elevation of the pipes will be much below the sea water level. Therefore, box culvert or U-drain with the cap will be adopted in place of the pipes at the upstream portion of the drainage pipe network. The box culvert or U-drain will be installed on both side of the road to be constructed in the EPZ. Meanwhile, for the installation in the factory lots, pipes will be used for reasons that their installation is easy and that concrete casting and form work in the deep ditch is comparatively difficult. The size of box culvert or U-drain will range from 240 mm x 240 mm to 600 mm x 600 mm. On the other hand, pipes will range from 600 mm to 1,100 mm.

Plan and profiles of the drainage system in the Esmeraldas EPZ are shown in Figure J-9 to J-18.

Other Structures

Flap gates will be installed at the outlet to the sea to prevent backwater at the high tide. Size of the flap gates are 700 mm, 900 mm and 1,100 mm in diameter, respectively.

Manhole will be designed in the same type as the one currently used by IEOS, judging from the easiness in construction and lower construction cost.

As for the construction of house inlets for sewerage and drainage system, one inlet for each system will be provided, so that each factory will provide conduction pipes from their

buildings to the inlets concerned.

The preliminary design of such structures as flap gates, manholes, house and street inlets, etc. is illustrated in Figure J-19 to J-21.

J.5 SOLID WASTE DISPOSAL SYSTEM

J.5.1 Present Solid Waste Disposal System in Esmeraldas

Solid waste disposal system in Esmeraldas city has been operated and maintained by the so called "union" under the municipal office. Due to continuous strikes held by the union members, the disposal system of the city was once held up for more than a year and the municipal office has been handling the work in place of the "union". The strikes, however, were over in mid 1991, and the "union" resumed to be in charge of the solid waste disposal in Esmeraldas.

The collection system of the solid waste has been applied in the following manner:

Present Solid Waste Disposal System

	Municipal	Government
a) No. of vehicles (5 ton truck)	6	9
b) Collecting period	every day	every day
c) Location of the disposal site	10 km (San Mateo)	1 km (in the city)
d) Workers	145	94
e) Method of Treatment	Dumping and incinerating	Dumping and soil covering

It is reported that the major problems of the existing solid waste disposal system are smelling, generation of insects, lack of vehicles and collecting instruments.

J.5.2 Solid Waste disposal System Proposed for Esmeraldas EPZ

1) Solid waste quantity

Weight of solid waste disposal for each type of industries has been estimated on the basis of unit weight of combustible and incombustible solid materials, as shown in Table J-4. Total weight of combustible and incombustible solid materials is estimated to be 4.0 ton and 6.0 ton, respectively.

2) Method of disposal

Two alternative methods of solid waste disposal have been studied. One is to provide an incinerator in the EPZ and the other is to provide the service of disposing to outer area from

the EPZ. In view of the facts that appropriate disposal sites can be found easily within the short range of less than 10 km from Esmeraldas and that the present solid waste of the city is disposed at the disposal site in the vicinity of the city, it is proposed that the service of disposing to outer area will be adopted for the Esmeraldas EPZ.

3) Operation method

Operation method of the proposed services will be as follows:

Vehicle for collection

Combustible and incombustible solid waste will be collected by collecting vehicles (5 tons), 3-times a day at most. For the factories which generate large volume of solid wastes, container will be used for collection. In order to meet this requirement, semitrailer (14 tons) and 8-ton truck crane will be provided as required. The container itself will be provided by each factory. The vehicles will be operated 5 times a week. One vehicle for each type will be provided as stand-by.

Method of Loading

Solid waste will be loaded by manual in case of less volume of solid waste. On the other hand, in case of greater volume of generation of solid waste, truck crane will be used for loading the container.

Man-power

For operation of the vehicle and collection of solid waste, following man-power will be required:

Operator of collecting vehicle	1 pers./day
Assistant	2 pers./day

Treatment after dumping

The combustible solid wastes collected and transported to the disposal site will be incinerated in the conventional incinerator. This incinerator should be a small type small and made of fire proof bricks prepared at the corner of the disposal site. Generated ashes should be dumped on the ground together with incombustible solid wastes and compacted by a bull-dozer or tractor shovel. After the compaction of solid wastes, soil should be filled on them to conserve sanitary environment. The land filling should be done before the dumped and compacted soils grow 3 m in height to prevent from smelling and generation of insects and animals. The thickness of land filling should 30 cm at once.

4) Provision of disposal site

The location of the disposal site will be found near San Mateo or at appropriate site within the distance of 10 km from the EPZ.

The proposed disposal site is to be provided with the following facilities and structures:

a) The area should consist of approximately 2 ha,

b) The site should be excavated and adjusted by a tractor shovel to figure out V-shaped valley with a depth of approximately 20 m.

c) Drain ditch should be provided around the site

d) At the end of the site, small scale incinerator should be provided.

5) Provision of monitoring system

For the operation and maintenance work, it is important to control the whole disposal system. In this regard monitoring system will be adopted. The followings are the main items recommended to be monitored:

a) Monitor volume and weight of solid wastes at a time of collection.

b) Monitor type of solids and slurry at a time of collection.

c) Monitor of accumulation of solid wastes at the disposal site once a month

d) Monitor conditions of wind direction, rainfall, duration of smoke spreading, smelling, noise, etc. every day

e) Monitor water quality of the stream water in the vicinity of the disposal site as required.

Table J-1 INDUSTRIAL WATER DEMEND

Category	Unit Water Demand (m3/day/ha) /1	Area for Each Lot (Ha)	Water Demand Per Day (m3/day)
S - 1 Food (Sea Food)	294	0.21	61.74
2 Food	436	0.15	65.40
3 Apparel (Label)	178	0.19	33.82
4 Furniture	29	0.15	4.35
5 Apparel (Blanket)	306	0.18	55.08
6 Apparel	50	0.15	7.50
7 Apparel	50	0.17	8.50
8 Apparel	50	0.15	7.50
9 Electric Lamp	201	0.15	30.15
10 Chemical (Cosmetic)	98	0.15	14.70
11 Apparel	50	0.16	8.00
12 Apparel	50	0.16	8.00
M - 1 Food	294	0.51	149.94
2 Apparel	50	0.60	30.00
3 Apparel (Sport Wear)	38	0.60	22.80
4 Apparel	50	0.60	30.00
5 Chemical (Plastic Film)	447	0.60	268.20
6 Chemical (Plastic Shoes)	230	0.60	138.00
7 Chemical (Cosmetic)	98	0.54	52.92
8 Apparel	50	0.57	28.50
9 Electric Control Device	84	0.58	48.72
10 Metal	84	0.58	48.72
11 Furniture	16	0.65	10.40
12 Wire Harness	52	0.60	31.20
13 Woodmill	29	0.60	17.40
L - 1 Apparel (Underwear)	28	1.20	33.60
2 Apparel (Sleepwear)	20	1.20	24.00
3 Animal Feed	274	1.20	328.80
4 Wood	34	1.30	44.20
5 Food (Canned)	387	2.20	851.40
Total	-	16.70	2,463.54

Remark: /1 Unit demand is assumed based on the result of demand survey and the data of Japanese industrial design standard.

Table J-2 SEWAGE POLLUTANT LOAD

Category	Water Demand Per Day (m3/day)	Unit Pollutant Load /1 BOD (mg/l)	COD (mg/l)	SS (mg/l)	Pollutant Load BOD (kg/day)	COD (kg/day)	SS (kg/day)
S - 1 Food (Sea Food)	61.74	1,200	1,350	425	74.0	83.0	26.0
2 Food	65.40	600	500	500	39.0	33.0	33.0
3 Apparel (Label)	33.82	10	10	50	0.3	0.3	1.7
4 Furniture	4.35	10	10	40	0.04	0.04	0.2
5 Apparel (Blanket)	55.08	10	10	30	0.6	0.6	1.7
6 Apparel	7.50	10	10	30	0.08	0.08	0.2
7 Apparel	8.50	10	10	30	0.09	0.09	0.3
8 Apparel	7.50	10	10	30	0.08	0.08	0.2
9 Electric Lamp	30.15	10	30	100	0.3	0.9	3.0
10 Chemical (Cosmetic)	14.70	350	350	100	5.0	5.0	1.5
11 Apparel	8.00	10	10	30	0.08	0.08	0.2
12 Apparel	8.00	10	10	30	0.08	0.08	0.2
M - 1 Food	149.94	1,200	1,350	425	180.0	202.0	64.0
2 Apparel	30.00	10	10	30	0.3	0.3	0.9
3 Apparel (Sport Wear)	22.80	10	10	30	0.2	0.2	0.7
4 Apparel	30.00	10	10	30	0.3	0.3	0.9
5 Chemical (Plastic Film)	268.20	300	460	100	80.0	123.0	27.0
6 Chemical (Plastic Shoes)	138.00	10	20	50	1.4	2.8	6.9
7 Chemical (Cosmetic)	52.92	350	350	100	18.5	18.5	5.3
8 Apparel	28.50	10	10	30	0.3	0.3	0.9
9 Electric Control Device	48.72	20	40	800	1.0	1.9	39.0
10 Metal	48.72	20	40	800	10.0	1.9	39.0
11 Furniture	10.40	10	10	30	0.1	0.1	0.3
12 Wire Harness	31.20	10	20	100	0.3	0.6	3.1
13 Woodmill	17.40	3,000	5,900	4,100	52.0	103.0	71.0
L - 1 Apparel (Underwear)	33.60	10	10	30	0.3	0.3	1.0
2 Apparel (Sleepwear)	24.00	10	10	30	0.2	0.2	0.7
3 Animal Feed	328.80	1,200	480	25	395.0	158.0	8.0
4 Wood	44.20	10	10	30	0.4	0.4	1.3
5 Food (Canned)	851.40	600	500	500	511.0	426.0	426.0
Total	2,463.54	-	-	-	1,362	1,163	764

Remark: /1 Unit load is assumed based on the result of demand survey and the data of Japanese industrial design standard.

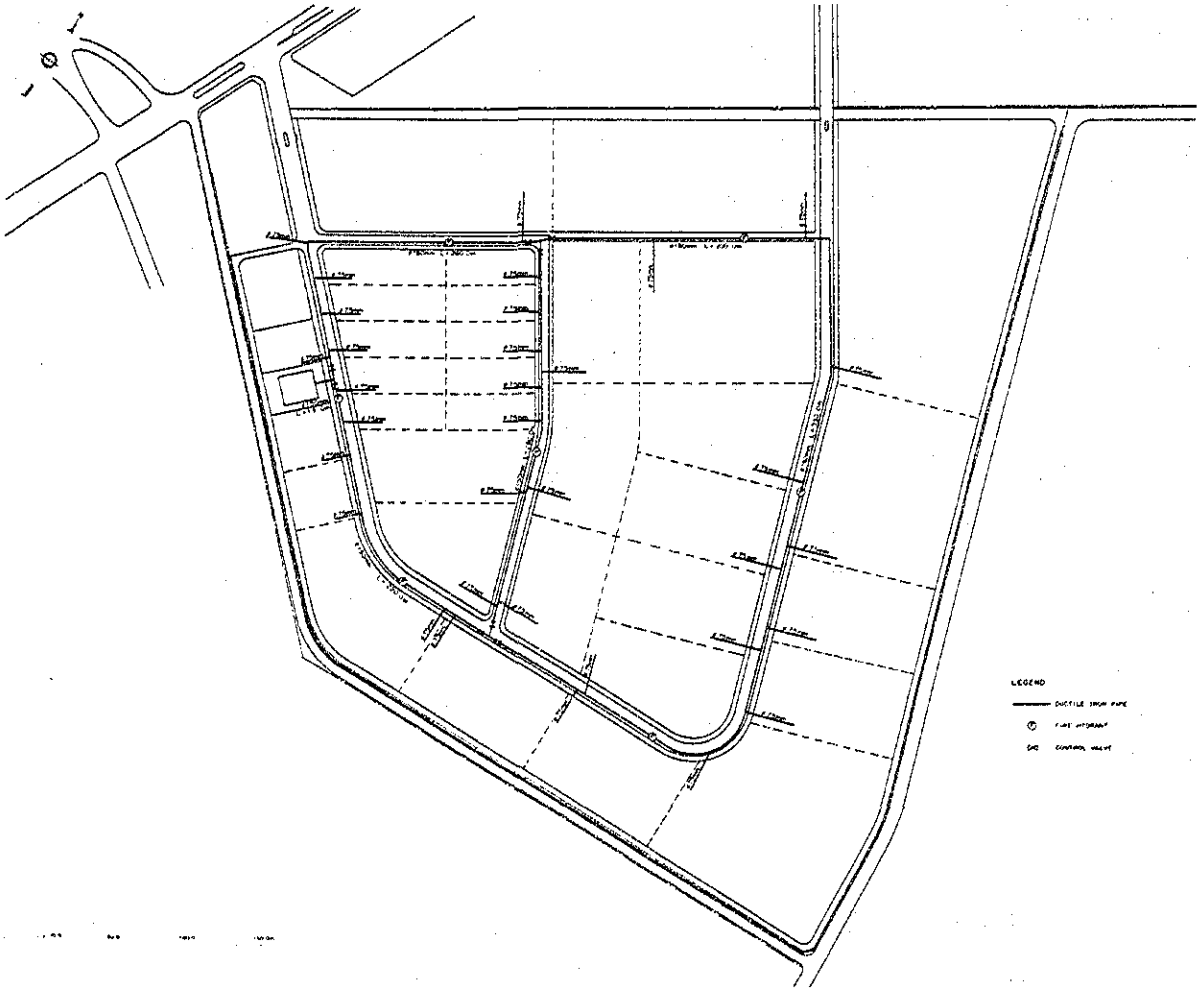
Table J-3 RUNOFF DISCHARGE

Pipe No.	Area	Accumulated Area	Discharge	Pipe Diameter	Velocity	Flow Capacity	Gradient
	(ha)	(ha)	(m3/s)	(mm)	(m/s)	(m3/s)	(‰)
1	0.36	-	0.048	U 300 x 240	0.58	0.056	2
2	0.26	0.62	0.082	U 300 x 360	0.639	0.094	2
3	0.37	0.99	0.131	U 450 x 450	0.79	0.226	2
4	1.50	2.49	0.329	U 600 x 600	0.991	0.512	2
5	0.54	3.03	0.401	U 600 x 600	0.991	0.512	2
	to 11						
6	0.29	-	0.038	U 300 x 300	0.614	0.076	2
7	0.50	0.79	0.105	U 360 x 360	0.691	0.122	2
8	0.42	1.21	0.16	U 450 x 450	0.79	0.226	2
9	0.50	1.71	0.226	U 450 x 450	0.79	0.226	2
10	0.68	2.39	0.316	U 600 x 600	0.991	0.512	2
11	0.36	5.78	0.765	U 600 x 600	1.469	0.765	4.4
12	1.25	7.03	0.93	U 600 x 600	1.854	0.96	8
	to 15						
13	0.33	-	0.044	U 240 x 240	0.541	0.044	2
14	0.17	0.50	0.066	U 360 x 360	0.691	0.122	2
15	0.71	8.24	1.09	ø 1100	1.282	1.218	1.8
	to 17						
16	0.41	-	0.054	U 300 x 240	0.58	0.056	2
17	-	8.65	1.144	ø 1100	1.282	1.218	1.8
	to the sea						
18	0.30	-	0.04	U 240 x 240	0.541	0.044	2
19	0.48	0.78	0.103	U 360 x 360	0.691	0.122	2
20	0.29	1.07	0.142	U 450 x 450	0.79	0.226	2
21	0.56	1.63	0.216	U 450 x 450	0.79	0.226	2
22	0.69	2.32	0.307	U 600 x 600	0.991	0.512	2
23	0.35	2.67	0.353	U 600 x 600	0.991	0.512	2
24	0.65	3.32	0.439	U 600 x 600	0.991	0.512	2
	to 29						
25	0.34	-	0.045	U 300 x 240	0.58	0.056	2
26	0.41	0.75	0.099	U 360 x 360	0.691	0.122	2
27	0.40	1.15	0.152	U 450 x 450	0.79	0.226	2
28	0.33	1.48	0.196	U 450 x 450	0.79	0.226	2
29	0.53	5.33	0.705	U 600 x 600	1.366	0.708	3.8
	to the sea						
30	0.25	-	0.033	U 240 x 240	0.541	0.044	2
31	0.42	0.67	0.089	U 300 x 360	0.639	0.094	2
32	0.42	1.09	0.144	U 450 x 450	0.79	0.226	2
	to 35						
33	0.24	-	0.032	U 240 x 240	0.541	0.044	2
34	0.44	0.68	0.09	U 300 x 360	0.639	0.094	2
35	0.55	2.32	0.307	ø 600	1.193	0.337	3.5
	to 39						
36	0.33	-	0.044	U 240 x 240	0.541	0.044	2
37	0.51	0.84	0.11	U 360 x 360	0.691	0.122	2
38	0.30	1.14	0.151	U 450 x 450	0.79	0.226	2
39	-	3.46	0.458	ø 700	1.203	0.463	2.9
	to the sea						
40	0.40	-	0.053	U 300 x 240	0.58	0.056	2
41	0.41	0.81	0.107	U 360 x 360	0.661	0.1	2
	to 44						
42	0.36	-	0.048	U 300 x 240	0.58	0.056	2
43	0.41	0.77	0.102	U 360 x 360	0.691	0.122	2
44	0.62	2.20	0.291	ø 600	1.193	0.337	3.5
	to 46						
45	0.41	-	0.054	U 300 x 240	0.58	0.056	2
46	-	2.61	0.345	ø 700	1.203	0.463	2.9
	to the sea						
47	0.32	-	0.042	U 240 x 240	0.541	0.044	2
48	0.39	0.71	0.094	U 300 x 360	0.639	0.094	2
49	0.29	1.00	0.132	U 450 x 450	0.79	0.226	2
50	0.22	1.22	0.161	U 450 x 450	0.79	0.226	2
51	0.37	1.59	0.21	U 450 x 450	0.79	0.226	2
52	0.62	2.21	0.292	U 600 x 600	0.991	0.512	2
53	0.59	2.80	0.37	U 600 x 600	0.991	0.512	2
	to 56						
54	0.36	-	0.048	U 300 x 240	0.58	0.056	2
55	0.21	0.57	0.075	U 300 x 300	0.614	0.076	2
56	-	3.37	0.446	ø 700	1.203	0.463	2.9

