THE GOVERNMENT OF MAURITIUS
MINISTRY OF ENERGY, WATER RESOURCES AND POSTAL SERVICES
CENTRAL WATER AUTHORITY

THE DETAILED DESIGN ON THE PORT LOUIS WATER SUPPLY PROJECT IN MAURITIUS

FINAL REPORT (1)

SUMMARY REPORT

MARCH 1991

JAPAN INTERNATIONAL COOPERATION AGENCY

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PREFACE

In response to a request from the Government of Mauritius, the Japanese Government decided to conduct a Detailed Design on the Port Louis Water Supply Project and entrusted the works to the Japan International Cooperation Agency (JICA).

JICA sent to Mauritius a study team headed by Mr. Norizo Fujita of Nippon Koei Co.,Ltd, composed of members from Nippon Koei Co.,Ltd. and Nihon Suido Consultants Co.,Ltd. from May to November,1990.

The team held discussions with concerned officials of the Government of Mauritius, and conducted field surveys. After the team returned to japan , further studies were made and the present report was prepared.

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between our two countries.

I wish to express my sincere appreciation to the officials concerned of the Government of Mauritius for their close cooperation extended to the team.

March,1991

Kensuke Yanagiya
President
Japan International Cooperation Agency

SUMMARY

Background

1. The Mauritius island with an area of about 1,860 km2 is located at about 900 km east from the Madagascar island in the Indian Ocean. Its population is counted to be about 1.0 million, and about 42% of the total population concentrates in the Port Louis city and neighbouring satellite cities. The Port Louis city plays an important role as a center of commerce and industry in the country.

2. The municipal and industrial water for the Port Louis city originates from the Grand River North West (GRNW) basin. The existing main water supply facilities are an intake weir called the Municipal Dike, water treatment facilities installed at Pailles, water transmission pipeline from the intake to the water treatment facilities at Pailles and water distribution system from the water treatment plant, etc.

3. The present water supply system has the following problems:

   (i) The water delivery system is now very old, and thereby, the water loss due to leakage from the system reaches 40 to 50% of the water volume treated.

   (ii) The GRNW river discharge is subject to a large seasonal fluctuation. On the other hand, the present water supply does not have any storage river discharge, and as a result, the Port Louis city is subject to severe water shortage in the drought season from July to November every year.

   (iii) Further, the treatment of highly muddy water is not possible due to the insufficient water treatment capacity, and therefore, the water supply to the Port Louis city is forced to be stopped frequently in the flood seasons.

4. Such being the situation, the Government of Mauritius requested a technical assistance from the Government of Japan for a study on a project to cope with the seasonal fluctuation of available water and to provide a stable water supply to the Port Louis city.

   In response to the above request, the Government of Japan agreed to carry out a Feasibility study on the Port Louis Water Supply Project and JICA (Japan International Cooperation Agency), the official agency responsible for the implementation of the technical cooperation programme of the Government of Japan, was appointed to undertake the Feasibility Study in cooperation with the Government of Mauritius.

5. The Feasibility Study was carried out during the period from March,1988 to July 1989.

The Feasibility Study made examinations on various conceivable alternative plans and found that the following scheme would be most advantageous.

(1) Water source:

- Damsite	:	TRO damsite (the Terre Rouge river at immediate downstream of the confluence with the Profonde river)
- Dam type	:	Rockfill dam
- Dam height	:	75 m
- Dam crest length	:	230m
- Gross storage	:	6.7 x $10^6 m^3$
- Effective storage	:	6.3 x $10^6 m^3$

(2) Raw water transmission pipeline (Additional one) :

- Discharge	:	660 l/sec.
- Number of lane	:	1
- Diameter	:	800 mm
- Total length	:	2,100 m

(3) Water treatment facilities (Additional one) :

- Type	:	Rapid sand filtration
- Capacity	:	40,000 m^3/day (30,000 m^3/day in the first stage, 10,000m^3/day in the second stage)

Furthermore, the Feasibility Study confirmed the technical, economic, financial, and social feasibility of the mentioned scheme, and recommended to realize the Project as early as possible.

6. Following the Feasibility Study, the Government of Mauritius determined to carry out the Detailed Design of the Project, and requested its technical assistance to the Government of Japan.

In response to the request from Government of Mauritius, the Government of Japan agreed to carry out the Detailed Design of the Project. JICA was decided to undertake the Detailed Design.

7. The Detailed Design works were commenced from March,1990, and have executed (i) additional field investigation, (ii) basic design for the whole project components and (iii) detailed design for Lot-I,etc. in accordance with the work schedule as shown in Fig.2.

Note : Division of Lots is as follows :

- Lot-I : Diversion tunnel and preparatory works
- Lot-II : Dam and related structures
- Lot-III : Raw water transmission pipeline and water treatment facilities

8. The Final Report (1) which incorporates all the results of the Detailed Design works for Lot-I has been prepared.

This Summary Report summarizes the above report.

Detailed Design Works for Lot-I

9. Construction works included in Lot-I are as follows :

(1) Construction of diversion tunnel (excluding the plug, pipes and valves,etc.)

(2) Diversion gate (including the guide frame)

(3) Preparatory works including,

- Construction of haul road of about 1.8 km in length,
- Construction of access roads in damsite,
- Construction of an access road between the Municipal Dike (Intake) and the Pailles treatment plant,
- Construction of aggregate plant,
- Construction of concrete batcher plant and cement silo,
- Construction of residences and office for the employer,
- Construction of quarters and office for the contractor,
- Construction of utility buildings,
- Construction of laboratory (including the supply of equipment),
- Construction of waste water treatment facilities,
- Construction of treatment facilities for muddy water from the concrete plant,
- Construction of electric power supply system,
- Construction of water supply system,
- Construction of buildings such as the repair shop,cement warehouse,guard house,etc.

Note : The access road from the outlet of the diversion tunnel to the spillway was included in Lot-II since this work is closely related to the spillway excavation work by Lot-II.

The access road to go to the dam crest in the right bank was also included in Lot-II in view that this work is also related to the excavation work of dam to be excavated by Lot-II.

Besides that, the construction of cofferdams was included in Lot-II since the cofferdams are designed to be a part of the main dam.

10. The following documents have been prepared through the Detailed Design works for Lot-I. The Final Report(1) is composed of these documents.

(1) Design Report for Lot-I

(2) Tender Documents for Lot-I

Vol. I
- : - Instruction to Tenderer
- : - Form of Tender Bond
- : - Form of Performance Bond
- : - Form of Advance Payment Bond
- : - Form of Agreement
- : - Letter of Acceptance of Tender
- : - Conditions of Contract
- : - Form of Certificates for Source and Origin, and Eligibility

Vol.II
- : - General Specification
- : - Technical Specification

Vol.III
- : - Form of Tender
- : - Bill of Quantities
- : - Schedule of Particulars

Vol.IV : - Drawings

(3) Cost Estimate for Lot-I

(4) Design and Quantity Calculations

Design of River Diversion

11. The design of the river diversion is shown in Fig.3 to 6.

Major concepts in the design are as follows :

(1) Layout :

- The diversion tunnel is located in the left bank of damsite from the topographical and economical aspects.

- The outlet of the diversion tunnel is aligned to come out to the adjacent Plaines Wilhem river in view that (i) this layout is more desirable hydraulically, (ii) the total tunnel length is approximately same, and (iii) this layout will not be affected by the future expansion of dam in mind.

- The location of the tunnel outlet is decided through comparative studies on four conceivable alternatives.
  The location which will maximize the discharge capacity is selected since there is little difference in the costs of four alternatives.

(2) Design discharge :

- The recorded maximum river discharge is measured to be 420 m^3/sec.Twenty (20)-year probable flood peak is assessed at 520 m^3/sec. Then, 20 - year probable flood peak discharge of 520 m3/sec is adopted as the design flood for the river diversion system in accordance with the standard.

- The Detailed Design works for Lot-I make a justification for the above application of the design flood.

  The examination is made through a risk analysis which tries to find the probable flood to minimize the sum of the construction cost and the probable damage.
  The risk analysis indicated that the application of 10 - year probable flood would be most economical.
  However, a comprehensive judgement concluded that the application of 20 - year probable flood is justifiable in view that it is desirable to lessen the occurrence of such troubles.

(3) Tunnel diameter and cofferdam height :

- The tunnel diameter and cofferdam height are decided through a comparative study on several combinations of tunnel diameter and cofferdam height which will satisfy the requirements for the river diversion system, and as a result, the most economical combination of tunnel diameter and cofferdam height is selected.

- The above comparative study indicated a tendency that the combination of less tunnel diameter and higher cofferdam would be more advantageous since the cofferdam will be a part of the main dam.

- The tunnel diameter and cofferdam height determined through the mentioned comparative study are as follows :

  Tunnel diameter : 6.8 m
  Cofferdam height : 28.5m

(4) Tunnel alignment :

- The design standard mentions that the radius of curvature in tunnel of ten times tunnel diameter will meet the hydraulic requirements in tunnel.

  However, the radius of curvature at the curve of the tunnel is provided with R = 200m, which is much more than ten times tunnel diameter, in view that the tunnel lining will be made by using a sliding form.

- The design standard also mentions that it is desirable to provide a length more than 20 m times tunnel diameter for the distance from the end of tunnel curve to the outlet.
  However, it is difficult to satisfy the above standard in the case of the Project.
  The present design provides 45 m for the above distance. Then, a concrete slab with 1.0 m in thickness and 10.0 m in length will be provided as a countermeasure at immediate downstream of tunnel outlet for the purpose of preventing the erosion.

- The distance from the tunnel outlet to the opposite bank of the Plaines Wilhem river is as long as about 120m.
  However, for ensuring to prevent the erosion of the opposite bank, the opposite bank is designed to be protected with gabions.

(5) Excavation and design of tunnel inlet portion :

- The excavation for diversion tunnel inlet is closely related to the excavation work for the water intake which will be done by Lot-II. It is not desirable that the secondary excavation in the tunnel inlet portion be made for the water intake by Lot-II. Then,the excavation in the tunnel inlet portion by Lot-I is made not to cause the mentioned secondary excavation by Lot-II.

  As for the excavation above El.196m, the excavation will overlap with that of the spillway by Lot-II. Therefore, the portion above El.196m is excavated with a temporary cutting slope of 1 to 0.5 without surface protection.

  The cutting slope of the portion below El.196m should be permanent one. Thus, the excavation is made with the cutting slope of 1:1.0 and 2m wide beam at an interval of 10 m in height. This cutting surface has a slope of 1 to 1.2 (about 40 degree) in average which coincides with the necessary slope for the water intake structure. The surface protection is considered necessary, provided with the shotcrete (5 cm x 2) as well as grouted anchor bars of D25.

- The shape of the inlet is designed to be the Bell Mouth, aiming to discharge the river flow as much as possible by the free flow condition and to minimize damages due to the cavitation.

  The transition in the tunnel inlet is arranged to be provided in the inlet portal (not in the tunnel portion) in consideration of more complicated excavation and support works in the case that it is provided in the tunnel portion.

(6) Grout :

- The curtain grout, consolidation grout and backfill grout are designed to be carried out in accordance with the usual design procedure : that is, the curtain grouting will be carried out for the water stop by two lines at the dam axis.

  The consolidation grouting will be carried out for the tunnel upstream of the plug as well as the plug portion, The tunnel downstream of the plug is, in principle, considered not to require the consolidation grouting. The design considers the consolidation grouting will be carried out in the tunnel downstream of the plug when judged necessary by the engineer.
  For the tunnel downstream of the plug, the design also considers to release the water pressure by drilling drain holes in the lining after installing the diversion gate.

The backfill grouting aims at filling any voids between the lining and the excavation surface, and has to be carried out throughout the tunnel.

(7) Structural analysis :

- The structural analysis are largely divided into three of the tunnel, inlet portal and outlet portal portions.

- The whole tunnel will be lined with concrete. Two types of tunnel lining are applied in accordance with geological conditions : that is, Type I (50cm in lining thickness) will be applied for C_M - C_H class of rock. Type II (80cm in lining thickness) will be applied for C_L - C_M class of rock.
  The diversion tunnel is a permanent structure which is intended to be used for the waterway for water supply, and therefore,all the concrete lining shall be the reinforced concrete structure.

- The maximum internal and external loads which will determine the design of the structure are the water pressure to act after impounding the reservoir (water level in the dam expansion scheme). As for the tunnel upstream of the plug where the internal and external water pressure are balanced in the normal condition, the following extreme loading conditions have to be taken into consideration : (i) the external water pressure due to the remaining groundwater when the reservoir water level will suddenly drawdown, and (ii) the internal water pressure to act to the lining before the external water pressure will act to the lining. These extreme cases of loading are rarely caused temporarily, and therefore,an allowable stress increased by 65% is applied in accordance with the standard. With regard to the loading during the river diversion, particular examinations are considered unnecessary since its loading is very small as compared with the mentioned extreme loading cases even though the increase of the allowable stress is taken into consideration in the extreme cases.

- In consideration that the internal and external water pressure will be balanced in the usual condition, application of consolidation grout pressure of 2 kg/cm^2 is considered sufficient. The grout pressure of backfill grout is 2 kg/cm^2 at maximum which is same as or less than the consolidation grout pressure.
  The curtain grout pressure to act to the lining is also less than 2 kg/cm^2. Hence, a particular examination for the backfill and curtain grout pressures is omitted. Since the grout pressure is also very tentative, the allowable stress is increased to 210 kg/cm^2 in concrete compressive stress and 18 kg/cm^2 in concrete shearing.

- The Otto-Frey-Bear's theory is applied for analysing the tunnel structure against the internal and external loadings. The cylindrical shell theory is applied for examination against the grout pressure.
  As for the inlet portal and outlet portal, the structures are examined by the frame structural analysis.

- It is assumed that the rock loads will be supported with the steel supports erected during tunnel excavation. Thus, no rock loads are taken into consideration in the analysis of tunnel lining.
  Hence, the safety of steel supports to be installed is examined.
  The examination is made by checking the stress of steel supports in the following steel support arrangements:

Tunnel Type	Steel Support Dimensions (H-Shape Steel,mm)	Interval of Steel Support (m)
Type I	200 x 200 x 12	1.5
Type II	200 x 200 x 12	1.0

Loadings to steel supports are based on those proposed by Terzaghi, and the examination confirmed that the proposed arrangements of steel supports would safely withstand the rock loads.

Design of Aggregate and Concrete Plant

12. The aggregate and concrete plants are designed in due consideration of the construction work schedule of Lot-II, concrete requirement of each structure, aggregate requirement by each size, required volume of dam filter material by each size.

The required production capacities of aggregate and concrete batching plant also takes into consideration the working days of 20 days/month and working hours of 10 hours/day.
The required production capacity of the aggregate and concrete batching plant are assessed as follows :

- Required production capacity of aggregate plant : 90 ton/hour
- Required production capacity of concrete batching plant : 30 ton/hour

The aggregate and concrete batching plants designed based on the required production capacities assessed above are shown in Fig. 7.

13. A cement silo of 100 ton is attached to the concrete batching plant. Its capacity will cope with the concreting works for two or three days which is a capacity slightly less than that in other similar projects.

