Chapter 4.

TECHNICAL CONSIDERATIONS ON CHOICE OF FINAL PRODUCTS AND PRODUCTION CAPACITY

Chapter 4. TECHNICAL CONSIDERATIONS ON CHOICE OF FINAL PRODUCTS AND PRODUCTION CAPACITY

4.1 General

Before proceeding to considerations on the choice of final products from technical considerations, a description will be presented on the results of pulping tests conducted in Japan on specimen wood fiber sampled at site.

The final choice will be seen to be given to corrugating medium and printing/writing paper, which present advantages over kraft liner.

Provisions on the future demand for these 2 products will be presented, and the envisaged production capacity will be calculated on the basis of these expected demands.

Targets to be set for product quality will also be presented in consideration of the expected market demand for different qualities of paper and paperboard.

4.2 Pulping Tests

4.2.1 Pulpwood Samples Subjected to Tests

Of the 16 species sampled in the Cayapas Forest Concession, 6 were eliminated - 5 which present basic densities exceeding 700 to 800 kg/m^3 and 1 which conversely was extremely light and contained corky tissue - leaving 10 species which were suitably blended in portions determined from the bone dry basic densities and with account taken of forest volume.

Pulping tests were applied on the blended feed, whose basic density is estimated to have been 450 kg/m^3.

For purposes of comparison, several species of hardwood occurring in Island of Hokkaido, Japan (situated 41° to 46°N, 140° to 146°E) were blended for testing under identical conditions.

These materials are actually utilized in Japan for producing the 3 products considered technically eligible for the present Project.

For further details of the pulping tests, see Annex 2 of this Report.

4.2.2 Suitability for Producing Kraft Liner

The pulping tests revealed the following properties of the Ecuadorian sample fibers as compared with the corresponding Japanese samples.

(1) Pulp Yield

- 3 to 3.5% higher for equal cooking speed and equal Kappa value

(2) Pulp Strength

- Bursting/tensile strength
  3 to 6% lower for equal freeness of stock

- Tearing strength/folding
  17 to 30% higher for equal freeness of stock

- Compressive strength
  Equal performance (Ring crush test)

The foregoing test results would indicate that the Ecuadorian pulpwood would be equally suitable to the Hokkaido hardwood material for producing base liner.

For forming kraft liner, however, the blending of N.UKP to 30 to 40% should be necessary.

4.2.3 Suitability for Producing Corrugating Medium

The pulping tests were conducted both by KSC and by NSSC processes, with the Ecuadorian and Japanese samples subjected to identical test conditions.

The results revealed the Ecuadorian samples to provide higher yield and equal or somewhat better pulp strength compared with the corresponding Japanese samples.

For cooking, the adoption of procedures that involve rapid digestion should incur undesirable results such as reduced pulp strength and increased power consumption for the refining process.

Whether the KSC or NSSC processes is used, they should be applied to provide relatively long durations of cooking.

Between the 2 processes named above, the NSSC process should ensure better yield.

In every event, the Ecuadorian material of mixed hardwood should prove amply utilizable for producing corrugating medium so long as rapid digestion is avoided, though the energy required may amount to 30 to 40% more that corresponding Japanese material.

4.2.4 Suitability for Producing Printing/Writing Paper

The bleachability and bleaching yield were found roughly equal between Ecuadorian and Japanese samples.

A brightness of 84 obtained on pulp bleached in 5-stage of Chlorine - Caustic extraction - Sodium hypochlorite - Caustic extraction - Sodium hypochlorite (C-E-H-E-H).

Viscosity after bleaching was slightly lower on Ecuadorian as compared with Japanese sample.

Other properties shown by the Ecuadorian as compared with Japanese samples were:

– Strength of bleached pulp	Higher
– Opacity	Equal
– Picking	Equal
– Vessel pick	Some signs manifested (characteristic of tropical wood).

These results indicate the Ecuadorian pulpwood to be equally suitable to the Japanese hardwood material for producing printing/writing paper.

4.2.5 Overall Technical Evaluation and Advise

The foregoing results of pulping tests would indicate that the Ecuadorian pulpwood sampled this time is from technical considerations, suitable for producing both corrugating medium and kraft liner (30 to 40% N. UKP required to be blended for kraft liner), as well as for manufacturing printing/writing paper.

It should be noted that, in conducting the pulping tests, the Ecuadorian samples had been 100% barked at site, the samples being further hand-chipped at the laboratory before presentation to test.

A uniform chip size was obtained, as seen from the annexed photos, the uniformity being far higher than normally obtained by mill chipping in industrial production.

It should also be borne in mind that the cooking was applied in autoclave in the laboratory, and in actual mill digester the yield would naturally tend to be less uniformity than obtainable with autoclave cooking.

The foregoing points require to be borne in mind when planning actual plant operation.

4.3 Choice of Final Products based on Technical Criteria

4.3.1 Considerations Leading to Final Choice

(1) Comparison between kraft liner and corrugating medium

The kraft liner currently used for manufacturing carton banana boxes for export is imported from the U.S and Canada, and produced from N. UKP.

In order to produce kraft liner of quality comparable with the above imported material, the tropical hardwood feed will require blending with 30 to 40% of imported N. UKP.

Moreover, the pulp yield in reference to the pulpwood feed would be significantly lower than obtainable for corrugating medium (approx. 50% for kraft base liner, approx. 75% for corrugating medium).

Another point to be borne in mind is that for equal production capacity, plant construction cost will be higher when it is intended for producing kraft liner than for corrugating medium.

The difference in product prices, on the other hand, is quite small between kraft liner and corrugating medium (US.$440/ton for kraft liner and US.$430/ton for corrugating medium, both C.I.F Guayaquil).

The foregoing technical considerations would definitely favor corrugating medium over kraft liner for production by the envisaged Plant.

(2) Advantages of corrugating medium as final product

The primary consideration for the product to be envisaged for the envisaged Plant is that the corrugating medium currently used for manufacturing export banana boxes is imported material of extremely strict quality specifications, and the these severe quality standards require to be matched by the product from the envisaged Plant in order to expect successful competition in the domestic market.

The quality of corrugating medium produced will depend largely on the suitability of the pulpwood used in its manufacture, and very careful selection of the species of pulpwood to be used will constitute an important item of consideration in planning the plant.

On the other hand, the process of manufacturing corrugating medium is quite simple compared with that for kraft liner and printing/writing paper; the level of operator skill for manipulating the equipment also is correspondingly less exacting.

It should therefore be most logical and natural to start by producing corrugating medium, to be followed by the manufacture of products involving increasingly complicated processes, such as printing/writing paper and kraft liner.

Corrugating medium as product will have the further advantage of already being assured a stable market by the box-makers manufacturing carton cases for export banana.

(3) Considerations concerning printing/writing paper

The varieties of printing/writing paper currently marketed in Ecuador would be considered to count far more than the 7 kinds specified in the official tariff code adopted by customs authorities.

As products to be envisaged for the envisaged Plant, it is strongly advised to limit to minimum practical number the varieties of printing/writing paper to be produced, so as to dispense with having to frequently change the product grade - an operation that entails marked lowering of production efficiency.

The range covered of product grades should also not be chosen too ambitiously, such as to cover low basis weight thin paper. The production of special varieties of paper should also be avoided.

For the present Project if printing/writing paper is to be manufactured, it is advised as a first step to limit to a minimum the number of grades of paper to be produced, and which should be selected to cover those grades that can be expected to meet the largest demands per lot.

The variety of paper grades could thereafter be gradually increased upon attainment of stable plant operation. A target figure of 50% share of the Ecuadorian printing/writing paper market might represent a practical objective for the time being.

What should be strictly avoided is to seek coverage of a wide and numerous variety of products, and to attempt compensating the resulting increase of production cost by raising the sales prices.

Paper, particularly of high grade, is not yet an indispensable commodity in Ecuador, so that an inflated price will immediately be reflected in curtailment of sales volume and will prove to be an unsalable product.

Detailed and through market study requires to be further conducted on the present sales of printing/writing paper as well as forecast for the future, in planning the product mix for the envisaged Plant.

4.3.2 Technical Considerations on Final Choice of Products for the Envisaged Plant

The technical considerations presented in the preceding Section 4.3.1 indicate that, among the 3 products of 1) kraft liner, 2) corrugating medium, and 3) printing/writing paper, corrugating medium should present definite advantages over kraft liner, while printing/writing paper also would present promising possiblities as product for the envisaged Plant.

Based on this conclusion, the considerations presented in the ensuring chapters will be limited to the 2 products of corrugating medium and printing/writing paper, the choice between the 2 being to be made with consideration also of non-technical factors.

4.4 Production Capacity

4.4.1 Corrugating Medium

The expected stable future demand for the kraft liner and the corrugating medium of 120,000 tons/year (see Section 2.3 of Chapter 2) would give a figure of roughly 40,000 tons/yer for the corrugating medium alone, which is considered to represent about 1/3 of the aggregate kraft liner plus corrugating medium consumption.

Translated into daily production capacity, a figure of 120 tons/day is derived for the corrugating medium.

To produce the above yearly output of corrugating medium, the pulpwood supply would amount roughly to 114,000 m^3, which could very amply be provided even from the Cayapas Forest Concession Lot 2 alone, representing a forest volume of 1,883,340 m^3.

4.4.2 Printing/Writing Paper

In Chapter 2, Section 2.4.3, a figure of 45,000 tons/year was mentioned as possible demand for printing/writing paper in the Ecuador in 1990. Adopting a conservative figure of 43,000 tons/year, and assuming for the envisaged Plant a share of 50% of this future market, in the event this product is adopted for the envisaged Plant, the manufacture of printing/writing paper from this plant would require to amount to 21,500 tons/year.

This would call for pulpwood feed at the rate of roughly 112,000 m^3 / year, which happens to equal the volume cited in the preceding Section for producing 40,000 tons/year of corrugating medium. Thus the adopting of either corrugating medium or printing/writing paper would be indifferent from the aspect of pulpwood supply, which could be amply covered by the forest volume available in Cayapas Forest Concession Lot 2 alone.

4.5 Quality Standards

4.5.1 Corrugating Medium

The corrugating medium that would be produced by the projected Plant would be wholly destined for the manufacture of export banana boxes, for which the specifications are already definitely established.

These specifications are reproduced in Table 4-1, cited from information made available by INCAESA. Comparison of the corresponding specifications for 1973, for 1975 and for 1982 reveal a tendency to tighten rather than relax the requirements for corrugating medium and betoken the stringency of the specifications governing the corrugating medium.

This level of quality would correspond to what was applied to corrugating medium in Japan about 20 years ago when it was produced from hardwood produced in Hokkaido (white birch, alder and other relatively soft hardwood) by means of NSSC process. A comparable product would no longer be obtainable in Japan today, when corrugating medium is produced mainly with hardwood pulp blended with waste paper.

The quality of imported paper board actually measured on samples is presented in Table 4-2.

The worldwide trend toward rationalization of packing practice has already had its effect on conditions in Ecuador, where banana exporters are seriously studying the means of realizing saving in packing material while maintaining the compressive strength, which is the principal criterion for box carton.

One approach is to increase the basis weight of the corrugating medium and to conversely reduce that of the liners. To permit such innovation, the corrugating medium will require to ensure a high level of Ring crush or Concora test value and such a trend will add greater importance to requirements specified for corrugating medium.

Table 4-1. Specification for Corrugating Medium

Grade	127 g/m² (26 lbs)	146 g/m² (30 lbs)	161 g/m² (33 lbs)
Basis Weight			
Max. g/m^2	129.	149.	164.
$lbs/1,000\ ft^2$	26.5	30.5	33.5
Min. g/m^2	125.	144.	159.
$lbs/1,000\ ft^2$	25.5	29.5	32.5
Thickeness			
mm	0.23	0.25	0.28
inch	0.009	0.010	0.011
Ring Crush			
M.D kg	–	32.7	–
lbs	–	72.	–
C.D kg	–	22.3	–
lbs	–	49.	–
Concora Test			
kg	34.	36.3	38.6
lbs	75.	80.	85.
Water Drop Absorption			
Max sec.	50.	50.	50.
Min. sec.	30.	30.	30.
Wet Strength			
%	7.	7.	7.
Moisture			
%	7.	7.	7.

Notes:

1) Samples were gotten from INCAESA.
2) Pulping process of the corrugating medium is SCP.
3) Testing condition; 23°C and 50% of relative humidity.

Table 4-2. Measured Quality of Imported Kraft Liner and Corrugating Medium

Measured Item	Kraft Liner Purchased from:		Corrugating Medium Purchased from:	
	International Paper	International Paper-Georgetown	International Paper-Canada	Papier Casodes
Basis Weight (g/m^2)	207.	459.	161.	152.
Density	0.60	0.61	0.53	0.51
Burst Factor	3.60	2.40	2.05	1.71
Breaking Length				
M.D, km	6.73	5.20	5.56	4.83
C.D, km	2.95	2.31	2.20	2.02
Elongation				
M.D, %	1.90	1.50	1.70	2.00
C.D, %	5.40	4.40	3.40	3.50
Ring Crush Factor				
C.D	16.8	14.1	13.7	13.1
Concora Crush Factor			18.6	17.7
Tear Strength Factor				
M.D	154.	145.		
C.D	176.	166.		
Folding Endurance				
M.D	459.	342.		
C.D	148.	158.		
Water Drop Time				
sec.			14.3	20.6

Note: 1) Samples are used by INCAESA.

2) Conditions of measurement; Temperature 20°C and relative humidity 65%.

It should further be borne in mind that in practical use, this corrugating medium, after being converted into banana boxes, serves for the maritime transportation of bananas in trip extending beyond a month over ocean, to reach distant destinations.

Such conditions of use should inevitably induce damping of the carton material during transit. Maintenance of compressive strength after absorption of moisture should thus constitute an indispensable requirement, and this justifies the extremely severe standards appearing in Table 4-1. To meet such standards, consideration may require to be given to the adoption of wet strength resin as additive for improving product quality.

Runnability and adhesion should also constitute important qualities that require to be processed by the corrugating medium, considering that the 87 inch corrugators have been observed running at speed of 140 to 150 m/min at the converting plants of both INCAESA and PRCASA visited by the survey team in Guayaquil.

The foregoing requirements that would governing the corrugating medium that would be produced by the envisaged Plant indicate the importance of very strict control in the production process to ensure uniformity of basis weight and moisture profiles in the direction across sheet.

4.5.2 Printing/Writing Paper

(1) Quality requirements for printing/writing paper

The largest portion of paper consumed in the world is printing/writing paper. The functional properties demanded of this kind of paper are (a) dimensional stability, (b) opacity, (c) printability, and (d) brightness.

The extremely high quality of printing/writing paper currently marketed in the advanced countries is a consequence of the stiffly competitive market for paper manufacturers, and does not reflect requirements dictated by the necessities of practical use.

For the present Project, there is no reason to follow such wasteful practice, and the target quality for printing/writing paper should be placed at a level that should simply adequately reflect the functional requirements dictated by national economical considerations.

(2) Considerations on quality of printing/writing paper

Rapid innovations affecting printing technology will call for the supply of printing paper that is adapted to the machines that will incorporate ever higher printing speeds, wider sheet widths, multi-color printing and automation systems.

Printing machines will also progress form flat printers to rotating machines and to rotary offset printers; the printing paper used by these machines will tend to become lower basis weight. The qualities that will be increasingly required by such machines would include:

- Freedom from curling, for flat printing
- Correctly layered rolls
- Universally printable quality (whether for letterpress, lithography or gravure)
- Quality ensuring printing free from linting, picking and other printing troubles.

Other basic functional qualities that will be increasingly demanded for printing paper would include:

- Uniformity of paper formation
- Smoothness
- Brightness
- Equality of two-sidedness
- Freedom from dirt
- Surface strength.