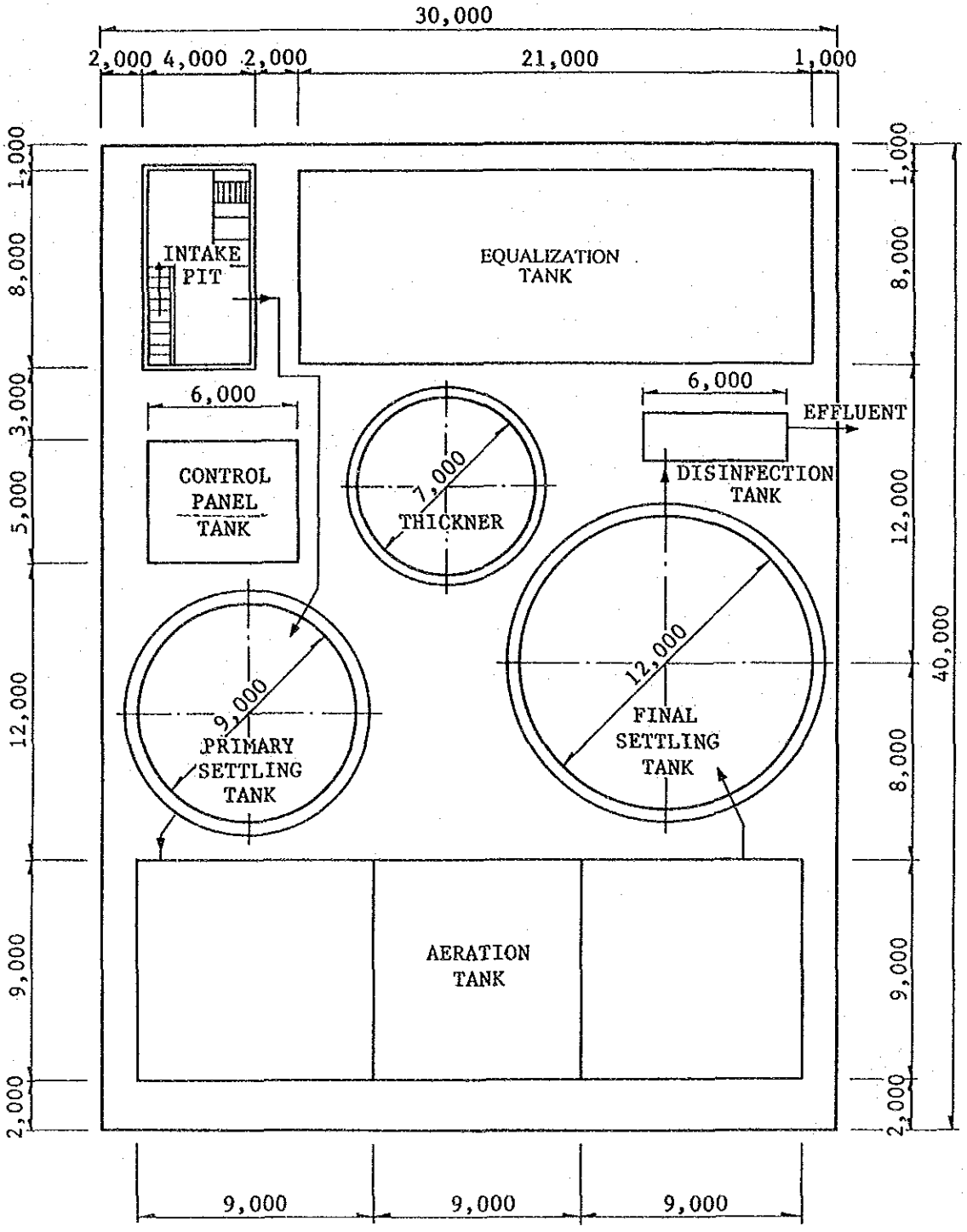
Table J-4 GENERATION OF SOLID WASTE

Category	Combustible \(1\) (Ton/Ha)	Incombustible Solid (2) (Ton/Ha)	Area of Each Lot (3) (Ha)	Combustible (1) x (3) Ton	Incombustible (2) x (3) Ton
S - 1 Food (Sea Food)	0.40	0.09	0.21	0.084	0.019
2 Food	0.40	0.09	0.15	0.060	0.014
3 Apparel (Label)	0.08	-	0.19	0.015	-
4 Furniture	0.34	0.03	0.15	0.051	0.005
5 Apparel (Blanket)	0.08	0.01	0.18	0.014	0.002
6 Apparel	0.08	0.01	0.15	0.012	0.002
7 Apparel	0.08	0.01	0.17	0.014	0.002
8 Apparel	0.08	0.01	0.15	0.012	0.002
9 Electric Lamp	0.04	0.09	0.15	0.006	0.014
10 Chemical (Cosmetic)	0.29	0.07	0.15	0.044	0.011
11 Apparel	0.08	0.01	0.16	0.013	0.002
12 Apparel	0.08	0.01	0.16	0.013	0.002
M - 1 Food	0.40	0.09	0.51	0.204	0.046
2 Apparel	0.08	0.01	0.60	0.048	0.006
3 Apparel (Sport Wear)	0.08	0.01	0.60	0.048	0.006
4 Apparel	0.08	0.01	0.60	0.048	0.006
5 Chemical (Plastic Film)	0.29	0.07	0.60	0.174	0.042
6 Chemical (Plastic Shoes)	0.29	0.07	0.60	0.174	0.042
7 Chemical (Cosmetic)	0.29	0.07	0.54	0.157	0.038
8 Apparel	0.08	0.01	0.57	0.046	0.006
9 Electric control Device	0.17	3.00	0.58	0.099	1.740
10 Metal	0.17	3.00	0.58	0.099	1.740
11 Furniture	0.34	0.03	0.65	0.221	0.020
12 Wire Harness	0.17	3.00	0.60	0.102	1.800
13 Woodmill	0.34	0.03	0.60	0.204	0.018
L - 1 Apparel (Underwear)	0.08	0.01	1.20	0.096	0.012
2 Apparel (Sleepwear)	0.08	0.01	1.20	0.096	0.012
3 Animal Feed	0.40	0.09	1.20	0.480	0.108
4 Wood	0.34	0.03	1.30	0.442	0.039
5 Food (Canned)	0.40	0.09	2.20	0.880	0.198
Total				3.956	

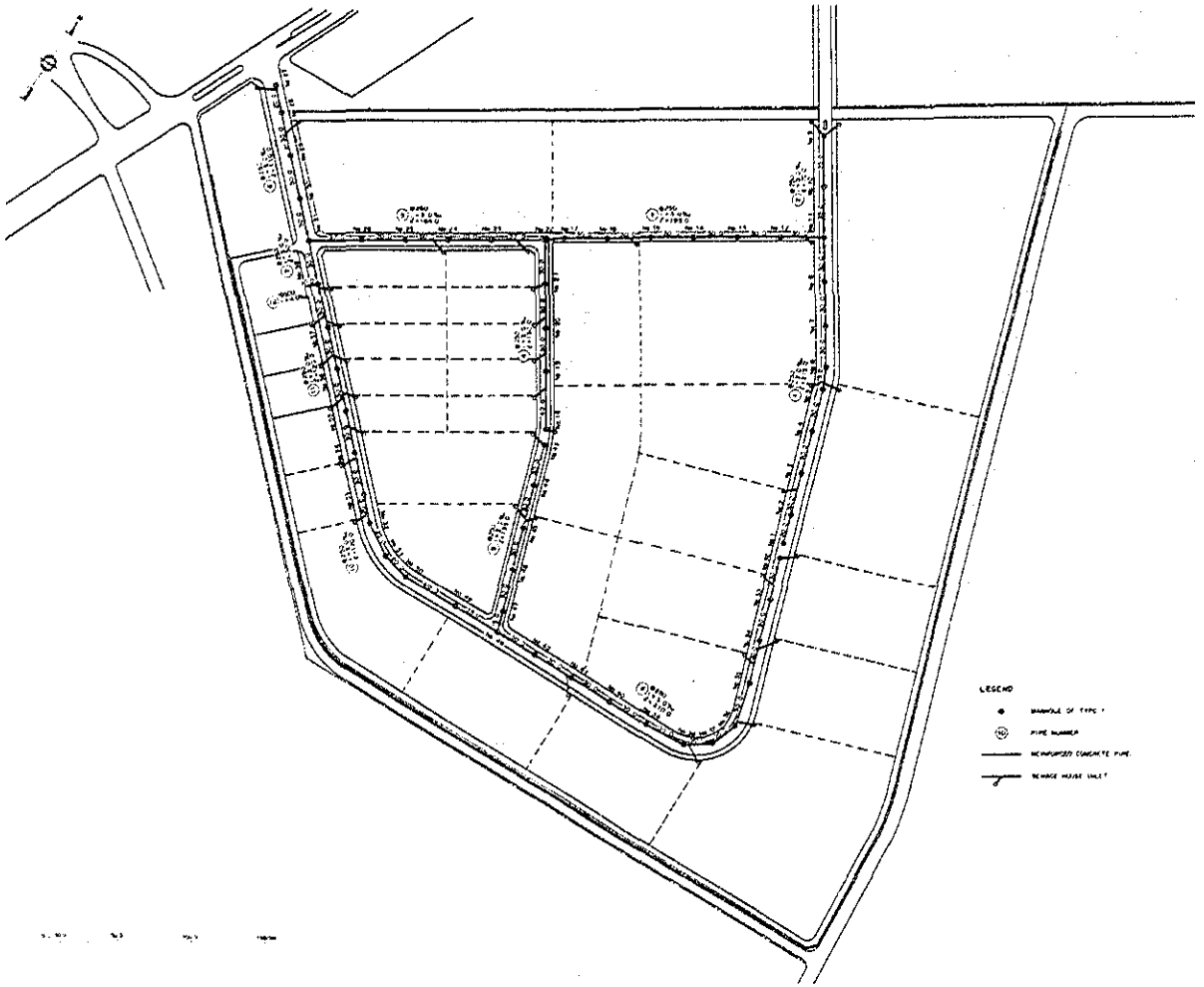
Remark: Unit generation is assumed based on the Japanese industrial design standard.



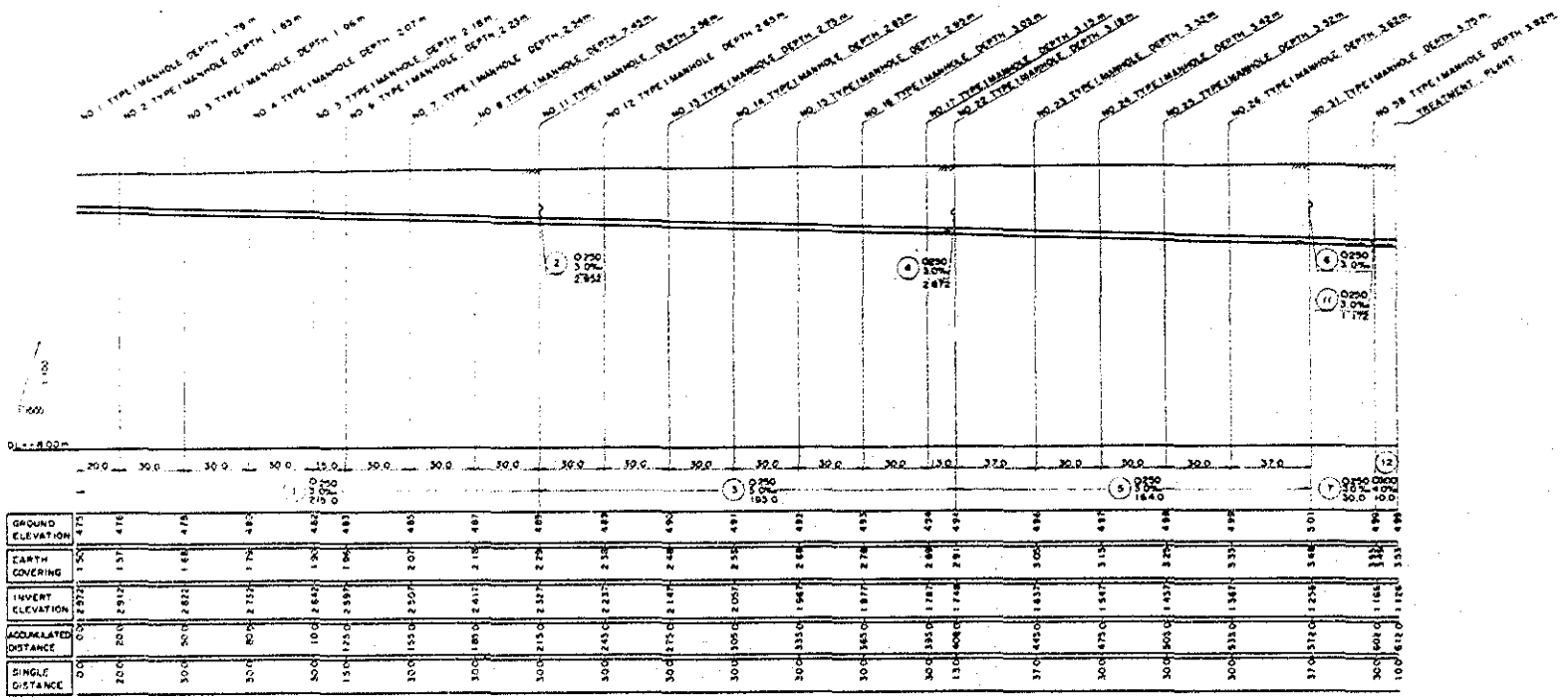
JAPAN INTERNATIONAL COOPERATION AGENCY	ESMERALDAS EXPORT PROCESSING ZONE DEVELOPMENT PROJECT	Fig. J-1	Plan of Water Supply System



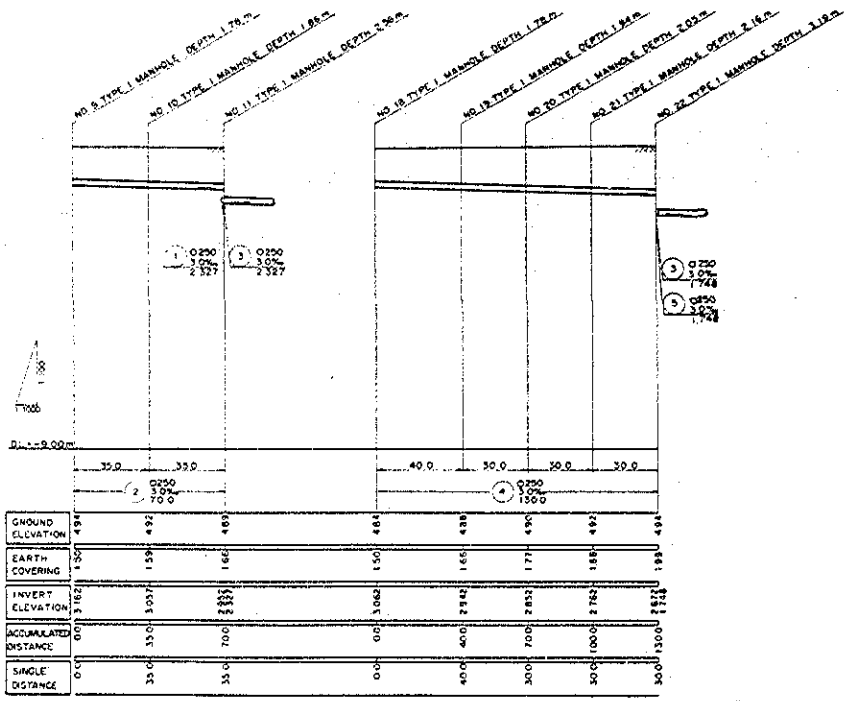
ESMERALDAS EXPORT PROCESSING ZONE DEVELOPMENT PROJECT	**Fig. J-2** Layout of Standard Activated Sludge Process
JAPAN INTERNATIONAL COOPERATION AGENCY	



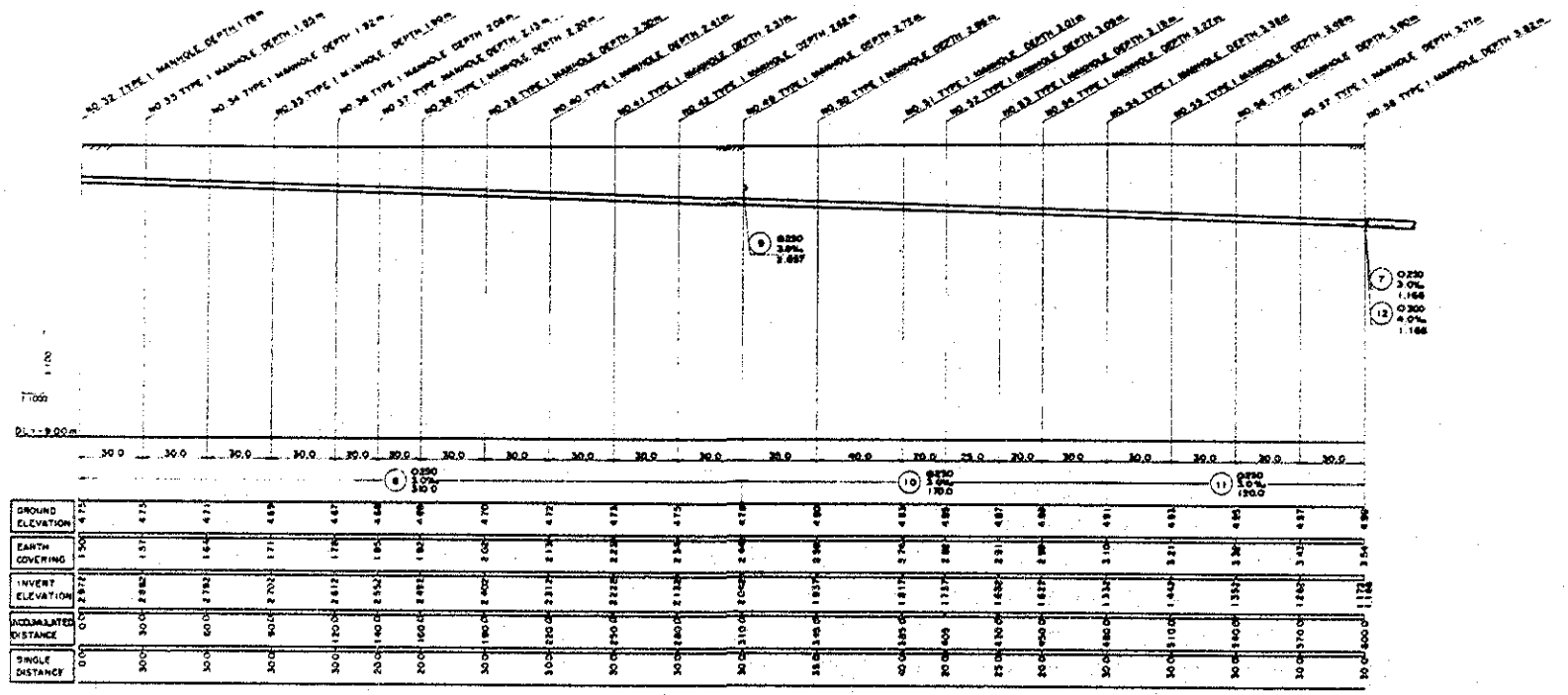
JAPAN INTERNATIONAL COOPERATION AGENCY	ESMERALDAS EXPORT PROCESSING ZONE DEVELOPMENT PROJECT	Fig. J-3 Plan of Sewerage System