The above is based on a consideration that the transportation and supply of cement will be much easier from the Port Louis harbour which is located near the project site and is equipped with a large stock of cement.

A cement warehouse having an area of 96 m^2 will be prepared. The cement warehouse intends to store the bag cement for the cement grouting works.
The cement warehouse can store the bag cement of about 50 to 60 tons. The capacity is considered sufficient since it will cope with the cement grouting works for two months or more.

Design of Haul Road and Access Roads

14. The existing trunk road passes through near the quarry site and damsite, which will not be impossible to use as the haul road for transporting the dam materials. However, a separate haul road of about 1.8 km in total length is planned to be constructed in order not to disturb the heavy traffics in the existing trunk road.

15. This haul road is a temporary structure for the construction works, and therefore, its design is made flexibly within a practical range, meaning that the design does not necessarily follow the design standard of a permanent road strictly.

The following outlines the design:

- Total length of haul road : About 1,800 m
- Width of haul road : 10 m
- Number of lanes : 2 lanes
- Maximum road gradient : 10%
- Design speed : 20 km/hr.
- Radius of curvature : 15 m or more
- Cant :

  $220 \leqq R$..... 2%

$150 \leqq R < 220$ 3%

$110 \leqq R < 150$ 4%

$80 \leqq R < 110$ 5%

$R < 80$ 6%

where, R: Radius of curvature

- Pavement : A simple pavement with the base course of 150 mm in thickness and surface course of 50 mm in thickness.
- Cutting slope :

  Earth : 1:1.0

  Weathered rock : 1:0.5

  Fresh rock : 1:0.3

  Note: A berm will be provided at 10 m interval in height.
- Embankment slope : 1:2.0 (Excavated materials will be used)

16. The haul road will be constructed from the quarry site to the right bank of the damsite.

The access road in damsite, which will be connected to the haul road, is required to be constructed for the construction works in the damsite.

It was decided through an economic examination that the access road should be provided at immediate downstream in the damsite right bank where the bank slope is gentler than others.

Details of its design are same as those in the haul road as mentioned.

Plans of the haul road and access road in damsite are shown in Fig. 8, 9 and 10.

Access Road between Water Treatment Plant and Municipal Dike:

17. An access road will be constructed along the existing pipeline between the Pailles Treatment Plant and the Municipal Dike, aiming at the use for construction works of newly installed pipeline and maintenance works in future.

This access road has one lane of 5 m in width and has no pavement in consideration of less traffics in the road. Other design details are similar to those in the haul road as mentioned.

18. This access road has to cross the river at two points. Its crossing will be made by constructing submergible bridges from an economical point of view.

The passage on the submergible bridges will not be possible during the time of floods, which is, however, considered not problematical practically in view that the occurrence of flood is very rare.

Design of Buildings:

19. As mentioned , Lot. I works include various buildings such as the offices, residences, utility buildings, laboratory and warehouses, etc.

These designs are based on the building design standard in Japan, i.e. "Architectural Institute of Japan Standard for Structural Calculation of Reinforced Concrete Structures and Commentary" and "Architectural Institute of Japan Standard for Structural Calculation of Steel Structures." Combinations of loadings and applications of allowable stress in accordance with characteristics of loadings, etc. are made in accordance with the mentioned standard.

20. The combinations of loadings applied are as follows:

Loading Condition	Combinations of Loadings
Permanent load (Normal)	Dead load + Live Load
Temporary load (At earthquake)	Dead Load + Live load + Seismic Force

21. The applications of allowable stress are as follows:

Materials	Type of Stress					
	For Permanent Load			For Temporary Load		
	Tension	Compression	Shear	Tension	Compression	Shear
- Concrete (Fc=210 kg/cm2)	-	Fc/s=70	4.25	--	2 Fc/3=105	12.75
- Reinforcing bar (JIS G3112)	1,800	1,800	1,000	2,700	2,700	1,500
- Steel (SS 41)	1,400	1,400	900	2,100	2,100	1,350

22. These building will be constructed on terrace in the damsite right bank. The location of each building is as seen in Fig. 11.

The design of each building is shown in the drawings for tendering.

Design of Water Supply System:

23. The necessary water for construction works in terms of the peak capacity is estimated at 5.5 m^3/min. as follows:

Items	Necessary Water at Peak Capacity (m^3/min.)
(1) Office and residences for Employer side:	0.3
(2) Office and quarters for Contractor:	0.5
(3) Aggregate plant:	2.5
(4) Concrete batching plant:	0.3
(5) Grouting works:	0.6
(6) Construction works of diversion tunnel:	0.5
(7) Construction works of spillway:	0.3
(8) Repair shop, etc.:	0.2
(9) Others:	0.3
Total	5.5 m^3/min.

24. Out of the total requirement of 5.5 m^3/min., 0.8 m^3/min. is for the use by the offices and residences, and the remaining 4.7 m^3/min. is for the construction works such as the aggregate plant, concrete plant, grouting works and concreting works, etc.

The water for the use by the offices and residences should be the treated water, and therefore, its supply will be made from the existing pipeline of treated water which passes near the project site. A new pipe will be installed from the existing pipeline to the offices and residences.

As for the water for the construction works, a study comes to a conclusion that the supply from an existing small reservoir near the project site is most economical. The water is taken from the Profonde river and is transmitted to the mentioned existing small reservoir.

25. The existing pipeline of the treated water and small reservoir as mentioned are situated in an elevation enough higher than those in the area requiring the water supply, and therefore, the water supply will be made by the gravity flow without any pumping up.

Diameters of pipes to respective water supply points are determined through an examination on the basis of the required water supply capacity, distance, difference of elevation, etc. The Design Report for Lot-I presents details of the examination. Fig. 12 presents a diagram of the water supply system.

Design of Electric Power Supply Systems:

26. The electric power supply capacity to be required for the offices, residences and construction works are approximately estimated at 1,750 kW, and this installation work is also scheduled to be done by Lot-I.

27. A comparative study indicated that the most economical measure would be to receive the power from the existing 22 kV power distribution line passing the project site.

The necessary facilities for receiving the power are (i) the receiving switching station, (ii) power distribution lines, and (iii) receiving stations at six points.

Fig. 13 and 14 present a diagram of the power supply system which is prepared through an examination on the necessary capacities of transformers at respective points, etc. The design is provided in the drawings for tendering.

Design of Diversion Gate:

28. Lot-I works will construct the diversion tunnel. In this construction work, the guide frames for the diversion gate should be embedded, and therefore, the manufacturing of the diversion gate is also included in Lot-I with consideration that the same contractor should manufacture both the diversion gate and its guide frames.

29. The type of the diversion gate is determined to be a slide gate which is considered to be most simple and to cause no troubles at the time of diversion gate closure.

30. The design of the diversion gate takes the water pressure up to the spillway crest level (EL. 189.0 m) as its loading in view that the water level rising after gate closure will be very rapid due to relatively small reservoir.

31. Fig. 15 and 16 show the design of the diversion gate. Detailed design calculations are presented in the Design Report for Lot-I.

Preparation of Tender Documents:

32. The Tender Documents require (i) Instructions to tenderers, (ii) Condition of contract, (iii) General and technical specifications, (iv) Various forms for tendering, bill of quantities, breakdowns, bonds and agreements, etc., and (v) Tender drawings, etc.

33. Then, the Tender Documents are composed of the followings:

Vol. I : Instruction to Tenderers
Forms for Bonds and Agreement
Condition of Contract

Vol. II : General Specification
Technical Specification

Vo. III : Form for Tender
Bill of Quantities
Schedules of Particulars

Vol. IV : Tender Drawings

34. The Tender Drawings are prepared with the following considerations:

(1) The Condition of Contract is based on the FIDIC (International Condition of Contract for Civil Engineering Works).

There are two methods to prepare the Condition of Contract: that is, (i) In part-I, FIDIC is presented as it is, and in Part-II, necessary revisions, additions or elimination, etc. are made, and (ii) necessary revisions, additions or eliminations are all incorporated into the FIDIC without any division into Part-I and Part-II.

In the case of the Project, the latter is adopted in consideration that the latter will be much more convenient for the readers.

(2) It is considered important that the specification corresponding to each work item in the Bill of Quantities can easily be verified. Therefore, the clause of specification corresponding to each work item is shown in the Bill of Quantities.

(3) A special attention is paid for letting the tenderers submit schedules of particulars as much as possible, which will greatly serve for evaluating the tenders or for dealing with claims from the contractor in future.

The schedules of particulars to be submitted by the tenderers include the following:

- Cash Flow Tabulation
- Labour Flow Tabulation, including Estimate of Mauritian Labour Employment
- Material Flow Tabulation
- List of Constructional Plant and Materials, including Their Sources
- Field Personnel
- List of Sub-Contractor(s)
- Daywork
- Breakdown of Prices
- Construction Time Schedule
- Drawings and documents Submitted with Tender
- Information and Qualification for Works of Hydromechanical Equipment
- List of Spare Parts of Constructional Plant

(4) The names of the consultant and financing agency, etc. which are not determined yet, are left blank.
Those should be filled before tendering.

(5) The cofferdams, access road from the outlet of diversion tunnel to the spillway and access road to be connected to the dam crest in the right bank are included in Lot-II, since these works are closely related to Lot-II as mentioned.

(6) Although the diversion gate closure will be made by Lot-II, the manufacturing of the gate is included in Lot-I, based on the consideration that the gate and its guide frame to be embeded in the inlet of the diversion tunnel by Lot-I should be manufactured by the same contractor.

Construction Cost Estimate:

35. The construction cost at the price level in January 1991 is estimated on the basis of results of the detailed design and analyses on unit prices.

36. Division between the foreign currency and local currency portions is made as follows:

- In principle, the local labour cost, inland transportation cost and compensation cost, etc. belong to the local currency portion.

- The indirect foreign cost, which is defined as the cost of imported raw materials and depreciation cost of imported equipment for the production of local construction materials, etc., is included in the foreign currency portion.

- All the construction equipment and plants are considered to be imported by the contractor. Thus, most of the equipment cost is composed of the foreign currency portion. A part of the repair and management cost, which is mainly the local labour cost, is considered to be the local currency portion included in the equipment cost.

Construction Schedule:

37. The construction schedule for Lot-I is shown in Fig. 17.

The tender procedures for Lot-I will commence in December, 1991, and the construction work is scheduled to be completed at the end of February, 1994.

Fig. 1

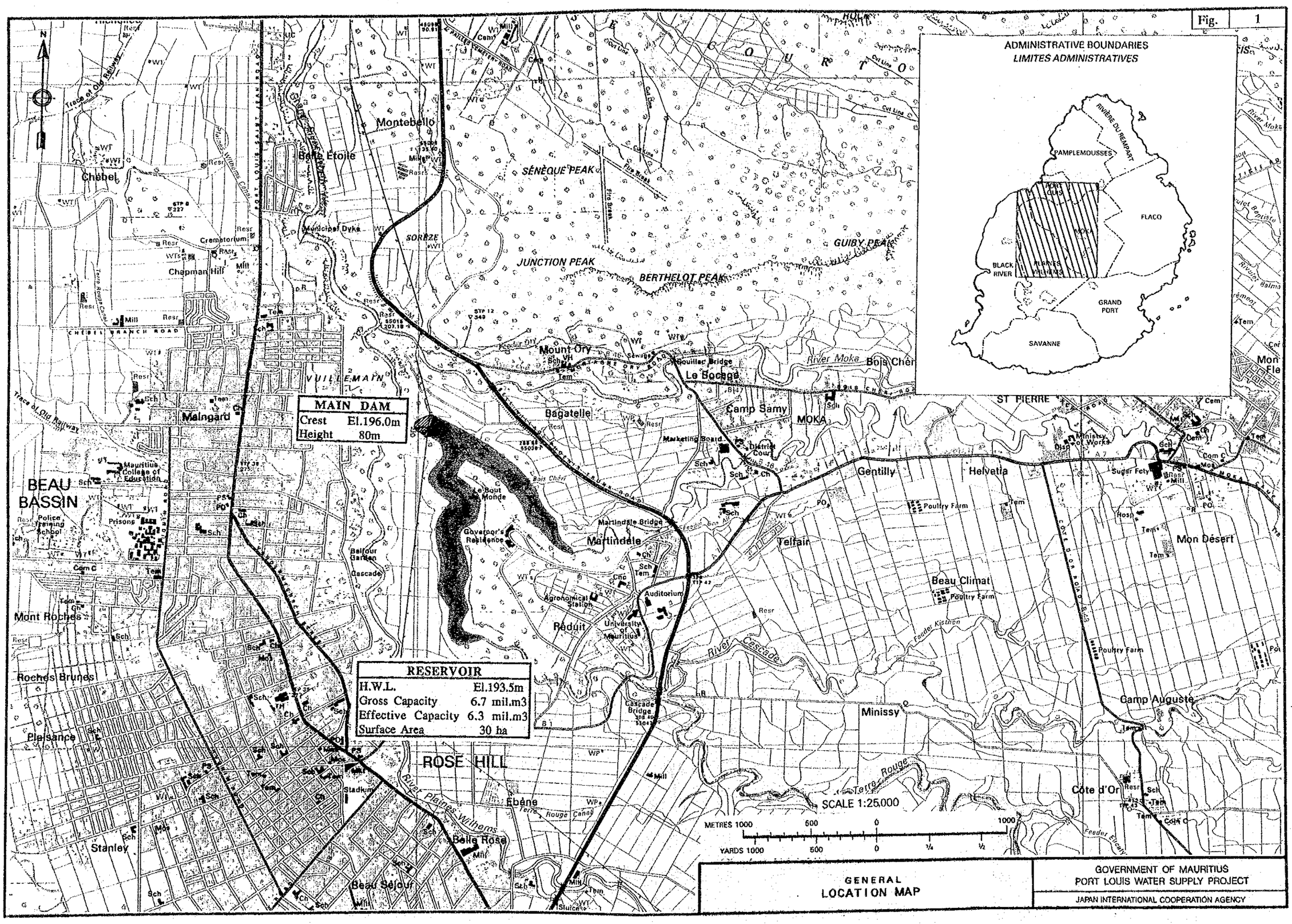

ADMINISTRATIVE BOUNDARIES
LIMITES ADMINISTRATIVES
RIVIÈRE DU REMPART
PAMPLEMOUSSES
FLACQ
MOKA
BLACK RIVER
PLAINES WILHEMS
GRAND PORT
SAVANNE
MAIN DAM
Crest El.196.0m
Height 80m
RESERVOIR
H.W.L. El.193.5m
Gross Capacity 6.7 mil.m3
Effective Capacity 6.3 mil.m3
Surface Area 30 ha
SCALE 1:25,000
METRES 1000 500 0 1000
YARDS 1000 500 0 ¼ ½
GENERAL
LOCATION MAP
GOVERNMENT OF MAURITIUS
PORT LOUIS WATER SUPPLY PROJECT
JAPAN INTERNATIONAL COOPERATION AGENCY