The composition of printing/writing paper consumed in Ecuador can be estimated from the customs statistics, which indicate that 43.2% of this kind of paper was constituted by printing paper, 52.5% by bond paper and 4.3% by writing paper.

Table 4-3 reproduces the results of quality test conducted on samples of bond paper obtained from the Ecuadorian market.

Table 4-3. Quality of Ecuadorian Bond Paper Sample

Measured Item	Unit	Measured Value
Basis Weight	g/m^2	79.1
Thickeness	mm	0.113
Density	g/cm^3	0.70
Brightness	%	
T.S		90.5
B.S		90.0
Opacity	%	90.0
Smoothness	%	
T.S		18.0
B.S		14.1
Ash	%	13.4
Moisture	%	7.8

Sample: Bond paper obtained from PANASA on October 1982.

(3) Target quality for printing/writing paper that would be produced by the envisaged Plant

Of the numerous varieties of printing/writing paper marketed currently in Ecuador, the category which sees the largest consumption is paper of basis weight above 30 g/m^2.

For the envisaged Plant, therefore, the range of basis weight tentatively envisaged has been set at 40 to 100 g/m^2, with ash content held below 7%.

Sheet width will be 2,500 mm; a proportion of 20 : 80 is assumed between roll and flat paper.

Details of quality targets that might be envisaged for the envisaged Plant are given in Table 4-4.

Table 4-4. Target Quality Parameters Envisaged for Printing Paper

Item	Unit	Basis Weight 60 g/m²	Basis Weight 80 g/m²
Density	g/cm³	0.70	0.70
Smoothness	sec.		
T.S		17.00	17.00
B.S		15.00	15.00
Brightness	%		
T.S		80.00	80.00
B.S		80.00	80.00
Opacity	%	75.00	80.00
Sizing Degree	sec.		
T.S		20.00	30.00
B.S		20.00	30.00
Picking			
T.S		9.00	9.00
B.S		9.00	9.00
Breaking Length	km		
M.D		5.00	5.00
C.D		3.00	3.00
Elongation	%		
M.D		2.20	2.20
C.D		4.50	4.50
Moisture	%	8.00	8.00
Ash	%	7.00	7.00

Chapter 5.

PLANT SITE

Chapter 5. PLANT SITE

5.1 General

In any industry, site selection calls for careful consideration of many factors-technical, economic, and social. This applies particularly to the case of the present Project, which involves the production of pulp and paper, essentially dependent on the supply of suitable pulpwood and water in suitable quality and adequate quantity, as well as imported kraft pulp, chemical additives, heavy oil, electricity and other auxiliary materials and supplies.

In addition to the foregoing basic factors, important elements requiring to be considered in the present instance include the choice of construction systems (platform-mounted or conventional piece-meal installation) and means of transporting the auxiliary materials and finished products to and from site, in view of the particularities presented by the San Lorenzo area on the Pacific Coast facing an inlet in an intricately indented coastline, and remote from the industrialized centers of the Republic.

Siting of the envisaged Plant will be the subject of careful examination of the foregoing principal factors governing the San Lorenzo area envisaged for locating the plant.

The present Study team has surveyed not only the vicinity of San Lorenzo, but extended its coverage to Recaurte for its possible interest as alternative source of water, and to other regions of the country, including Quito, Guayaquil, and Esmeraldas.

5.2 Siting Considerations

5.2.1 General

The area around San Lorenzo has been designated between both parties of the Preliminary Study team and the Ecuadorian counterpart as location for the envisaged Plant (see Fig. 5-1). 3 sites judged best for locating the plant were selected in this area, and the Study team surveyed these sites to evaluate their suitability for siting the plant, based on the following factors which were examined during its visit to the locality.

(1) Availability, cost and transportation means of pulpwood

(2) Availability of water in suitable quality and adequate quantity

(3) Availability and cost of auxiliary materials (imported kraft pulp), chemicals, utilities (heavy oil, diesel oil, electric power, etc.)

(4) Possibility of adopting the platform-mounted system of construction (availability of access waterway, water surface and flat land required for installing the plant platform)

(5) Infrastructure (port facilities, roadways, railroads, communication systems, and public facilities)

(6) Available means of transporting plant components, auxiliary materials and finished products to and from plant site

(7) Available labor force and wage levels

(8) Convenience of plant construction period required for construction; construction cost

(9) Anti-pollution measures

(10) Distance from center of consumption

(11) Concordance with basic national policy (contribution to development of local economy)

The foregoing 11 factors were applied in comparatively evaluating the 3 alternative locations A, B, and C indicated in Fig. 5-2 for their suitability as site for the envisaged plant.

The following paragraphs describe the characteristics of the 3 alternative locations, followed by comparative evaluations of each location in reference to various factors.

– Location A

As shown in the map of Fig. 5-2, the Location A is situated on the bank opposite the plywood mill operated by I.F.C, facing an inlet with an opening about 100 m wide and extending over a length of about 1,000 m. This inlet is entirely dried of water at maximum ebb (see Fig. 5-3 reproducing aerial photograph of Locations A and B at maximum ebb).

Location of the plant at this site will call for the construction of a new access road about 3.5 km long connecting with the highway linking San Lorenzo with Ibarra.

Fig. 5-1. Location of Envisaged Plant Site

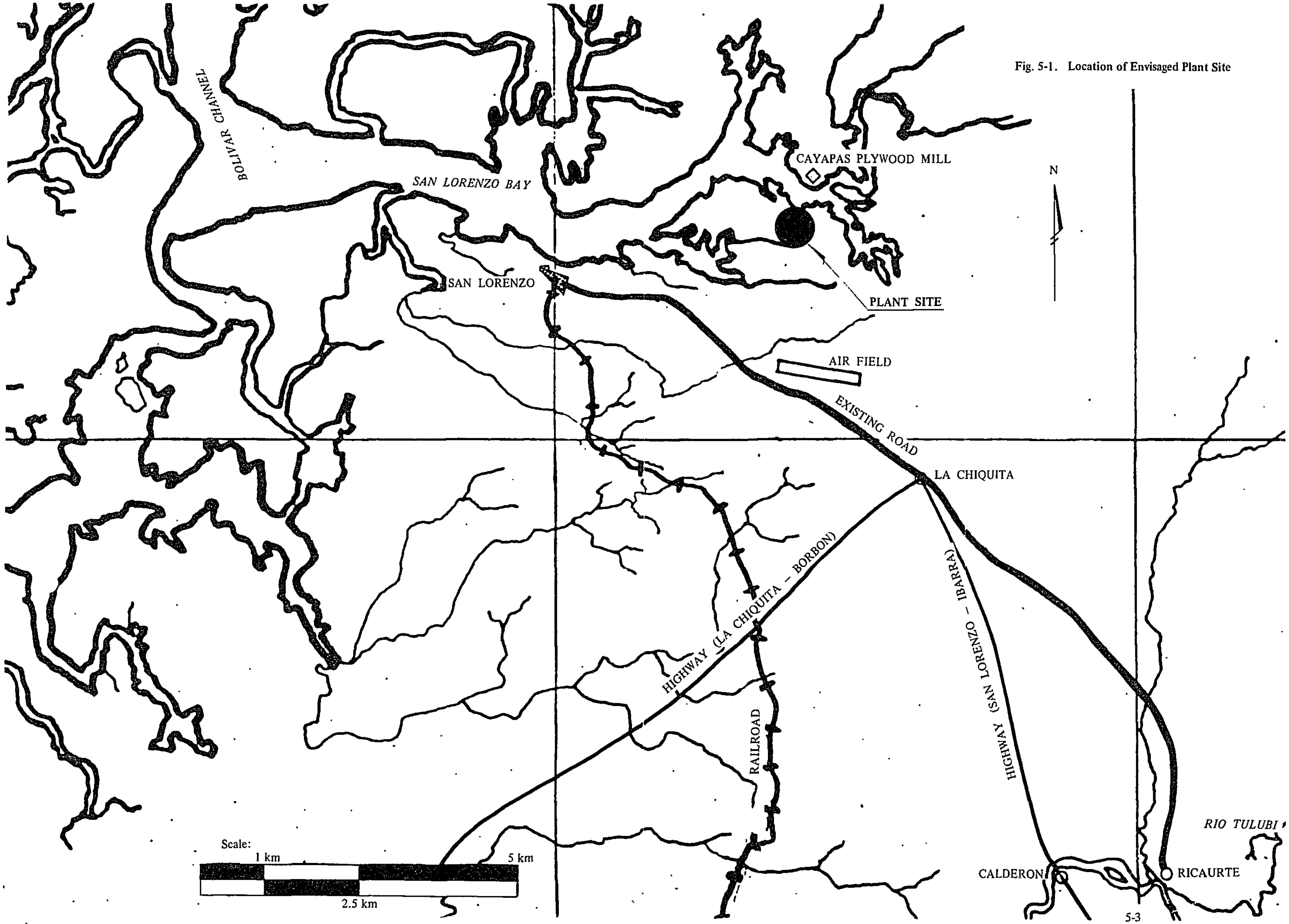


Fig. 5-2. The 3 Alternative Locations A, B, and C

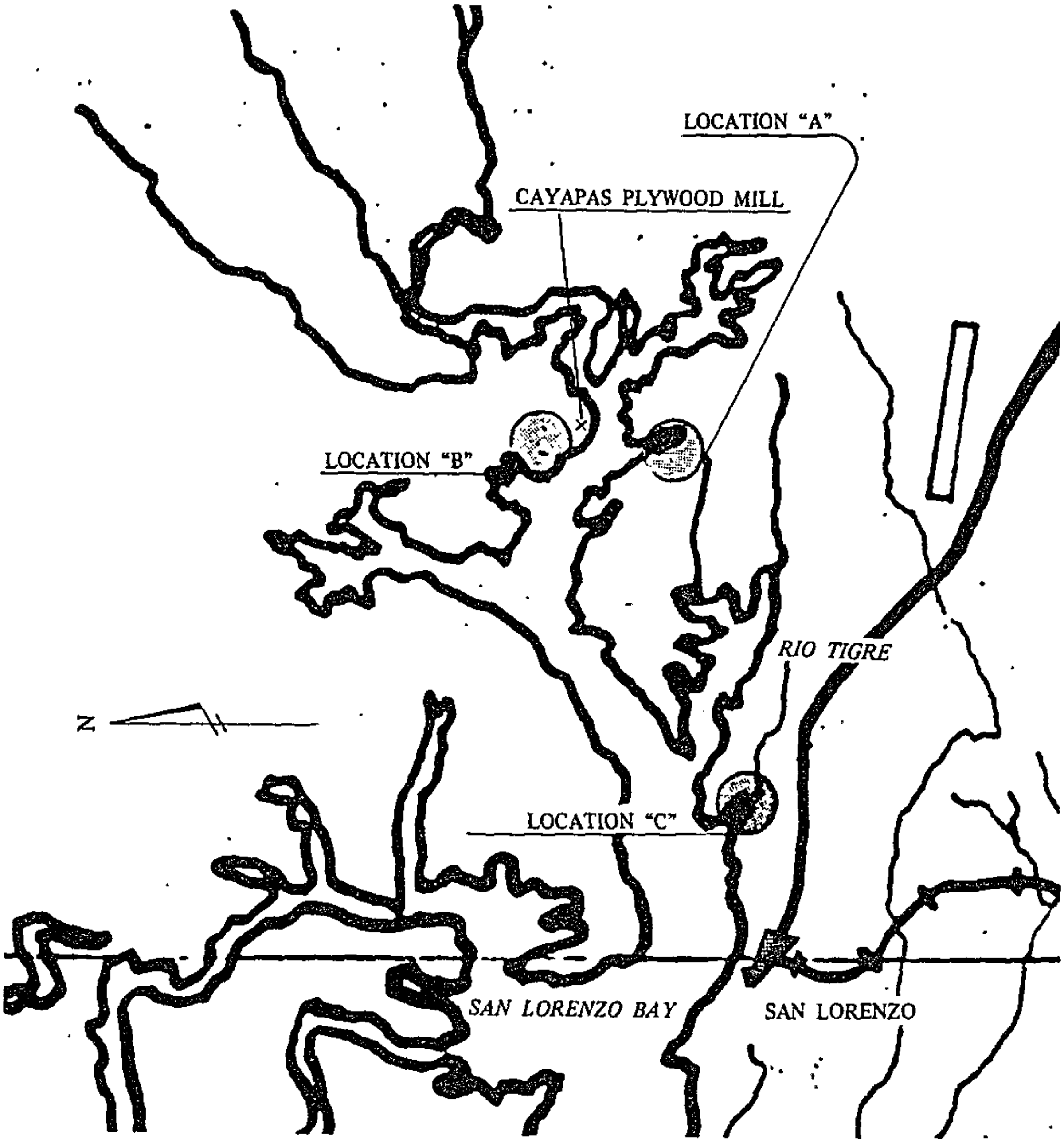
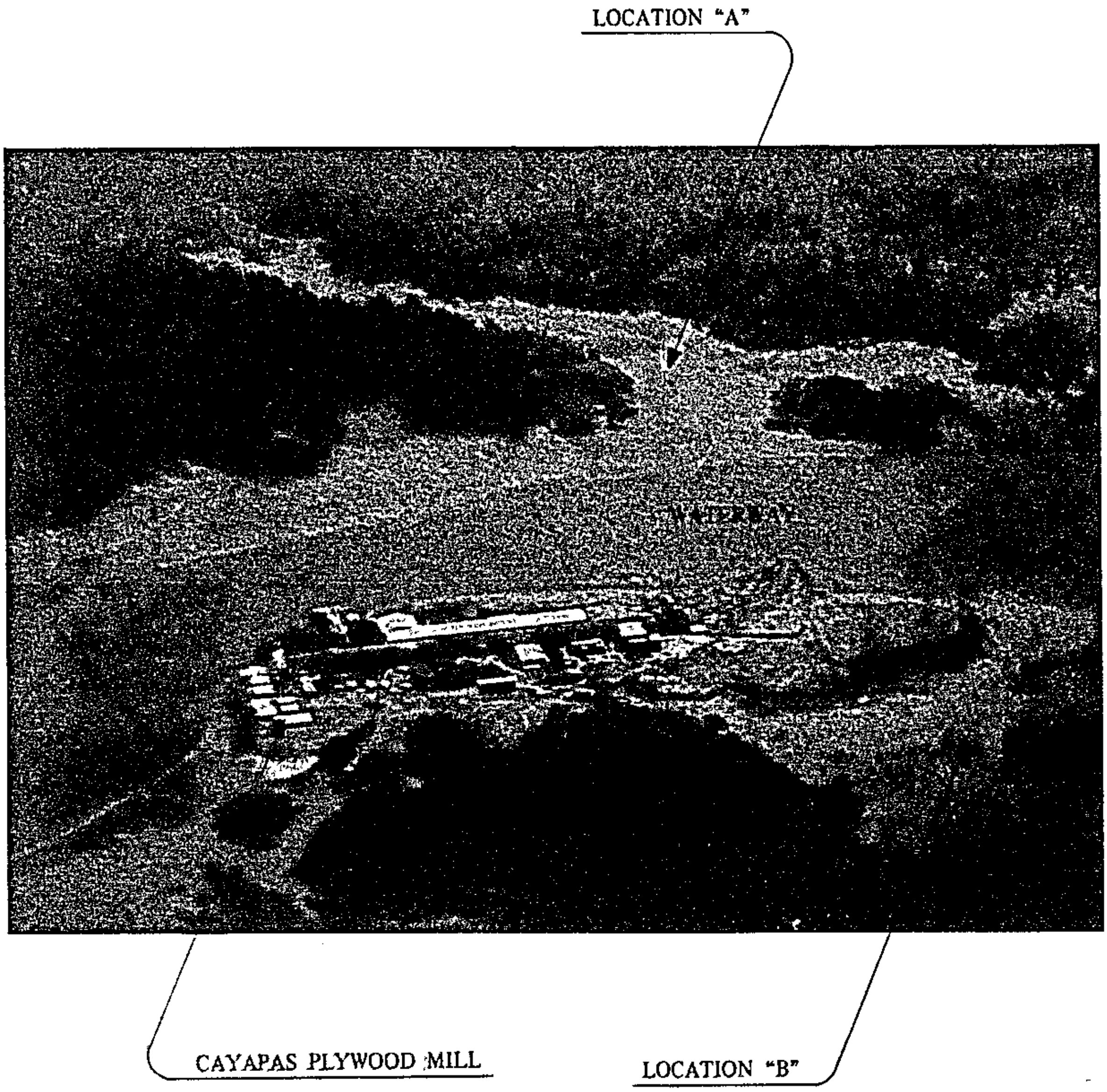


Fig. 5-3. Reproducing Aerial Photograph of Locations A and B



– Location B

Location B is on an inlet about 70 m wide at inlet and about 300 m long, on the west side of the plywood mill (see Fig. 5-2). Similarly to the Location A, this inlet also is completely dried of water at maximum ebb.