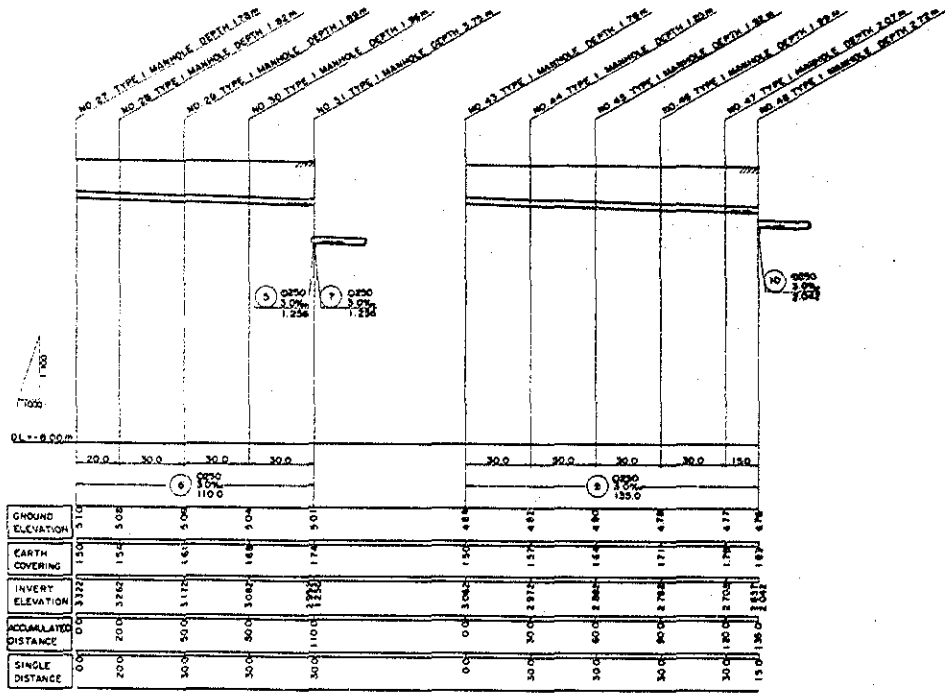
JAPAN INTERNATIONAL COOPERATION AGENCY	ESMERALDAS EXPORT PROCESSING ZONE DEVELOPMENT PROJECT	Fig. J-4	Profile of Sewerage (1/4)



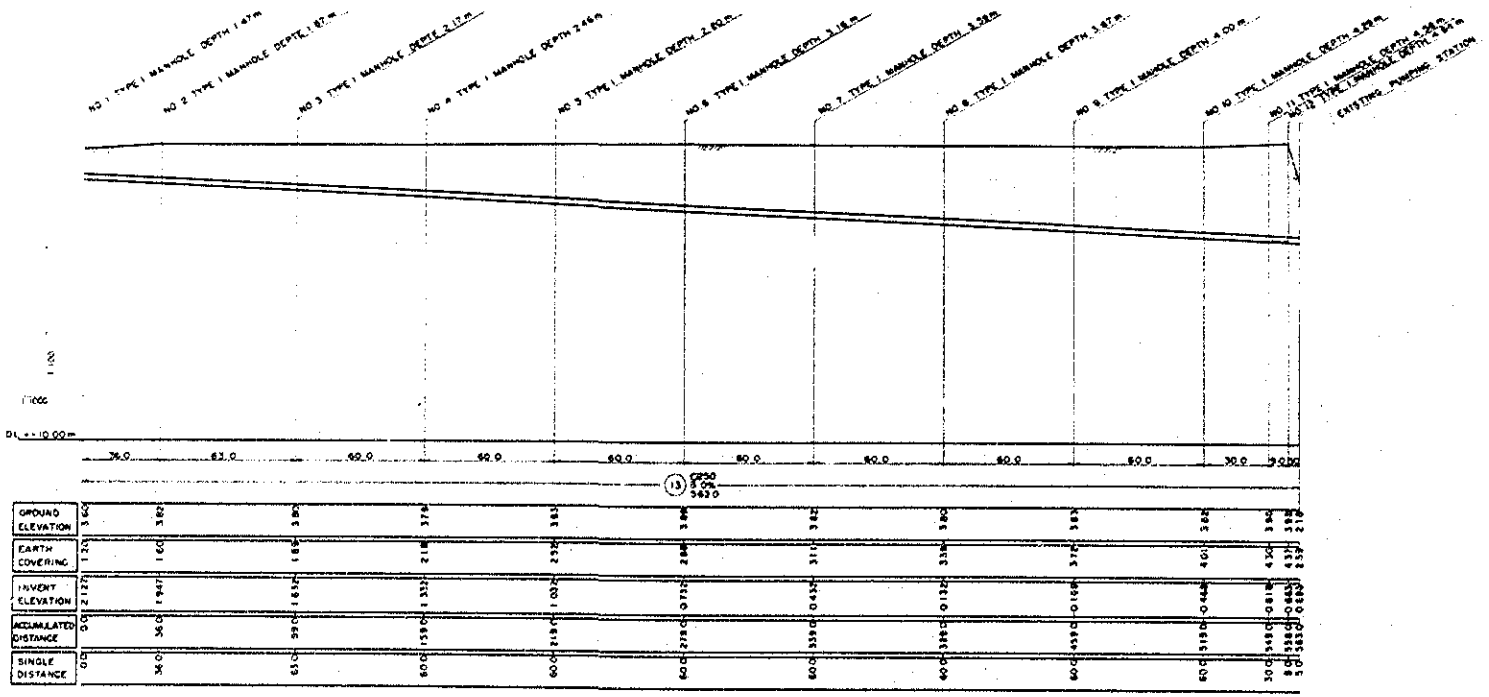
JAPAN INTERNATIONAL COOPERATION AGENCY	ESMERALDAS EXPORT PROCESSING ZONE DEVELOPMENT PROJECT	Fig. J-5 Profile of Sewerage (2/4)



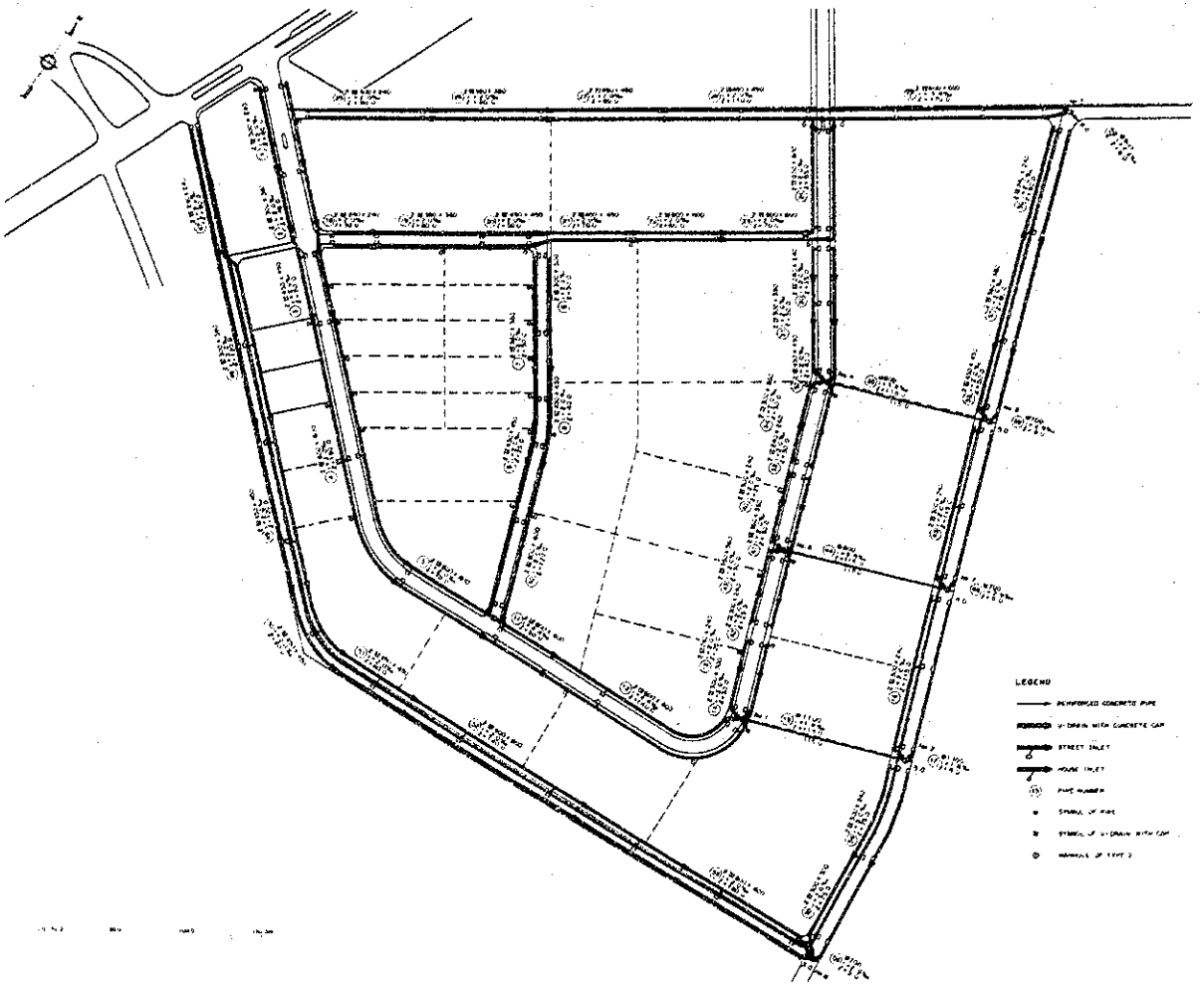
JAPAN INTERNATIONAL COOPERATION AGENCY	ESMERALDAS EXPORT PROCESSING ZONE DEVELOPMENT PROJECT	Fig. J-6	Profile of Sewerage (3/4)



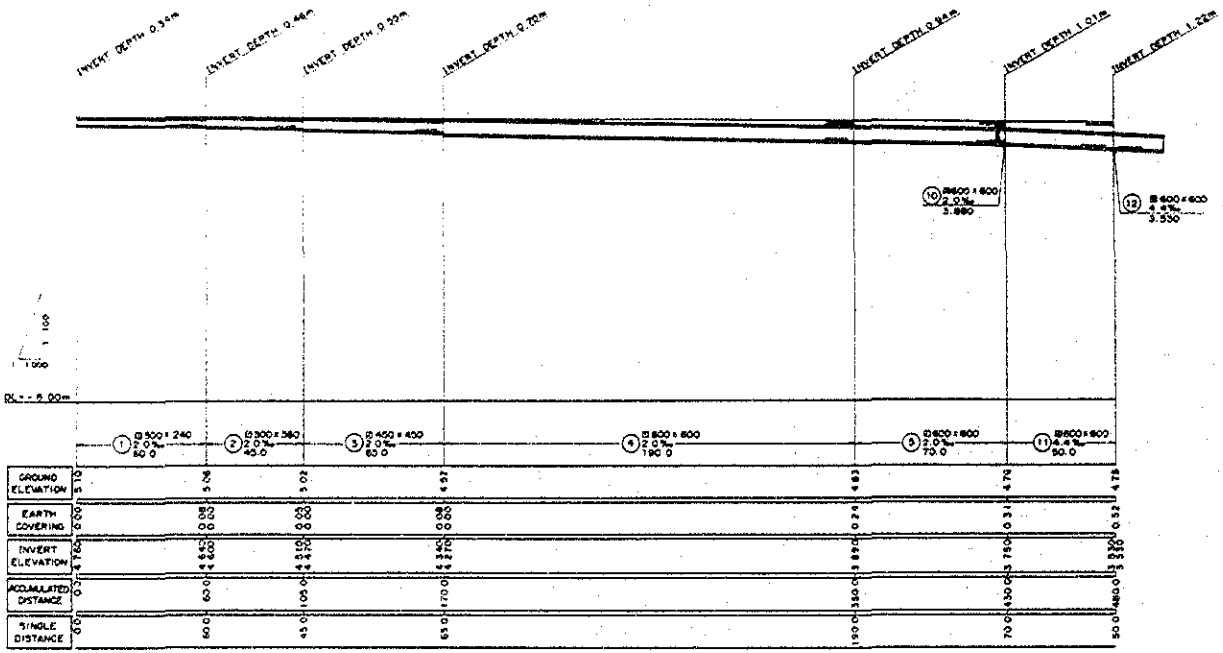
JAPAN INTERNATIONAL COOPERATION AGENCY	ESMERALDAS EXPORT PROCESSING ZONE DEVELOPMENT PROJECT	Fig. J-7 Profile of Sewerage (4/4)



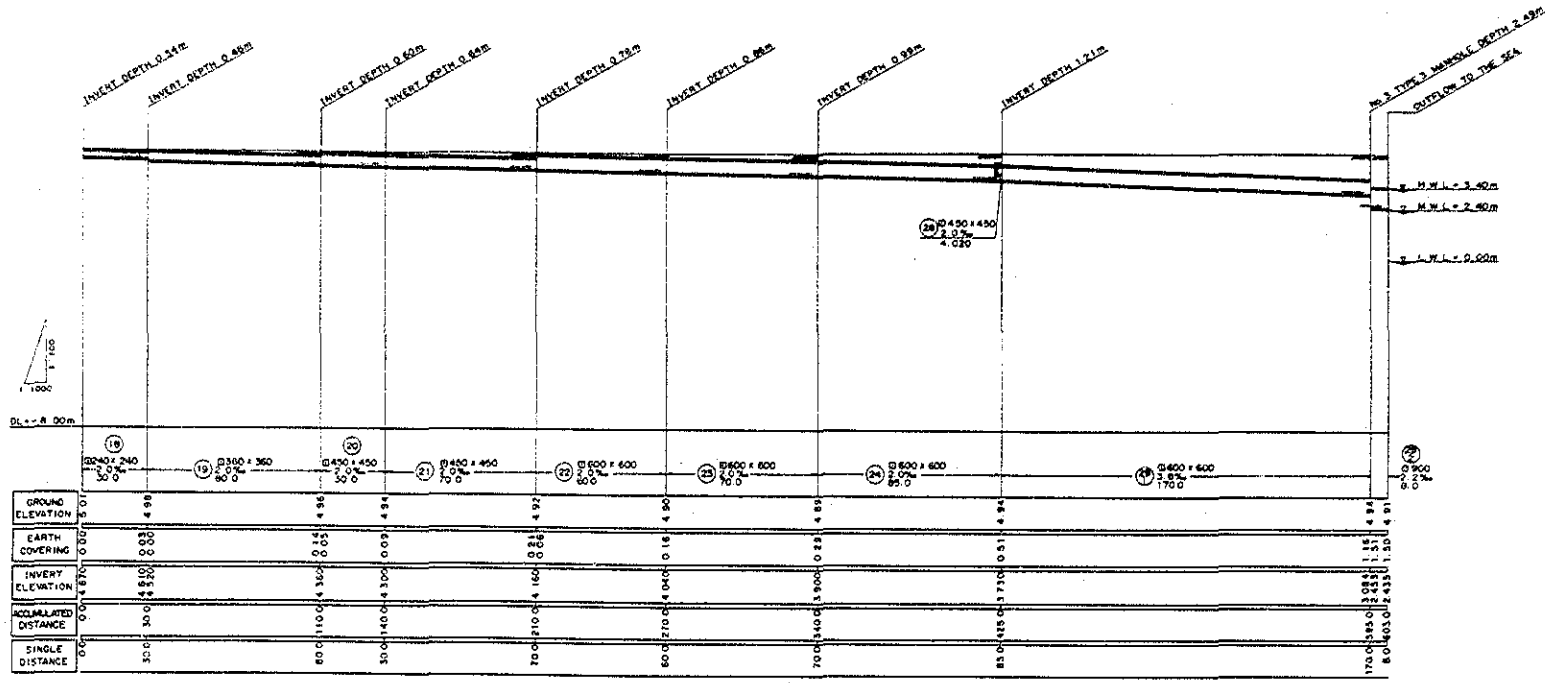
JAPAN INTERNATIONAL COOPERATION AGENCY	ESMERALDAS EXPORT PROCESSING ZONE DEVELOPMENT PROJECT	Fig. J-8 Profile of Sewerage (From Treatment Plant to Existing Pumping Station)



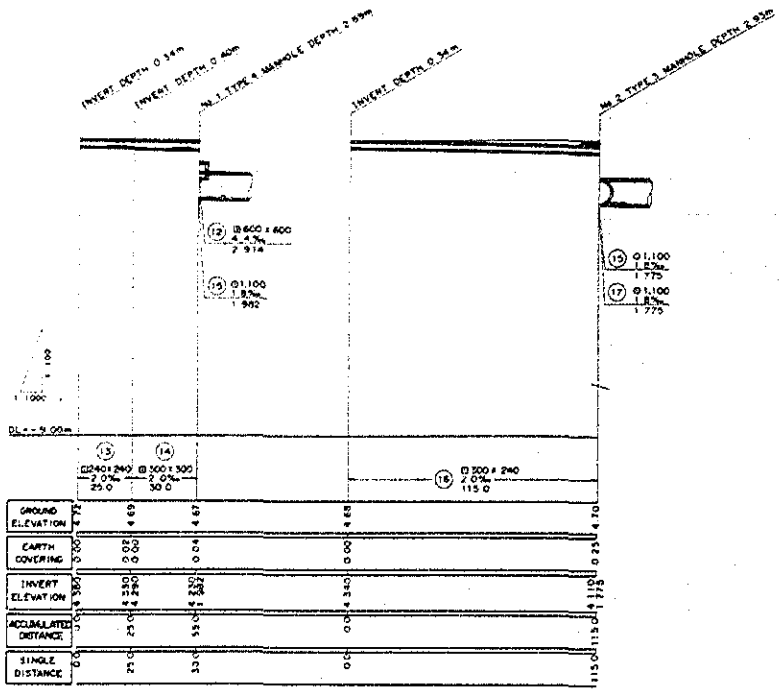
JAPAN INTERNATIONAL COOPERATION AGENCY	ESMERALDAS EXPORT PROCESSING ZONE DEVELOPMENT PROJECT	Fig. J-9	Plan of Drainage System