Fig.2 : General Work Schedule

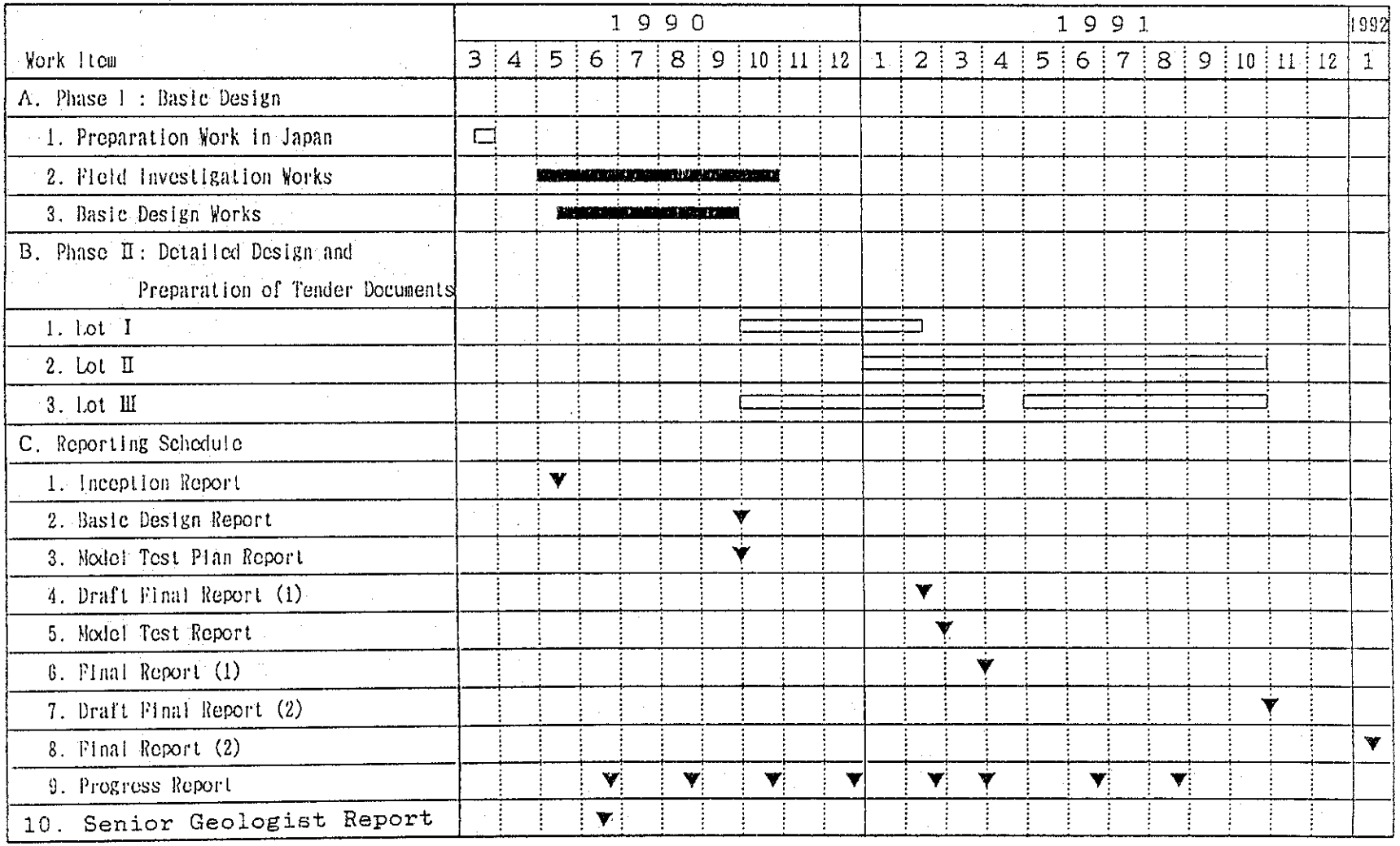
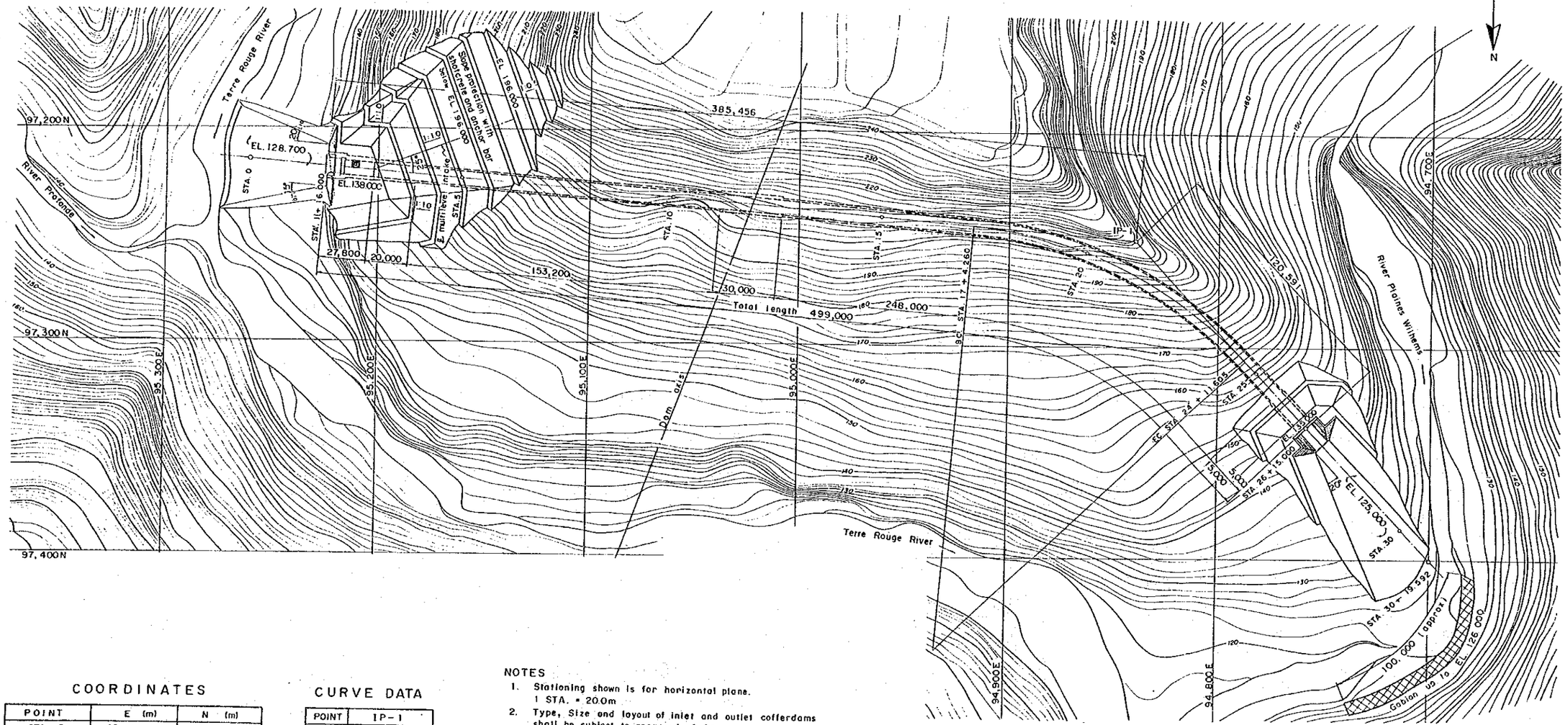


Fig. 3



COORDINATES

POINT	E (m)	N (m)
STA. 0	95,260.000	97,215.000
STA. 1 + 16.000	95,224.124	97,217.990
IP – 1	94,840.000	97,250.000
STA. 26+ 15.000	94,757.719	97,338.159
STA. 30+ 19.592	94,700.000	97,400.000

CURVE DATA

POINT	IP-1
I.A.	42°-12'-40.7"
R	200,000
TL	77,196
CL	147,345

NOTES

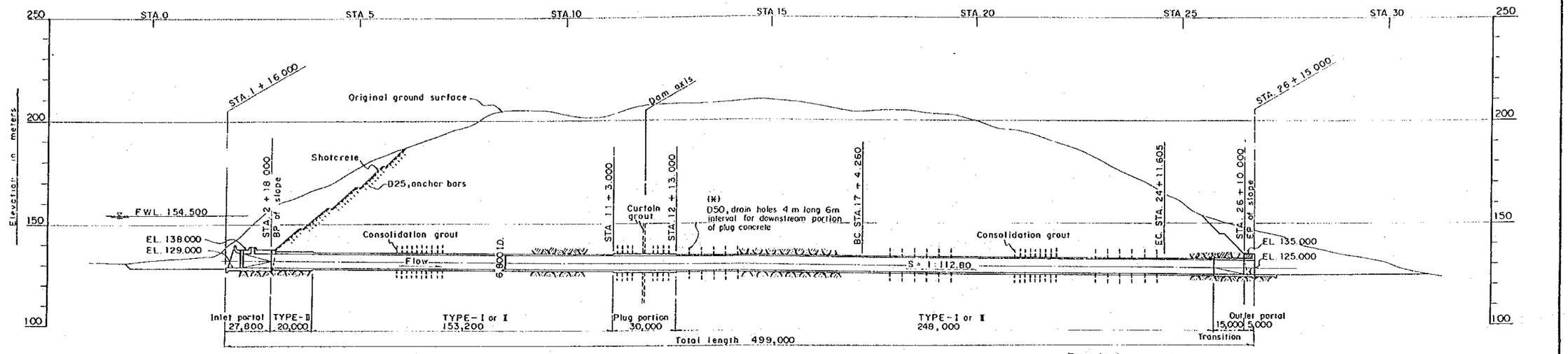
1. Stationing shown is for horizontal plane. 1 STA. = 20.0m
2. Type, Size and layout of inlet and outlet cofferdams shall be subject to approval of the Engineer.
3. Application of tunnel type may be changed as approved or directed by the Engineer to suit actual geological condition to be encountered.
4. Application of consolidation grouting downstream of plug portion (STA. 12 + 13 m) shall be directed by the Engineer.
5. Plug work shall be made by Lot-II.
6. Marked with (X) shall be made by Lot-II.

DIVERSION TUNNEL
PLAN

GOVERNMENT OF MAURITIUS
PORT LOUIS WATER SUPPLY PROJECT

JAPAN INTERNATIONAL COOPERATION AGENCY

Fig. 4

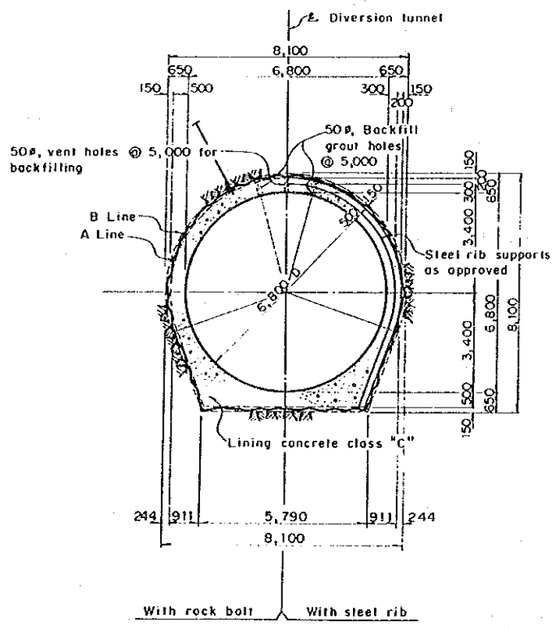


SCALE 0 100m

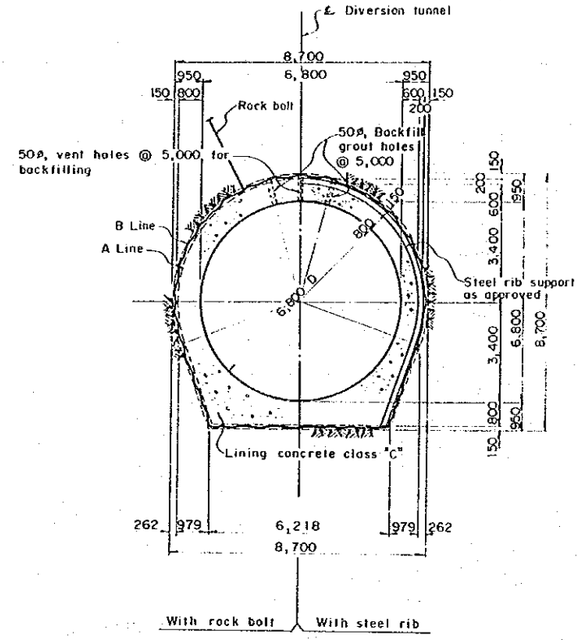
PROFILE

Remarks :

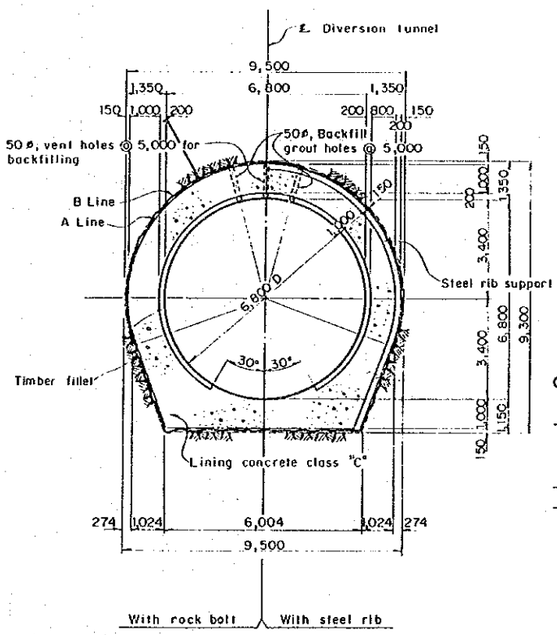
(*) D50, drain holes shall be constructed by Lot-II



TYPE – I



TYPE – II



PLUG PORTION

SCALE 0 10m

NOTES :

1. All wooden materials except blockings of steelribs shall be removed prior to placing of lining concrete.
2. Lagging shall also be removed prior to placing of lining concrete so that the lining concrete will be in contact with at least 65% of the excavated rock surface bounded, by the center lines of adjacent steel ribs.
3. Material of timber fillet shall be 1st-rate oak of other equivalent hard timber impregnated with creosote by full-cell process pressure treatment. Retention of creosote after treatment shall be not less than 150 kg/m³.
4. As for application of tunnel type, see notes on DWG. No D-001 and G-014.