This Location situated within Lot 4 of the Cayapas Forest Concession, so that it would be advantageous for logging from this Lot, but considering that this Lot is already designated as source for the plywood mill, sourcing of pulpwood from other lots would require the construction of an access road about 10 km long from the San Lorenzo – Ibarra highway – a factor calling for serious consideration.

– Location C

Location C is situated on a height around Rio Tigre, and is nearest of all 3 locations to the city of San Lorenzo. This location faces directly the San Lorenzo Bay.

The drawback of Location C is that it is covered by a dense growth of mangrove trees, which will require to be effectively removed and followed up by bank protection work.

5.2.2 Supply of Pulpwood Material

The stock volume of pulpwood, logging area and method of logging are discussed in detail in Chapter 3, "Forest Resources" and Chapter 8, "Pulpwood Supply".

The present Section will therefore mainly consider the aspect of the access road to plant requiring to be constructed from the San Lorenzo – Ibarra highway.

It is obvious from Fig. 5-2 that the Location C will require the shortest access road, followed by Locations A and B.

The last-named location, in particular, will call for constructing a road encircling the San Lorenzo Bay, thus presenting a considerable disadvantage.

The cost of road construction will be influenced not only by length but also by topography: In this latter aspect, the area around San Lorenzo presents a gently undulating height with an average rise above water level of approximately 10 m, with no significant differencce between the 3 alternative locations.

5.2.3 Supply of Process Water

No regular supply of industrial water is available in the San Lorenzo area. Consequently, apart from seawater that can be used for cooling the turbine condenser, all water used in the plant will have to be sourced from wells or from river.

With the view of examining the possibility of using underground water for plant process, the Study team visited I.E.O.S of San Lorenzo to obtain pertinent information, as well as the plywood mill of I.F.C, to observe the situation of mill water supply.

It was found as a result that an abundant water vein extended over the entire San Lorenzo area, which would in principle permit the use of well water as process water source for the envisaged Plant, this observation being equally valid for all 3 alternative locations.

Further details concerning water supply are given in Section 5.5 of this Chapter "Utilities".

5.2.4 Supply of Auxiliary Materials, Chemicals and Utilities

All auxiliary materials – imported kraft pulp and chemicals – require to be supplied via Guayaquil; no such material is available in San Lorenzo.

Heavy oil and diesel oil will have to be procured from Esmeraldas. Electricity is envisaged to be supplied from a house power plant, to be installed as part of the Project installations

Consequently, all 3 alternative localities stand on equal ground in respect of the supply of auxiliary materials, chemicals and utilities.

5.2.5 Suitability to adoption of the Platform-mounted System of Construction

The essential condition for permitting the adoption of the platform-mounted system of construction is the availability of access channels of water for towing the floating platform directly to the construction site. Details of considerations on the water channels are given in section 5.4.4 of this Chapter "Waterway for Access of Industrial Platform".

The overall conclusion is that the waterway up to San Lorenzo from the Pacific Ocean possesses ample depth and width, but dredging would be required further upstream, with the volume of work required increasing from Location C to A and to B.

Installation at site of the industrial platform will require a water surface – artificial basin or natural inlet – adequately large to accommodate the platform. Construction cost will be appreciably influenced by the amount of civil work involved in providing the necessary water surface.

Location C will call for the smallest amount of dredging work for securing access to plant site, but on the other hand, will involve by far the largest expenditure for excavating required water surface. Locations A and B, on the other hand, will permit the utilization of natural inlets, which will minimize the work of securing the installation water surface, and while the dredging work necessitated to ensure access of the platform will be greater, the expenses involved in this work will be far below those that will be required for the excavation on Location C.

It will be recalled, however, that Location B has the drawback of requiring a much longer access road to be constructed.

5.2.6 Infrastructure

Details of infrastructure are given in Section 5.5 of this Chapter "Infrastructure".

Location C has the advantage of being situated nearest San Lorenzo, whose jetty would be directly available; Location A will rank next respect of available infrastructure, followed by Location B.

5.2.7 Means of Transporting Plant Components, Auxiliary Materials and Final Products

The San Lorenzo jetty is not equipped with any cargo handling facilities, and for this reason, the unloading of plant components will require bringing in cranes and other handling equipment. This means that the San Lorenzo jetty will not fully serve for the transportation of plant components, but on the other hand, this jetty can be expected to serve usefully in unloading auxiliary materials and in loading finished products.

Consequently, the proximity to San Lorenzo of Locations C and A have the advantage over Location B, in that order.

5.2.8 Labor Supply

In respect of labor supply, the 3 alternative locations stand on completely equal ground.

Measures for recruiting requiste labor are described in detail in Chapter 10, "Plant Operation"

5.2.9 Convenience of Plant Construction

Assuming that the platform-mounted system of plant construction is adopted, the Locations A and B facing natural inlets have a decisive advantage over Location C, situated on a height, which is favorable for conventional piece-meal construction system but will demand considerable expenditure in excavation for implementing the platform-mounted system.

It will again be recalled here that Location B has the drawback of requiring a very long access road.

5.2.10 Anti-pollution (Environmental Protection) Measures

The geographical situation of San Lorenzo – recessed 15 km from the Pacific Ocean in a deep inlet – and the particular communal environment – large fishing population whose fishing grounds extend into the San Lorenzo Bay – will make it indispensable to provide amply adequate measures for treating the effluent water emanating from the envisaged Plant. This requirement applies completely equally to all 3 locations.

Measures for abating effluent gases, smell and noise, on the other hand, will have to be considered most seriously in the case of Location C, situated closest to the city of San Lorenzo, whereas both Locations A and B will require relatively small expenditures for these measures, being placed remote from habitations.

5.2.11 Distance from Center of Consumption

The products emerging from the envisaged Plant will be wholly shipped to Guayaquil to be all consumed in that city.

For this reason, proximity to san Lorenzo will play no part in this respect, and all 3 locations stand on equal ground.

5.2.12 Concordance with Basic National Policy; Contribution to Development of Local Economy

The establishment of an integrated pulp and paper plant in the area of San Lorenzo, Esmeraldas Province, envisaging the utilization of pulpwood available from nearby national forest – the Cayapas Forest Concession – will not fail to bring a vast economic impact to the region, to contribute most effectively to regional economic development, which constitutes an important element in the national policy of the Republic.

Placing the envisaged Plant in the San Lorenzo area will further satisfy to fullest extent the call for making better utilization of domestically available resources, with the exploitation of nationally-owned forest.

Thus, while all 3 Locations A, B, and C in the San Lorenzo area stand on equal ground in this respect, any other location outside this area would, if considered, wholly upset the basic conditions governing plant construction, supply of pulpwood feed and other factors that have led to the choice of this area for the envisaged Plant.

Such an entirely different location for the plant will further compromise the profitability of the present Project, with the probably result of negative prospects for successful commercialization.

5.3 Final Choice of Location

Having selected the 3 Locations A, B, and C as sites judged most suitable for locating the envisaged Plant, as set forth in Section 5.2.1, comparative evaluations were made of the 3 locations in reference to the 11 factors enumerated in the same Section.

The final choice emerging from this evaluation is in favor of Location A for the envisaged plant site.

Table 5-1 gives the results of the individual evaluations made of the alternative locations for each of the 11 factors.

Table 5-1. **Comparative Evaluation of Alternative Locations for Plant Siting**

Factor Considered	LOCATION A	LOCATION B	LOCATION C
1. Supply of pulpwood material	Excellent	Good	Excellent
2. Supply of process water	Good	Good	Good
3. Supply of auxiliary materials, chemicals, utilities	Fair	Fiar	Fair
4. Siutability to adoption of platform-mounted system of construction	Excellent	Good	Fair
5. Infrastructure	Fair	Poor	Good
6. Means of transporting plant components, auxiliary materials and final products	Good	Poor	Excellent
7. Labor supply	Good	Good	Good
8. Convenience of plant construction	Excellent	Good	Poor
9. Anti-pollution measures	Good	Good	Fair
10. Distance from center of consumption	Poor	Poor	Poor
11. Concordance with basic national policy	Excellent	Excellent	Excellent
Overall Numerical Evaluation	75	61	66

5.4 Geographical Characteristics of Proposed Plant Site

5.4.1 Outline

San Lorenzo – envisaged as site for the projected Plant – is situated 01°18'N, 78°51'W, close to the Columbia frontier. The key industries supporting the area are forestry and the associated sawing activity, followed in importance by fishery. It was with the objective of developing the forestry and sawing industries that the Ecuadorian National Railroad line was constructed to link San Lorenzo with Ibarra.

San Lorenzo has a population of approx. 18,000 and counts 14 schools including 3 colledges. Town water supply is ensured by I.E.O.S, which is today pursuing its project for installing a sewer system for the city.

5.4.2 Topography and Geology

The San Lorenzo area faces a deep inlet of complex configuration bounded to the north by the Columbian border and to the southwest by the localities of La Tola and Borbon. The banks of this inlet are covered by mangrove forest.

A channel of water permitting the passage of 2,000 ton class vessels flows along the northwest part of the city, providing a waterway to the Pacific Ocean.

No notable rivers flow directly into this inlet, all major rivers having their outlets directly on the Pacific Ocean, mainly around La Tola and Borbon after meandering through the Cayapas Forest Concession.

Inland of this inlet, there occurs a natural tropical rainforest covering the plains extending from the Pacific Coast eastward to the Andes. This tropical rainforest lies over flat land averaging an elevation over sea level of 10 to 20 m, dotted with hills 400 to 500 m high.

The geology of this region comprises argillaceous and alluvial layers, the former layer reaching a depth of 2 m from ground surface. The alluvial layer beneath is mainly composed of fine and medium sand.

The subsoil beneath the locations selected as possible plant sites have not been investigated in detail, so that precise evaluation as ground for plant installation cannot be made at this instance, but in so far as indicated by information obtained from I.E.O.S and I.F.C, as well as from local general contractors, there would exist little prohabitality of encountering soft soil that present problems in foundation work.

5.4.3 Climate

The climate of Ecuador differs widely from region to region and according to altitude, with the influence of various factors such as the presence of the Andes, the Humboldt Current, the Equatorial warm current and the complex topography.

The Province of Esmeraldas – in which the San Lorenzo area is included – is situated on the plains facing the Pacific Coast, which is generally hot and humid.

With particular reference to San Lorenzo, its situation facing an inlet connected to the ocean ensures an almost constant temperature, humidity and rainfall throughout the year, the daytime temperature averaging 30°C and lowering to 25°C in the morning and evening; humidity is 85% and the annual rainfall 2,500 mm.

No records exist of hurricanes, tornadoes or earthquakes during the past several decades: Apart from the high humidity, the climate can be considered favorable.

5.4.4 Waterway for Passage of Industrial Platform

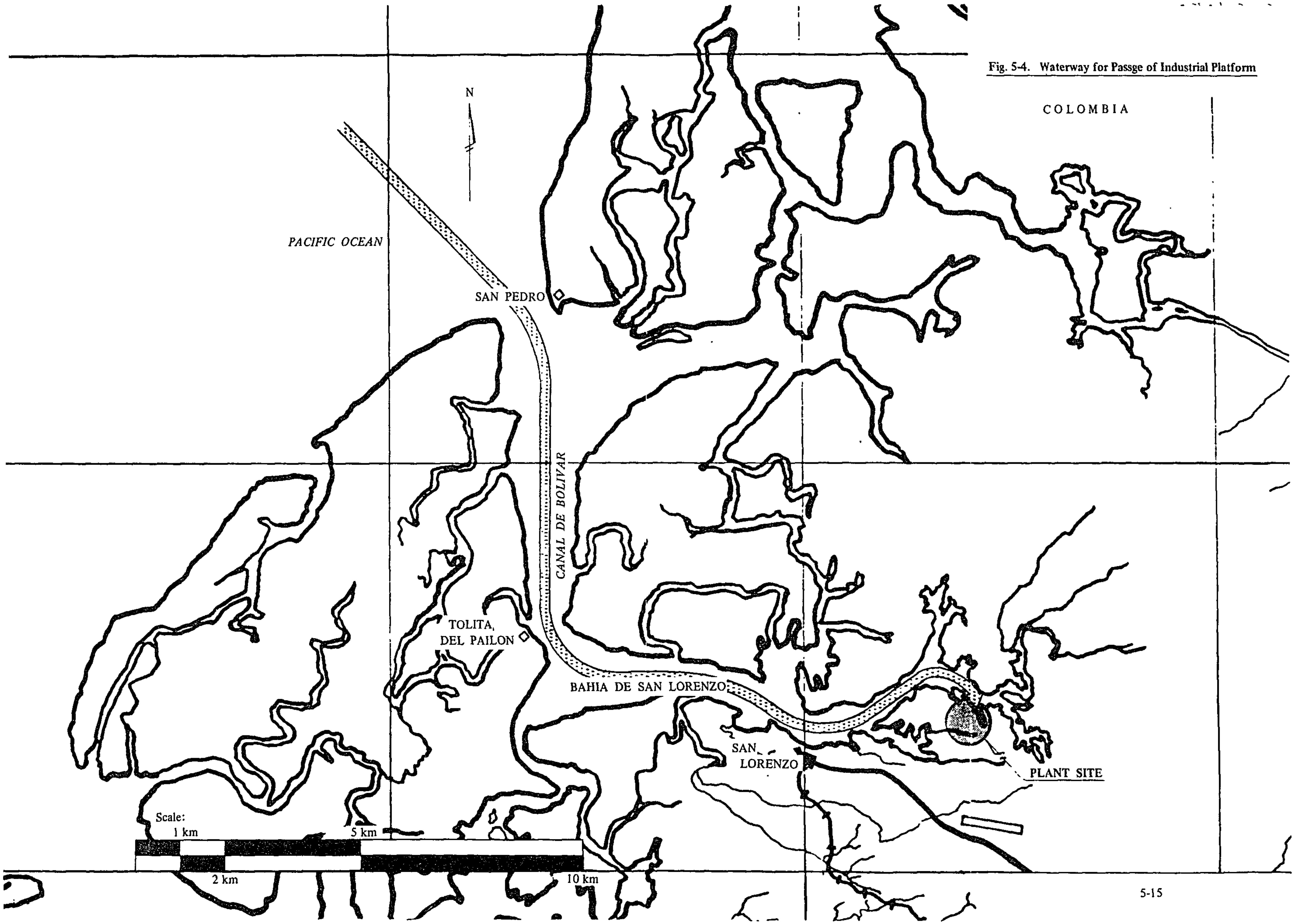
Access to the plant site from the ocean by towage of the floating platform over water is premised upon the availability of a waterway satifying the following conditions:

(1) Width and radius of passageway adequate for the passage of the industrial platform of the designed size
(2) Effective depth and width adequate for same
(3) Moderate speed of water flow through channels, if at all.