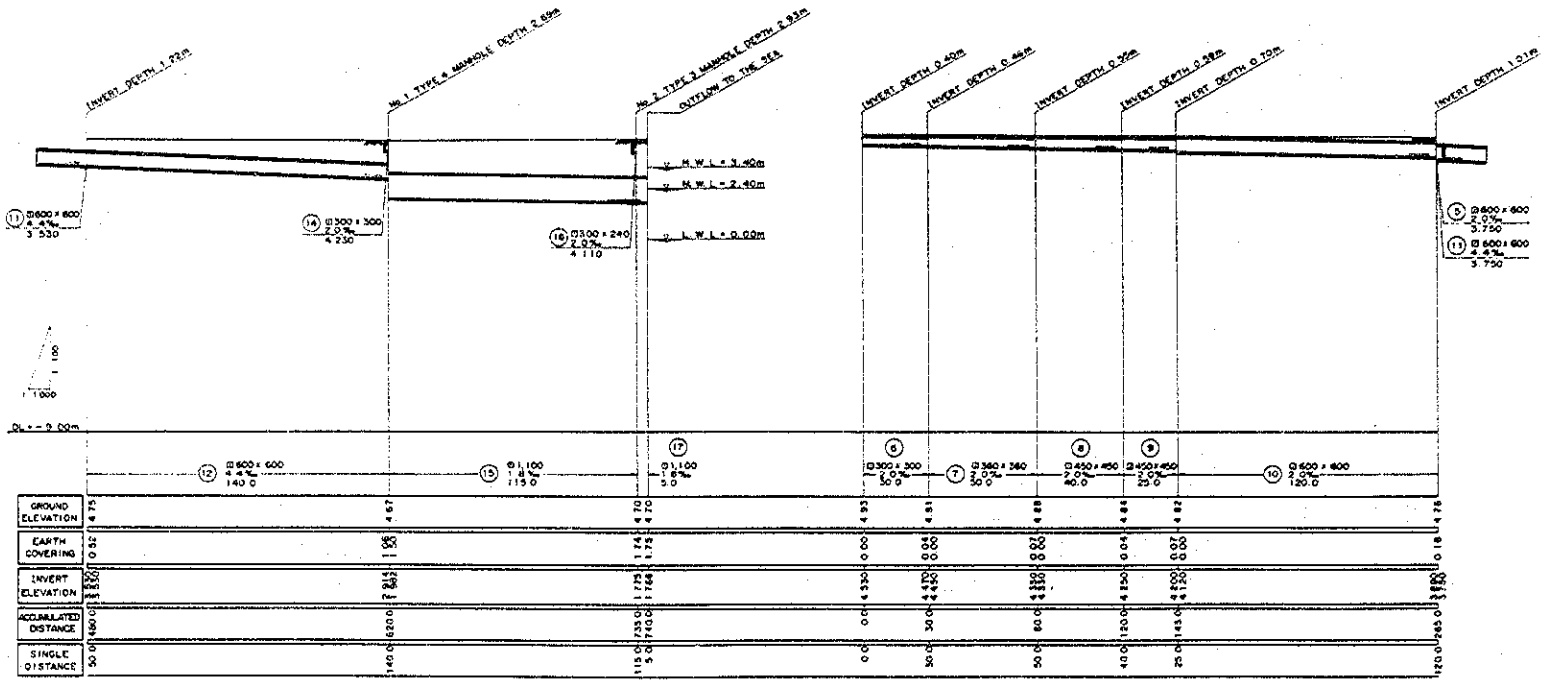
JAPAN INTERNATIONAL COOPERATION AGENCY	ESMERALDAS EXPORT PROCESSING ZONE DEVELOPMENT PROJECT	Fig. J-10	Profile of Drainage (1/9)



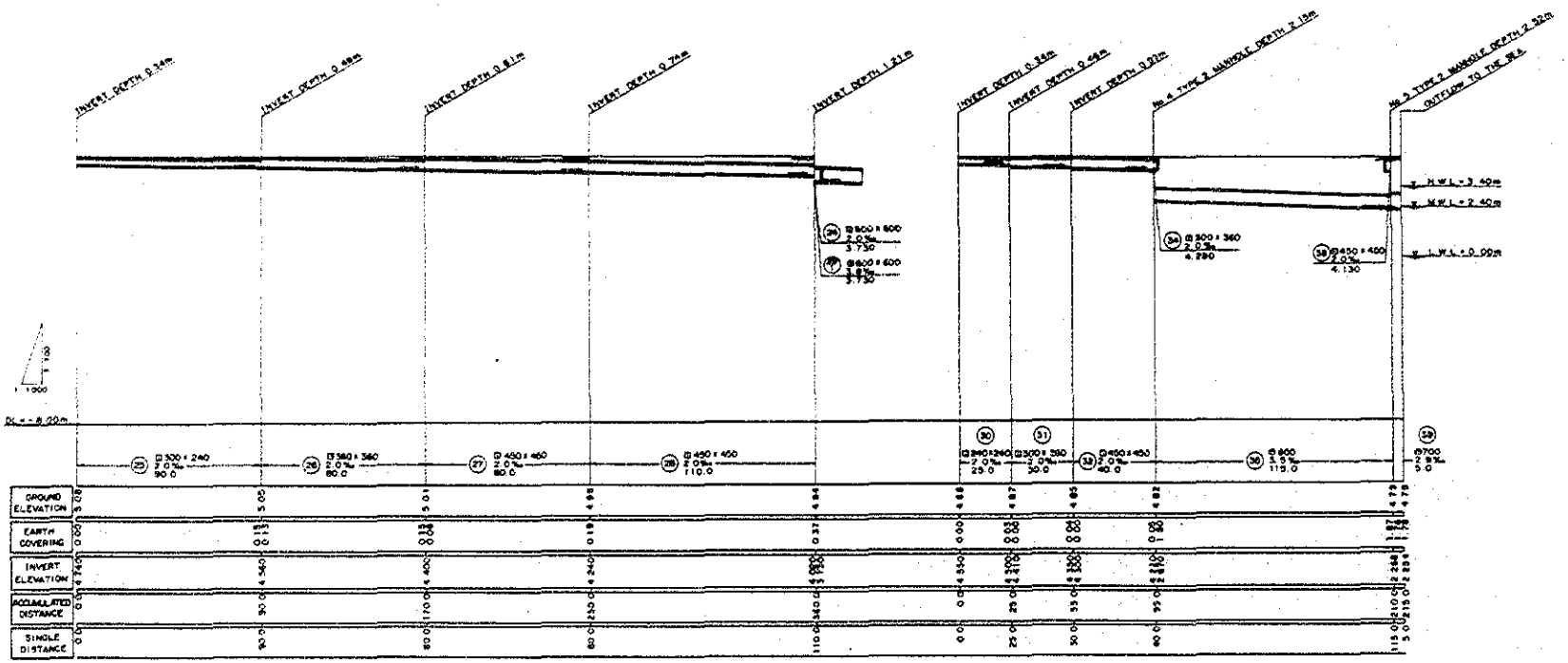
JAPAN INTERNATIONAL COOPERATION AGENCY	ESMERALDAS EXPORT PROCESSING ZONE DEVELOPMENT PROJECT	Fig. J-11	Profile of Drainage (2/9)



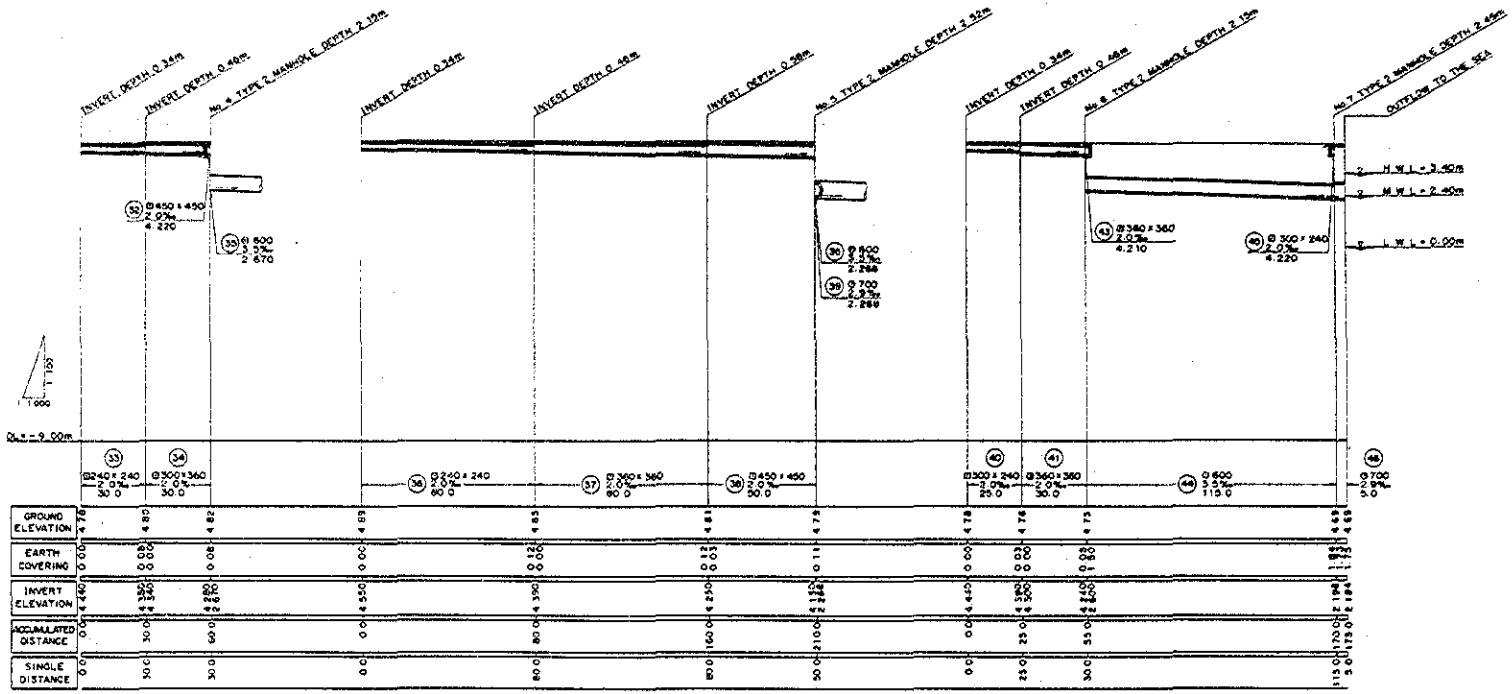
JAPAN INTERNATIONAL COOPERATION AGENCY	ESMERALDAS EXPORT PROCESSING ZONE DEVELOPMENT PROJECT	Fig. J-12	Profile of Drainage (3/9)



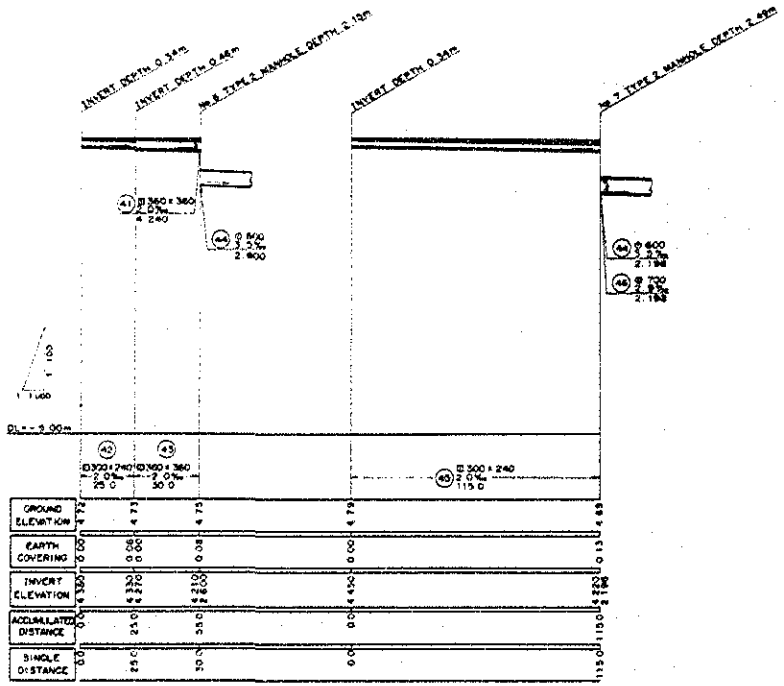
JAPAN INTERNATIONAL COOPERATION AGENCY	ESMERALDAS EXPORT PROCESSING ZONE DEVELOPMENT PROJECT	Fig. J-13	Profile of Drainage (4/9)



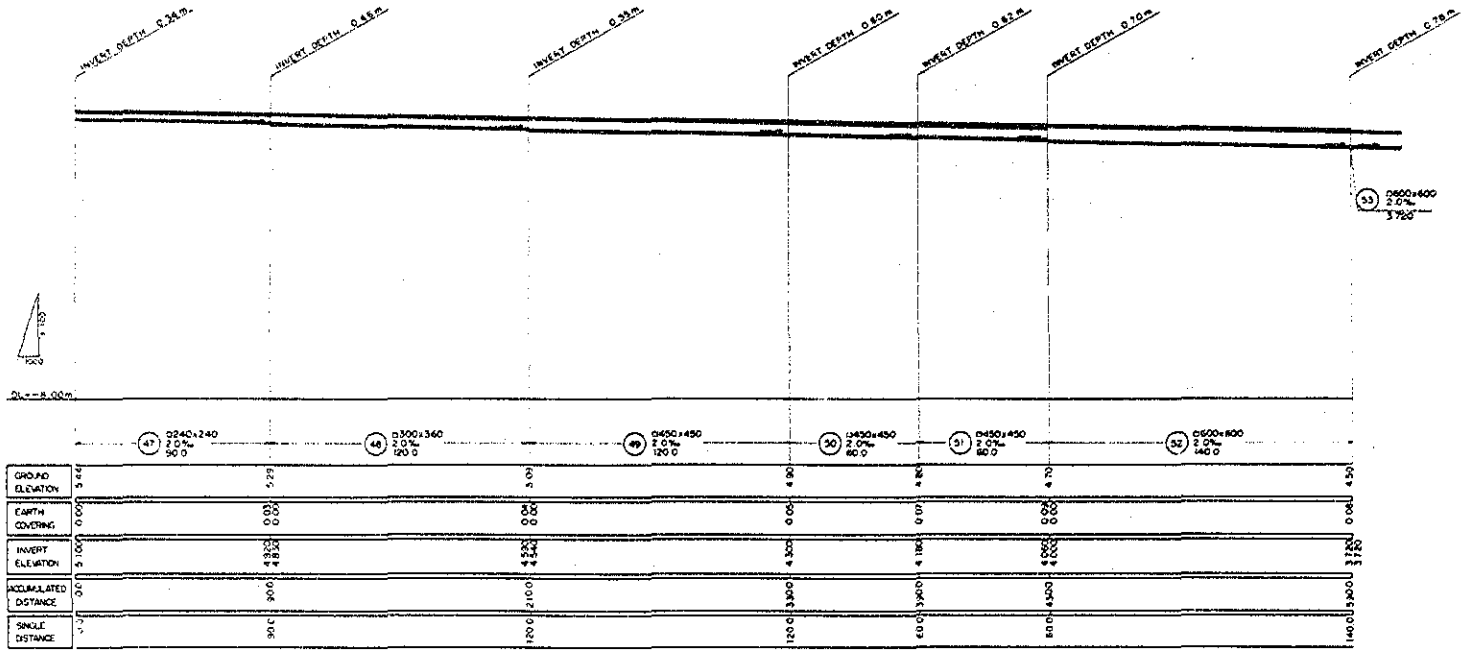
JAPAN INTERNATIONAL COOPERATION AGENCY	ESMERALDAS EXPORT PROCESSING ZONE DEVELOPMENT PROJECT	Fig. J-14	Profile of Drainage (5/9)



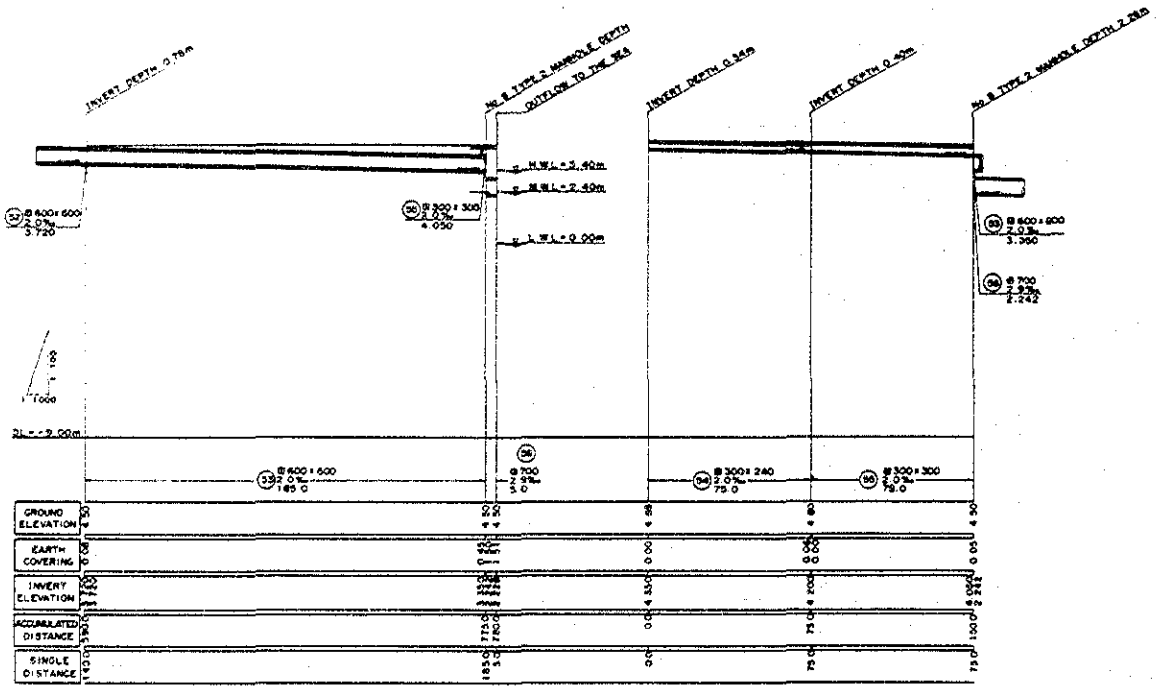
JAPAN INTERNATIONAL COOPERATION AGENCY	ESMERALDAS EXPORT PROCESSING ZONE DEVELOPMENT PROJECT	Fig. J-15	Profile of Drainage (6/9)



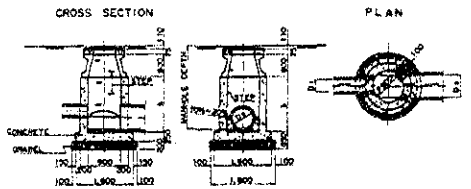
JAPAN INTERNATIONAL COOPERATION AGENCY	ESMERALDAS EXPORT PROCESSING ZONE DEVELOPMENT PROJECT	Fig. J-16 Profile of Drainage (7/9)



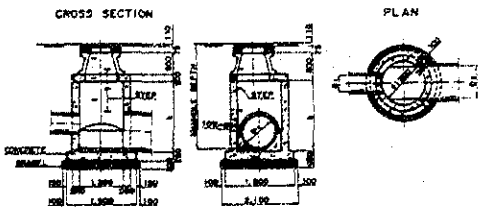
JAPAN INTERNATIONAL COOPERATION AGENCY	ESMERALDAS EXPORT PROCESSING ZONE DEVELOPMENT PROJECT	Fig. J-17 Profile of Drainage (8/9)



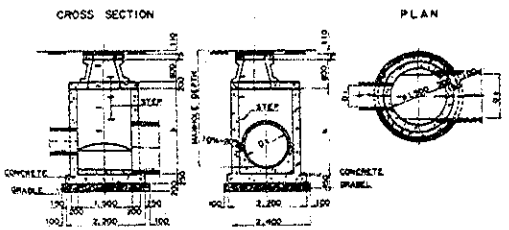
JAPAN INTERNATIONAL COOPERATION AGENCY	ESMERALDAS EXPORT PROCESSING ZONE DEVELOPMENT PROJECT	Fig. J-18	Profile of Drainage (9/9)