CONCRETE FINISHES :

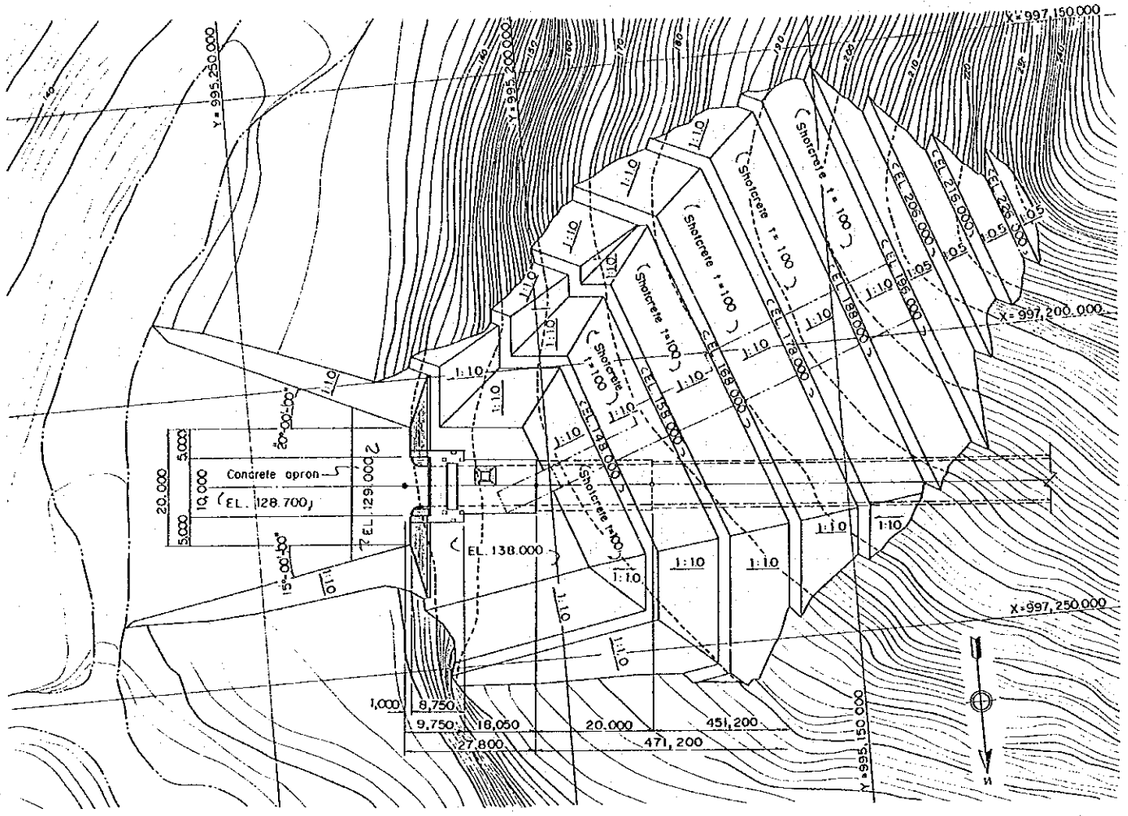
- All exposed surfaces in Inlet Portal, Tunnel and Outlet Portal...F4 or U2
- Protection wall...F2 or U2
- All other surface...F1 or U1

DIVERSION TUNNEL
PROFILE AND SECTIONS

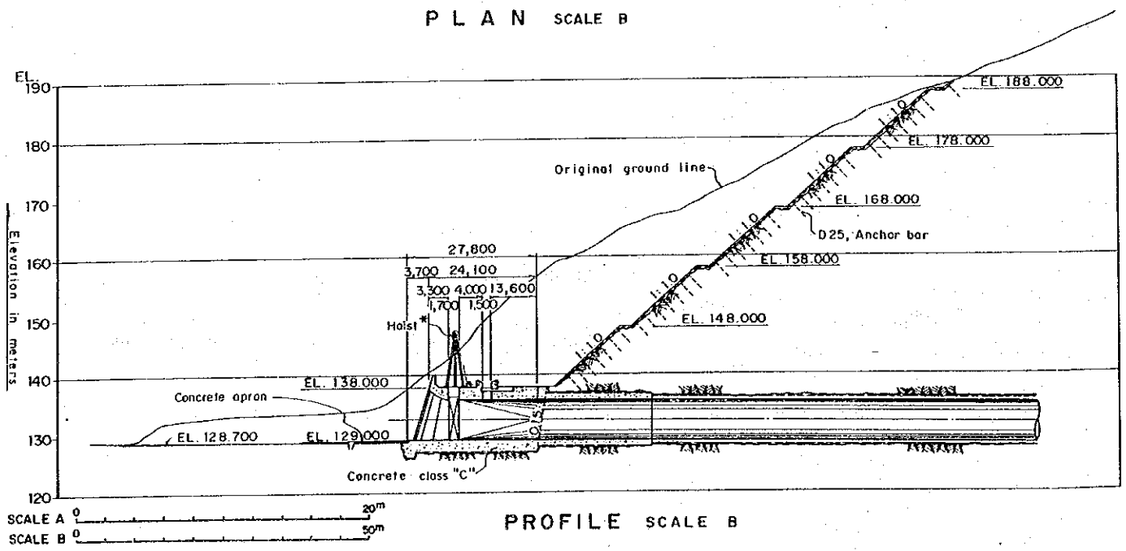
GOVERNMENT OF MAURITIUS
PORT LOUIS WATER SUPPLY PROJECT

JAPAN INTERNATIONAL COOPERATION AGENCY

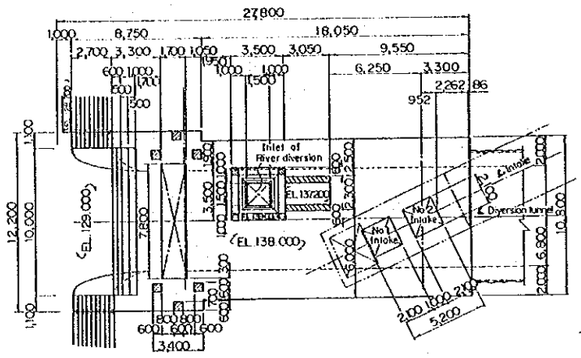
Fig. 5



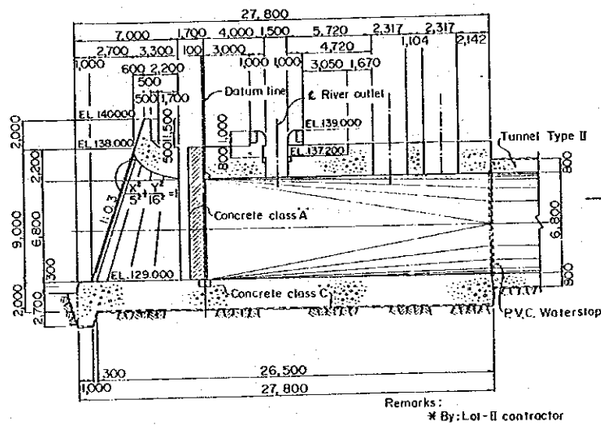
PLAN SCALE B



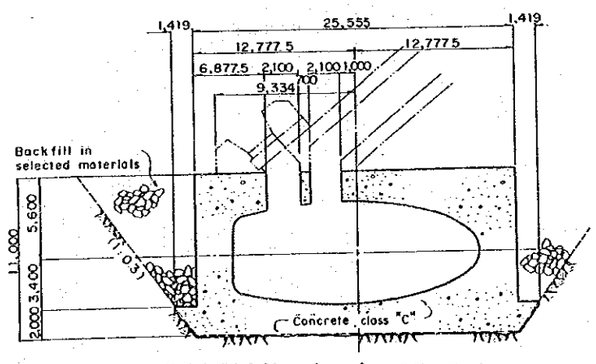
PROFILE SCALE B



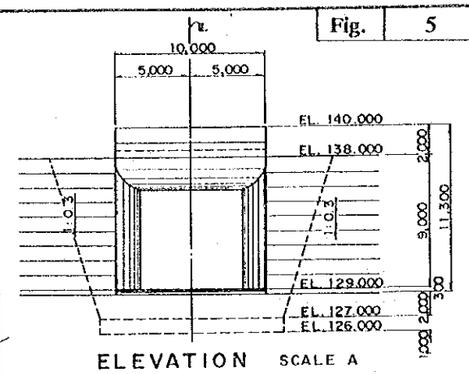
PLAN SCALE A



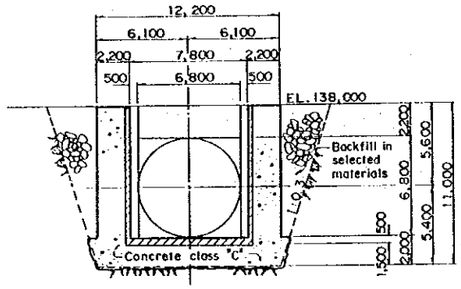
PROFILE SCALE A



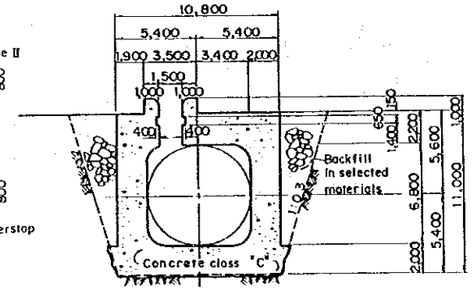
SECTION A-A SCALE A



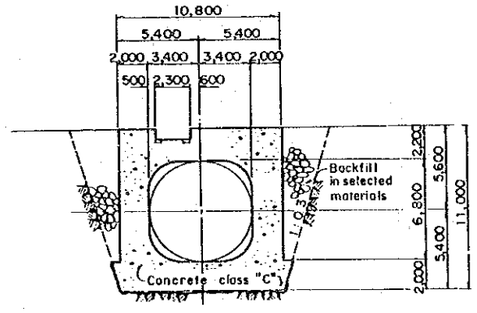
ELEVATION SCALE A



SECTION B-B SCALE A



SECTION C-C SCALE A



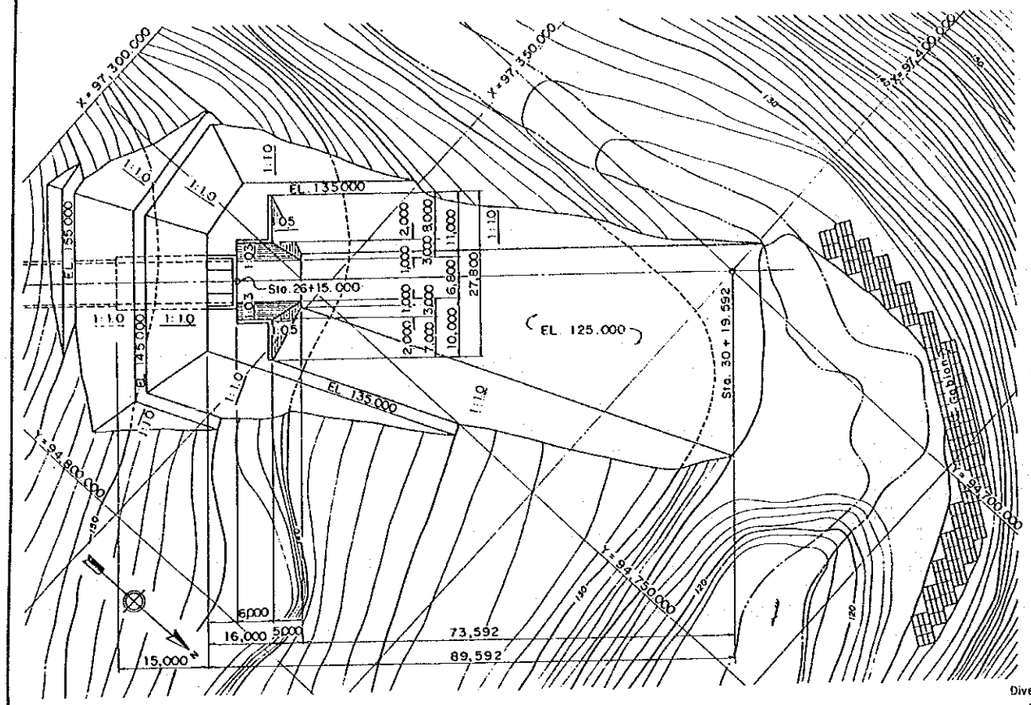
SECTION D-D SCALE A

NOTE :
Cutting slope protection for the part where the multi-level water intake will be constructed shall be made without anchor bars.