Assuming the choice of Location A for plant site (see Section 5.3), the entire route that would be taken by the industrial platform from the ocean to the plant site was investigated, and found to satisfy all 3 of the foregoing conditions (see Fig. 5-4).

The site investigation was initiated at the inlet mouth on the Pacific Ocean, San Pedro. The inlet mouth is about 2,000 m wide, with a depth exceeding 50 m, with the banks

Fig. 5-4. Waterway for Passge of Industrial Platform



dropping steeply on both sides. Channels marks are installed at San Pedro.

The floating platform, having entered the inlet, will proceed through the Bolivar Channel heading south toward the channel mark at Tolita del Pailon. The Bolivar Channel is about 8 km long about 1,000 m wide at its narrowest point; water depth exceeds 50 m with steep sides. Having passed Tolita del Pailon to its starboard, the platform will bear east; a course radius exceeding 1,000 m is available for this maneuver. Having thus entered the San Lorenzo Bay, the platform will then proceed along this bay for about 5 km heading for the channel mark off San Lorenzo along a roughly straight course. Over this channel, about 800 m wide at its narrowest point, the water depth was measured and found to average 8 to 16 m over a channel width of 300 m. After passing San Lorenzo, the platform will further proceed past the Location C, to reach Location A about 5 km further on. The channel presents along this stretch a minimum width of about 160 m, the measured average depth being 7 to 12 m for an effective width of 100 m.

The currents generated in the San Lorenzo Bay by tides have not been precisely investigated, but visual observation indicated no cause for envisaging any problem for towage of the platform. The maximum range of tide in the San Lorenzo Bay is 4 m according to the tide table issued by A.E.I.O.

The results of the foregoing site investigation reveal that:

(1) The waterway from the ocean to off San Lorenzo should present no problem of passage for the floating platform.

(2) Between San Lorenzo and Location A, dredging will be required for part of the waterway, particularly to ensure adequate depth for the tugboat.

5.5 Utilities

5.5.1 Water Supply

As stated in section 5.2.3 "Supply of Process Water", it is envisaged to source the process water for the envisaged Plant from several wells to be sunk within the plant site, to furnish all the water required for plant operation, including drinking water but excluding turbine cooling water.

Prior to this, the Study team obtained from I.E.O.S, San Lorenzo, the following information concerning the water vein existing under the San Lorenzo area: An underground water layer 20 m thick is known to exist around 60 m beneath ground level. Further boring data will be required to determine the distribution of this water vein and to estimate precisely the volume and quality of water extractable throughout the year. Water sampled by the Study team at the time of its visit was analyzed with the results presented in Table 5-2. The data reveal absence of harmful chlorine and low values of both turbidity and hardness: No problems should be foreseen for the treatment required to produce drinking as well as process water.

To provide against the event of well water not being utilizable, an investigation was also made on the volume and quality of water available from the Rio Tulubi, as alternative source of water. The water volume was measured at Ricaurte, about 15 km southeast of the Location A: it was found that, despite the season being in the dry period of the year, the river flowed with the width of 28 m and average depth of 0.5 m, at a speed of 1m/sec., representing a volume of 1.2 million tons per day, quite ample if adopted as substitute source of water supply.

The results of analysis conducted on the Rio Tulubi water are presented in Table 5-3, which reveals excellent water quality, similarly to the San Lorenzo well water.

If it is decided to utilize this water from Rio Tulubi, the best point for water intake would be at Calderón, where the river is crossed by the road now under construction between San Lorenzo and Ibarra

5.5.2 Electricity

All the electric power required for plant operation and for household use in the living compound will require to be furnished from private power source by turbo-generator installed within the envisaged Plant.

The existing San Lorenzo power supply possesses no surplus capacity, and its reliability in terms of availability and current quality will be extremely low when considered as source of plant power

5.5.3 Fuel

The high-pressure steam required for power generation, as well as the medium and low-pressure process steam will be generated from fuel wood and waste wood burned as main

Table 5-2. Water Analysis Data (San Lorenzo Well)

Constituent or Property	Chemical Composition
Color-APHA units	20.
Turbidity-NUT	3.
ph	7.50
Residual chlorine, ppm	0.
Carbonate, ppm	0.
Bicarbonate, ppm	175.7
Chloride, ppm	7.9
Sulfate, ppm	0 0
Total alkalinity, ppm	144.0
Phosphate, ppm	0.4
Nitrate, ppm	0.0
Total hardness, ppm	74.6
Carbonate hardness, ppm	74.6
Uncarbonated hardness, ppm	0.0
Fluorine, ppm	0.2
Calcium, ppm	25.7
Magnesium, ppm	2.3
Iron, ppm	0.5
Manganese, ppm	0.2
Disolved total solid, ppm	165.0
Conductivility, mohms/cm	278.0
Suspended solid, ppm	14.0

Table 5-3. Water Analysis Data (Rio Tulubi)

Constituent or Property	Chemical Composition
Color-APHA units	25.
Turbidity-NUT	4.
ph	7.45
Residual chlorine, ppm	0.
Carbonate, ppm	0.
Bicarbonate, ppm	12.2
Chloride, ppm	13.8
Sulfate, ppm	1.0
Total alkalinity, ppm	10.0
Phosphate, ppm	0.5
Nitrate, ppm	0.1
Total hardness, ppm	13.1
Carbonate hardness, ppm	10.0
Uncarbonated hardness, ppm	3.1
Fluorine, ppm	0.3
Calcium, ppm	1.6
Magnesium, ppm	2.2
Iron, ppm	0.3
Manganese, ppm	0.0
Disolved total solid, ppm	38.6
Conductivility, mohms/cm	28.0
Suspended solid, ppm	17.4

fuel, supplemented by heavy oil, by means of the boiler installation to be provided in the envisaged Plant.

The waste wood constituting the main fuel will be material generated in the course of log handling, chipping, as well as from the process rejects; log bark will also contribute to this fuel. Additional wood will also be directly logged as fuel wood. All this wood will thus be generated from the plant operation.

The supplementary heavy oil will be supplied from Esmeraldas by tankers operated by CEPE. Supply from the same source will also be sought for the gasoline and diesel oil required for operating the power saws, automobiles and other machinery.

5.6 Infrastructure

5.6.1 Roads

The only highway existing at present in the San Lorenzo area is the line linking San Lorenzo with Ibarra, but which is unpaved double-lane road, with bridges of flimsy structure.

In respect of future prospects, it was ascertained from information from persons in charge at the San Lorenzo Municipal Office, from plans published by CONADE for road construction in the northwest region, and from site survey in the Cayapas Forest Concession Lot 2 envisaged as source of pulpwood supply for the plant and of the stretch of road between San Lorenzo and Ricaurte that:

- Of the main road linking San Lorenzo with Ibarra, the stretch between San Lorenzo and La Chiquita will be completed by 1984,

- Of the main road linking Esmeraldas with San Lorenzo, the stretch between La Chiquita and Borbon will also be completed about the same time.

The final specifications for these roads could not be ascertained, but judging from the conditions at construction site, the completed road would likely be 4-lane simple blacktop line.

The above 2 lines of road will pass right through the Cayapas Forest Concession

Lot 2, and would constitute an invaluable means of transportation for the logged pulpwood to the envisaged Plant.

The timing of 1984 for the completion of this road, already mentioned, will be most opportune for the present Project whose envisaged Plant is planned to come into trial operation end 1986. The projected roadways will thus provide an extremely valuable support to the present Project.

5.6.2 Port Facilities

San Lorenzo Port today possesses only jetty, which was originally constructed for the purpose of shipping out logwood. It was observed by the Survey team, however, that this jetty has fallen into a condition needing repair due no doubt to the windling volume of logwood shipments.

According to plans published by CONADE for extending port facilities in Ecuador, a sum of Sc. 23 million has been appropriated for implementing a project for improving the San Lorenzo Port facilities, which provides for rebuilding the jetty infrastructure construction and reclamation work. The Survey team has ascertained during its visit to San Lorenzo that work on jetty rebuilding is already in progress.

The above project for port facility extention is announced by CONADE to be completed 1984, which calls in most opportunely with the envisaged commencement of site construction work in early 1985 of the present Project, and would contribute vastly to facilitating the unloading of construction equpment and plant components, as well as for handling the auxiliary materials and finished products.

5.6.3 Railroads

Railroads generally serve as extremely effective means of mass transportation of goods and passengers.

In Ecuador, all railroads are nationalized under the Empresa de Ferrocarriles del Estado, with a network extending over 1,153 km and comprising three main lines, one of which is the Quito-Ibarra-San Lorenzo line in the Esmeraldas province, and which is utilized mostly for local passenger transport.

This line, however, is judged to be unsuitable for mass rapid transporation of goods on account of insufficient rolling stock (particularly fleet cars) and inadequate track maintenance.

For the present Project, however, no dependence on railroad transportation need be considered, since all means of land transportation should be amply provided by the San Lorenzo – Ibarra highway expected to be completed in 1986, as mentioned under Section 5.6.1, "Roads".

5.6.4 Airways

In supplementation of the inadequate infrastructure serving land transportation, airways are in comparison well developed in Ecuador. Quito and Guayaquil both are served by international airports.

In respect of Esmeraldas Province; Esmeraldas is served by a domestic airline link. San Lorenzo possesses an airfield with 1,000 m long runway, which however is today not served by a regular airline: it is being utilized for private flights and for emergency landings.

Chapter 6.

CONCEPTUAL DESIGN

Chapter 6. CONCEPTUAL DESIGN

6.1 Conceptual Design for Corrugating Medium

6.1.1 Plant Design Basis

(1)	Plant Capacity	120 tons a day, 39,600 tons a year
(2)	Pulp Production Rate	42,580 A.D tons a year
(3)	Operating Days	330 days a year
(4)	Final Product	Corrugating medium for carton boxes use
(5)	Raw Materials	Mixed tropical hardwoods from Cayapas Forest Concession
(6)	Pulpwood Consumption	113,548 m^3 a year, based on 450 kg/m^3 basic density
(7)	Cooking Yield (B.D Pulp/B.D Chip)	75%
(8)	Total Yield (Final Products/Pulp Consumed)	93%
(9)	Make-up Chemicals	
	– Sodium Sulphite (Na_2SO_3)	2,138.4 tons a year
	– Sodium Carbonate (Na_2CO_3)	534.6 tons a year

(10) Chemicals for Paper Making

–	Dry Strength Resin	594 tons a year
–	Wet Strength Resin	198 tons a year

(11) Utilities

–	Process Water	8,400 m^3 a day
–	Electric Power	1,000 kWh/ton pulp
		400 kWh/ton paper
–	Steam	2.5 tons/ton pulp
		2.5 tons/ton paper
–	Heavy Oil for Boiler	13,200 tons a year

(12) Operating Materials

–	Fourdrinier Machine Wire	0.05 m^2/ton paper
–	Felt Consumption	0.05 kg/ton paper
–	Canvas Consumption	0.02 m^2/ton paper

6.1.2 Process for Corrugating Medium

(1) Cooking

NSSC process will be adopted using a rotary globe digester to provide for slow cooking (see Chapter 4, Section 4.2.3).

(2) Refining

A double disc refiner will be used. Energy consumption should be 30 to 40% higher than required for comparative Japanese material.

(3) Washing

A two-stage drum type washer will be used.

(4) Stock Preparation

A mixer will be provided to permit addition of dry and wet strength resins.

(5) Chemical Recovery

Black liquor will be concentrated in a evaporator to 60% total solid, to be burned in a recovery boiler. The smelt remaining from the combustion will be oxidized in air to produce sodium sulfite, which will be combined with that generated by absorbing in sodium carbonate the sulfur dioxide contained in the effluent gas.

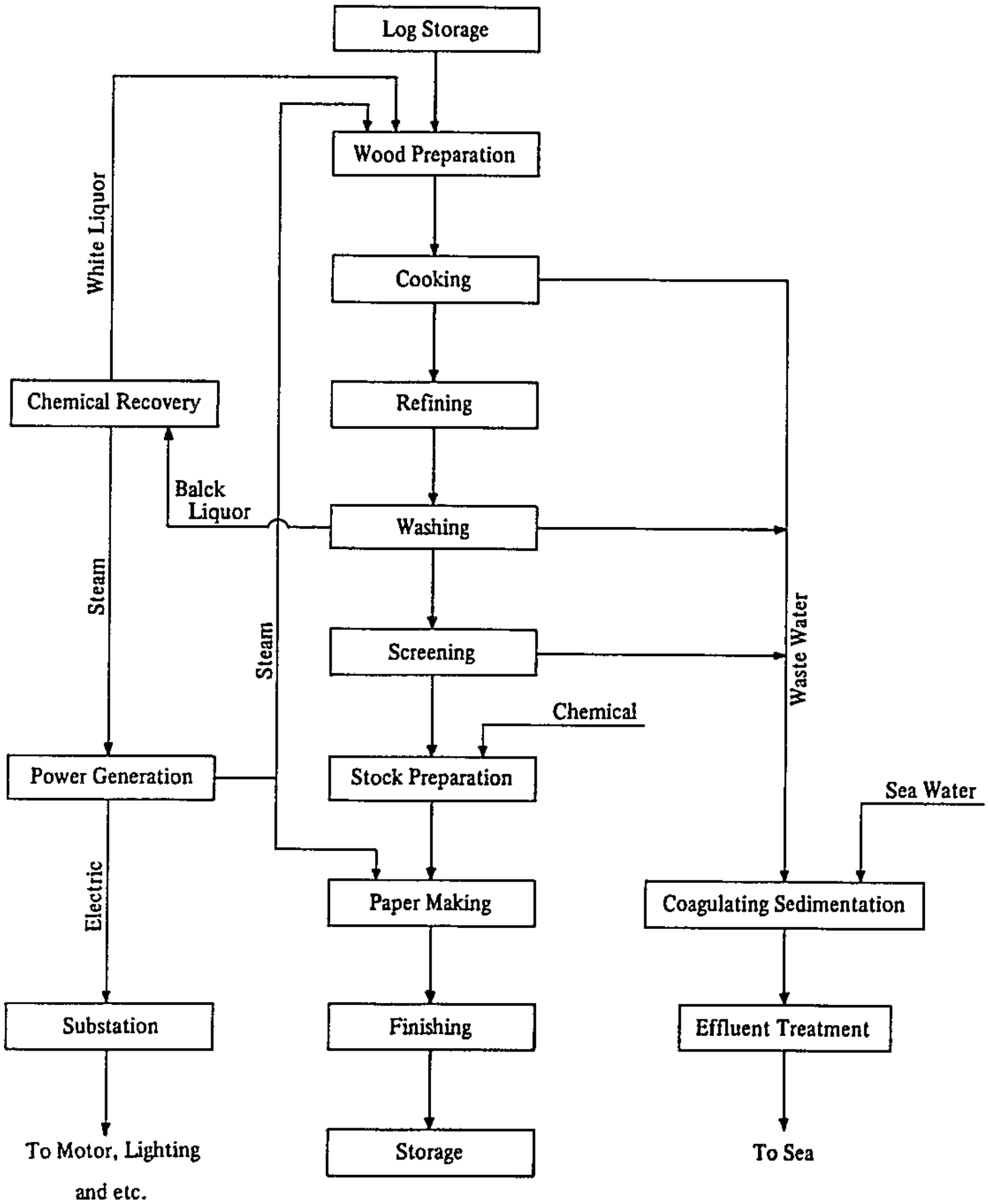
(6) Paper Machine

To match the 87 inch corrugators accepting sheet widths up to 85-3/4 inch (2,180 mm) used for making banana box cartons, the paper machine will be a multi-roll foundrinier of 4,360 mm (double width).