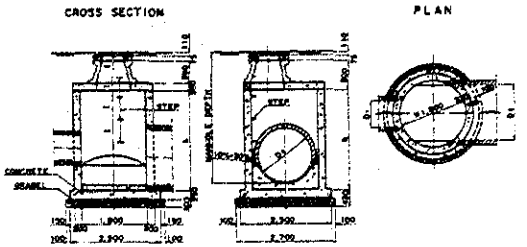
TYPE 1 MANHOLE (SEWAGE, DRAINAGE)



TYPE 2 MANHOLE (DRAINAGE)

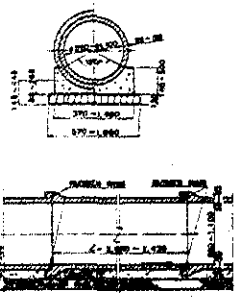


TYPE 3 MANHOLE (DRAINAGE)

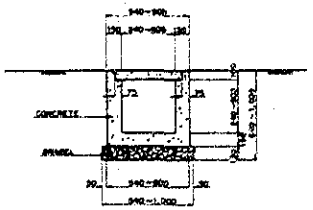


TYPE 4 MANHOLE (DRAINAGE)

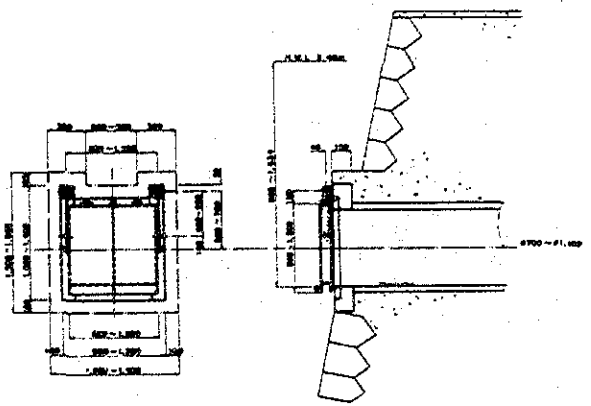
JAPAN INTERNATIONAL COOPERATION AGENCY	ESMERALDAS EXPORT PROCESSING ZONE DEVELOPMENT PROJECT	Fig. J-19 Sewage and Drainage Manholes



REINFORCED CONCRETE PIPE INSTALLATION (D=250mm ~ 1,100mm)

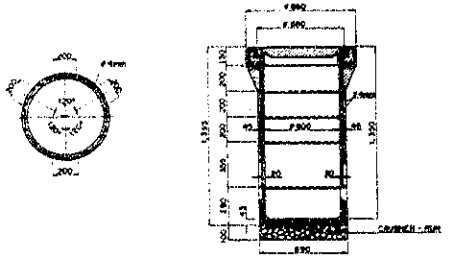


U - DRAIN CROSS SECTION

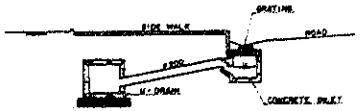


OUTFLOW STRUCTURE

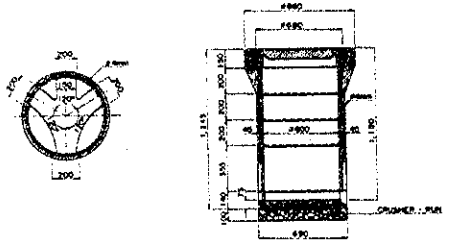
JAPAN INTERNATIONAL COOPERATION AGENCY	ESMERALDAS EXPORT PROCESSING ZONE DEVELOPMENT PROJECT	Fig. J-20 Drainage and Sewage Pipes and Facilities



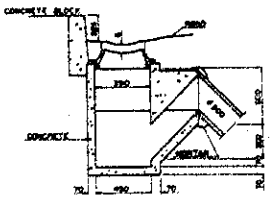
RAIN WATER INLET IN LOTS



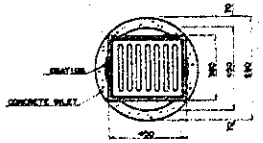
CONNECTION FROM STREET INLET



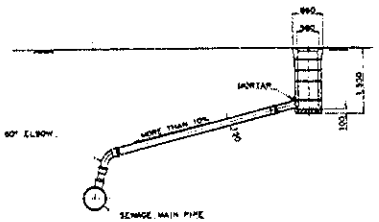
SEWAGE INLET IN LOTS



STREET INLET



GRATING CAP OF STREET INLET



CONNECTION FROM SEWAGE INLET

JAPAN INTERNATIONAL COOPERATION AGENCY	ESMERALDAS EXPORT PROCESSING ZONE DEVELOPMENT PROJECT	Fig. J-21	Rain and Sewage Inlets

ANNEX K

ENVIRONMENTAL ASSESSMENT

ANNEX - K

ENVIRONMENTAL ASSESSMENT

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K.1 GENERAL

The objectives of the environmental study in this Annex-K are to preliminarily evaluate the general environmental conditions around the Esmeraldas EPZ area and to preliminarily assess the environmental impacts that the Esmeraldas EPZ would have on the surrounding environment.

It has been found through the study that the data and information concerning the environmental conditions in Esmeraldas are quite limited. Consequently, the minimum data on quality of water around Esmeraldas have been collected during the period of this study. The data on air pollution and other aspects have remained unavailable, and the quantitative environmental assessment on these aspects has not been practicable.

On the other hand, the categories of industries to be located in the Esmeraldas EPZ have been selected for the planning purposes, but the exact type and scale of these industries have been undefinable through the study. Consequently, the extent of pollutant load to be generated by the operation of industries in the Esmeraldas EPZ should be evaluated preliminarily by referring to the examples of other industrial parks and free zones, as well as to the available standards of the industrialized country. Further, standards for air pollution in Ecuador have yet to be set up.

The environmental study of the Esmeraldas EPZ, therefore, has been mainly concentrated to the study on water pollution to be possibly generated by the establishment and operation of the Esmeraldas EPZ.

K.2 PRESENT ENVIRONMENTAL CONDITIONS

K.2.1 Social Environmental Conditions

Population

Population of urban area in Esmeraldas, according to 1990 census, was approximately 98,000. It is estimated to reach 140,000 in the year 2000. The growth rate of population is not acute, though urbanization has been gradually in progress. Population in Esmeraldas will not be increased substantially with the implementation of the Esmeraldas EPZ, in view of the estimate that the employment opportunities to be offered by the EPZ would be around 2,600.

Land use

Esmeraldas city extends north to south for approximately 10 km. It is bounded by the Esmeraldas river to the east, the Pacific ocean to the north, and small mountain ranges to the south and west. The land to be developed in the urban areas of Esmeraldas is quite limited, except for some valleys scattered to the south of the city. Consequently, from the view point of land use, possibility of large scale development in and around Esmeraldas would be rather limited.

Industry

There is a few industry in Esmeraldas. Among others, oil refinery is the largest, with its employment of approximately one thousand. The others are one ice making and two wood industries, in accordance with the data of manufacturing industries in 1988. There is no concrete plan to locate industries in Esmeraldas, except for the plan for the Esmeraldas EPZ.

Fishery

According to the data in 1986, workers engaged in fishery were 765 in total in Esmeraldas. Reportedly, this number is relatively high. Among 765 fishermen, 400 are engaged in coast fishing in a small scale. Effect of water contamination in the sea and river water has been recently observed, and further contamination should be avoided from the viewpoint of fishery in the coastal waters.

Recreation

Shore line of the Pacific ocean, particularly near the estuary of the Esmeraldas river, is a recreational area in Esmeraldas. Reportedly, the water area is not clean any more due to contamination of the sea water brought by the contaminated rive water flow, as well as direct discharge of wastewater from Esmeraldas city and industrial wastewater discharge from the oil

refinery. Protection of water contamination would be a major concern in the development of any project in Esmeraldas.

K.2.2 Natural Conditions

Topography and geology

Esmeraldas city is located along the Esmeraldas river, having small mountain ranges behind. The city has expanded by reclamation of the river and cutting the mountain slope. Some residential areas were developed on the slope of the mountain where resided especially by the lower income residents. The lowland portion in the city area is laid on the alluvial soil layer brought by the river flood. The soils mainly consist of silty sand.

Climate

Esmeraldas is located in tropical climate with annual mean temperature at 26°C and the annual mean humidity ranging from 77% to 86%. Annual rainfall shows wide variation ranging from 432 mm to 924 mm in 1977-86. (For further detail, Refer to Annex G.2). Wind direction is usually west, south and southwest. This indicates that odor, soot and dust, if generated in the Esmeraldas EPZ, will be mainly directed to the opposite direction from the center of the city.

Air pollution

Air pollution has not been detected in and around Esmeraldas city. In the vicinity of oil refinery and thermal power station located to the south of the city, some complaint concerned with offensive odor, smoke and noise have been heard.

Water quality

Potable water for Esmeraldas city is presently obtained from the wells located in the sands of the Esmeraldas river. Treatment of this water is carried out by means of slow sand filtration system. Water quality after the treatment is not preferable due to relatively high contents of iron and manganese.

Water quality of the river has been getting worse these years due to direct discharge of domestic wastewater to the river and increase in squatter living on and alongside the river.

Water quality of the sea has also been getting worse, due to such factors that contaminated river water is flowing into the sea, and that direct discharge of domestic

wastewater in the vicinity of the sea coast.

K.2.3 Environmental Control and Regulations

In Ecuador, the law for the prevention and control of environmental contamination was first enacted in 1976. Thereafter, "CIPA" (Institutional Committee for Environmental Protection) was established by six authorities, Ministry of Agriculture, Ministry of Health, Ministry of Defense, Ministry of Energy and Mining, and CONADE, to control environmental problems. The Ministry of Health, acting as chairman of CIPA, has three main functions of "Obras Sanitarias" (Water Supply and Sewage), "Centro de Salud" (Hospital), "Medias Ambiente" (Environment Impact Assessment, Solid Waste Disposal and Laboratories).

Water quality standards have been issued by the Ministry of Health in 1989 as an official registration of the Government. Some of the standard derived from the registration are indicated as follows:

- Table K-1 and K-2 show the standard of quality of potable water for conventional treatment and for disinfection,
- Table K-3 indicates a standard for fish feeding,
- Table K-4 indicates a standard of recreational use,
- Table K-5 indicates a standard for agricultural use.
- Table K-6, K-7 and K-8 indicate standard for discharge of public water, public sewage and sanitary implications, respectively.

K.3 ENVIRONMENTAL ASSESSMENT

K.3.1 Water Pollution

1) Water sampling

Major items of pollutant load are divided principally into three categories: i) heavy metals ii) toxic substances and iii) biological organic substances. However, as described previously, none of the data exist on water quality in and around the Esmeraldas EPZ. Therefore, water quality examination has been carried out in this Study to grasp the general condition of pollutant load.

Samples were taken at 5 locations as shown in Figure K-1. Location No. 1 is a sea water area 1,500 m off the coast where the domestic wastewater from Esmeraldas city is discharged through a submarine pipeline by way of the existing pumping station. Location No. 2 is the sea water area where comparatively fresh water was thought to be obtainable. *Distance from the coastal line is approximately 1,500 m and it is 1,000 from the Location No.* 1 to the upstream of the tide. Location No. 3 is a downstream of the Esmeraldas river, 20 m from the river side. In the vicinity of this sampling point, many squatters are residing on the river and river side. Location No. 4 is the upper stream of the river, around the entrance of the city. The water sample was taken 5 m from the river side. No. 5 is in a chamber of the pumping station constructed in 1966 in order to discharge wastewater to the sea by a submarine pipe.

2) Results of water examination

Table K-9 shows the results of the water examination analysed in this Study. The quality of water is briefly summarized as follows:

(1) BOD

BOD concentration at the Location No. 1 to No. 4 is relatively smaller than expected. Highest concentration among these 4 points was 13.5 mg/l which was taken at the downstream of the river. BOD of domestic wastewater at the pumping station (Location No. 5) is 510 mg/l and is relatively higher than the ordinal concentration of domestic wastewater.

(2) MPN Coliform

MPN coliform is the largest at the Location No. 1 (with the number of 3,600) and it endorsed the discharge of domestic wastewater from the pumping station.

According to the standard of the official registration, maximum permissible value of coliform is set forth as 1,000 in MPN, so that the water quality at the sea shore may not be preferable for the recreation use.

3) Assessment of Water Pollution

Pollution of wastewater in the Esmeraldas EPZ has been assessed by referring to the unit pollutant load as shown in Table K-10 and as summarized hereunder.

BOD	:	Total pollutant load	1,362 kg/day
		Total water use	2,464 m^3/day
		BOD	553 mg/l
SS	:	Total pollutant load	764 kg/day
		Total water use	2,464 m^3/day
		SS	310 mg/l

Through the treatment of wastewater proposed in the Esmeraldas EPZ, BOD of the treated water is assessed to be 55 mg/l and SS is 70 mg/l. (This implies that the removal efficiency of BOD is about 90% and the SS removal efficiency is about 77%.)

On the other hand, the discharge of treated water from the EPZ is estimated to be 0.037 m^3/sec. This water is proposed to be led to the existing pumping station, where BOD was assessed to be 510 mg/l and SS was 568 mg/l.

Judging from the discharge of 0.76 m^3/sec in the disposal of wastewater to the sea through the existing pumping station and pipeline, the additional discharge of 0.037 m^3/sec from the Esmeraldas EPZ will not be substantial. It is also evaluated that the diffusion of polluted water originally estimated to be 340 m in diameter in the existing disposal system will not be enlarged substantially by the additional disposal of treated water from the Esmeraldas EPZ.

4) Recommendations

In the light of the study on the extent of the water pollution in and around Esmeraldas EPZ, following observations are presented in a summarised form:

- For potable water, the New Regional Water Supply System is scheduled to be operated in 1992, or before the start of operation of the Esmeraldas EPZ, and water required for the industrial use is planned to be conducted from this new system. Therefore, there is no problem of water quantity in the potable water supply.

However, it should be noted that some of the old pipes will remain in the city and the so - called "red water" or "black water" will probably occur. In this connection, it is requested that IEOS and Water Supply Enterprise of Esmeraldas city would continue the maintenance work constantly.

- The river and sea water is relatively polluted. Present degree of pollution is not fatal, but it will soon be worsen up to the serious level. In order to solve this problem, improvement of the existing drainage and sewerage system is inevitably necessary. For this purpose, provision of the wastewater treatment plant is recommended to treat the domestic wastewater from the city. It is for this reason that the Esmeraldas EPZ is proposed to have a wastewater treatment plant in the EPZ area.

- It is also recommended to establish a monitoring system, in order to assess the present condition of water pollution and to know the indication to the solution of the water pollution.

K.3.2 Air Pollution

As described in the previous Section, there is no obvious air pollution in Esmeraldas city at present. With the new industries to be established in the Esmeraldas EPZ, air pollution would be generated to some extent.

1) Source of air pollution

In the Esmeraldas EPZ, SOx, NOx, soot and dust and particulate are considered to be the major air pollution sources.

Incineration of the solid waste is not proposed in the Esmeraldas EPZ, and the air pollution is generated only by the industrial producing process. In this context, it is not possible to assume the detail process on each industry, and it is therefore hard to estimate SO_2, NO_2, SPN and CO. In any case, SO_2 and NO_2 to be generated by the selected categories of industries to be located in the Esmeraldas EPZ will be quite negligible.

2) Standard of environment

Standard of environment concerning air pollution has not been clearly established in Ecuador. Example of standard which is currently applied in Peru is referred to hereunder:

SO_2	24 hour value	0.14 ppm
	Annual average	0.03 ppm
NO_2	24 hour value	0.65 ppm
	Annual average	0.05 ppm
SPN	24 hour value	260 ug/m^3
	Annual average	80 ug/m^3
CO	1 hour value	35 ppm
	8 hour value	9 ppm

3) Monitoring system

Current practice in relation to monitoring of air quality made in Japan is referred to hereunder:

(1) Location

CO_2 : Sampling point will be set at the density of 1 location in 25 km^2. In case that air pollution seems to grow, location number will be increased.

CO : Measurement point will be set where mobility of vehicle is frequent in the EPZ.

SPM and NO_2 : Measurement point will basically be the same as above CO.

(2) Period of measurement

Measurement will be basically executed twice a month throughout the year.

(3) Method of measurement

SO_2 : Electric conductivity with hydrogen peroxide method will be recommendable.

NO_2 and CO : Absorptiometry will be recommendable.

SPM : Collection of suspended particulate on the filter and measurement of the weight will be recommended.

K.3.3 Other Environment

Other environmental aspects will involve noise and oscillation, groundwater contamination, solid waste disposal and so forth.

During the construction and operation of the Esmeraldas EPZ, noise and oscillation would be generated to some extent. However, the location of the EPZ is apart for the urban area of Esmeraldas city, except for some residential area to be developed by navy in the area extended to the south of the Esmeraldas EPZ. From this navy residential area, the EPZ is separated by the roads and fence zone of about 12 m in width. The industries to be planned in the southern corner of the EPZ are mainly apparel industries which are low in generating noise and oscillation.

With respect to the groundwater contamination, attention has been drawn to the relatively high groundwater level (2.50 m from the ground surface as verified through the geotechnical survey as presented in Annex G). Drainage and sewerage systems have been proposed to prevent groundwater contamination, as presented in Annex J. Further attention should be drawn not to leave contaminated materials of industries in such a form and in such an area as undrainable to the drainage system.

The solid waste disposal system has been proposed in Annex J. Major points of solid waste disposal related with the environmental aspects are offensive odor, generation of insects and discharge of infiltrated water into the public water course. These problems are contemplated to be solved by periodical monitoring and improvement work. The problems related with this system can be avoided by the provision of well managed disposal system as proposed in Annex J.