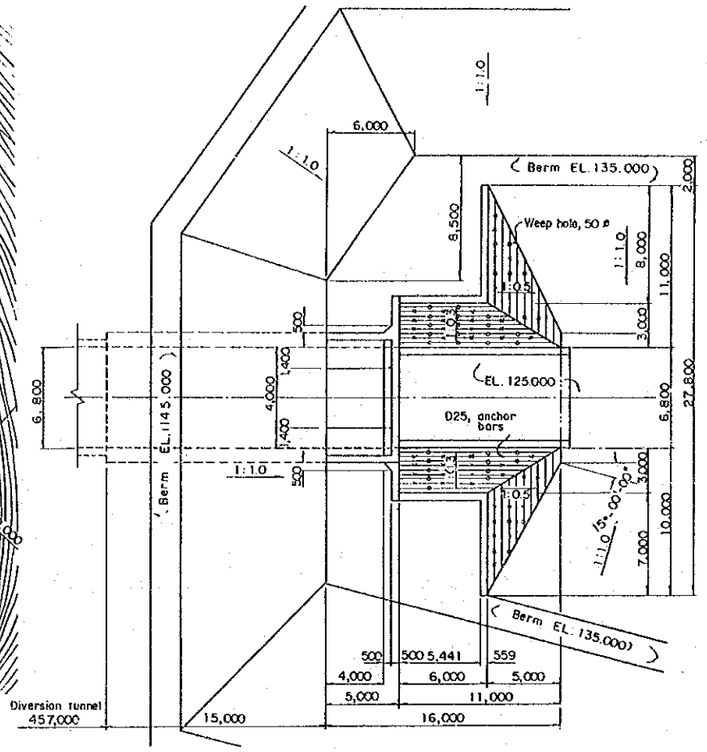
DIVERSION TUNNEL
INLET, PLAN, PRLFILE AND SECTIONS

GOVERNMENT OF MAURITIUS
PORT LOUIS WATER SUPPLY PROJECT
JAPAN INTERNATIONAL COOPERATION AGENCY

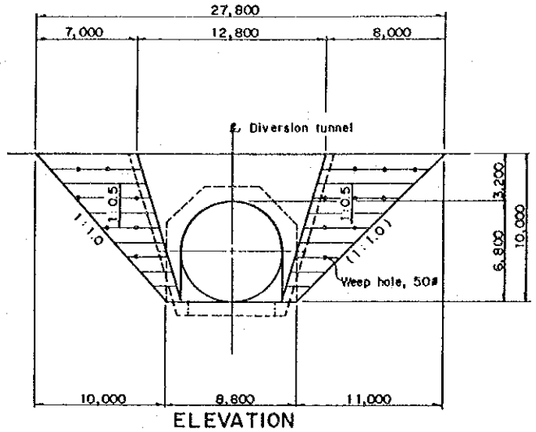
Fig. 6



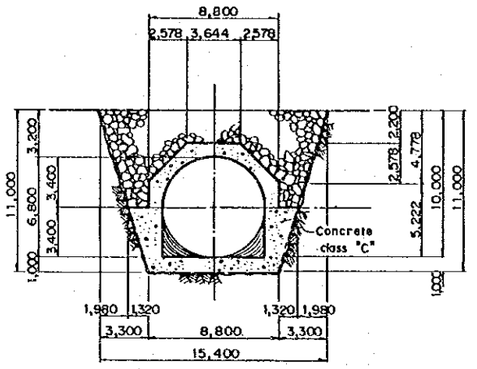
PLAN SCALE B



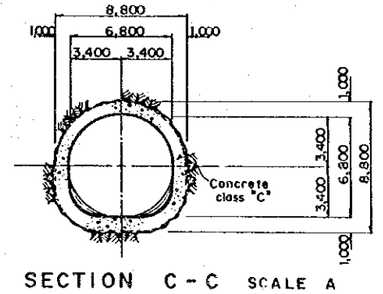
PLAN SCALE A



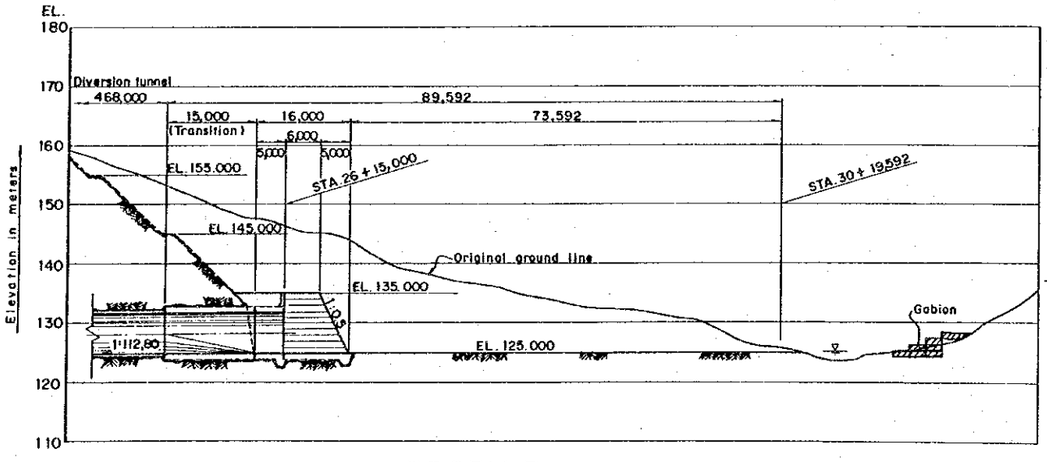
ELEVATION
SECTION A – A SCALE A



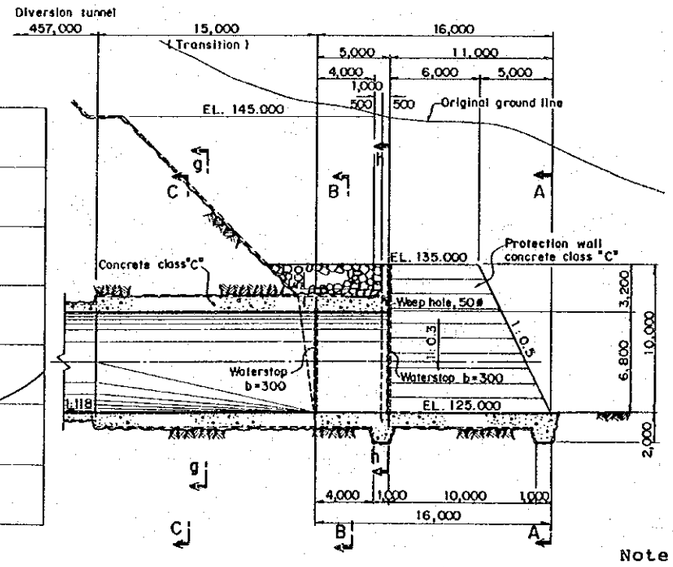
SECTION B – B SCALE A



SECTION C – C SCALE A



PROFILE SCALE B



PROFILE SCALE A

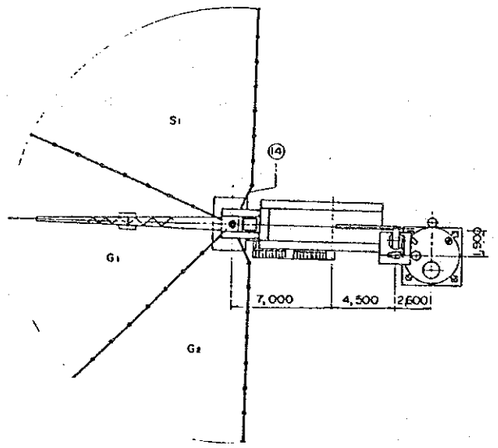
Note : For concrete finishes, see Dwg. No. D-002

SCALE A 0 20

SCALE B 0 50

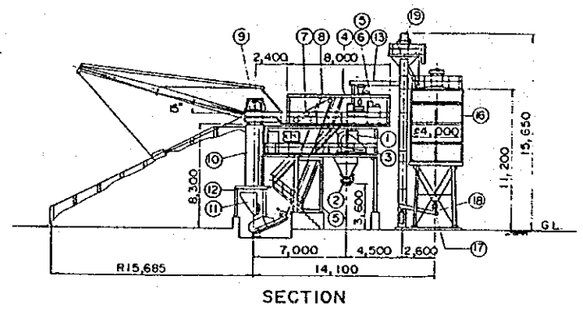
DIVERSION TUNNEL OUTLET, PLAN, PROFILE AND SECTIONS	GOVERNMENT OF MAURITIUS PORT LOUIS WATER SUPPLY PROJECT JAPAN INTERNATIONAL COOPERATION AGENCY

Fig. 7



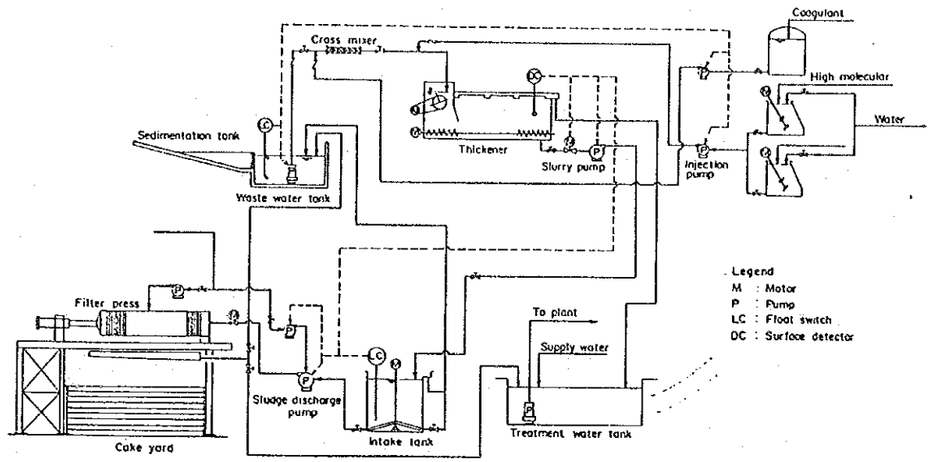
PLAN

1	Mixer
2	Concrete hopper
3	Mixing unit and control room
4	Cement weigher
5	Water weigher
6	Additive agent weigher
7	Winch unit for hoisting an aggregate skip
8	Weigher unit
9	Radial scraper
10	Radial scraper stand
11	Aggregate weighing device
12	Aggregate weighing stand
13	Upper cement screw conveyer
14	Stockyard control part partition board
15	Stand and guide rails
16	Cement silo
17	Rotary feeder
18	Under cement screw conveyer
19	Bucket elevator

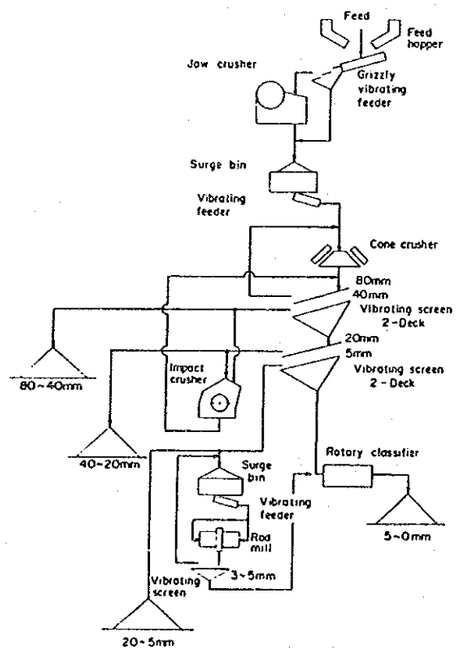


SECTION

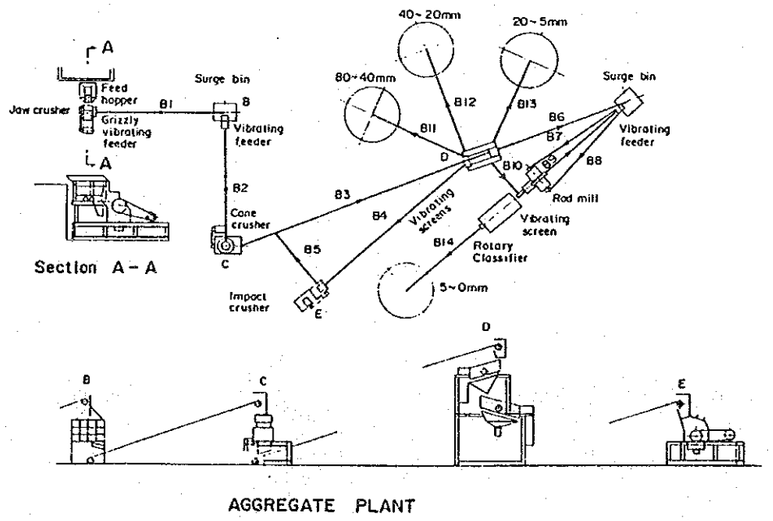
CONCRETE PLANT



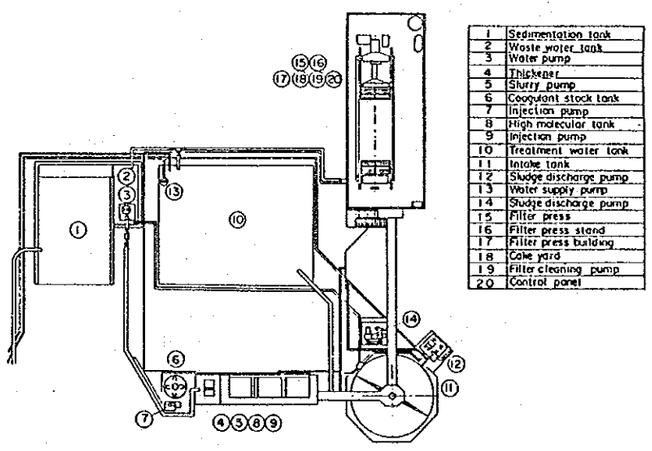
FLOW SHEET OF WASTE WATER TREATMENT



FLOW SHEET FOR AGGREGATE PLANT



AGGREGATE PLANT



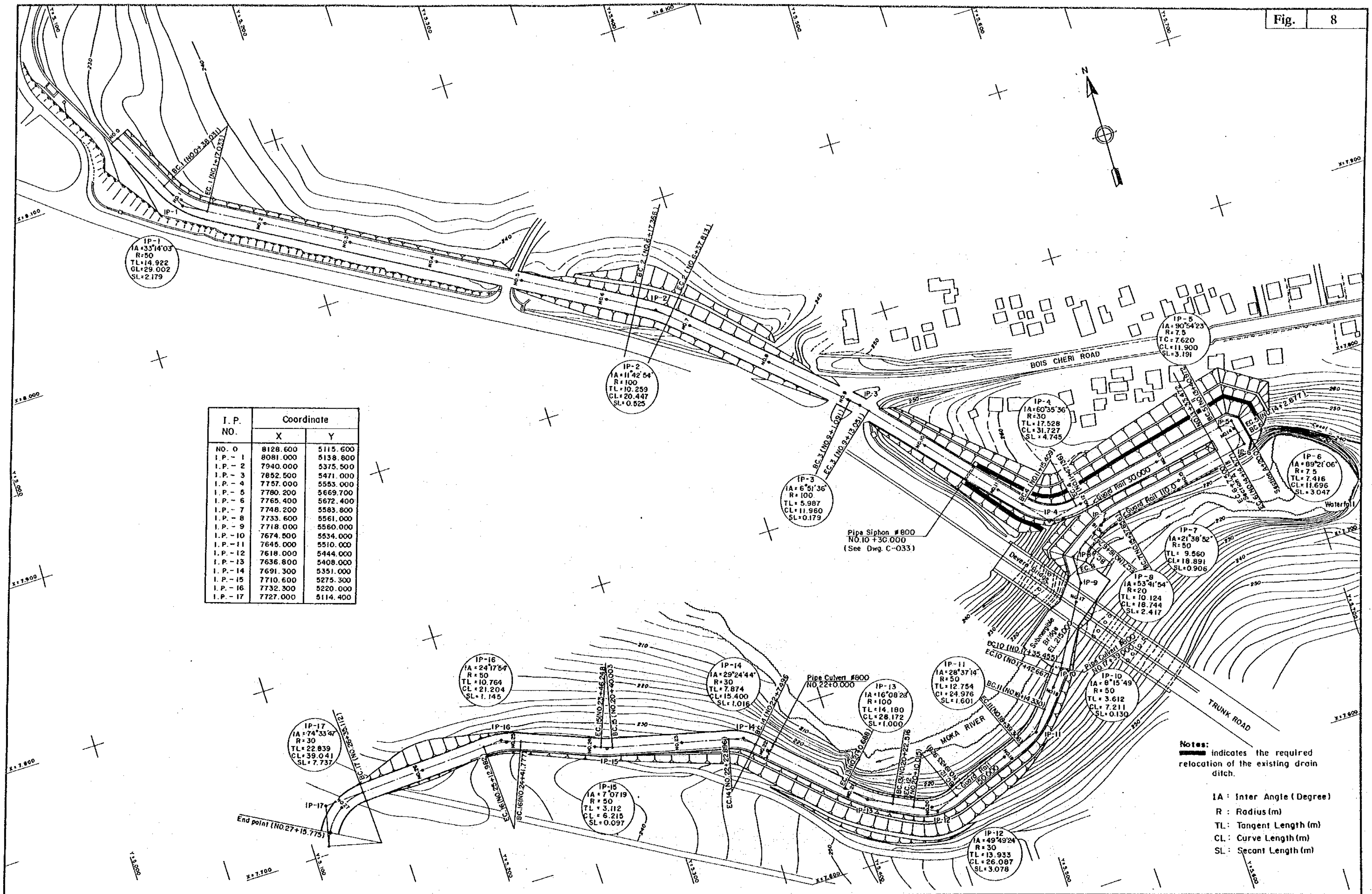
1	Sedimentation tank
2	Waste water tank
3	Water pump
4	Thickener
5	Slurry pump
6	Coagulant stock tank
7	Injection pump
8	High molecular tank
9	Injection pump
10	Treatment water tank
11	Intake tank
12	Sludge discharge pump
13	Water supply pump
14	Sludge discharge pump
15	Filter press
16	Filter press stand
17	Filter press building
18	Cake yard
19	Filter cleaning pump
20	Control panel