(7) Effluent Treatment

Waste water will be mixed with seawater to 30% and injected with slaked lime for sedimentation and treatment in aerated lagoon (10 days retention), before release.

Fig. 6-1. Block Diagram for Corrugating Medium Process



6.2 Conceptual Design for Printing/Writing Paper

6.2.1 Plant Design Basis

(1)	Plant Capacity	70 tons a day 23,100 tons a year
(2)	Pulp Production Rate	22,719 A.D tons a year
(3)	Operating Days	330 days a year
(4)	Final Product	Printing/Writing Paper
(5)	Raw Materials	Mixed tropical hardwoods from Cayapas Forest Concession and Imported N. BKP
(6)	Pulpwood Consumption	112,192 m^3 a year, based on 450 kg/m^3 basic density
(7)	Consumption of Imported N. BKP	2,524 A.D tons a year
(8)	Pulp Blending Ratio (Ratio of Indigeneously Produced Hardwood Pulp and Imported N. BKP)	90 : 10
(9)	Cooking Yield (B.D Unbleached Kraft Pulp/B.D Chip)	45%
(10)	Bleaching Yield	
	(Refered to Unbleached Pulp)	90%
	(Refered to B.D Chip)	40.5%
(11)	Finishing Yield	91%
(12)	Total Yield (Final Products/Pulp Consumed plus Clay)	86%

(13) Make-up Chemicals

–	Salt Cake (Na_2SO_4)	1,818 tons a year
–	Lime Stone	726 tons a year

(14) Chemicals for Bleaching

–	Salt	2,781 tons a year

(15) Chemicals for Paper Making

–	Clay	2,145 tons a year
–	Sizing Agent	231 tons a year
–	Alum	693 tons a year
–	Starch (or modified starch)	346.5 tons a year
–	Dyestuff	1.4 tons a year

(16) Utilities

–	Process Water	14,000 m^3 a day
–	Electric Power	866 kWh/ton pulp
		1,000 kWh/ton paper
–	Steam	5.0 tons/ton pulp
		3.5 tons/ton paper
–	Heavy Oil for Lime Kiln	1,650 klit a year
–	Heavy Oil for Boiler	4,455 tons a year

(17) Operating Materials

–	Fourdrinier Machine Wire	0.09 m^2/ton paper
–	Felt Consumption	0.07 kg/ton paper
–	Canvas Consumption	0.09 m^2/ton paper

6.2.2 Process for Printing/Writing Paper

(1) Cooking

Batch cooking by KP process will be adopted using stationary digester.

(2) Washing

A conventional three-stage drum type washer will be used.

(3) Bleaching

The following five-stage sequence will be adopted.

(4) Screening

Fore-screening before bleaching will be by centrifugal, KCS or pressure type screen; after-screening by centri-cleaner.

(5) Stock Preparation

Energy consumption will be somewhat higher for comparable Japanese material. A disc and conical type refiner will be combined for.

Table 6-1. Basic Bleaching Sequence

Stage	Chemical Addition %	Temerature °C	Pulp Consistency %	Reaciton Time hours
C	Kappa No. x 24%	Room temp.	4	1
E	NaOH x 1.5%	60	10	2
H	NaClO x 2.0% NaOH x 0.7%	40	10	2
E	NaOH x 0.5%	60	10	2
H	NaClO x 1.0% NaOH x 0.5%	40	10	2–3

Equipment to be provided will include:

- Chemical injection device
- Equipment for clay dissolution and addition
- Starch cooker for size press.

(6) Paper Machine

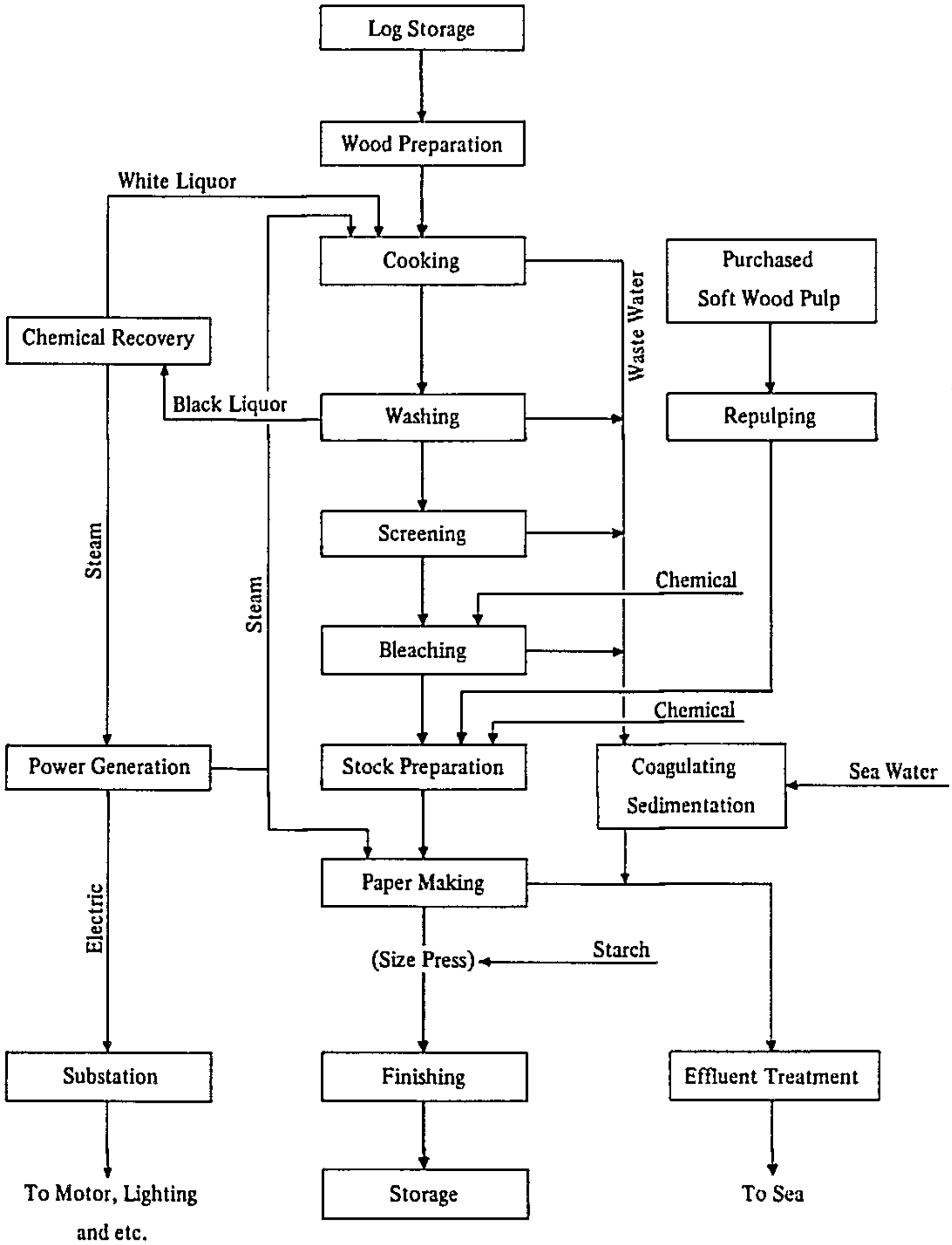
Fourdrinier of 2,500 mm sheet width will be used, provided with size press.

(7) Effluent Treatment

Pulping effluent, principally consists of bleaching effluent, will be mixed with seawater to 30% and injected with slaked lime for coagulating sedimentation.

After this treatment, overflow mixed with paper machine effluent will be treated in aerated lagoon of 7 days.

Fig. 6-2. Block Diagram for Printing/Writing Paper Process



Chapter 7.

RAW MATERIALS, CHEMICALS AND UTILITIES REQUIREMENTS

Chapter 7. RAW MATERIALS, CHEMICALS AND UTILITIES REQUIREMENTS

7.1 Pulpwood

The source of pulpwood envisaged for the projected Plant is the Cayapas Forest Concession Lot 2.

The entire Consession is today covered with natural tropical hardwood species in mixed occurrence.

Reforestation should in future aim at concentrating on species of high productivity.

Reforestation should therefore be undertaken upon wholesale logging, to be followed by the plantation of species most adapted as pulpwood.

The Lots 2 and 4 should be utilized to best effect by selecting the uses of the various species occurring in these lots so as to obtain the highest value added for each species.

Applying this principle, about 25% of the wood volume should be used for producing plywood and sawn log, 60% as pulpwood and the remaining 15% as fuel.

The pulpwood required annually for the envisaged plant amounts to about 113,500 m^3, which applying the above apportionment would call for annually logging a total volume of approximately 190,000 m^3.

Against the above requirement, the available forest volume is 2,354,600 m^3 counting Lot 2 alone (see Chapter 3), which would suffice for about 10 years even accounting for a loss of 20% for rot or other causes.

Lot 4 is at present being selectively logged for deriving wood suitable for feeding the existing plywood mill.

This Lot too could become an abundant source of plupwood if switched to wholesale logging, but in this instance it is envisaged to reserve this Lot as source of veneer for plywood, with the provision that in the event of any shortage in the supply of pulpwood from Lot 2, this Lot 4 should then be available as emergency source to cover the shortage.

7.2 Softwood Pulp for Blending

While no softwood pulp will require to be blended for producing corrugating medium, printing/writing paper will require the addition of about 10% softwood bleached kraft pulp.

This call for the purchase of about 2,300 A.D t/year of softwood bleached kraft pulp for operating a 70 t/d printing/writing paper plant, all of which will have to be imported from the U.S.A or Canada, since this pulp is not available domestically.

Foreign payments to cover this importation will amount to a sizable sum considering that a C.I.F price of US.$789.4 per ton is being paid today for imported softwood pulp, according to data obtained from B.C.E.

Payments for importing such pulp for blending should therefore come to occupy a considerable fraction of the manufacturing cost of printing/writing paper.

For this reason, if printing/writing paper is to be chosen as final product, it should be of benefit to reforest some of the mountainous regions with softwood species to make softwood pulp available indigeneously.

7.3 Chemicals

The chemicals that will come to be required for operating the envisaged Plant will comprise mainly the following.

7.3.1 Chemicals Required for Corrugating Medium Production

(1) Pulping Chemicals

- Sodium Sulphite (Na_2SO_3)
- Sodium Carbonate (Na_2CO_3)

(2) Other Chemicals

- Sulfuric Acid (H_2SO_4)
- Hydrogen Chloride (HCL)
- Calcium Hydroxide ($Ca(OH)_2$)

7.3.2 Chemicals Required for Printing/writing Paper Production

(1) Pulping Chemicals

- Sodium Sulfate (Na_2SO_4)
- Lime Stone
- Chlorine (CL_2)
- Caustic Soda (NaOH)

(2) Paper Making Chemicals

- Clay
- Rosin
- Alum

(3) Other Chemicals

- Sulfuric Acid (H_2SO_4)
- Hydrogen Chloride (HCL)
- Calcium Hydroxide ($Ca(OH)_2$)

None of the chemicals listed above are produced domestically, and will require to be all imported.

The import prices of some of the representative chemicals, as obtained from B.C.E. are listed below, together with the corresponding F.O.B U.S. prices.

(Unit: US.$/ton)

Chemicals	1980 C.I.F	1981 C.I.F	1982 C.I.F	F.O.B U.S.A prices
Chlorine	1,073	1,355	1,332	150
Caustic Soda	–	–	381	
Sodium Sulphite	488	582	545	
Sodium Sulfate	183	321	241	80
Sodium Carbonate	271	236	317	90

Apart from chlorine, which will be discussed further on the difference between U.S.A and Ecuadorian prices is represented by a factor of about 3, and this has been found to apply to most currently imported chemicals (factors ranging between 2 and 3).

The reason for the inordinately high price of chlorine is considered attributable to its being a highly dangerous gas contained in cylinders at high pressure, and also to the small quantities that are handled.

There exists in Ecuador an electrolysis plant for producing chlorine and caustic soda, but it is today not in operation on account of the uneconomical disparity between the domestic demands for caustic soda (14,850 t/year for caustic soda and 850 t/year for chlorine).

To eliminate the problem of high chlorine price, it is envisaged to annex an electrolysis facility to the projected Plant, which will produce 1,600 t/year of chlorine accompanied by 1,800 t/year of caustic soda.

The plant will consume the 1,600 t/year of chlorine but only 1,400 t/year of caustic soda, and the remaining 400 t/year could be sold in the domestic market.

7.4 Fuel

Ecuador today produces 200,000 bbl/day of oil, of which half is exported to provide a precious source of foreign currency.

The rapidly rising domestic consumption, however, had led to estimate that within a few years the country may come to require importing oil.

Based on such consideration, the present Project emvisaged minimizing the use of fuel oil, through the use of fuel wood, bark, hog and other burnable materials available from the Concession.

7.4.1 Fuel Wood

As discussed in Chapter 3 "Forest Resources", with the aim of making the fullest use of the available forest resources, all material unfit for use in producing plywood, sawn log or pulp is envisaged to be consumed as boiler fuel, with the view to minimizing the consumption of fuel oil.

The sources of fuel wood include the following.

- Rotted and blighted wood, branches short diameter logs

  A yield of 80% has been assumed in Chapter 3 for the principally utilizable wood, and of the remaining 20%, a considerable fraction could be expected to be available as fuel.

- Wood unsuitable for other uses

  Of the wood brought into the projected Plant, 15% is envisaged in Chapter 3 to be found unsuitable for use in producing plywood, sawn log or pulp, including defective and waste material, and this out-of-specification wood should be available as fuel.

- Waste from plywood mill

  The yield registered today in the plywood mill averages 42%.

  Even accounting for future improvements in this performance through better selection of the raw logs fed to the mill, the fraction of wood waste generated from wood core and other factors cannot be expected to increase much above 1/2, and the other half will remain available as fuel.

- Bark

  All the figures concerning forest volume, wood supply and other quantities are expressed in volumes of barked wood.

  Wood as logged are covered with bark representing an average of 10% of the wood volume, and this material also constitutes a useful source of fuel.

- Other sources

  Saw dust, chip screen dust and similar waste generated in the course of wood preparation will provide a further source of fuel.

Assuming that 75% of the waste wood generated from all the foregoing sources can be expected to be effectively consumed as fuel, approximately 76,000 m^3/year would contribute to economizing fuel oil.

The calorific equivalent of 1 m^3 of fuel wood can be considered to amount to 178 kg of fuel oil, and converted at this rate, the above utilization of wood as fuel will represent a saving of 13,500 tons of fuel oil per year.

7.4.2 Fuel Oil

The principal uses envisaged for fuel oil (bunker C) are:

(1) For Main Boiler

Consumption for corrugating medium	13,200 t/year
Consumption for printing/writing paper	4,450 t/year

(2) For Rotary Kiln

Consumption for printing/writing paper	1,650 t/year

The above figures are premised on the utilization of 76,000 m^3/year of fuel wood in the main boiler : If no wood were utilized, a further 13,500 t/year of fuel oil would have to be consumed.

Market prices of various petroleum fueld, as obtained from the CEPE are as follows.

– Fuel oil	Sc. 7.6/gal
– Diesel oil	Sc. 9.3/gal
– Gasoline-regular*	Sc. 20/gal
– Ditto-special*	Sc. 30/gal
– Ditto-super*	Sc. 40/gal
– Lubricating oil	Sc. 91/gal

*) Prices of the various grades of gasoline have been updated to accord with the new prices brought into effect on October 29, 1982.