Table K-1 STANDARD FOR POTABLE WATER QUALITY FOR CONVENTIONAL TREATMENT

Parameter	Expressed as	Unit	Maximum Permissible Value
Temperature		°C	Natural Condition ± 3
Hydrogen Potential	pH		6 - 9
Dissolved Oxygen	D.O.	mg/l	80% of saturation and not less than 6 mg/l
Biochemical Oxygen Demand	BOD5	mg/l	10% BOD5 admissible and maximum 2 mg/l
Coliform	MPN/100cm^3	Coli. Tot.	3,000
		Coli. Fet.	600
Oil & Grease	Visible		Absence
Dissolved Solids		mg/l	1,000
Turbidity		UTF	100
Color	Real color	Unit of color	100
Odor & flavor			Odor and flavor removable by conventional treatment
Floating Material			Absence
Ammonia	N-ammonia	mg/l	1.0
Arsenic	As	mg/l	0.05
Barium	Ba	mg/l	0.1
Cadmium	Cd	mg/l	0.01
Cyanide	CN-	mg/l	0.2
Zinc	Zn	mg/l	5.0
Chloride	Cl	mg/l	250.0
Copper	Cu	mg/l	1.0
Phenolic Compound	Fenol	mg/l	0.002
Chromium	Cr^{+6}	mg/l	0.05
Diphenyle Polychlorate	Concentration of active agent		Not detectable
Mercury	Hg	mg/l	0.002
Nitrate	N-nitrate	mg/l	10.00
Nitrite	N-nitrite	mg/l	1.0
Silver	Ag	mg/l	0.05
Lead	Pb	mg/l	0.05
Selenium	Se_2	mg/l	0.01
Sulfate	So_4	mg/l	400.0
Tensoactivos	Active substances with methylene blue	mg/l	0.5

Source: Official Registration, Organ of the Government of Ecuador 1989

Table K-2 STANDARD FOR POTABLE WATER QUALITY FOR TREATMENT OF DISINFECTION

Parameter	Expressed as	Unit	Maximum Permissible Value
Temperature		°C	Natural Condition ± 3
Hydrogen Potential	pH		6 - 9
Dissolved Oxygen	D.O.	mg/l	80% of saturation and not less than 6 mg/l
Biochemical Oxygen Demand	BOD_5	mg/l	10% BOD_5 admissible and maximum 2 mg/l
Coliform	$MPN/100cm^3$	Coli. Tot.	100
		Coli. Fet.	20
Oil & Grease	Visible		Absence
Dissolved Solids		mg/l	1,000
Turbidity		UTF	10
Color	Real color	Unit of color	20
Odor & flavor			Absence
Floating Material			Absence
Ammonia	N-ammonia	mg/l	1.0
Arsenic	As	mg/l	0.05
Barium	Ba	mg/l	1.0
Cadmium	Cd	mg/l	0.01
Cyanide	CN-	mg/l	0.2
Zinc	Zn	mg/l	5.0
Chloride	Cl	mg/l	250.0
Copper	Cu	mg/l	1.0
Phenolic Compound	Fenol	mg/l	0.002
Chromium	Cr^{+6}	mg/l	0.05
Diphenyle Polychlorate	Concentration of active agent		Not detectable
Mercury	Hg	mg/l	0.002
Nitrate	N-nitrate	mg/l	10.00
Nitrite	N-nitrite	mg/l	1.0
Silver	Ag	mg/l	0.05
Lead	Pb	mg/l	0.05
Selenium	Se_2	mg/l	0.01
Sulfate	So_4	mg/l	400.0
Tensoactivos	Active substances with methylene blue	mg/l	0.5

Source: Official Registration, Organ of the Government of Ecuador 1989

Table K-3 STANDARD FOR FISH FEEDING

Parameter	Expressed as	Unit	Maximum Permissible Value
Aluminum	Al	mg/l	5.0
Arsenic	As	mg/l	0.2
Baron	B	mg/l	5.0
Cadmium	Cd	mg/l	0.05
Zinc	Zn	mg/l	25.0
Copper	Cu	mg/l	0.5
Chromium	Cr^{+6}	mg/l	1.0
Mercury	Hg	mg/l	0.01
Nitrates + Nitrites	N	mg/l	10.0
Nitrites	N-nitrites	mg/l	1.0
Lead	Pb	mg/l	0.05
Total Dissolved Solid	TDS	mg/l	3000

Source: Official Registration, Organ of the Government of Ecuador 1989

Table K-4 STANDARD FOR RECREATIONAL USE

Parameter	Expressed as	Unit	Maximum Permissible Value
Coliform Bacteria	MPN/100 cm^3	Coli. Fecal Coli. Total	200 1000
Phenolic Compounds	Fenol	mg/l	0.002
Dissolved Oxygan	D.O	mg/l	80% concentration of saturation and no less than 6 mg/l
Hydrogen Potential	pH		6.5 ~ 8.5
Teso Actives	Active Substances with methylene blue	mg/l	0.5
Grease and Oils	Visible		Absense
Floating Material			Absense
Nitrogen-organic phosphorus ratio			15 : 1

Remark: Visibility of disk shall be at least 2 m keep.

Source: Official Registration, Organ of the Government of Ecuador 1989

Table K-5 STANDARD OF WATER FOR AGRICULTURAL USE

Parameter	Expressed as	Unit	Maximum Permissible Value
Aluminium	Al	mg/l	5.0
Arsenic	As	mg/l	0.1
Beryllium	Be	mg/l	0.1
Boron	B	mg/l	1.0
Cadmium	Cd	mg/l	0.01
Zinc	Zn	mg/l	2.0
Cobalt	Co	mg/l	0.05
Copper	Cu	mg/l	2.0
Chromium	Cr^{+6}	mg/l	0.1
Fluorine	F	mg/l	1.0
Iron	Fe	mg/l	5.0
Lithium	Li	mg/l	2.5
Manganese	Mn	mg/l	0.2
Molybdenum	Mo	mg/l	0.01
Nickel	Ni	mg/l	0.2
Hydrogen Potential	pH	mg/l	6-9
Lead	Ph	mg/l	0.05
Selenium	Se	mg/l	0.02
Vanadium	V	mg/l	0.1
Coliform	Mfn/100 cm^3	Colif. total	1000
Parasite Eggs			Absense
Oil & Grease	Visible		Absense
Floating Material			Absense

Source: Official Registration, Organ of the Government of Ecuador 1989

Table K-6 STANDARD OF DISCHARGE TO THE WATER BODY

	Parameter	Expressed as	Maximum Permissible Value
1)	Hydrogen Potential	pH	5 - 9
2)	Temperature	°C	< 35
3)	Floating Material	-	Absence
4)	Greases & Oils	-	Absence
5)	Suspended Solids	-	Removal of > 80% in load
6)	Biochemical Oxygen Demand for domestic or industrial wastes		Removal of > 80% in load

Source: Official Registration, Organ of the Government of Ecuador 1989

Table K-7 STANDARD OF EFFLUENT WATER INTO PUBLIC SEWERAGE

Parameter	Expressed as	Unit	Maximum Permissible Value
Hydrogen Potential	pH	-	5 - 9
Temperature	-	°C	< 40
Acids or bases that could cause pollution explosive or flammable substance	-	-	Absence
Sedimentable Solids	-	ml/l	10
Soluble substances in hexane	-	mg/l	50
Suspended Solids (SS)	-	-	Removal of > 80% in load
Biochemical Oxygen Demand (BOD)	BOD_5	-	Removal of > 80% in load
Maximum Flow	1.5 times the average hourly flow		

Source: Official Registration, Organ of the Government of Ecuador 1989

Table K-8 CONCENTRATION OF LOADS FOR SANITARY IMPLICATIONS

Substance	Expressed as	Unit	Concentration
Arsenic	As	mg/l	0.1
Barium	Ba	mg/l	5.0
Cadmium	Cd	mg/l	0.02
Copper	Cu	mg/l	1.0
Chromium	Cr^{+6}	mg/l	0.5
Phenolic Compound	Fenol	mg/l	0.2
Mercury	Hg		0.01
Nickel	Ni	mg/l	2.0
Silver	Ag	mg/l	0.5
Lead	Pb	mg/l	0.5
Selenium	Se	mg/l	0.5
Cyanide	CN-	mg/l	1.0
Diphenil Polychlorates	Concentration of active agent	mg/l	Not detectable
Organic Mercury	Hg	mg/l	Not detectable
Trichloroetylene	Trichloroetylene	mg/l	1.0
Chloroform	Carbon Chloroform Extract (CCE)		
Carbon Tetrachloride	Carbon Tetrachloride	mg/l	1.0
Dichloethylene	Dichloethylene	mg/l	1.0
Carbon Sulfide	Carbon Sulfide	mg/l	1.0
Other organic chloride compounds (each type)	Concentration of active agent	mg/l	0.05
Organic phosphate compounds (each type)	Concentration of active agent	mg/l	0.1
Carbonate		mg/l	0.1
Hydrocarbon		mg/l	20.0
Active Chlorine		mg/l	0.5

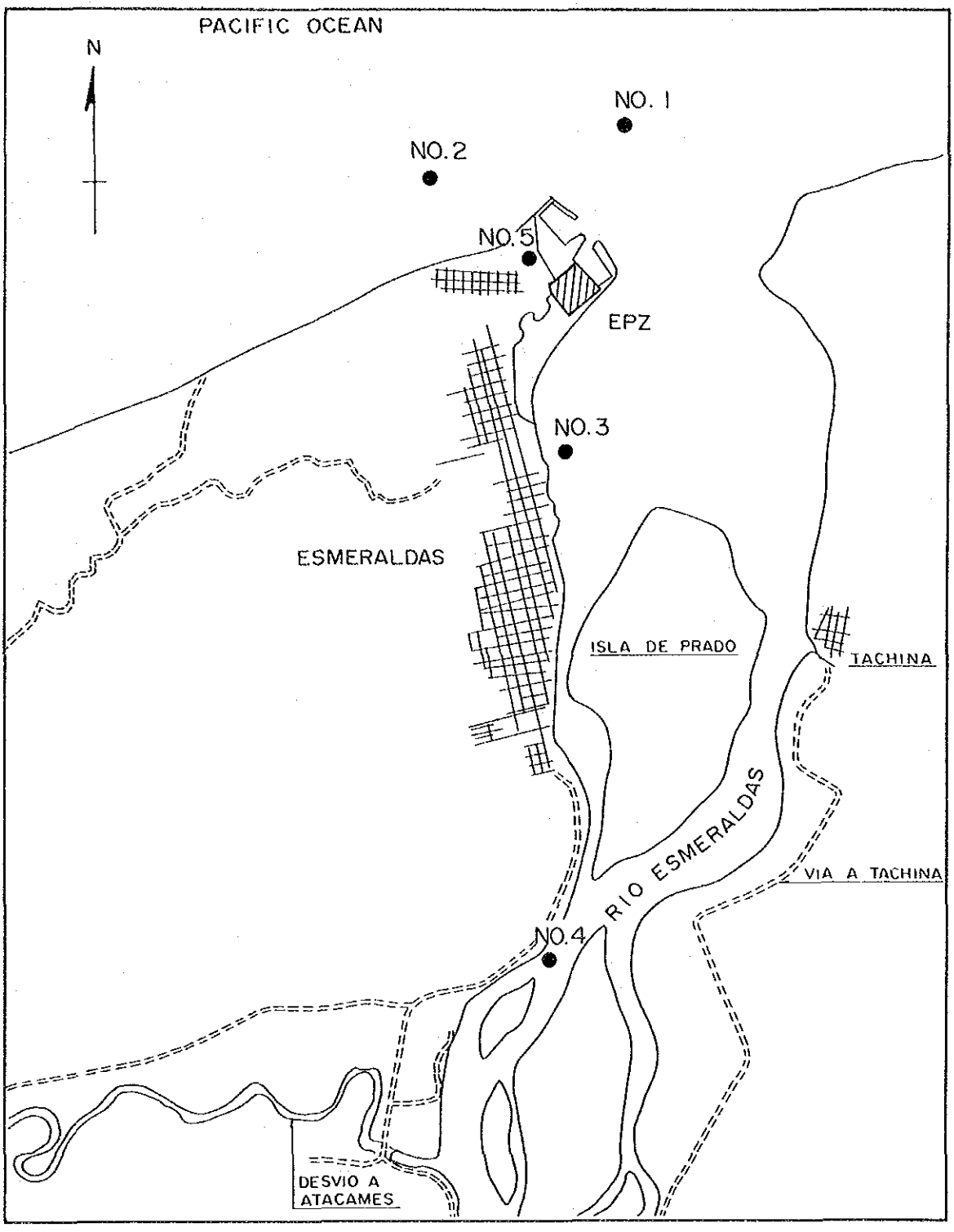
Source: Official Registration, Organ of the Government of Ecuador 1989

Table K-9 RESULTS OF WATER QUALITY EXAMINATION

Point No.	1	2	3	4	5
Location	Polluted Water Area in the Sea	Clean Water Area in the Sea	Downstream of the River	Upperstream of the River	Chamber of Pumping Station
Time	7:40	8:00	8:45	9:20	10:40
Atmospheric Temperature (°C)	26	28	30	30	35
Water Temperature (°C)	23	24	25	26	30
pH	7.70	7.90	7.66	7.40	8.10
Transparency (m)	1.40	1.70	0.80	0.60	-
Turvidity (NTV)	0.90	0.75	7.50	14.0	-
Color (Pt/co)	10	5	20	30	-
Dissolved Oxygen (mg/l)	6.20	6.70	7.10	6.90	-
BOD (mg/l)	7.5	6.3	13.5	1.2	510
COD (mg/l)	577	106	462	19	
SS (mg/l)	8720	8180	584	60	568
Coliform (MPN/100 ml)					
Total	3600	20	460	9	110×10^6
Fatal	0	0	15	3	35×10^6

Table K-10 WAER USE AND POLLUTANT LOAD

Name of Industry	Water Demand Per Day (m3/day)	Unit Pollutant Load /l			Pollutant Load		
		BOD (mg/l)	COD (mg/l)	SS (mg/l)	BOD (kg/day)	COD (kg/day)	SS (kg/day)
S - 1 Food (Sea Food)	61.74	1,200	1,350	425	74.0	83.0	26.0
2 Food	65.40	600	500	500	39.0	33.0	33.0
3 Apparel (Label)	33.82	10	10	50	0.3	0.3	1.7
4 Furniture	4.35	10	10	40	0.04	0.04	0.2
5 Apparel (Blanket)	55.08	10	10	30	0.6	0.6	1.7
6 Apparel	7.50	10	10	30	0.08	0.08	0.2
7 Apparel	8.50	10	10	30	0.09	0.09	0.3
8 Apparel	7.50	10	10	30	0.08	0.08	0.2
9 Electric Lamp	30.15	10	30	100	0.3	0.9	3.0
10 Chemical (Cosmetic)	14.70	350	350	100	5.0	5.0	1.5
11 Apparel	8.00	10	10	30	0.08	0.08	0.2
12 Apparel	8.00	10	10	30	0.08	0.08	0.2
M - 1 Food	149.94	1,200	1,350	425	180.0	202.0	64.0
2 Apparel	30.00	10	10	30	0.3	0.3	0.9
3 Apparel (Sport Wear)	22.80	10	10	30	0.2	0.2	0.7
4 Apparel	30.00	10	10	30	0.3	0.3	0.9
5 Chemical (Plastic Film)	268.20	300	460	100	80.0	123.0	27.0
6 Chemical (Plastic Shoes)	138.00	10	20	50	1.4	2.8	6.9
7 Chemical (Cosmetic)	52.92	350	350	100	18.5	18.5	5.3
8 Apparel	28.50	10	10	30	0.3	0.3	0.9
9 Electric Control Device	48.72	20	40	800	1.0	1.9	39.0
10 Metal	48.72	20	40	800	10.0	1.9	39.0
11 Furniture	10.40	10	10	30	0.1	0.1	0.3
12 Wire Harness	31.20	10	20	100	0.3	0.6	3.1
13 Woodmill	17.40	3,000	5,900	4,100	52.0	103.0	71.0
L - 1 Apparel (Underwear)	33.60	10	10	30	0.3	0.3	1.0
2 Apparel (Sleepwear)	24.00	10	10	30	0.2	0.2	0.7
3 Animal Feed	328.80	1,200	480	25	395.0	158.0	8.0
4 Wood	44.20	10	10	30	0.4	0.4	1.3
5 Food (Canned)	851.40	600	500	500	511.0	426.0	426.0
Total	2,463.54	-	-	-	1,362	1,163	764



LEGEND NO. 1 - NO. 5 : Sampling Point Scale 1 : 50,000	ESMERALDAS EXPORT PROCESSING ZONE DEVELOPMENT PROJECT Fig. K-1 Location Map of Sampling JAPAN INTERNATIONAL COOPERATION AGENCY

ANNEX L

CONSTRUCTION SCHEDULE

AND COST ESTIMATE

ANNEX-L

DEVELOPMENT SCHEDULE AND COST ESTIMATE

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L.1 GENERAL

Establishing of the Esmeraldas EPZ has been planned to be constructed in one stage in view of the minimal scale of construction work as the industrial estate. It is noted, however, that the standard factories which will require larger investments will be scheduled for construction step by step.

The construction schedule is tentatively programed as summarized hereunder.

1. Land levelling	1992
2. Construction of road & utilities	1992 and 1993
3. Construction of standard factories	1993, 1994 and 1995 (3 stages)
4. Construction of administration & service facility	1993 ~ 1995
5. Start of factory operation	Beginning of 1994
6. Full scale operation	1996

The construction cost will cover the cost of land leveling, utilities, standard factory and other facilities. The costs of the detailed design and supervision work, as well as the promotion work, are also estimated on the basis of the mid 1991 prices.

The construction cost will be divided into two costs; i.e. internal cost and external cost. The internal cost is the direct cost that ZOFREE should bear as the executing agency of the project implementation. On the other hand, the external cost is the associated cost that the other agencies and institutions would be responsible for.

L.2 DEVELOPMENT SCHEDULE

L.2.1 Construction Schedule

The construction schedule of the Esmeraldas EPZ has been programmed in the light of construction work volume, climatic conditions, availability of construction materials and capability of the contractors, as illustrated in Figure L-1.

The financial arrangement for the construction and the promotion work to the potential investors are necessary prior to the construction work to be started in the middle of 1992. The preparation of land and construction of utilities and other facilities will be scheduled to start in July 1992 and to complete in the end of 1993. The construction work of the standard factory and some service facilities will be continued until the year of 1995. Consequently, completion of the total construction work of the Esmeraldas EPZ will be set at the end of 1995.

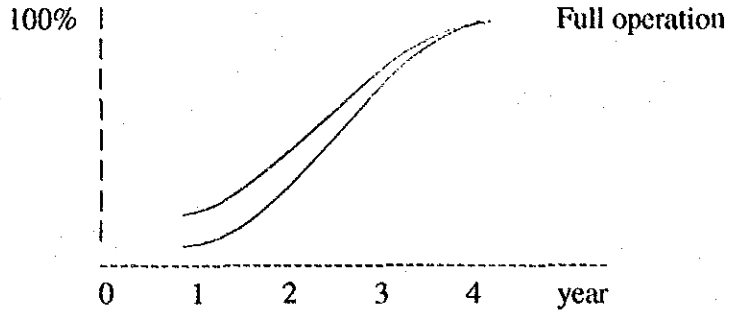
The construction schedule of the standard factory will be planned in line with the investment demand as shown below.

	1993	1994	1995	Total
• No. of standard factory	2	3	5	10
• Floor area (m2)	1,500	3,500	13,300	18,300
• Lot area (m2)	3,700	9,200	38,600	51,500

L.2.2 Programme of Factory Operation

It is expected and planned that the Esmeraldas EPZ will be put into full operation in three (3) years after the commencement of EPZ operation.

In the light of the cumulative curve of factory operation in other existing EPZs, in general, as shown below, the ratio of the factory operation for the Esmeraldas EPZ will be assumed as tabulated hereunder.



	Ratio (%)	Cumulative Ratio(%)
1994	20	20
1995	30	50
1996	50	100

The operation schedule by number of investors is calculated on the basis of the following assumption:

(1) 20%, 30% and 50% of the number of factory is distributed in the year 1994, 1995 and 1996, respectively.

(2) Foreign investors will be scheduled to start its operate in 1996.

(3) Apparel industry will start in the early stage, while food and chemical industries will operate in the latter stage.

(4) Small lots will be occupied in the early stage, while large lots will be occupied in the latter stage.