WASTE WATER TREATMENT

PREPARATORY WORKS
CONSTRUCTION PLANT
PLAN, PROFILE AND FLOW SHEET

GOVERNMENT OF MAURITIUS
PORT LOUIS WATER SUPPLY PROJECT
JAPAN INTERNATIONAL COOPERATION AGENCY

Fig. 8



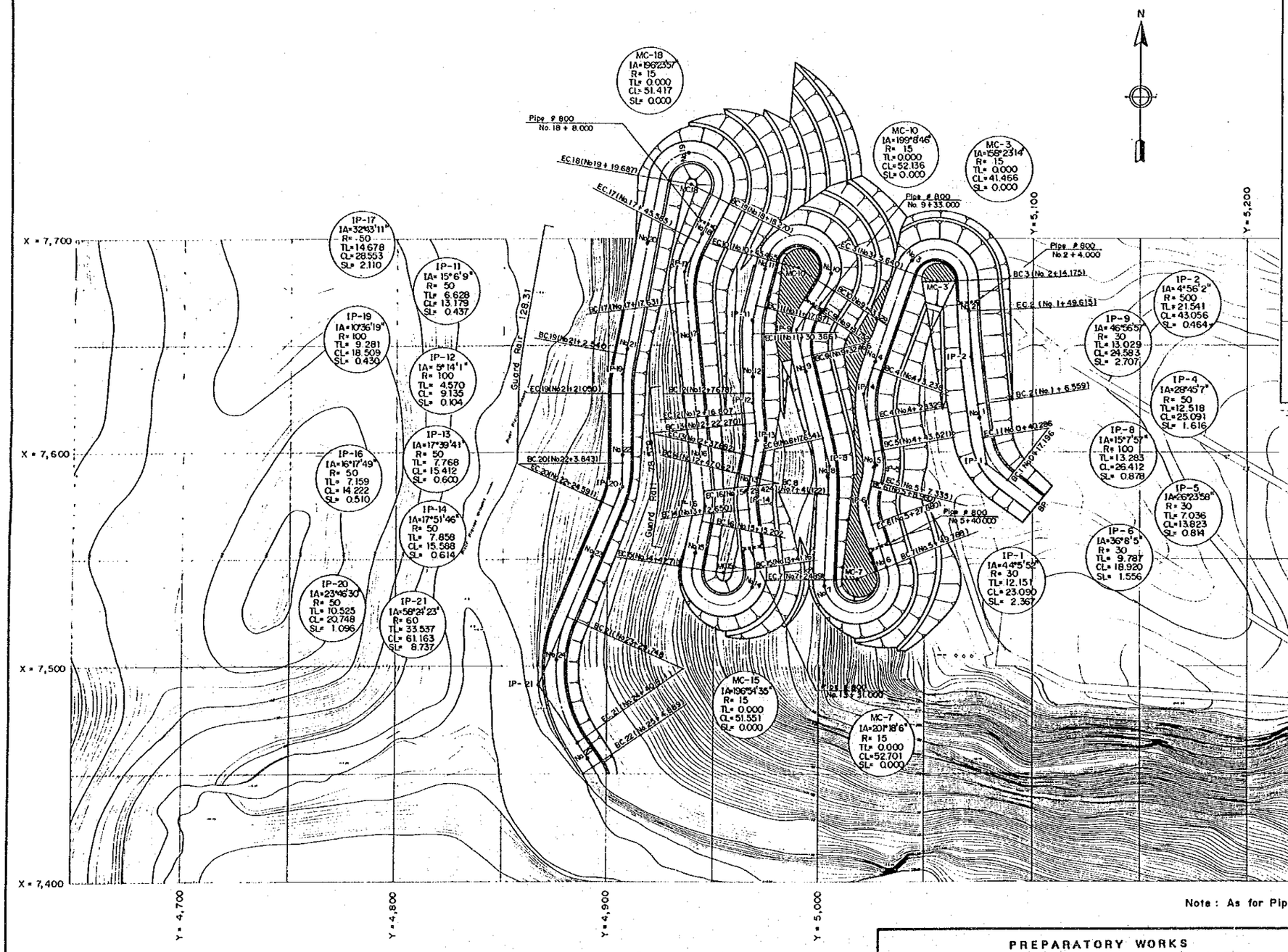
I. P. NO.	Coordinate	
	X	Y
NO. 0	8128.600	5115.600
I.P.- 1	8081.000	5138.800
I.P.- 2	7940.000	5375.500
I.P.- 3	7852.500	5471.000
I.P.- 4	7757.000	5553.000
I.P.- 5	7780.200	5669.700
I.P.- 6	7765.400	5672.400
I.P.- 7	7748.200	5583.800
I.P.- 8	7733.600	5561.000
I.P.- 9	7718.000	5560.000
I.P.-10	7674.500	5534.000
I.P.-11	7645.000	5510.000
I.P.-12	7618.000	5444.000
I.P.-13	7636.800	5408.000
I.P.-14	7691.300	5351.000
I.P.-15	7710.600	5275.300
I.P.-16	7732.300	5220.000
I.P.-17	7727.000	5114.400

Notes:
▬ indicates the required relocation of the existing drain ditch.

IA : Inter Angle (Degree)
R : Radius (m)
TL : Tangent Length (m)
CL : Curve Length (m)
SL : Secant Length (m)

PREPARATORY WORKS
HAUL ROAD TO QUARRY SITE
PLAN

GOVERNMENT OF MAURITIUS
PORT LOUIS WATER SUPPLY PROJECT
JAPAN INTERNATIONAL COOPERATION AGENCY



IP. No.	COORDINATE	
	X	Y
B P	7577.000	5100 900
I. P — 1	7595 100	5077 800
I. P — 2	7644.600	5071 000
M C — 3	7679 900	5054 200
I. P — 4	7627. 500	5020. 600
I P — 5	7593 000	5026. 700
I. P — 6	7575. 300	5021. 500
M.C. — 7	7540. 400	5018. 100
I.P. — 8	7592. 700	5004. 500
I.P. — 9	7656. 800	4989. 000
M.C. — 10	7685. 600	4990. 000
I.P. — 11	7661. 800	4968. 500
I.P. — 12	7623. 300	4969. 100
I.P. — 13	7605. 600	4971. 000
I P. — 14	7581. 100	4966. 000
M.C. — 15	7543. 300	4955 100
I.P. — 16	7575. 200	4945 800
I.P — 17	7684 100	4934 900
M.C. — 18	7724. 200	4938. 500
I.P. — 19	7636 400	4906 800
I. P — 20	7583 800	4906 800
I P. — 21	7493. 000	4866 800
I.P. — 22	7441. 600	4902 300
I. P — 23	7401. 000	4869. 500
I.P. — 24	7372 300	4944. 600
I.P. — 25	7352 000	5032. 800
I. P. — 26	7350. 400	5126 400
I. P. — 27	7334. 800	5182. 100
I. P. — 28	7293. 500	5205. 400
I. P. — 29	7232. 200	5264. 200
E P	7210. 000	5265. 000
B P'	7422. 421	4886. 805
I. P. — 1'	7401. 000	4869. 500
I. P. — 2'	7431. 000	4833. 400
I. P. — 3'	7414. 000	4708. 400
E P'	7383. 000	4709. 000

TYPE OF THE ROAD

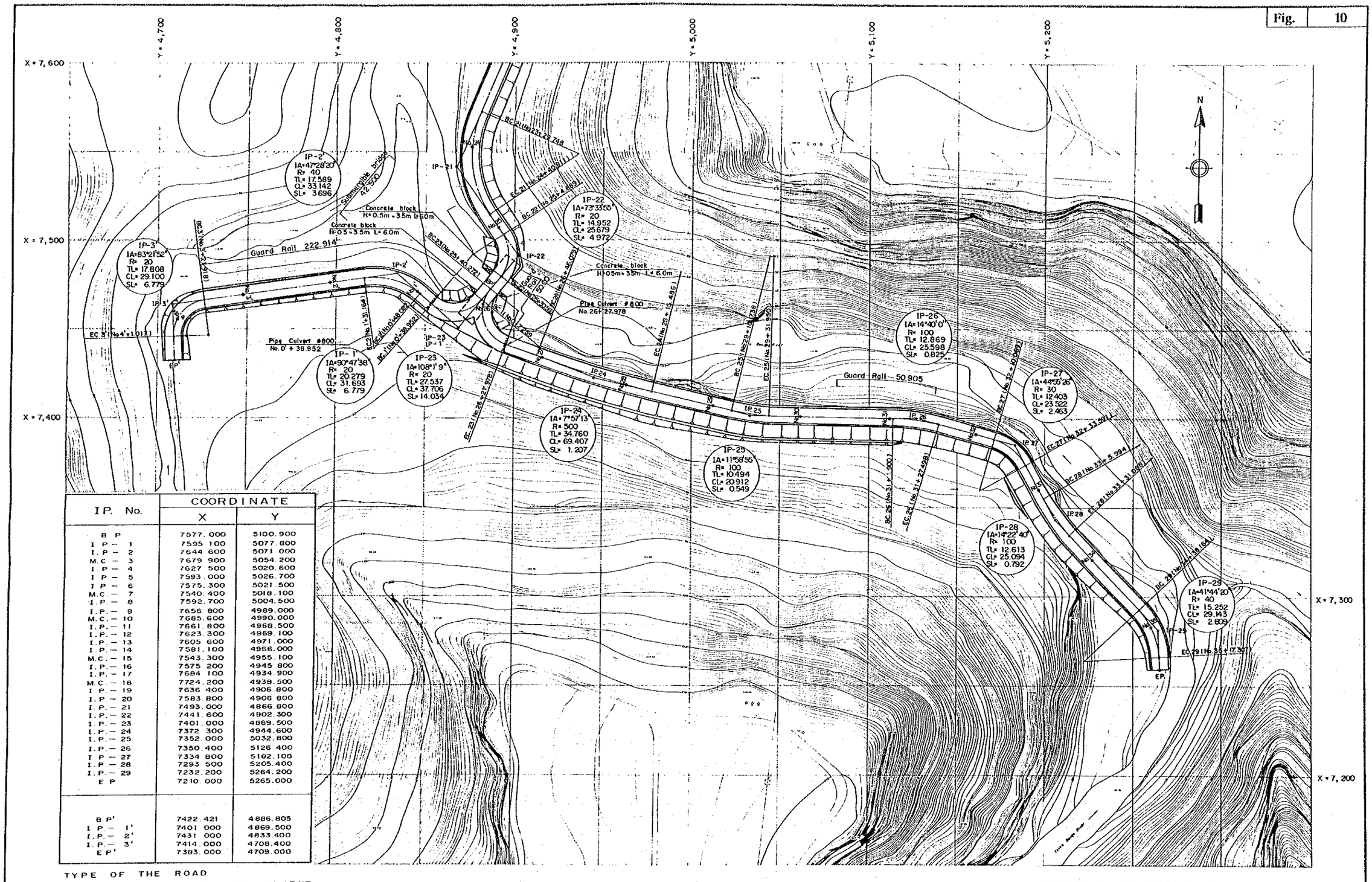
FROM BP. TO NO. 7	PERMANENT
FROM NO.7 TO EP	TEMPORALY
FROM BP. TO EP	TEMPORALY

Note : As for Pipe Siphon , See Dwg. No. C — 033

PREPARATORY WORKS
ACCESS ROAD AROUND DAM SITE
PLAN (1)

GOVERNMENT OF MAURITIUS
PORT LOUIS WATER SUPPLY PROJECT
JAPAN INTERNATIONAL COOPERATION AGENCY

Fig. 10



IP. No.	COORDINATE X	COORDINATE Y
B P	7577.000	5100.900
I P — 1	7595.100	5077.800
I.P — 2	7644.600	5071.000
M.C — 3	7679.900	5054.200
I.P — 4	7627.500	5020.600
I P — 5	7593.000	5026.700
I P — 6	7575.300	5021.500
M.C.— 7	7540.400	5018.100
I.P — 8	7592.700	5004.500
I.P.— 9	7656.800	4989.000
M.C.— 10	7685.600	4990.000
I.P.— 11	7661.800	4968.500
I.P.— 12	7623.300	4969.100
I.P.— 13	7605.600	4971.000
I P.— 14	7581.100	4956.000
M.C.— 15	7543.300	4955.100
I.P.— 16	7575.200	4945.800
I.P.— 17	7684.100	4934.900
M.C — 18	7724.200	4938.500
I P — 19	7636.400	4906.800
I.P — 20	7583.800	4908.800
I P.— 21	7493.000	4866.800
I.P.— 22	7441.600	4902.300
I P.— 23	7401.000	4869.500
I.P.— 24	7372.300	4944.600
I.P.— 25	7352.000	5032.800
I.P.— 26	7350.400	5126.400
I P — 27	7334.800	5182.100
I.P — 28	7293.500	5205.400
I.P.— 29	7232.200	5264.200
E P	7210.000	5265.000
B P'	7422.421	4886.805
I P — 1'	7401.000	4869.500
I.P.— 2'	7431.000	4833.400
I.P.— 3'	7414.000	4708.400
E P'	7383.000	4709.000

TYPE OF THE ROAD

FROM BP. TO NO.7	PERMANENT
FROM NO.7 TO EP	TEMPORALY
FROM BP. TO EP	TEMPORALY

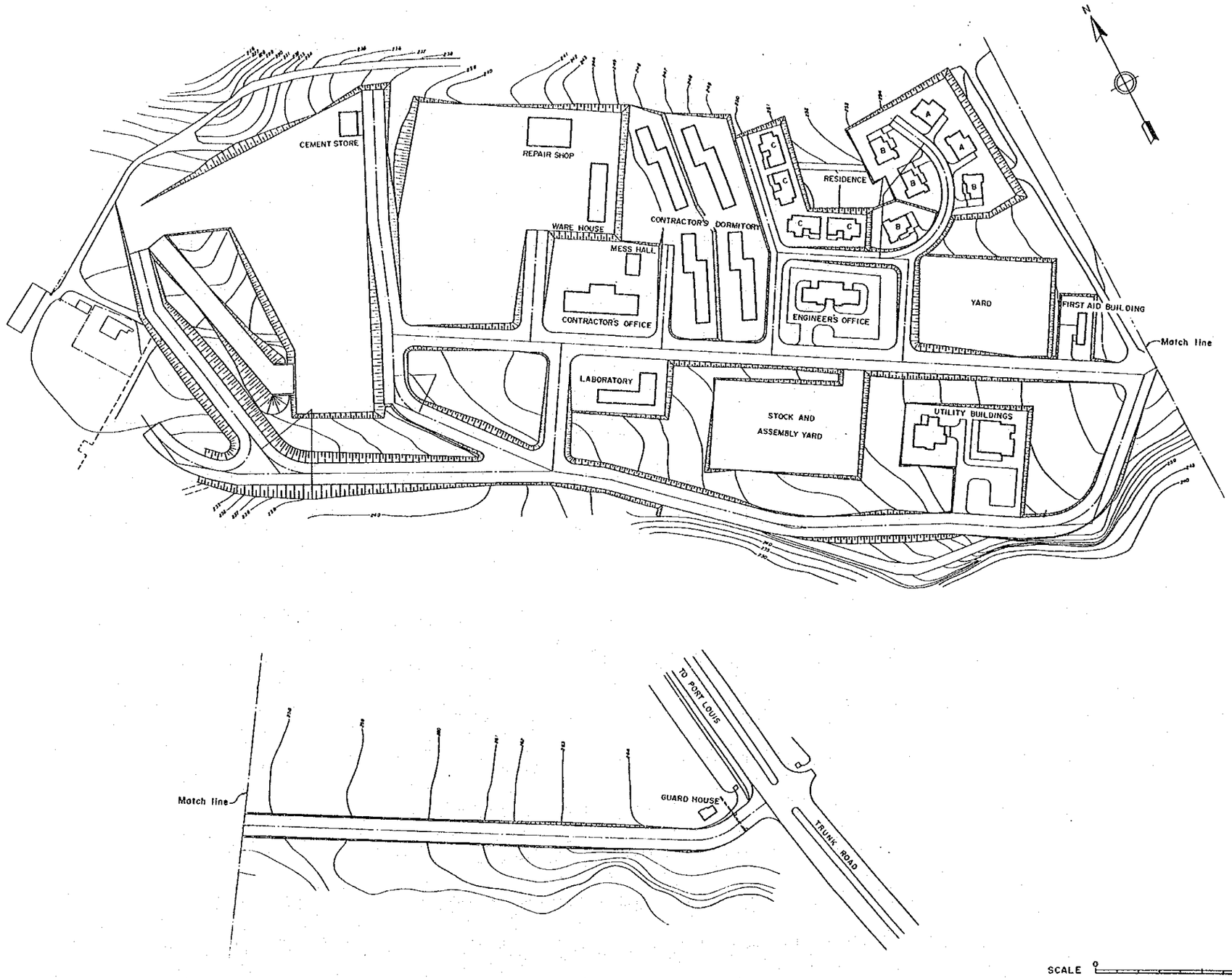
SCALE 0 — 50m

Note : See Dwg. No. C-032 for pipe culvert.