7.5 Electric Power

Extension of power generating installations has been accorded priority considerations in Ecuador national development plans during the past several years, but the districts to be served by the additionally available electricity are limited to the principal cities such as Quito and Guayaquil.

Peripheral districts such as San Lorenzo are completely outside the zones to benefit from these plans for extending electric power supply.

The existing San Lorenzo power supply system covers only a limited demand for household use, and is far from being available for industrial use by the envisaged Plant.

It is noted that the existing plywood mill also is depending for its power on private power generation.

The foregoing circumstances have led to envisaging the installation of a private power station a source for the projected Plant.

The capacity required of this Plant will be 7,700 kW in the case where a 120 t/d corrugating medium plant is to be established, and 6,000 kW in the case of a 70 t/d printing/writing paper plant.

In either case, a high-pressure boiler is envisaged, feeding a two-stage extraction condensed turbine.

The capacities required of the boiler would be:

(1) Recovery Boiler

Capacity for corrugating medium	7.5 t/h
Capacity for printing/writing paper	15.0 t/h

(2) Main Boiler

Capacity for corrugating medium	15.0 t/h
Capacity for printing/writing paper	35.0 t/h

In addition, a 500 kW diesel-driven generator will be installed as emergency source as well as for covering the period until the power station becomes fully operative.

7.6 Water Supply

Process water constitutes a factor of importance equal to feed material in a pulp and paper plant.

A daily supply of approximately 8,400 tons is required for operating the projected Plant, to cover process water as well as boiler feed and as drinking water, but excluding requirements for cooling in the power station, which are to be satisfied by using seawater.

Supply at a rate such as referred to above could very probably be covered by sinking a number of new wells within and around the envisaged site (drinking water is being supplied from wells for the city network serving the San Lorenzo district).

In the event water supply from wells should not suffice for covering the process water requirements, water could be drawn from the Rio Tulubi, flowing a distance of about 15 km from the envisaged plant site.

Chapter 8.

PULPWOOD SUPPLY

Chapter 8. PULPWOOD SUPPLY

8.1 General

Wholesale felling of the forest will be adopted for exploiting the forest resources.

The logged wood should be classified according to species and sizes in order to utilize the wood to best advantages, as set forth in Chapter 3, Section 3.2.3. The clearances remaining after the felling should be reforested at an early oportunity with rapid-growing species adapted to industrial uses.

Against objections that may be raised against blanket wholesale felling, the fact should be noted that, past experience of selective felling, particularly in tropical regions, have very often resulted in the remaining clearance left to natural reforestation, with the result of endangering the regeneration of useful tree species.

The artificial creation of forests of useful species that would be ensured through wholesale felling and reforestation will bring benefits that should far offset the drawback of temporary damage that would be suffered by the vegetable cover, and would further eliminate the technical difficulties of selective felling in terms of practical logging operations.

8.1.1 Available Pulpwood Sources

The present survey covered the Cayapas Forest Concession Lot 2.

(1) Area that can be practically logged in Lot 2 is 14,600 ha which composed of:

- Plain terrain 9,600 ha
- Undulating terrain 5,000 ha.

The remaining areas of Lot 2 amounting to 8,700 ha, to total 23,300 ha with the 14,600 ha of available area, is constituted as follows.

Table 8-1. Remaining Areas of Lot 2

(Unit: ha)

Terrain	Inaccessible	Unforested
Plain	–	3,600
Unldulating	3,300	1,800
Total	3,300	5,400
Grand Total	8,700	

Source: J.C.I.

(2) Available Forest Volume Under Bark in Lot 2

Table 8-2. Available Forest Volume Under Bark in Lot 2

Terrain	B.H.D		All Diameter (m^3/ha)	Forest Area (ha)	Total Volume (m^3)
	10–50cm (m^3/ha)	50cm + (m^3/ha)			
Plain	56.52	89.54	146.06	9,600	1,402,176
Undulating	72.67	117.83	190.50	5,000	952,000
Grand Total	–	–	–	14,600	2,354,176

Source: J.C.I.

(3) Average Forest Volume per Unit Area

2,354,176 m^3 / 14,600 ha = 161.24 m^3/ha.

(4) Net Utilizable Wood Volume

$2,354,176 \text{ m}^3 \times 0.8$ (factor of utilization) $\doteqdot 1,833,400 \text{ m}^3$ (= 129 m^3/ha).

8.1.2 Pulpwood Requirement at Maximum Plant Operation

–	For pulp requirement	113,548 m^3/year (60%)

The above pulpwood logging amount derives plywood and sawn log and fuel wood as follows (see Chapter, 3 and 6).

–	For plywood and sawn log	47,312 m^3/year (25%)
–	For fuel	28,387 m^3/year (15%)
	Total	189,247 m^3/year

The above requirements sourced from the net utilizable wood volume cited above would be suppliable during a period of:

$1,883,400 \text{ m}^3 / 189,247 \text{ m}^3 / \text{year} = 9.95$ years.

8.1.3 Area Logged per Year

14,600 ha / 9.95 years = 1,467 ha/year.

8.2 Logging Phases

8.2.1 Outline Description

The highway under construction between San Lorenzo and Ibarra would be utilized as logging road.

This would leave a branch leading into the logging site to be constructed.

This logging road would branch off from the highway at a point quite near the plant site; its construction would proceed as the felling operations advance progressively away from the highway.

The other projected highway between La Chiquita and Borbon should also serve usefully as logging road.

The branch logging roads to be constructed should pose no problems, considering that a large part of the Lot 2 is constituted of "Plain" terrain and devoid of any sizable river.

8.2.2 Organization for Pulpwood Supply Operation

As presented in the Table 8-3 "Organization Chart", the pulpwood supply operation would be entruste to an organization comprising sections charged with (a) felling, (b) transportation, (c) mechanical equipment, and (d) administration.

The felling section will also comprises as group charged with constructing the branch logging road.

A fifth division would engage in reforestation operations.

8.2.3 Substance of Logging Operations

(1) Numberof Working Days per Year

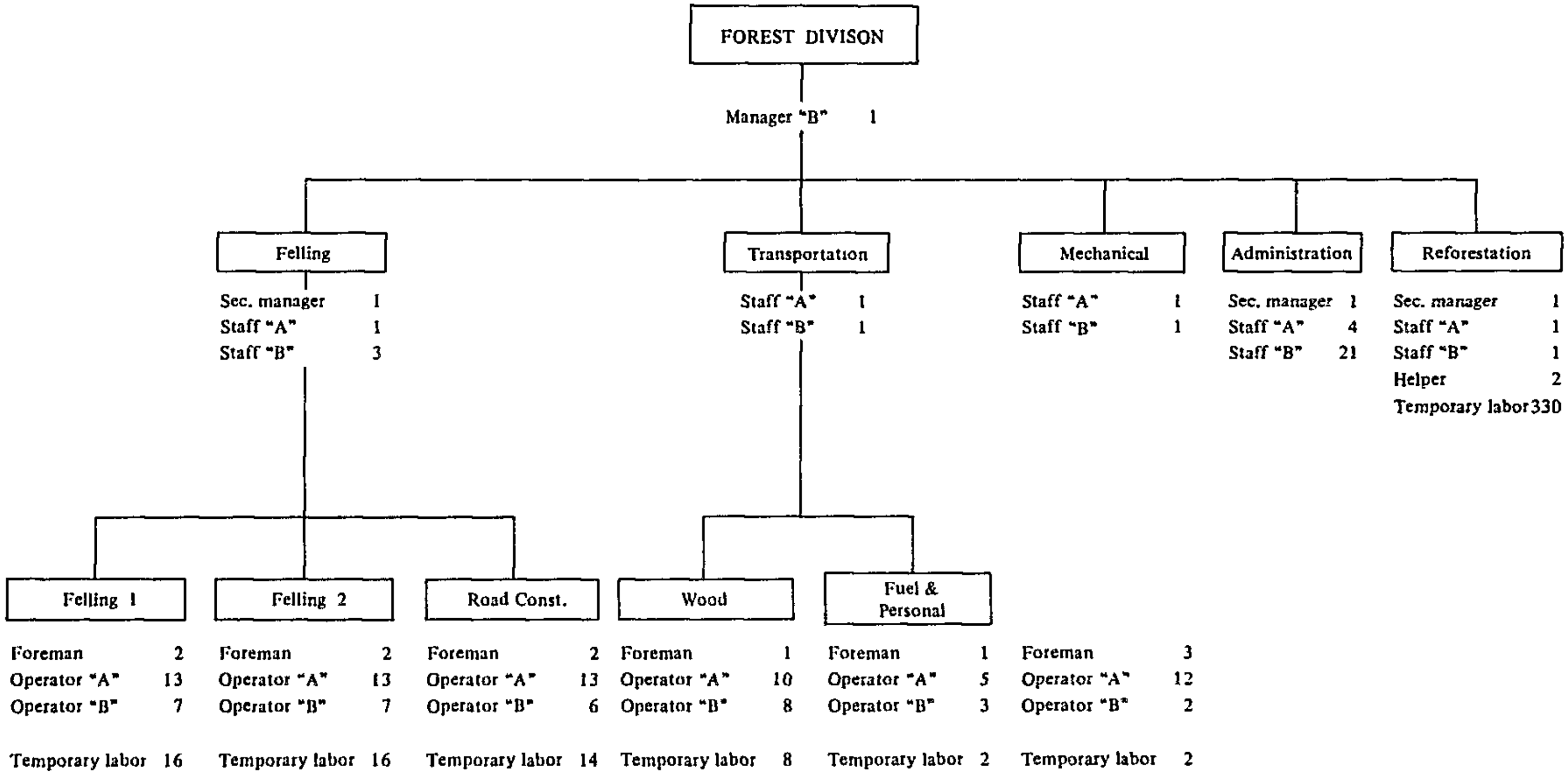
–	Felling including topping	220
–	Skidding and loading	220
–	Wood transportation	220
–	Branch logging road construction	200

(2) Machine Productivity

–	Felling and topping	50 m^3/day
–	Skidding	68 m^3/day
–	Loading	270 m^3/day
–	Wood transportation	40 m^3/day

The above machine productivity is decided by the experience obtained from the tropical area.

Table 8-3. Organization Chart for Forestry Division



8.2.4 Number of Machines and Operators Required

(1) Machines

–	Chain saw (24 inch)	22
–	Angledozers (equipped with towing winch)	14
–	Skid loaders	4
–	Road trucks (capacity 13 to 14 m^3)	26

(2) Operators

–	Operators	62
–	Assistant hands	32
–	Others	4
	Total	98

8.3 Branch Road Construction

8.3.1 Yearly Requirement

In order to evacuate the 189,247 m^3/year of wood cited in Section 8.1.2 above from forest containing a net utilizable volume of 129 m^3/ha, cited in Section 8.1.2, a branch logging road extending 18.3 km/year will have to be constructed.

With road construction work maintained during 200 days a year (see Section 8.2.3), the daily extension of road will require to amount to:

18,300 m / 200 days = 91.5 m/day.

8.3.2 Branch Logging Road Width

The amount of traffic that would utilize the branch logging road is constructed to be as follows.

– Wood volume to be transported: 205,000 m^3/220 days = 932 m/day

- Number of truck-roads to transport the wood:
  932 m^3/day/13.3 m^3/truck = 70 truck-roads/day

Note: The annual wood volume of 189,247 m^3 cited in Section 8.1.2 requires the annual total logging volume of 236,559 m^3. The log volume of 205,000 m^3/year to be transported was calculated based on the consideration of handling loss in the logging points.

The capacity of truck-roads was decided 13.3 m^3 a truck.

Trucks will thus pass the logging road 70 times a day in both directions, and added to this, there will be other traffic carrying loggers, supervisors, maintenance equipment, to add up to a total traffic density of 200 vehicles per 8 hours, or 25 vehicles per hour.

The branch logging road to carry this volume of traffic will require to have a paved two-lane carriageway (8 m wide).

A pavement thickness of 100 mm would be considered adequate in consideration of the reinforcing the carriageway pavement cited in Section 8.3.5, gravel not obtainable in the vicinity and having to be brought from Ricaurte or Calderón.

8.3.3 Clearances on Both Sides of Branch Logging Road

Trees should be cleared on both sides of the branch logging road to a total width of 30 to 50 m, to ensure adequate natural evaporation and drying as well as ventilation and drainage, by providing at least 6 hours of sunshine during the day.

8.3.4 Bridges; Culverts

The terrain to be covered by the branch logging road contains many meandering rivers, which will require to be crossed by bridges or culverts.

The bridges could be of wooden construction utilizing the hardwood occurring in the region.

Intervals of about 4 km should be foreseen as a rough estimate (18.3 km/4 km = 4.6 bridges to be constructed per year).

A rough average specification would be: 10 m span, 12 m length, 7 beams laid in parallel, 6 m overall width, to accommodate a single traffic lane.

Culverts might require to be provided at average intervals of 2 km (18.3 km/2 km = 9.15 culverts to be constructed per year).

These culverts could be constituted of corrugated steel pipes 1 m diameter, in 3 parallel channels, 16 m long.

8.3.5 Reinforcing the Carriageway Pavement

The branch logging road would require to pass trucks weighing about 25 ton (12 ton tire plus 13 ton load) throughout the year under all weather.

Road construction materials, particularly gravel, is not available from the vicinity, and to obtain a roadbed of requisite resistance with a minimized thickness of paving, special techniques making use of large mechanized equipment will have to be adopted.

The technqiue would call for:

- Compacting the earth banking: Performed by repetedly running a buldozer
- Compacting the subgrade body tire roller
- Compacting the subgrade surface: By 10 ton three-wheel McAdam-type road roller.

A thin layer of gravel is laid over the subgrade thus closely compacted and reinforced.

8.3.6 Equipment Required for Branch Road Construction

The following equipment would be required for road construction.

– Buldozers	3
– Buldozers	1
– Bucket loader	1
– Back hoe shovel	1
– Motor grader	1

–	16 ton Crane	1
–	24 inch Chain saw	1
–	8.5 ton Tire roller	1
–	10 ton McAdam-type road roller	1
–	Motorized piledriver	1
–	5 m^3 Capacity dump trucks	6
–	8 ton Truck	1

8.3.7 Personnel Required for Road Construction

Personnel required for road construction would be as follows.

–	Operators	19
–	Assistant hands	6
–	Other personnel	8
	Total	33

8.4 Other Equipment

8.4.1 Personnel and Equipment Required for Adminsitrative and Technical Services

(1) Personnel

–	Operators	17
–	Assistant hands	21
–	Other personnel	13
	Total	51

(2) Equipment

For maintenance and repair

–	Maintenance and repair trucks	2
–	Maintenance shop machine tools	1 set

–	Generating set	1
–	Air compressor	1

For construction material transportation

–	8 ton Trucks	3

For fuel distribution

–	10 ton Tank trucks	2

For lighting at logging camp site

–	Generating sets	2

For administrative service

–	40-passengers Buses	2
–	Patrolling cars	3
–	Generating sets	2

8.4.2 Fuel Consumption

Table 8-4. Fuel Consumption

(Unit: k lit/year)

	Diesel oil	Gasoline	Lubricating oil
Administrative services	280.0	-	3.84
Technical services (maintenance, etc.)	280.0	-	4.16
Logging:			
– Road construction	420.3	1.3	8.18
– Felling and skidding	563.2	23.9	17.50
– Transportation	957.0	-	13.42
Total	2,500.5	25.2	47.1

8.5 Timber Dues

Annual timber dues for the wood supply operations for the envisaged Plant would be calculated as follows according to the contract of the Cayapas Forest Concession utilization.