(Unit: Investors)

	1994	1995	1996	Total
Small lot	4	3	5	12
Medium lot	2	4	7	13
Large lot	0	2	3	5
Total	6	9	15	30

The detailed operation schedule by lot area and floor area are shown in Table L-1 and Table L-2.

L.3 CONSTRUCTION COST

L.3.1 Basis of Cost Estimate

1) Direct construction cost

Construction cost of each item of work has been estimated on the basis of work quantity calculated from the preliminary design of each work, as well as on the basis of unit prices prevailing in the middle of 1991.

2) Engineering and architectural fee

Rate of engineering service and architectural services to be applicable on the direct construction cost has been estimated to be 8%. Detailed design and supervision of the construction work are included in the engineering service.

3) Physical contingencies

Physical contingency covering the uncertainty of the design conditions has been estimated at the rate of 10% of the direct construction cost and the engineering and architectural fee.

4) Promotion cost

Cost of promotion activities has been estimated independently on the basis of the remuneration and relevant direct costs.

L.3.2 Estimated Cost

The investment cost of the Esmeraldas EPZ is estimated to be US$6.14 million in total as summarized hereunder.

(Unit: $1,000)

		Foreign Currency	Local Currency	Total
I.	Internal Cost			
	- Direct Construction cost	1,290	3,110	4,400
	- Engineering & Architectural fee	100	250	350
	- Promotion cost	230	160	390
	- Physical contingency	140	340	480
	Total	1,760	3,860	5,620
II.	External Cost			
	- Direct Construction cost	150	290	440
	- Engineering & Architectural fee	10	20	30
	- Physical contingency	20	30	50
	Total	180	340	520
III.	Total Cost			
	- Direct Construction cost	1,440	3,400	4,840
	- Engineering & Architectural fee	110	270	380
	- Promotion cost	230	160	390
	- Physical contingency	160	370	530
	Total	1,940	4,200	6,140
		(33.0) %	(67.0) %	(100%)

Remark: The external cost which is expected to be financed by the other agency or institutions will include the cost of access road to the fishing port, water supply facility and gasoline station.

The breakdown of the cost estimate is shown in Table L-3 to Table L-17.

L.3.3 Cost Disbursement

Construction cost will be disbursed in each year as shown in Table L-18 to Table L-20, and as summarized hereunder. Larger expenses will be allocated in 1993 and 1995 when the construction work of utilities and factory buildings are concentrated.

(Unit: $1,000)

	1992	1993	1994	1995	Total
Internal cost	860	2,180	560	2,020	5,610
External cost	160	340	0	20	520
Total	1,020	2,520	560	2,040	6,140

L.3.4 Operation and Maintenance Cost

Operation and maintenance cost have been calculated on the basis of the remuneration and the direct cost of O&M (2% of construction cost). It is estimated to total $206,000 annually after the year of 1996 for the internal cost. The detailed estimate of the operation and maintenance cost is presented in Table L-21 to Table L-23.

Table L-1 OPERATION SCHEDULE OF FACTORY

		Number of Investment				Lot Area (ha)				Floor Area (ha)			
		94	95	96	Total	94	95	96	Total	94	95	96	Total
Own Built Factory	Small lot	2	1	4	7	0.30	0.16	0.61	1.07				
	Medium lot	2	3	5(1)	10(1)	1.17	1.76	2.85	5.78				
	Large lot	0	2	1	3	0	2.50	2.20	4.70				
	Subtotal	4	6	10(1)	20(1)	1.47	4.42	5.66	11.55				
Standard Factory	Small lot	2	2	1	5	0.37	0.32	0.21	0.90	0.15	0.14	0.07	0.36
	Medium lot	0	1	2(2)	3(2)	0	0.60	1.25	1.85	0	0.21	0.42	0.63
	Large lot	0	0	2(2)	2(2)	0	0	2.40	2.40	0	0	0.84	0.84
	Subtotal	2	3	5(4)	10(4)	0.37	0.92	3.86	5.15	0.15	0.35	1.33	1.83
Total	Small lot	4	3	5	12	0.67	0.48	0.82	1.97				
	Medium lot	2	4	7(2)	13(2)	1.17	2.36	4.10	7.63				
	Large lot	0	2	3(3)	5(3)	0	2.50	4.60	7.10				
	Subtotal	6	9	15(5)	30(5)	1.84	5.34	9.52	16.70				

Remark:( ) represents the foreign investor, inclusive in total number.

Table L-2 OPERATION SCHEDULE BY LOT (ASSUMPTION)

Lot No.	Industrial Category	Lot area	Emp-loyee	Standard Factory (floor area m2)	Commencement of operation '94	'95	'96	Remarks
(Small Size Lot)		(m2)						
S-1	Food(Sea food)	2,100	15	X(750m2)			X	
S-2	Food	1,500	15	-			X	
S-3	Apparel(Label)	1,900	50	X(750m2)	X			
S-4	Furniture	1,500	5	-			X	
S-5	Apparel(Blanket)	1,800	50	X(750m2)	X			
S-6	Apparel	1,500	40	-	X			
S-7	Apparel	1,700	40	X(750m2)		X		
S-8	Apparel	1,500	40	-	X			
S-9	Electric(Lamp)	1,500	15	X(600m2)		X		
S-10	Cosmetic	1,500	15	-			X	
S-11	Apparel	1,600	40	-		X		
S-12	Apparel	1,600	40	-			X	
(Medium Size Lot)								
M-1	Food	5,100	30	-			X	
M-2	Apparel	6,000	150	X(2,100m2)		X		
M-3	Sport wear	6,000	150	X(2,100m2)			X	(USA)
M-4	Apparel	6,000	150	-	X			
M-5	Plastic film	6,000	60	-			X	
M-6	Plastic shoes	6,000	150	-			X	
M-7	Cosmetic	5,400	50	-			X	
M-8	Apparel	5,700	140	-	X			
M-9	Electric device	5,800	60	-		X		
M-10	Metal	5,800	60	-		X		
M-11	Furniture(Rattan)	6,500	150	X(2,100m2)			X	(Mexico)
M-12	Wire harnesses	6,000	100	-			X	(USA)
M-13	Furniture	6,000	15	-		X		
(Large Size Lot)								
L-1	Underwear	12,000	300	X(4,200m2)			X	(USA)
L-2	Sleep wear	12,000	300	X(4,200m2)			X	(USA)
L-3	Animal feed	12,000	60	-		X		
L-4	Wood	13,000	60	-		X		
L-5	Canned food	22,000	100	-			X	
Total		67,000	2,450	10 lots	6	9	15 lots	

Table L-3 SUMMARY OF CONSTRUCTION COST (INTERNAL AND EXTERNAL COST)

(Unit : $1,000)

Item	Foreign Currency	Local Currency	Total	Remarks
I Construction Cost				
1 Land leveling	0	132	132	Refer to Table L-6
2 Infrastructure				
1) Road	0	107	107	Refer to Table L-7
2) Drainage	0	326	326	Refer to Table L-8
3) Water supply	152	256	408	Refer to Table L-9
4) Sewerage	1,029	265	1,294	Refer to Table L-10
5) Solid Waste Disposal	0	217	217	Refer to Table L-11
6) Electric facility	0	50	50	Refer to Table L-12
7) Telecommunication	0	0	0	
8) Sub total	1,181	1,222	2,402	
3 Standard factory	242	1,749	1,990	Refer to Table L-13
4 Administrative facility	9	86	95	Refer to Table L-14
5 Service facility	11	107	117	Refer to Table L-15
6 Others	0	105	105	Refer to Table L-16
7 Sub total	1,441	3,400	4,841	
II Engineering and Administration Cost	115	272	387	8 % of Construction cost
III Promotion Cost	227	157	384	Refer to Table L-17 Cost for 3.5 years
IV Physical Contingency	156	367	523	10 % of (I and II)
Total	1,939	4,196	6,135	

Remarks: /1 At June 1991 prices

/2 Land is subsidized by Port Authority.

Table L-4 SUMMARY OF CONSTRUCTION COST (INTERNAL COST)

(Unit : $1,000)

Item	Foreign Currency	Local Currency	Total	Remarks
I Construction Cost				
1 Land leveling	0	132	132	Refer to Table L-6
2 Infrastructure				
1) Road	0	91	91	Refer to Table L-7
2) Drainage	0	326	326	Refer to Table L-8
3) Water supply	0	0	0	Refer to Table L-9
4) Sewerage	1,029	265	1,294	Refer to Table L-10
5) Solid Waste Disposal	0	217	217	Refer to Table L-11
6) Electric facility	0	50	50	Refer to Table L-12
7) Telecommunication	0	0	0	
8) Sub total	1,029	950	1,979	
3 Standard factory	242	1,749	1,990	Refer to Table L-13
4 Administrative facility	9	86	95	Refer to Table L-14
5 Service facility	9	90	99	Refer to Table L-15
6 Others	0	105	105	Refer to Table L-16
7 Sub total	1,288	3,112	4,400	
II Engineering and Administration Cost	103	249	352	8 % of Construction cost
III Promotion Cost	227	157	384	Refer to Table L-17 Cost for 3.5 years
IV Physical Contingency	139	336	475	10 % of (I and II)
Total	1,757	3,854	5,611	

Remarks: /1 At June 1991 prices

/2 Land is subsidized by Port Authority.

Table L-5 SUMMARY OF CONSTRUCTION COST (EXTERNAL COST)

(Unit : $1,000)

Item	Foreign Currency	Local Currency	Total	Remarks
I Construction Cost				
1 Infrastructure				
1) Access Road to fishing port	0	16	16	Refer to Table L-7
2) Water supply	152	256	408	Refer to Table L-9
3) Sub total	152	272	424	
2 Gasoline station	2	16	18	Refer to Table L-15
3 Sub total	154	288	441	
II Engineering and Administration Cost	12	23	35	8 % of Construction Cost
III Promotion Cost	0	0	0	
IV Physical Contingency	17	31	48	10 % of (I and II)
Total	182	342	524	

Remark: /1 At June 1991 prices

/2 Land is subsidized by Port Authority.

Table L-6 COST OF LAND LEVELLING

Itm	Unit	Q'ty	Unit Price($)			Amount ($1,000)			Remarks
			FC	LC	Total	FC	LC	Total	
1 Leveling	m2	220,000	0	0.5	0.5	0	110.00	110.00	
2 Miscellaneous	LS	1	0	22	22	0	22.00	22.00	20 % of (1)
3 Total						0	132.00	132.00	

Remarks: /1 At June 1991 prices
/2 Tax is inclusive.

Table I.-7 CONSTRUCTION COST OF ROADS

Item		Unit	Q'ty	Unit Price($)			Amount ($1,000)			Remarks
				FC	LC	Total	FC	LC	Total	
	1 Boulevard	m	129	0	70.06	70.06	0.00	9.04	9.04	W==20m
	2 Main road	m	940	0	54.45	54.45	0.00	51.18	51.18	W==16m
Internal	3 Sub road	m	415	0	27.72	27.72	0.00	11.50	11.50	W==12m
Facility	4 Patroll road	m	1,310	0	12.84	12.84	0.00	16.82	16.82	W==4m
	5 Pedestrian deck	m	180	0	15.66	15.66	0.00	2.82	2.82	W==6m
	6 Sub total		2,974				0.00	91.36	91.36	
External	7 Access road									
Facility	to fishing port	m	785	0	20.31	20.31	0.00	15.94	15.94	W==7m
Total			3,759				0.00	107.31	107.31	

Remarks: /1 At June 1991 prices
/2 Tax is inclusive.

Table L-8 CONSTRUCTION COST OF DRAINAGE SYSTEM

Item	Unit	Q'ty	Unit Price ($)			Amount ($1,000)			Remarks
			FC	LC	Total	FC	LC	Total	
1 Ductile Iron Pipe (ø600)	m	230	0	82.29	82.29	0	18.92	18.92	
2 Ductile Iron Pipe (ø700)	m	15	0	135.73	135.73	0	2.03	2.03	
3 Ductile Iron Pipe (ø900)	m	8	0	179.87	179.87	0	1.43	1.43	
4 Ductile Iron Pipe (ø1100)	m	120	0	233.62	233.62	0	28.03	28.03	
5 U-Drain	m	7010	0	28.79	28.79	0	201.81	201.81	
6 Rain Connecting Pipe (ø200)	m	144	0	21.25	21.25	0	3.06	3.06	
7 Street Connecting Pipe (ø200)	m	453	0	20.66	20.66	0	9.35	9.35	
8 Outflow Facility	unit	5	0	4,771.80	4,771.80	0	23.85	23.85	
9 Street Inlet	unit	138	0	173.09	173.09	0	23.88	23.88	
10 Rain Inlet in Lot	unit	36	0	100.25	100.25	0	3.61	3.61	
11 Manhole	set	8	0	1,253.12	1,253.12	0	10.02	10.02	
Total						0	325.99	325.99	

Remarks: /1 At June 1991 prices
/2 Tax is inclusive.

Table L-9 CONSTRUCTION COST OF WATER SUPPLY SYSTEM

Item		Unit	Q'ty	Unit Price ($)			Amount ($1,000)			Remarks
				FC	LC	Total	FC	LC	Total	
	1 Ductile Iron Pipe (ø1m		1525	0	82.44	82.44	0	125.72	125.72	
	2 Ductile Iron Pipe (ø?m		1190	0	41.38	41.38	0	49.24	49.24	
Internal	3 Water Storage Tank	set	1	151.97	55.49	207.46	151.97	55.49	207.46	
Facility	4 Valves	unit	8	0	612.92	612.92	0	4.9	4.9	
	5 Hydrants	unit	7	0	836.17	836.17	0	5.85	5.85	
External Facility	1 Ductile Iron Pipe (ø1m		177	0	82.44	82.44	0	14.59	14.59	
Total							151.97	255.79	407.76	

Remarks: /1 At June 1991 prices
/2 Tax is inclusive.

Table L-10 CONSTRUCTION COST OF SEWERAGE SYSTEM

Item			Unit	Q'ty	Unit Price ($)			Amount ($1,000)			Remarks
					FC	LC	Total	FC	LC	Total	
	1	Concrete Pipe (ø250	m	1647	0	29.72	29.72	0.00	48.94	48.94	
	2	Treatment Plant	set	1	1,028,571	87,781	1,116,352	1,028.57	87.78	1,116.35	
Internal	3	Concrete Pipe (ø300	m	10	0	54.4	54.4	0.00	0.54	0.54	
Facility	4	Connecting Pipe (ø1	m	432	0	69.74	69.74	0.00	30.12	30.12	
	5	Sewage Inlet	unit	36	0	100.25	100.25	0.00	3.60	3.60	
	6	Manhole	unit	58	0	1,109.24	1,109.24	0.00	64.33	64.33	
External Facility	1	Concrete Pipe (Conduction ø250)	m	563	0	29.72	29.72	0.00	16.73	16.73	
	2	Manhole	unit	12	0	1,109.25	1,109.25	0.00	13.31	13.31	
Total								1,028.57	265.35	1,293.92	

Remarks: /1 At June 1991 prices
/2 Tax is inclusive.

Table L-11 CONSTRUCTION COST OF SOLID WASTE DISPOSAL SITE

Itm	Unit	Q'ty	Unit Price($)			Amount ($1,000)			Remarks
			FC	LC	Total	FC	LC	Total	
1 Earth Work	m3	210.00	0	1.00	1.00	0.00	210.00	210.00	
2 Conventioanl Incinerator	unit	1.00	0	7,142.00	7,142.00	0.00	7.14	7.14	
Total						0.00	217.14	217.14	

Remarks: /1 At June 1991 prices
/2 Tax is inclusive.

Table L-12 CONSTRUCTION COST OF ELECTRIC FACILITY

Itm	Unit	Q'ty	Unit Price($)			Amount ($1,000)			Remarks
			FC	LC	Total	FC	LC	Total	
1 Civil work of sub station	LS	1	0	12,000	12,000	0	12	12	
2 Building work	LS	1	0	12,000	12,000	0	12	12	
3 Transportation and installation	LS	1	0	8,000	8,000	0	8	8	
4 Street light	LS	1	0	18,000	18,000	0	18	18	
5 Total						0	50	50	

Remarks: /1 At June 1991 prices
/2 Tax is inclusive.

Table L-13 CONSTRUCTION COST OF STANDARD FACTORY

Item	Unit	Q'ty	Unit Price($)			Amount ($1,000)			Remarks
			FC	LC	Total	FC	LC	Total	
Construction Cost									
1 Small lot	m2	3,600	13.2	96.00	109.20	47.52	345.60	393.12	
2 Medium lot	m2	6,300	13.2	95.83	109.03	83.16	603.72	686.88	
3 Large lot	m2	8,400	13.2	95.14	108.34	110.88	799.20	910.08	
Total						241.56	1748.52	1990.08	
(Unit Cost)									
1 Small lot									
1) Structure with roof,floor,wall	m2	600	0	70	70	0.00	42.00	42.00	
2) Electric installation	m2	600	6	2	8	3.60	1.20	4.80	
3) Sanitary installation	m2	600	5	5	10	3.00	3.00	6.00	
4) Pavement	m2	900	0	2	2	0.00	1.80	1.80	
5) Miscellaneous(green,gate,,etc.	LS	1	1.32	9.6	10.92	1.32	9.60	10.92	20 % x(1~4)
6) Total						7.92	57.60	65.52	
7) Unit cost($/m2)						13.20	96.00	109.20	
2 Medium lot									
1) Structure with roof,floor,wall	m2	2,100	0	70	70	0.00	147.00	147.00	
2) Electric installation	m2	2,100	6	2	8	12.60	4.20	16.80	
3) Sanitary installation	m2	2,100	5	5	10	10.50	10.50	21.00	
4) Pavement	m2	3000	0	2	2	0.00	6.00	6.00	
5) Miscellaneous(green,gate,,etc.	LS	1	4.62	33.54	38.16	4.62	33.54	38.16	20 % x(1~4)
6) Total						27.72	201.24	228.96	
7) Unit cost($/m2)						13.20	95.83	109.03	
3 Large lot									
1) Structure with roof,floor,wall	m2	4,200	0	70	70	0.00	294.00	294.00	
2) Electric installation	m2	4,200	6	2	8	25.20	8.40	33.60	
3) Sanitary installation	m2	4,200	5	5	10	21.00	21.00	42.00	
4) Pavement	m2	4,800	0	2	2	0.00	9.60	9.60	
5) Miscellaneous(green,gate,,etc.	LS	1	9.24	66.6	75.84	9.24	66.60	75.84	20 % x(1~4)
6) Total						55.44	399.60	455.04	
7) Unit cost($/m2)						13.20	95.14	108.34	

Remarks: /1 At June 1991 prices
/2 Tax is inclusive.