PREPARATORY WORKS
ACCESS ROAD AROUND DAM SITE
PLAN (2)

GOVERNMENT OF MAURITIUS
PORT LOUIS WATER SUPPLY PROJECT
JAPAN INTERNATIONAL COOPERATION AGENCY

Fig. 11



PREPARATORY WORKS
BUILDING WORKS
GENERAL PLAN

GOVERNMENT OF MAURITIUS
PORT LOUIS WATER SUPPLY PROJECT

JAPAN INTERNATIONAL COOPERATION AGENCY

Fig. 12

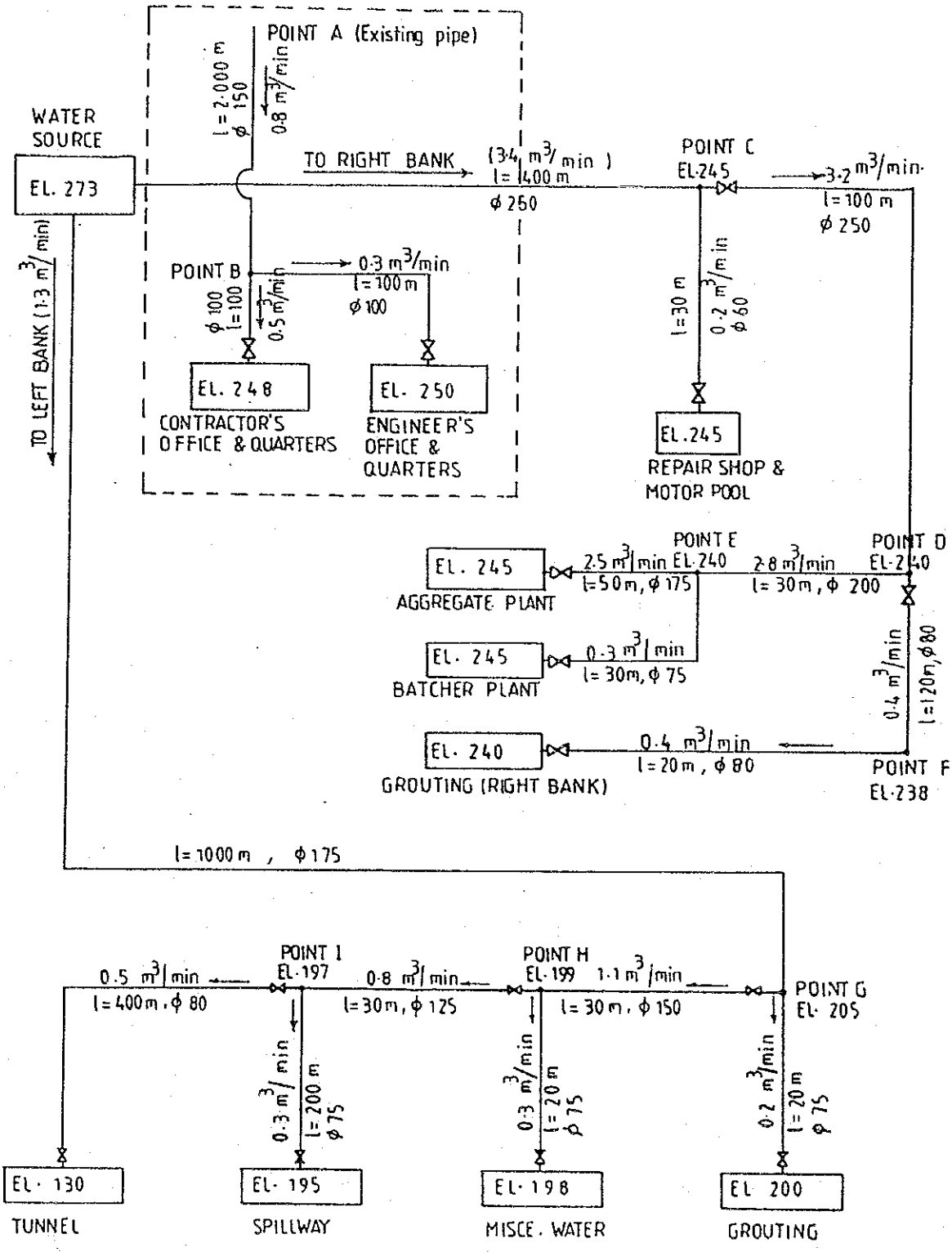
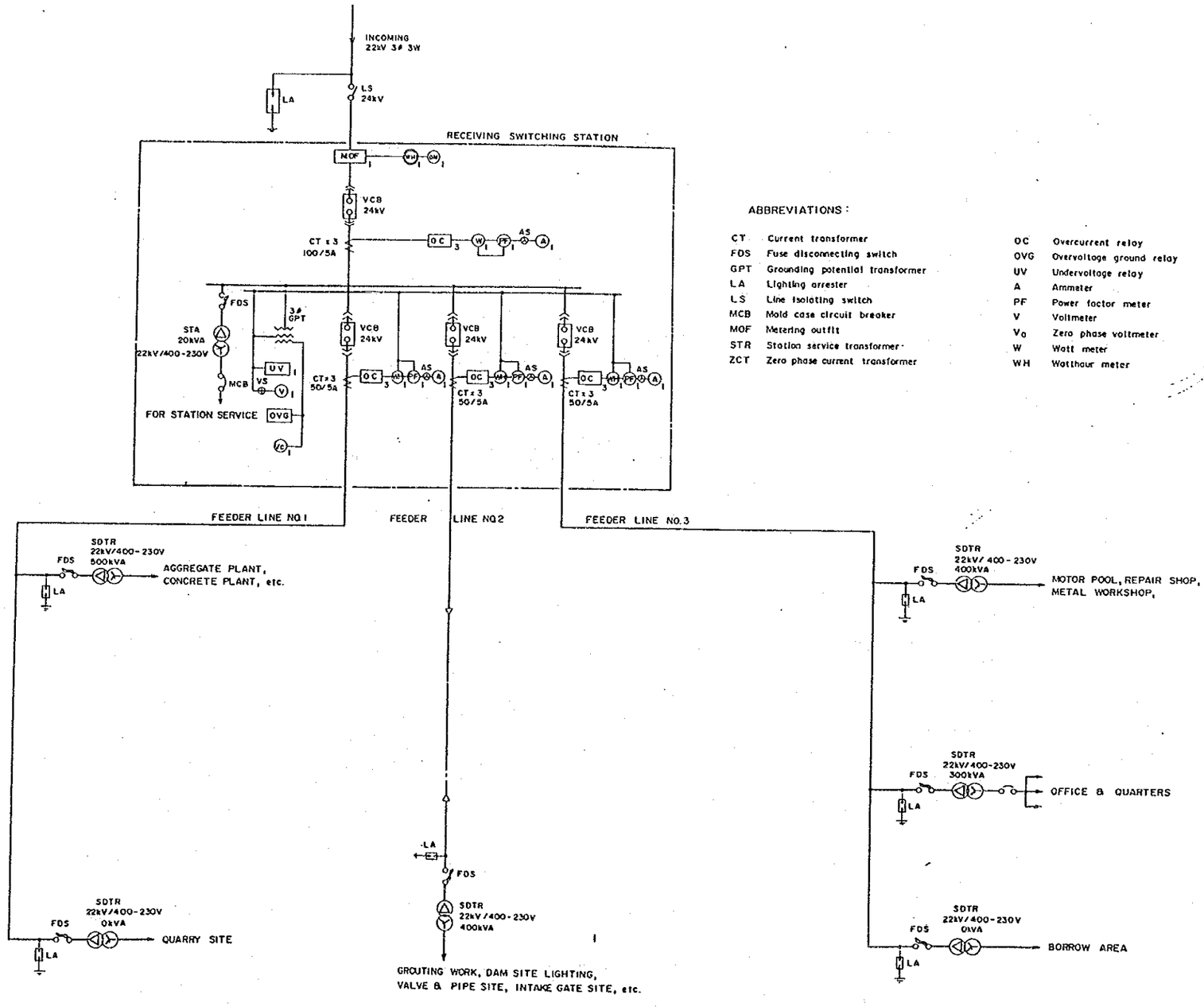


DIAGRAM OF WATER SUPPLY SYSTEM

GOVERNMENT OF MAURITIUS
PORT LOUIS WATER SUPPLY PROJECT
JAPAN INTERNATIONAL COOPERATION AGENCY

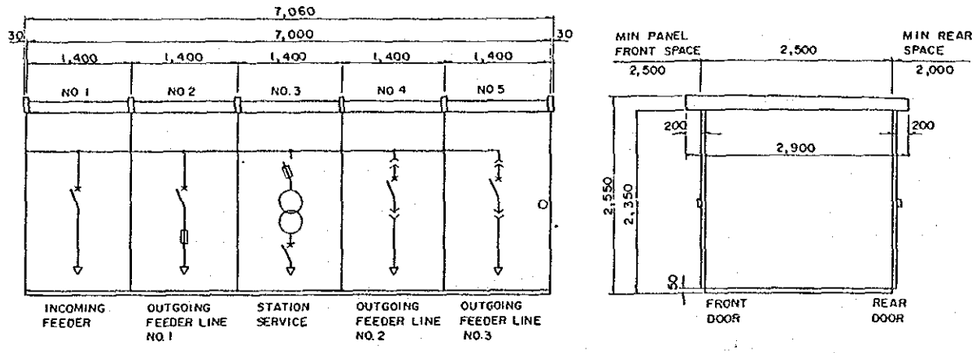


ABBREVIATIONS :

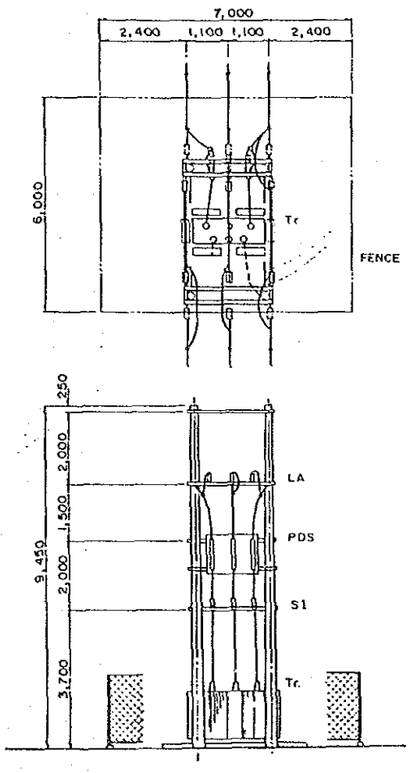
CT	Current transformer	OC	Overcurrent relay
FDS	Fuse disconnecting switch	OVG	Overvoltage ground relay
GPT	Grounding potential transformer	UV	Undervoltage relay
LA	Lighting arrester	A	Ammeter
LS	Line isolating switch	PF	Power factor meter
MCB	Mold case circuit breaker	V	Voltmeter
MOF	Metering outfit	V_0	Zero phase voltmeter
STR	Station service transformer	W	Watt meter
ZCT	Zero phase current transformer	WH	Watthour meter

PREPARATORY WORKS
POWER SUPPLY SYSTEM
CONNECTION DIAGRAM OF POWER SYSTEM (1)