8.5.1 Basic Conditions for Calculation

– Dues per annual volume of roundwood utilization	Sc.15.0/m^3/year
– Dues per area logged annually	Sc.2.5/ha/year
– Roundwood volume utilized annually	236,559 m^3/year
– Area logged annually	1,467 ha/year

8.5.2 Annual Timber Dues

– Due for annual roundwood utilization volume

Sc.15/m^3 x 236,559 m^3 = Sc.3,548,385

– Due for annual logged area

Sc.2.5/ha x 1,467 ha = Sc.3,668

– Total Dues Sc.3,552,053

Chapter 9.

PLANT CONSTRUCTION

Chapter 9. PLANT CONSTRUCTION

9.1 Method of Plant Construction

The conventional practice in constructing an industrial plant is to import piece by piece the main equipment and part of the materials, to be fashioned, assembled, installed, piped, and wired at site. This system of construction, however, is very often subject to extended delays on the established work schedule, on account of insufficient infrastructure, shortages and delays in delivery of required construction equipment and materials, unavailability of skilled labor, and other difficulties that obstruct maintenance of the site work schedule.

A very effective measure for overcoming the foregoing difficulties encountered in the construction of industrial plants in localities remote from centers of industry is what is known as "Industrial Platform System" or "Platform-mounted Construction System", developed and increasingly utilized in recent years by Japanese shipbuilders, by which, complete industrial plants are installed on a floating platform, which is towed to site as a self-contained package already mounted and adjusted, for installation ready to operate. Many successful examples are seen today of industrial plants constructed by this system in various parts of the world.

Based on considerations on the national policy of the Ecuadorlan Government, as well as in view of the advantages expected in respect of construction period and cost, available infrastructure in the vicinity of envisaged site, conditions of climate and labor market, together with other pertinent factors verified by the Study team, it is concluded that the platform-mounted system of construction is best suited for application to the present Project.

Table 9-1 presents a comparative evaluation between the plåtform-mounted and conventional piece-meal systems of construction.

Table 9-1. Comparison between Construction Systems

Item	Platform-mounted System	Conventional Piece-meal System
Construction period	Early, certain completion	Late, uncertain completion
Quality of installed plant	High quality ensured skilled workforce	Dependent on skill of locally available workforce
Influence of site conditions	Little influenced by site conditions	Strongly influenced by site conditions
Available infrastructure at site	Not required for work	Indispensable for construction work
Required ground surface	Small	Large
Economic considerations	Capital requirement precisely predictable	Capital requirements subject to contingencies

To explain in detail each of the items adopted in the above comparison:

(1) Construction Period

The greatest advantage offered by the platform-mounted system is that the difficulties inherent in construction work at site during the wet season can be avoided, and the work can proceed with minimum effect received from external condition. In the preset instance, the contract construction period can be expected to diminish by roughly 28% through the adoption of the platform-mounted system as compared with conventional piece-meal installation.

(2) Quality of Installed Plant

Not only manufacture but also the installation of all principal components can be carried out within the facilities of advanced industrial center where highly skilled labor is available; the installed equipment is completely tested and trially run before shipment to site in installed condition.

Possible damage during towage is prevented by complete measures for preservation, so as to ensure unimpaired high plant quality for the plant in its finally established form at site.

(3) Influence of Site Conditions

In so far as the site is accessible by water for the floating platform, the plant can be installed at any location, uninfluenced by environmental conditions that may affect conventional piece-meal installation work at site.

(4) Available Infrastructure at Site

All heavy and bulky structures being already mounted on the platform before shipment, no facilities are required to be available at site for their unloading from ship or load-resisting roads and bridges for inland transportation. Required transportation facilities at site will be limited to those for shipping the finished products and for landing raw materials (auxiliary materials and chemicals, etc. in the present instance).

(5) Required Ground Surface

The plant components being arranged in compact 3-dimensional configuration, the area of ground required for establishing the plant is extremely small.

(6) Economic Consideration

As it will be made clear in the ensuring Chapter covering Financial Estimates, the platform-mounted system offers advantages in this respect. Another significant merit is that the high standard of plant quality ensured by this system will permit production to be initiated and to reach full capacity in a very short period, and this will contribute appreciably to the attainment of profitable operation by the plant.

The foregoing considerations definitely indicate that the adoption of the platform-mounted system will permit plant construction to proceed smoothly and rapidly despite adverse site conditions, to let the installation reach full operation in the shortest possible period with little risk of delays.

9.2 Construction Scheldule

The period required for project realization comprises the overall lapse of time between the decision to finance the project and commencement of commercial production, and includes the principal stage of contract signature, design, manufacture, installation at the site, startup and test operation. In the meantime, at the plant site, the plant owner will proceed with securing the necessary land, grading work, civil and building construction, recruitment and training of plant operators; the supply of materials, chemicals, and other supplies required for production, will be arranged, together with that of pulpwood feedstock through measures to ensure the necessary logging, selecting and hauling operations.

The construction schedule envisaged for the present Project is shown in Chapter 11, "Project Implementation": A period of 30 months is foreseen between contract effectuation and completion of site construction work, and this period will be followed by test operation to take a further 3 months, to total 33 months between contract effectuation and commencement of commercial operation.

9.3 Transportation to Site of Plant Equipment

The complete plant assembled and installed on the floating platform in the contractor's factory will, after careful inspection and testing, be subjected to preservation treatment in readiness for the trip over ocean.

The floating platform-mounted plant will then be towed across ocean to the port of Esmeraldas, where it will undergo customs clearance procedures. Thereafter, the platform will be taken over by river tug, to proceed past San Pedro to enter the Bolivar Channel, and past San Lorenzo to the envisaged site about 3 km beyond (see Fig. 9-1).

For this inland towage, it is recommended to use the 340 hp tug owned by A.P.E. As shown in Fig. 9-2, the inlet mouth of San Pedro is marked by shallows, and the Bolivar Channel varies widely in depth from point to point, so that an experienced pilot should be indispensable for traversing this waterway. It is also advised to undertake a detailed hydrographic survey of this waterway to have on hand a precise chart of the depths and flow speeds, together with data on tides.

The industrial platform, as envisaged at this time will possess a draft of 2.5 m,

Fig. 9-1. Waterway for Passage of Industrial Platform

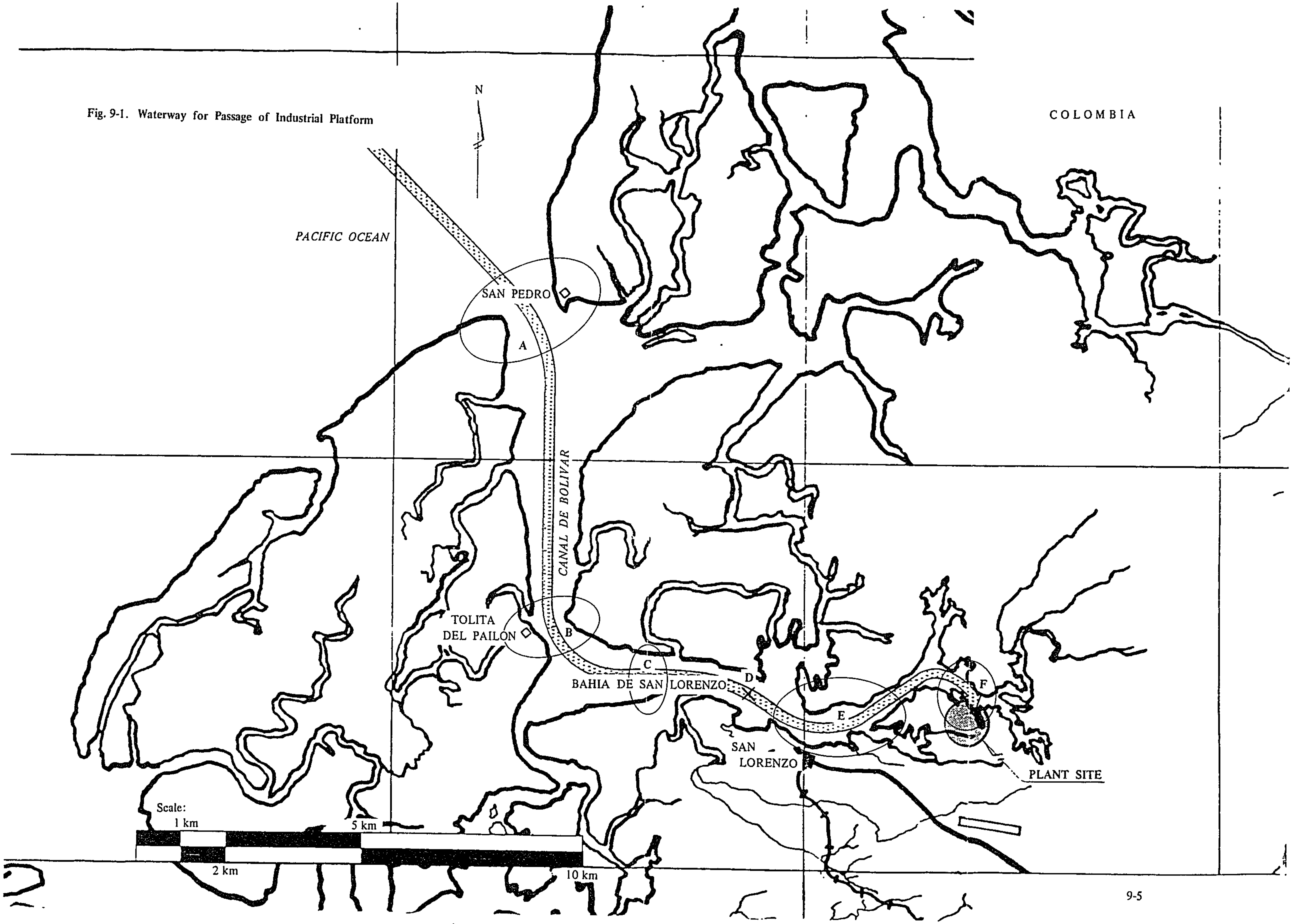
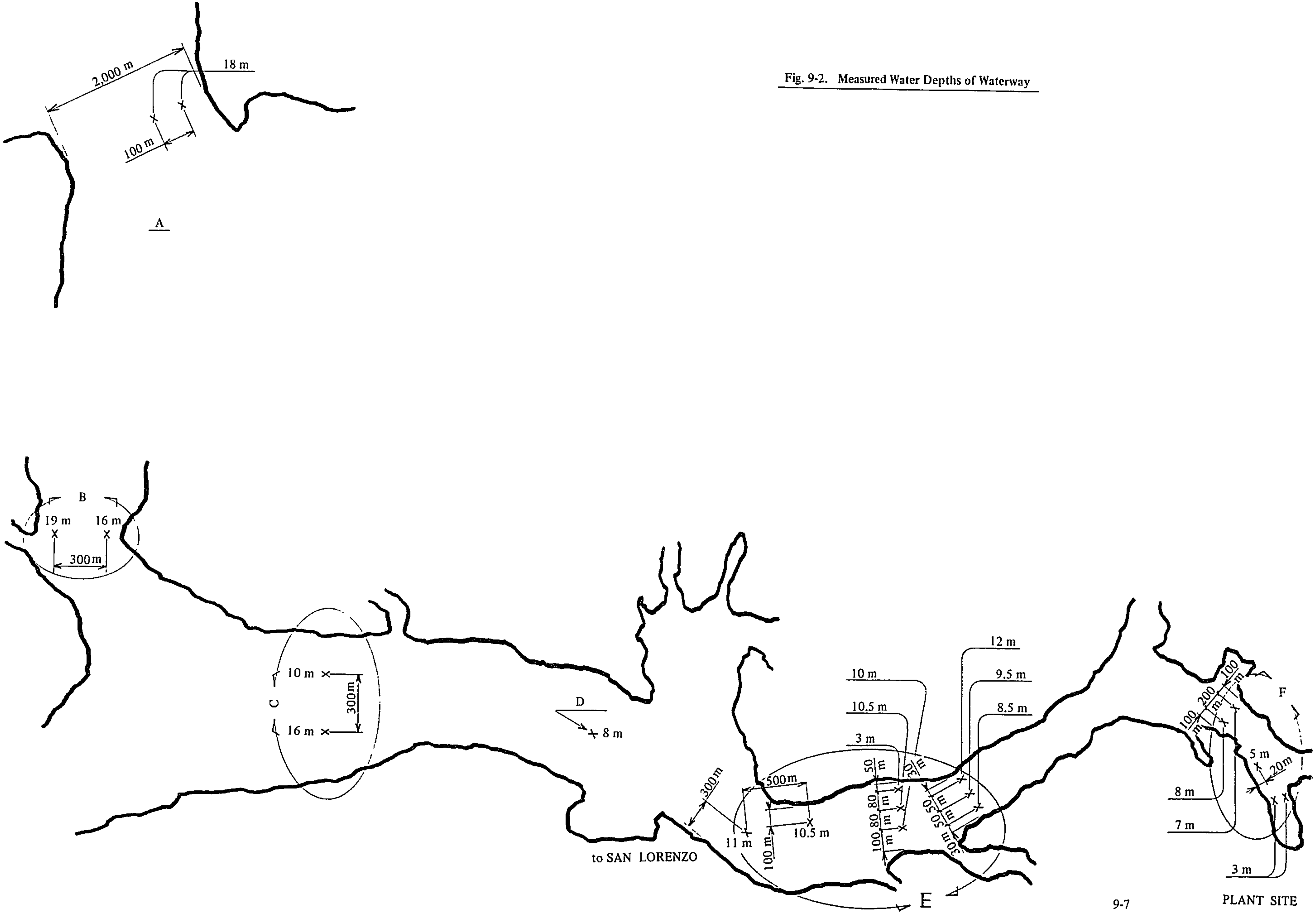


Fig. 9-2. Measured Water Depths of Waterway



width of 30 m and length of 100 m in net values, so that no serious problem of towage should be foreseen up to San Lorenzo. Beyond this port, a stretch extending about 2 km present a shallow natural channel requiring dredging work to pass the floating platform. The dredger owned by A.E.D.D should best suit this purpose.

9.4 Setting the Platform at Site

The platform can be set at site by either of 2 alternative forms, which are (a) moored and (b) grounded, both forms of setting having their merits and drawbacks, neither of which however presents insuperable technical difficulties, and the choice will depend on the kind of plant and site conditions, as well as on the anticipated load of utilization of the plant after installation.

For the present Project, the grounded form of setting judged to be more suitable in consideration of:

- Extremely large dimensions of the paper machine (approx. 4.8 m x 80 m in the case of corrugating medium)
- Machine centerline offset from that of the platform, necessitated for reasons of lay-out
- Precise horizontality required of the paper machine in operation.

Advantages of this form of platform setting is that, once it is firmly set on ground, the stability of the machine base will become identical to an installation constructed by conventional piece-meal mounting on firm ground, so that the precision ensured for the paper machine will be quite independent of any variation of load distribution during service operation.

The problem of platform shell rusting will also be minimized, to facilitate maintenance.

9.4.1 Procedure for Setting the Platform

(1) Dredging

The basin for setting the platform is dredged to a depth such as to leave 5 to 6 meters of water at high tide.

(2) Dike Construction

The dredger is removed from the basin into the main stream; the basin inlet is closed by constructing a dike of dredged soil (7 to 10 meters dike width to prevent seepage, 1 to 2 meters dike height above high water level).

(3) Draining

The water trapped inside the closed basin is drained out using several pumps.

(4) Leveling

The basin bottom is leveled over an area 1.5 times the surface to be occupied by the platform, to facilitate the ensuring work.

(5) Piling

Long concrete piles are driven by mechanical power.

The tops of the driven piles are connected together by beams, in the zones subjected to heavy loading.

(6) Cutting the Dike; Flooding the Basin

The dike constructed by the operation described in the above is cut open over a length of about 40 meters to admit water into the basin, and later the platform.