Table L-14 CONSTRUCTION COST OF ADMINISTRATIVE FACILITY

Item	Unit	Q'ty	Unit Price(S)			Amount ($1,000)			Remarks
			FC	LC	Total	FC	LC	Total	
I Administration building									
A ZOFREE office,meeting room, etc									
1 Structure with roof,floor,wall	m2	470	0	100	100	0.00	47.00	47.00	
2 Electric installation	m2	470	6	2	8	2.82	0.94	3.76	
3 Sanitary installation	m2	470	5	5	10	2.35	2.35	4.70	
4 Pavement	m2	1,000	0	2	2	0.00	2.00	2.00	
5 Miscellaneous	LS	1	1.034	10.458	11.492	1.03	10.46	11.49	20 % x(1~4)
6 Sub total						6.20	62.75	68.95	
B Post office									
1 Structure with roof,floor,wall	m2	30	0	100	100	0.00	3.00	3.00	
2 Electric installation	m2	30	6	2	8	0.18	0.06	0.24	
3 Sanitary installation	m2	30	5	5	10	0.15	0.15	0.30	
4 Pavement	m2	0	0	2	2	0.00	0.00	0.00	
5 Miscellaneous	LS	1	0.066	0.642	0.708	0.07	0.64	0.71	20 % x(1~4)
6 Sub total						0.40	3.85	4.25	
II Fire station									
1 Structure with roof,floor,wall	m2	150	0	100	100	0.00	15.00	15.00	
2 Electric installation	m2	150	6	2	8	0.90	0.30	1.20	
3 Sanitary installation	m2	150	5	5	10	0.75	0.75	1.50	
4 Pavement	m2	100	0	2	2	0.00	0.20	0.20	
5 Miscellaneous	LS	1	0.33	3.25	3.58	0.33	3.25	3.58	20 % x(1~4)
6 Sub total						1.98	19.50	21.48	
Total						8.58	86.10	94.68	

Remarks: /1 At June 1991 prices
/2 Tax is inclusive.

Table L-15 CONSTRUCTION COST OF SERVICE FACILITY

Item	Unit	Q'ty	Unit Price(S)			Amount (S1,000)			Remarks
			FC	LC	Total	FC	LC	Total	
I Service building									
A Lunch service center, Kiosk, Restaurant, Tenant									
1 Structure with roof,floor,wall	m2	590	0	100	70	0.00	59.00	59.00	
2 Electric installation	m2	590	6	2	8	3.54	1.18	4.72	
3 Sanitary installation	m2	590	5	5	10	2.95	2.95	5.90	
4 Pavement(parking,etc.)	m2	1,300	0	2	2	0.00	2.60	2.60	
5 Miscellaneous	LS	1	1.298	13.146	14.444	1.30	13.15	14.44	20 % x(1~4)
6 Total						7.79	78.88	86.66	
B Clinic									
1 Structure with roof,floor,wall	m2	90	0	100	70	0.00	9.00	9.00	
2 Electric installation	m2	90	6	2	8	0.54	0.18	0.72	
3 Sanitary installation	m2	90	5	5	10	0.45	0.45	0.90	
4 Pavement(parking,etc.)	m2	0	0	2	2	0.00	0.00	0.00	
5 Miscellaneous	LS	1	0.198	1.926	2.124	0.20	1.93	2.12	20 % x(1~4)
6 Total						1.19	11.56	12.74	
II Gasoline station									
1 Structure with roof,floor,wall	m2	120	0	100	70	0.00	12.00	12.00	
2 Electric installation	m2	120	6	2	8	0.72	0.24	0.96	
3 Sanitary installation	m2	120	5	5	10	0.60	0.60	1.20	
4 Pavement(parking,etc.)	m2	300	0	2	2	0.00	0.60	0.60	
5 Miscellaneous	LS	1	0.264	2.688	2.952	0.26	2.69	2.95	20 % x(1~4)
6 Total						1.58	16.13	17.71	
Total						10.56	106.56	117.12	

Remark: /1 At June 1991 prices
/2 Tax is inclusive.

Table L-16 CONSTRUCTION COST OF OTHER FACILITY

Item	Unit	Q'ty	Unit Price(S)			Amount ($1,000)			Remarks
			FC	LC	Total	FC	LC	Total	
1 Gate	Unit	4	0	400	400	0.00	1.60	1.60	
2 Fence	m	1,500	0	28	28	0.00	42.00	42.00	
3 Bus terminal	LS	1				0.00	3.42	3.42	
4 Sub total						0.00	47.02	47.02	
5 Sports park	LS	1				0.00	47.93	47.93	
6 Park	LS	1				0.00	10.13	10.13	
7 Sub total						0.00	58.06	58.06	
8 Total						0.00	105.08	105.08	

Remarks: /1 At June 1991 prices
/2 Tax is inclusive.

Table L-17 COST FOR PROMOTION (ANNUAL EXPENSE)

Item	Unit	Q'ty	Unit Price($)			Amount ($1,000)			Remarks
			FC	LC	Total	FC	LC	Total	
I Remuneration and daily allowance									
1 Staff	person	4	3,000	4,800	7,800	12.00	19.20	31.20	
2 Secretary	person	4	3,000	2,800	5,800	12.00	11.20	23.20	
3 Sub total						24.00	30.40	54.40	
II Direct cost									
1 Trip	LS					30.00	2.00	32.00	
2 Brochure, etc.	LS					0.00	5.00	5.00	
3 Sub total						30.00	7.00	37.00	
III Miscellaneous	LS					10.8	7.48	18.28	20 % of (I~II)
Total						64.8	44.88	109.68	
Cost for total period of 3.5 years						226.8	157.08	383.88	

Remarks: /1 At June 1991 prices
/2 Tax is inclusive.

Table L-18 DISBURSEMENT PLAN OF CONSTRUCTION COST (INTERNAL AND EXTERNAL COST)

(Unit : $1,000)

Item	TOTAL			1992			1993			1994			1995		
	FC	LC	Total	FC	LC	Total	FC	LC	Total	FC	LC	Total	FC	LC	Total
I Construction Cost															
1 Land leveling	0	132	132	0	132	132									
2 Infrastructure															
1) Road	0	107	107				0	107	107						
2) Drainage	0	326	326	0	109	109	0	217	217						
3) Water supply	152	256	408	51	85	136	101	171	272						
4) Sewerage	1,029	265	1,294	343	88	431	686	177	863						
5) Solid waste disposal	0	217	217				0	217	217						
6) Electric facility	0	50	50				0	50	50						
7) Telecommunication	0	0	0				0	0	0						
8) Sub total	1,181	1,222	2,402	394	282	676	787	939	1,726	0	0	0	0	0	0
3 Standard factory	242	1,749	1,990				20	143	163	46	332	378	176	1,273	1,449
4 Administrative facility	9	86	95				9	86	95						
5 Service facility	11	107	117										11	107	117
6 Park,Sports park	0	58	58										0	58	58
7 Others(Gate,Fence,Bus terminal	0	47	47				0	47	47						
8 Sub total	1,441	3,400	4,841	394	414	808	815	1,216	2,031	46	332	378	186	1,438	1,624
II Engineering and Admini. Cost	115	272	387	31	33	65	65	97	163	4	27	30	15	115	130
III Promotion Cost	227	157	384	32	22	55	65	45	110	65	45	110	65	45	110
IV Physical Contingency	156	367	523	42	45	87	88	131	219	5	36	41	20	155	175
Total	1,939	4,196	6,135	500	515	1,015	1,034	1,489	2,523	119	440	559	286	1,753	2,039

Remark: /1 At June 1991 prices

Table L-19 DISBURSEMENT PLAN OF CONSTRUCTION COST (INTERNAL COST)

(Unit : $1,000)

Item	TOTAL			1,992			1,993			1,994			1,995		
	FC	LC	Total	FC	LC	Total	FC	LC	Total	FC	LC	Total	FC	LC	Total
I Construction Cost															
1 Land leveling	0	132	132	0	132	132									
2 Infrastructure															
1) Road	0	91	91				0	91	91						
2) Drainage	0	326	326	0	109	109	0	217	217						
3) Water supply	0	0	0	0	0	0	0	0	0						
4) Sewerage	1,029	265	1,294	343	88	431	686	177	863						
5) Solid waste disposal	0	217	217				0	217	217						
6) Electric facility	0	50	50				0	50	50						
7) Telecommunication	0	0	0				0	0	0						
8) Sub total	1,029	950	1,979	343	197	540	686	753	1,439	0	0	0	0	0	0
3 Standard factory	242	1,749	1,990				20	143	163	46	332	378	176	1,273	1,449
4 Administrative facility	9	86	95				9	86	95						
5 Service facility	9	90	99										9	90	99
6 Park,Sports park	0	58	58										0	58	58
7 Others(Gate,Fence,Bus terminal	0	47	47				0	47	47						
8 Sub total	1,288	3,112	4,400	343	329	672	714	1,029	1,744	46	332	378	185	1,421	1,606
II Engineering and Admini. Cost	103	249	352	27	26	54	57	82	139	4	27	30	15	114	128
III Promotion Cost	227	157	384	32	22	55	65	45	110	65	45	110	65	45	110
IV Physical Contingency	139	336	475	37	36	73	77	111	188	5	36	41	20	154	173
Total	1,757	3,854	5,611	440	413	853	913	1,268	2,181	119	440	559	284	1,734	2,018

Remark: /1 At June 1991 prices

Table L-20 DISBURSEMENT PLAN OF CONSTRUCTION COST (EXTERNAL COST)

(Unit : $1,000)

Item	TOTAL			1992			1993			1994			1995		
	FC	LC	Total	FC	LC	Total	FC	LC	Total	FC	LC	Total	FC	LC	Total
I Construction Cost															
I Infrastructure															
1) Access road to fishing port	0	16	16				0	16	16						
2) Water supply	152	256	408	51	85	136	101	171	272						
3) Sub total	152	272	424	51	85	136	101	186	288	0	0	0	0	0	0
2 Gasoline station	2	16	18										2	16	18
3 Sub total	154	288	441	51	85	136	101	186	288	0	0	0	2	16	18
II Engineering and Admini. Cost	12	23	35	4	7	11	8	15	23	0	0	0	0	1	1
III Physical Contingency	17	31	48	5	9	15	11	20	31	0	0	0	0	2	2
Total	182	342	524	60	101	161	120	222	342	0	0	0	2	19	21

Remark: /1 At June 1991 prices

Table L-21 MAINTENANCE AND OPERATION COST (INTERNAL AND EXTERNAL COST)

Item	Unit	Unit Price($)	1991 ($1,000)				1992 ($1,000)				1993 ($1,000)				1994 ($1,000)				1995 ($1,000)				1996~ ($1,000)			
			Q'ty	FC	LC	Total	Q'ty	FC	LC	Total	Q'ty	FC	LC	Total	Q'ty	FC	LC	Total	Q'ty	FC	LC	Total	Q'ty	FC	LC	Total
I Remuneration																										
1 General manager	person	10,800	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	11	11	1	0	11	11
2 Chief	person	7,560	2	0	15	15	2	0	15	15	4	0	30	30	4	0	30	30	4	0	30	30	4	0	30	30
3 Staff	person	3,240	0	0	0	0	1	0	3	3	3	0	10	10	6	0	19	19	6	0	19	19	7	0	23	23
4 Secretary	person	1,560	1	0	2	2	1	0	2	2	1	0	2	2	2	0	3	3	2	0	3	3	2	0	3	3
5 Others(guard,driver,etc.)	person	960	0	0	0	0	0	0	0	0	0	0	0	0	10	0	10	10	20	0	19	19	20	0	19	19
6 Sub total				0	17	17		0	20	20		0	42	42		0	62	62		0	83	83		0	86	86
II Direct cost of O/M (2 % of Construction Cost)																										
1 Infrastructure	LS			0	0	0		0	0	0		0	0	0		3	81	84		3	81	84		3	81	84
2 Standard factory	LS			0	0	0		0	0	0		0	0	0		0	3	3		1	10	11		5	35	40
3 Administrative facility	LS			0	0	0		0	0	0		0	0	0		0	1	1		0	1	1		0	1	1
4 Service building	LS			0	0	0		0	0	0		0	0	0		0	0	0		0	0	0		0	2	2
5 Park,Sports park				0	0	0		0	0	0		0	0	0		0	0	0		0	0	0		0	1	1
6 Others(gate,fence,bus terminal)	LS			0	0	0		0	0	0		0	0	0		0	1	1		0	1	1		0	1	1
7 Sub total				0	0	0		0	0	0		0	0	0		4	86	90		4	93	97		8	121	130
Total				0	17	17		0	20	20		0	42	42		4	148	152		4	176	180		8	208	216

Remark: /1 At June 1991 prices

Table L-22 MAINTENANCE AND OPERATION COST (INTERNAL COST)

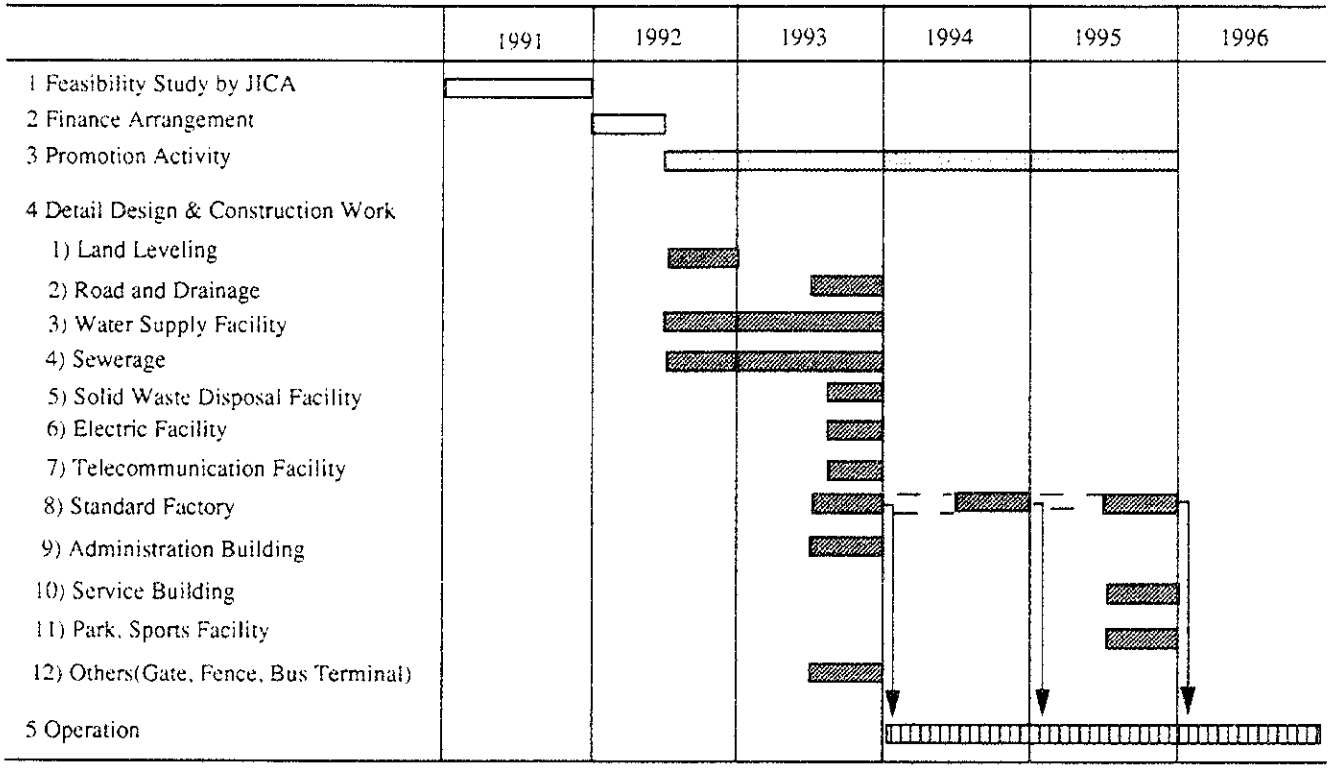
Item	Unit	Unit Price($)	1991 ($1,000)				1992 ($1,000)				1993 ($1,000)				1994 ($1,000)				1995 ($1,000)				1996~($1,000)			
			Q'ty	FC	LC	Total	Q'ty	FC	LC	Total	Q'ty	FC	LC	Total	Q'ty	FC	LC	Total	Q'ty	FC	LC	Total	Q'ty	FC	LC	Total
I Remuneration																										
1 General manager	person	10,800	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	11	11	1	0	11	11
2 Chief	person	7,560	2	0	15	15	2	0	15	15	4	0	30	30	4	0	30	30	4	0	30	30	4	0	30	30
3 Staff	person	3,240	0	0	0	0	1	0	3	3	3	0	10	10	6	0	19	19	6	0	19	19	7	0	23	23
4 Secretary	person	1,560	1	0	2	2	1	0	2	2	1	0	2	2	2	0	3	3	2	0	3	3	2	0	3	3
5 Others(guard,driver,etc.)	person	960	0	0	0	0	0	0	0	0	0	0	0	0	10	0	10	10	20	0	19	19	20	0	19	19
6 Sub total				0	17	17		0	20	20		0	42	42		0	62	62		0	83	83		0	86	86
II Direct cost of O/M (2 % of Construction Cost)																										
1 Infrastructure	LS			0	0	0		0	0	0		0	0	0		0	75	75		0	75	75		0	75	75
2 Standard factory	LS			0	0	0		0	0	0		0	0	0		0	3	3		1	10	11		5	35	40
3 Administrative facility	LS			0	0	0		0	0	0		0	0	0		0	1	1		0	1	1		0	1	1
4 Service building	LS			0	0	0		0	0	0		0	0	0		0	0	0		0	0	0		0	2	2
5 Park,Sports park				0	0	0		0	0	0		0	0	0		0	0	0		0	0	0		0	1	1
6 Others(gate,fence,bus terminal)	LS			0	0	0		0	0	0		0	0	0		0	1	1		0	1	1		0	1	1
7 Sub total				0	0	0		0	0	0		0	0	0		0	80	80		1	86	88		5	114	120
Total				0	17	17		0	20	20		0	42	42		0	142	142		1	169	170		5	200	206

Remark: /1 At June 1991 prices

Table L-23 MAINTENANCE AND OPERATION COST (EXTERNAL COST)

Item	Unit	Unit Price($)	1991 ($1,000)				1992 ($1,000)				1993 ($1,000)				1994 ($1,000)				1995 ($1,000)				1996~ ($1,000)			
			Q'ty	FC	LC	Total	Q'ty	FC	LC	Total	Q'ty	FC	LC	Total	Q'ty	FC	LC	Total	Q'ty	FC	LC	Total	Q'ty	FC	LC	Total
I Remuneration				0	0	0		0	0	0		0	0	0		0	0	0		0	0	0		0	0	0
II Direct cost of O/M (2 % of Construction Cost)																										
1 Infrastructure	LS			0	0	0		0	0	0		0	0	0		3	6	9		3	6	9		3	6	9
2 Fire station & post office				0	0	0		0	0	0		0	0	0		0	0	1		0	0	1		0	0	1
3 Gasoline station	LS			0	0	0		0	0	0		0	0	0		0	0	0		0	0	0		0	1	1
4 Sub total				0	0	0		0	0	0		0	0	0		3	6	10		3	6	10		3	7	10
Total				0	0	0		0	0	0		0	0	0		3	6	10		3	6	10		3	7	10

Remark: /1 At June 1991 prices



JAPAN INTERNATIONAL COOPERATION AGENCY	ESMERALDAS EXPORT PROCESSING ZONE DEVELOPMENT PROJECT	Fig. L-1 Development Schedule