GOVERNMENT OF MAURITIUS
PORT LOUIS WATER SUPPLY PROJECT
JAPAN INTERNATIONAL COOPERATION AGENCY



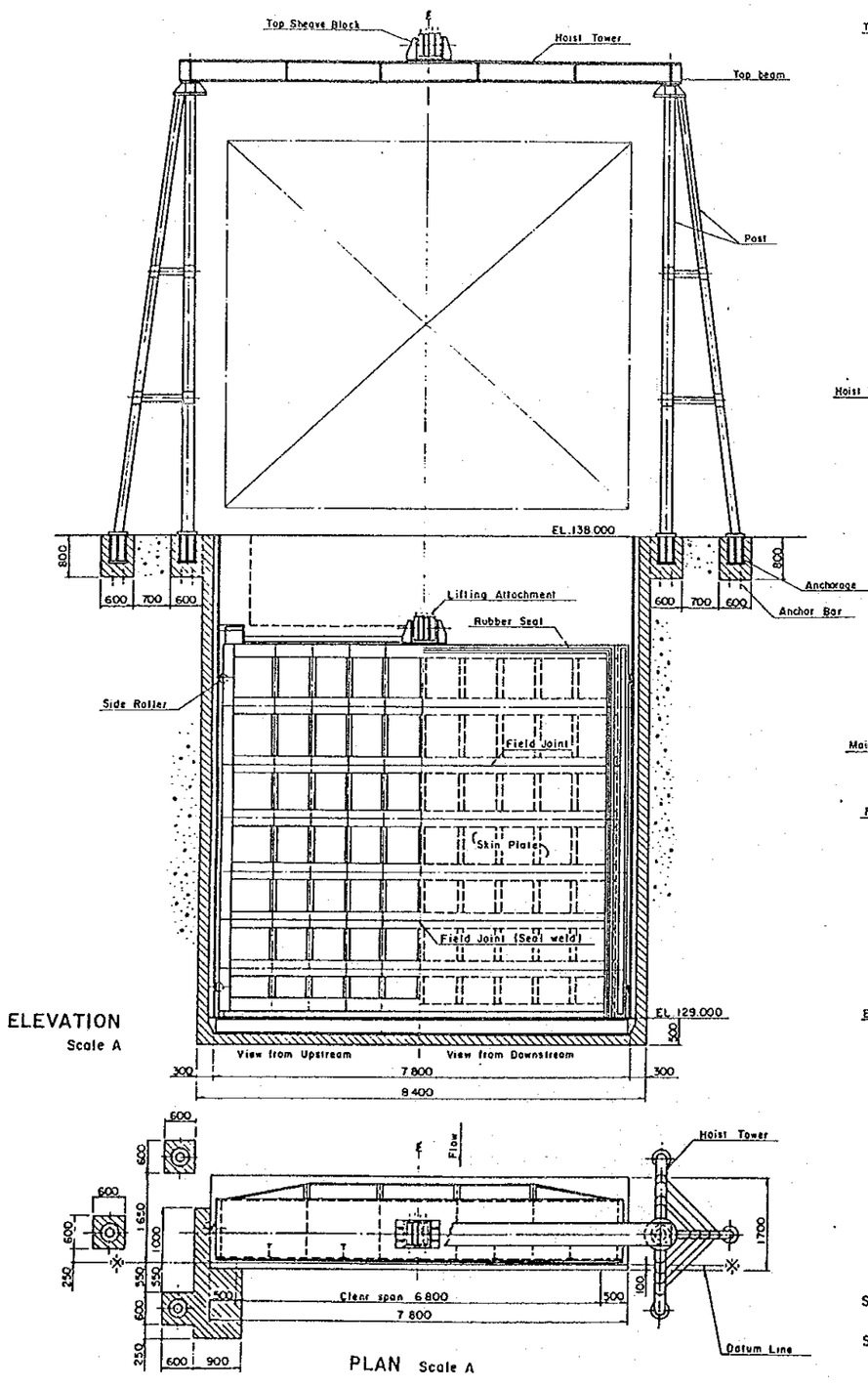
22KV OUTDOOR SWITCHGEAR AT RECEIVING SWITCHING STATION



TYPICAL RECEIVING STATION ARRANGEMENT

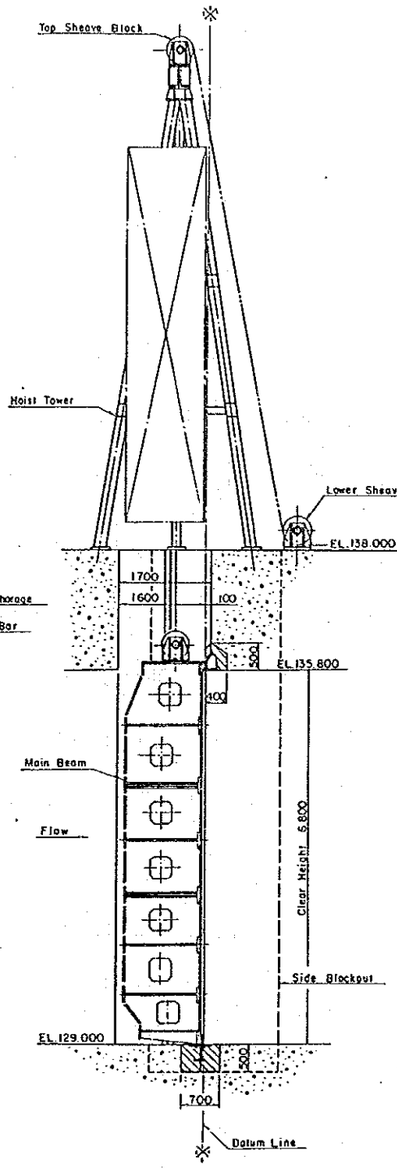
PREPARATORY WORKS POWER SUPPLY SYSTEM CONNECTION DIAGRAM OF POWER SYSTEM (2)	GOVERNMENT OF MAURITIUS PORT LOUIS WATER SUPPLY PROJECT JAPAN INTERNATIONAL COOPERATION AGENCY

Fig. 15

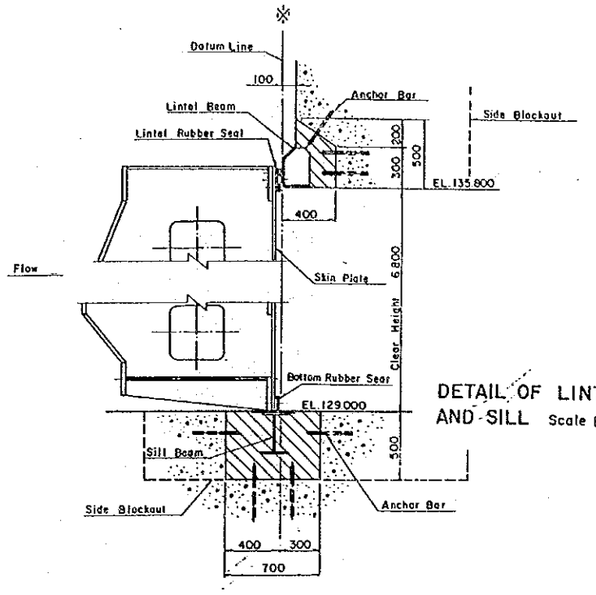


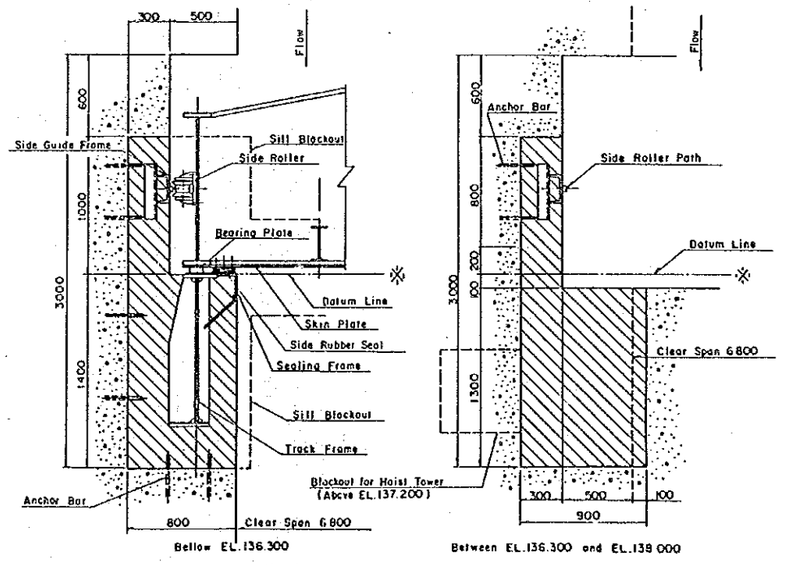
ELEVATION
Scale A

PLAN Scale A



PROFILE Scale A

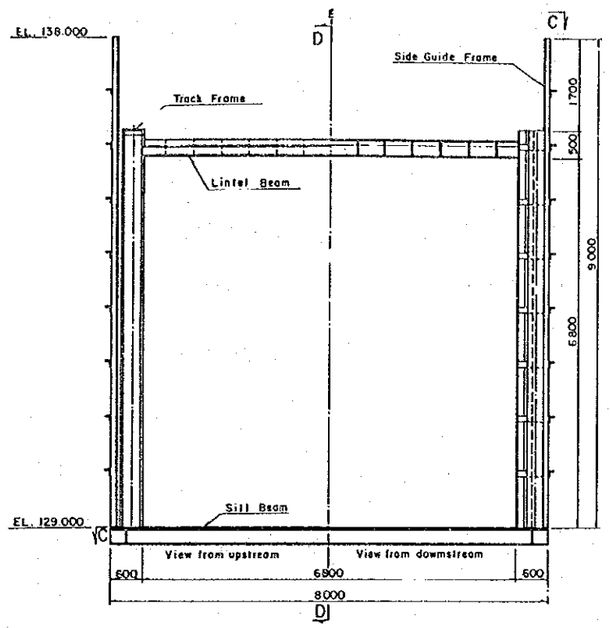




DETAIL OF SLOT Scale B

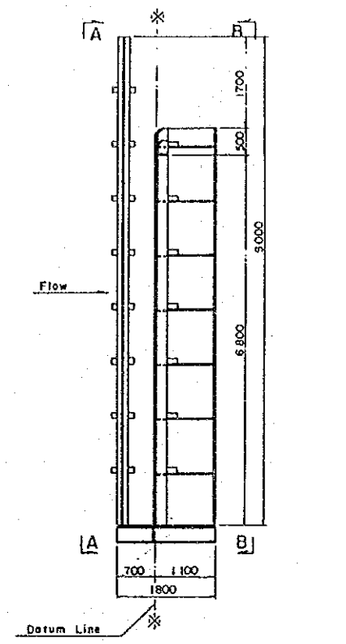
Scale A 0 5m
Scale B 0 2m

METAL WORK DIVERSION GATE	GOVERNMENT OF MAURITIUS PORT LOUIS WATER SUPPLY PROJECT JAPAN INTERNATIONAL COOPERATION AGENCY

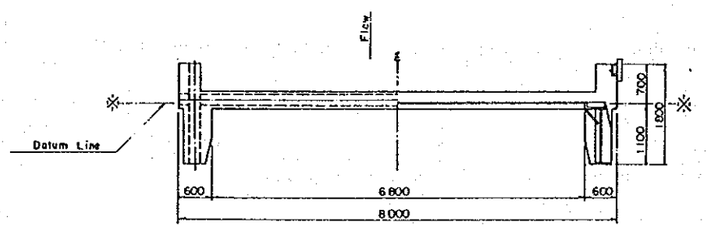


VIEW A-A VIEW B-B

Scale A



SECTION D-D Scale A



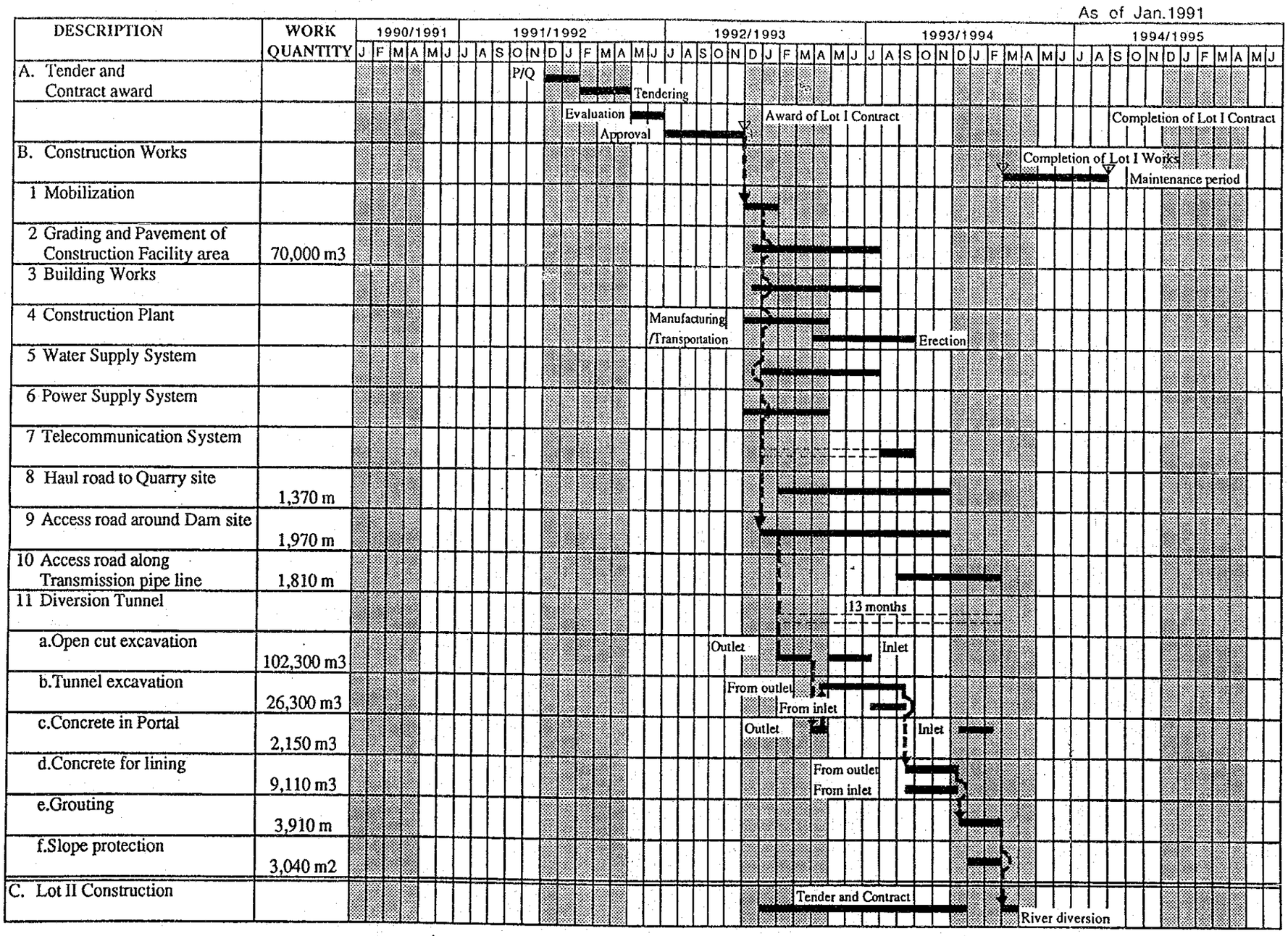
SECTION C-C Scale A

Scale A 0 5m

METAL WORK GUIDE FRAME OF DIVERSION GATE	GOVERNMENT OF MAURITIUS PORT LOUIS WATER SUPPLY PROJECT JAPAN INTERNATIONAL COOPERATION AGENCY

As of Jan.1991

DESCRIPTION	WORK QUANTITY
A. Tender and Contract award	
B. Construction Works	
1 Mobilization	
2 Grading and Pavement of Construction Facility area	70,000 m3
3 Building Works	
4 Construction Plant	
5 Water Supply System	
6 Power Supply System	
7 Telecommunication System	
8 Haul road to Quarry site	1,370 m
9 Access road around Dam site	1,970 m
10 Access road along Transmission pipe line	1,810 m
11 Diversion Tunnel	
a.Open cut excavation	102,300 m3
b.Tunnel excavation	26,300 m3
c.Concrete in Portal	2,150 m3
d.Concrete for lining	9,110 m3
e.Grouting	3,910 m
f.Slope protection	3,040 m2
C. Lot II Construction	



Note ———— Critical path

GENERAL
CONSTRUCTION TIME SCHEDULE

GOVERNMENT OF MAURITIUS
PORT LOUIS WATER SUPPLY PROJECT

JAPAN INTERNATIONAL COOPERATION AGENCY