(7) Towing in the Platform

Choosing high tide, the platform is towed through the breach made in the dike into the basin, by means of tug and by pulling with winch installed on land.

(8) Restoring the Dike

The breach made on the dike under preceding Item is restored as soon as the platform has been towed in.

(9) Redraining; Grounding the Platform

The water in basin is redrained by pumps; the platform is grounded and set in its prescribed position.

(10) Connection of Platform with Installations on Ground

After setting the platform, necessary connections are made with the installations on ground; necessary openings are cut on the platform shell; passageways are created for materials and products.

The foregoing Item (1) to (10) have described the general method of setting the platform.

Depending on the results of further detailed surveys of tide levels, tide flow and other factors, it may be possible to eliminate the Step (3) (Draining) if the existence of a large difference in tide level would permit the dike to be constructed during low tide when the basin bottom is above water level.

Whichever procedure is adopted, the operations will require to be precisely timed with the ebb and flow of tide, for which precise and accurate planning and execution will be essential.

9.5 Civil and Foundation Work

As stated earlier in Section 9.1, the platform-mounted system of construction is envisaged for the present Project, and assuming the adoption of this system of construction, the Study team surveyed the availability and technical capability of contractors for the civil and foudation work required in this connection.

The substance of this work will comprise mainly:

- Dredging the waterway for a distance of about 2.5 km between San Lorenzo and the envisaged site

- Dredging (or excavation) of the basin required for towing in the platform

- Civil work required for setting the platform

- Linking the platform to associated land installations

- Some installations unavoidably requiring to be established on land.

9.5.1 Technical Capability of Contractors

These exist in Ecuador a limited number of general contractors that should fully qualify for undertaking the required civil work at site, judging from their capability for engineering, possession of construction equipment and past records of large construction work. Criteria for selecting the contractor for actually performing the civil work are those set forth in the foregoing paragraphs; consideration should also be given to the points noted in Section 9.4.

The following paragraphs present further considerations concerning the work requiring to be done at site.

(1) Dredging Work

The 3,300 hp suction cutter dredger owned by A.E.D.D is capable of dredging down to a depth of 17 m, amply sufficient for the purpose of the present Project.

It is understood that enlisting the assistance of A.E.D.D will require a contract to be concluded with them by an enterprise with representative established in Ecuador and acceptable to A.E.D.D: This should call for early initiation of administrative procedure to this end (contract to be signed at least 6 months before start of dredging work).

A prerequisite to conclusion of such a contract would be to prepare a detailed chart of the channels to be dredged, calculation of estimated volume of soil to be dredged, period and term of work, etc., for which accurate preliminary surveys would be called for.

(2) Linking the Platform Installations with Connections on Land

Judging from the level of construction work observed in progress in the country and from installations realized, as well as the general technical capability, Ecuadorian contractors should be amply capable of performing the work of piping, cabling, passageway, conveyor and other connections required to be installed to link the platform equipment with those installed on land.

(3) Foundation and Building Work

While definitive judgement will have to await detailed investigation of the subsoil, it would appear from the presently available informations of the subsoil in the coastal terrains is mainly argillaceous layer averaging 2 meters in depth covering alluvial deposit and there appears to be little presence of soil presenting particularly poor bearing capacity that the platform carrying heavy equipment would need to be supported on piles, but the auxiliary installations on land could rest on foundations devoid of piling.

A local contractor has experience in driving concrete piles 50 x 50 cm x 30 m long, using pile drivers owned by the same contractors.

The contractor could therefore be expected to perform the pile driving work for the present Project with no problem.

In respect of building construction, observation of building construction work actually in progress in the country, as well as existing buildings constructed in the hands of local contractors amply attest to the high technical level possessed by leading enterprises in the field, who should have no problem of undertaking detailed design and construction of buildings upon provision of basic specifications.

(4) Road Construction

Observation of highway construction work in progress under the five-year plan has indicated that there should be no problem for local contractors to undertake the construction of the access road to extend for 3–4 km to site from the main highway under construction.

(5) Site Preparation Work

The installations requiring to be constructed on land include auxiliary facilities, material stockyard, administrative building and warehouse, for which the ground will need to be prepared. The site being located on a hill, the ground should advantageously be prepared in stepped terrace arranged functionally to suite the respective installations. Such work should present no problem to local contractors, including the equipment required for such work.

The foregoing observations indicate that contractors available in the country should be amply capable of undertaking all the civil and building work requiring to be performed in connection with the Project. What is important for successful implementation of this work is to draw up a reliable and realistic master schedule covering the entire work including from dredging, piling, platform setting and site preparation, with due consdieration to avoiding the wet season for executing construction work.

9.6 Building Construction

The buildings requiring to be constructed on land (administrative building, mess-room, etc.) should be constructed using the current local practice of utilizing blocks and bricks; some steel structures will also be required (e.g. chemical store, housing for land-installed machinery).

All buildings will have slate roofs.

9.6.1 Outline Arrangement of Buildings

The envisaged floor areas and structural particulars are as shown in Table 9-2.

Table 9-2. Principal Buildings

Designation	Structure	Floor Space
Administration Building including Laboratory	Block and brick structure, some steel structure will be applied.	1,000 m^2
Warehouse	Pipe truss structure, block and brick structure.	5,100 m^2
Maintenance Shop and Locker House	Block and brick structure, some steel structure will be applied.	600 m^2
Chipper and Chip Screen Room	Pipe truss structure, block and brick structure.	72 m^2
Gate and Fire Station	Block and brick structure	25 m^2

9.6.2 General Principles for Building Design

The warehouse and other buildings incorporated wide spans between supporting columns should be of pipe truss structure, which has the advantage of light weight and ease of installation.

Foundations of both buildings and machinery should be laid directly on ground, in so far as the bearing power presented by the soil is compatible with the estimated load of buildings and machinery; concrete piling will only be adopted when found indispensable.

9.6.3 Construction Materials

Imported materials would be limited to structural steel and other important materials of construction; reinforcing bars, cement, sand, aggregates, brick, concrete blocks, slating and such other materials will in so far as possible be procured within the country.

9.6.4 Electrical Installation

All electric power required for the envisaged plant will be furnished from a private constructed power station.

The generated current will be transformed in a substation to the form required for distribution within the plant through aerial wiring, with adequate current outlets for lighting and other uses both indoors and outdoors.

9.6.5 Water Supply and Effluent Treatment Facilities

(1) Drinking Water

Deep wells will be sunk within the site, from which will be pumped up into reservoirs, where it will be disinfected with chlorine before distribuiton to the various buildings.

(2) Process Water

Deep wells will be sunk both within the site and proximate surrounding area, from which water will be pumped up into setting tank before distribution to the points of consumption.

In the event the underground water proves insufficient as source of process water, it will be necessary to draw the water over a distance of about 15 km from the Tululbi River, whose water quality has proved to present no problems for use as process water, as a result of water sample analysis.

(3) Effluent Water Treatment

Sanitary sewage will be rejected into gutter through septic tank and plant effluent will be treated by means of flocculation and sedimentation in lagoon, to bring effluent water quality within limits of regulations applied in Japan.

(4) Air Conditioning and Ventilation

Air conditioning for the administrative building, laboratory and control rooms will be provided by packaged units.

9.7 Installation Work

The work of setting the platform and other installation work will be preceded by the establishment of temporary facilities such as filed office, storehouse, as well as other installations like power generators for construction work, water and air supply. Preparatory site work, including foundations and buildings, as well as dredging and other work associated with the setting of platform will have to be completed before commencement of installation work.

Constructional equipment, vehicles and other facilities required for the installation work have been verified by the Study team to be all available in the hands of local contractors in the country. Access of such equipment to the construction site, however, will be premised upon completion of the access road (approx. 3.5 km) from the main highway.

During the installation work, an adequate team of supervisory personnel will have to be assigned from abroad, for site management, work progress control, construction superintendence and guidance.

9.8 Scope of Work

The estimates for project cost presented in Section 12.2 of Chapter 12, further on include as scope of supply the design, manufacuture, delivery and installation of all equipment and facilities required for the plant to be located within the battery limits of the envisaged plant site.

No work beyond the above battery limits is included in the estimates, with the exception of:

(1) Dredging work covering the waterway necessary for access to site of the floating platform

(2) Construction of the access road (approx. 3.5 km long) linking the site to the main highway.

9.8.1 Site Preparation

Included in the estimates are the expenses for acquisition of land (in this instance, nationally owned ground), for preparing the ground into terraced configulation for constructing the plant facilities, including leveling down the hill located at the site for the purpose of closing the inlet envisaged berth the platform.

9.8.2 Civil Work

Included in the civil work are:

(1) Entrance gate and fencing

(2) Roads within battery limits and access road referred to above; Drainage ditches

(3) Foundations and buildings for land-installed equipment

(4) Dredging work required for towing platform into basin

(5) Civil work associated with setting of the platform

(6) Facility for waste water treatment

(7) Facility for water supply.

9.8.3 Building Construction

Included are all buildings to be located within the battery limits, together with appurtenant equipment including air conditioner, lighting and sanitary facilities and telecommunication equipment.

The principal buildings are enumerated in Table 9-2.

9.8.4 Installation Work

Included in the installation work are:

(1) Unloading at site of equipment and materials for land installations

(2) Temporary storage and transfer within site of the above equipment and materials

(3) Assembly and installation of same

(4) Site work on equipment installed on platform, including removal of applications provided for preservation during towage, verification of machinery alignment and freedom from damage during towage, and connections with installations on land.

(5) Piping, electrical cabling and wiring, instrumentation, heat insulation, painting, ventilation work.

9.8.3 Equipment and Machinery

The estimates cover the supply of all equipment for the plant, including cost of design, manufacture, testing and inspection, towage, customs clearance.

The range of equipment to be furnished include those for the following functions (common to both cases of corrugating medium and printing/writing paper production, except where otherwise specified):

- Felling, logging, transporting and logging road cosntruction
- Log handling and chipping
- Cooking and refining
- Washing and screening
- Bleaching (for printing/writing paper only)
- Stock preparation
- Paper making and finishing
- Chemical recovery
- Bleaching chemical preparation (for printing/writing paper only)
- Power generation and distribuiton
- Electrical equipment and instrumentation
- Process water treatment
- Plant effluent treatment
- Plant air service system
- Plant outer piping
- Maintenance shop
- Laboratory
- Firefighting
- Communication equipment

- Office facilities
- Vehicles

9.9 Consultant Service

Included in the estimates are expenses for the following consultant services associated with the implementation of the Project.

9.9.1 Surveys

Detailed surveys based on the present Feasibility Study including:

(1) Detailed site survey

(2) Charting of Bolivar Channel and waterway, including measurement of water flow

(3) Survey of subsoil conditions

(4) Boring for determining underground water

(5) Survey of route to be taken by access road from main highway.

9.9.2 Tender Management

Expenses for:

(1) Preparing tender specifications and documents

(2) Evaluation of submitted tenders

(3) Conclusion of contracts.

9.9.3 Project Implementation

Expenses for continued consultations in the course of project implementation.

9.9.4 Recruitment and Training

A nucleus of say 30 such key personnel might be sent to neighboring countries successfully operating plants of similar nature and scale, for on-the-job training suring a period of stay 6 months, to return before the start on installation of the envisaged Plant.

Provision also is made for recruiting plant personnels and training prior to plant tendering, and technical assistance by foreign engineers after plant startup operation.

Chapter 10.

PLANT OPERATION

Chapter 10. PLANT OPERATION

10.1 General

The success or failure of the present Project will largely depend on whether or not management and operating personnel of capabilities matching the requirements of the envisaged Plant can come to be recruited and trained in due time to take over and operate the Plant to best effect.

Many instances are known of the most modern plants being furnished from advanced countries, to be left to operate under conditions very far from satisfactory, through improper manipulation and inadequate maintenance, with resulting deterioration of operating efficiency and impairment of capacity utilization, and consequent inflated manufacturing cost, to the prejudice of national economy.

In the present instance, to overcome the scarcity of skilled operators acquainted with pulp and paper plants, particularly in the region of Esmeraldas envisaged for locating the projected Plant, a possible expedient may be to follow the examples of PANASA and REFORMA (Guayaquil), and INCASA (Quito), to invite qualified personnel from Colombia, Chile and other neighboring countries, but considering that this national Project is being promoted as measure for regional development, the greatest effort should be directed to recruiting Ecuadorian nationals of sound character who have completed their basic education, and to have them acquire the requisite additional knowledge and skills through appropriate professional training.

10.2 Training and Technical Assistance for Plant Operation

To provide adequate training for the Ecuadorian personnel, as set forth in the preceding Section, it is advised that persons of requisite qualities be selected beforehand, to be designated to receive professional training as supervisors, and as technical and other key personnel, to take over the operation of the Plant in replacement of the foreign technical assistants as they terminate their mission of operating the Plant and of providing instruction on Plant operation.

Special emphasis should be placed in recruiting persons of high personal character and aspirations for the technical services, who will be actually charged with operating and maintaining the machines, since their proficiency and willingness to do their jobs should contribute possibly even more than their colleagues in supervisory positions to the successful operation of the Plant.

A nucleus of say 30 such key personnel might be sent to neighboring countries successfully operating plants of similar nature and scale, for on-the-job training during a period of stay 6 months, to return before the start on installation of the envisaged Plant.

Installation and startup operations of the Plant will serve the trainees in receiving instruction from the technical assistants on the actual equipment which the trainees will eventually be entrusted to operate and maintain.

In respect of the team of foreign technical assistants to provide the supervisory and instructional services, information concerning the period required for assilmilation of foreign technology has been gathered from visits by the survey team to the plants operated by PANASA in San Carlos, already 14 years in operation and planning to extend the plant next year.

It was observed that about 10 years were spent in bringing the plant to full production, and it is judged that at least 5 to 6 years should required for full assimilation of the know-how and skills involved in pulp and paper manufacture.

Based on the foregoing observations, the following program of technical assistance by foreign experts is considered advisable.

Table 10-1. Number of Foreign Technical Assistants to be assigned for Supervisory and Instructional Services

Year of plant startup	2nd. year following startup	3rd. year following startup	4th. year following startup
* 20	12	8	4
** 23	14	8	5

Note: *: Case where corrugating medium is chosen as final product

**: Case where printing/writing paper is chosen as fianl product.

After the Plant enters commercial operation, the training will continue within the Plant, with particular emphasis laid on key skills.

This will include maintenance of Plant components, for which training would be provided by the manufacturers of the individual components.

A tentative carriculum of training for relating to paper machine within the Plant is given in following Section 10.2.1.

The training should be provided separately for groups to be charged with:

(1) Operations and control
(2) Maintenance of mechanical components
(3) Maintenance of electrical equipment and instrumentation.

10.2.1 Tentative Carriculum of Training for Preceding Paper Machine Startup

- Pulp supplying and stock preparation
- Broke system
- White water system
- Chemical supply system
- Paper machine by sections
- Drying and ventilation
- Calendering, winding, and roll finishing
- Wire and felt changing
- Grade specification and quality control procedures
- Process control
- Material handling
- Preventive maintenance
- Fire protection
- Safety

10.3 Organization and Manpower

An excellent example of organization for operating a pulp and paper plant is that of PANASA, which is operating an integrated bagasse pulp and paper mill with personnel counting only 230, and organized in an extremely simple system under a supervisory staff comprising only the plant manager, one superintendent and four supervisors per shift team (14 supervisors in all including daytime supervisors).

Other plants like REFORMA and INCASA also have been found to be operating with the surprisingly limited staff of 220 and 158, respectively.

These examples have been taken as reference in drawing up the proposed in Table 10-2 for the envisaged plant, to cover the case of corrugating medium manufacture, and in Table 10-3 for printing/writing paper manufacture.

Table 10-2. Organization and Manpower for Corrugating Medium Plant

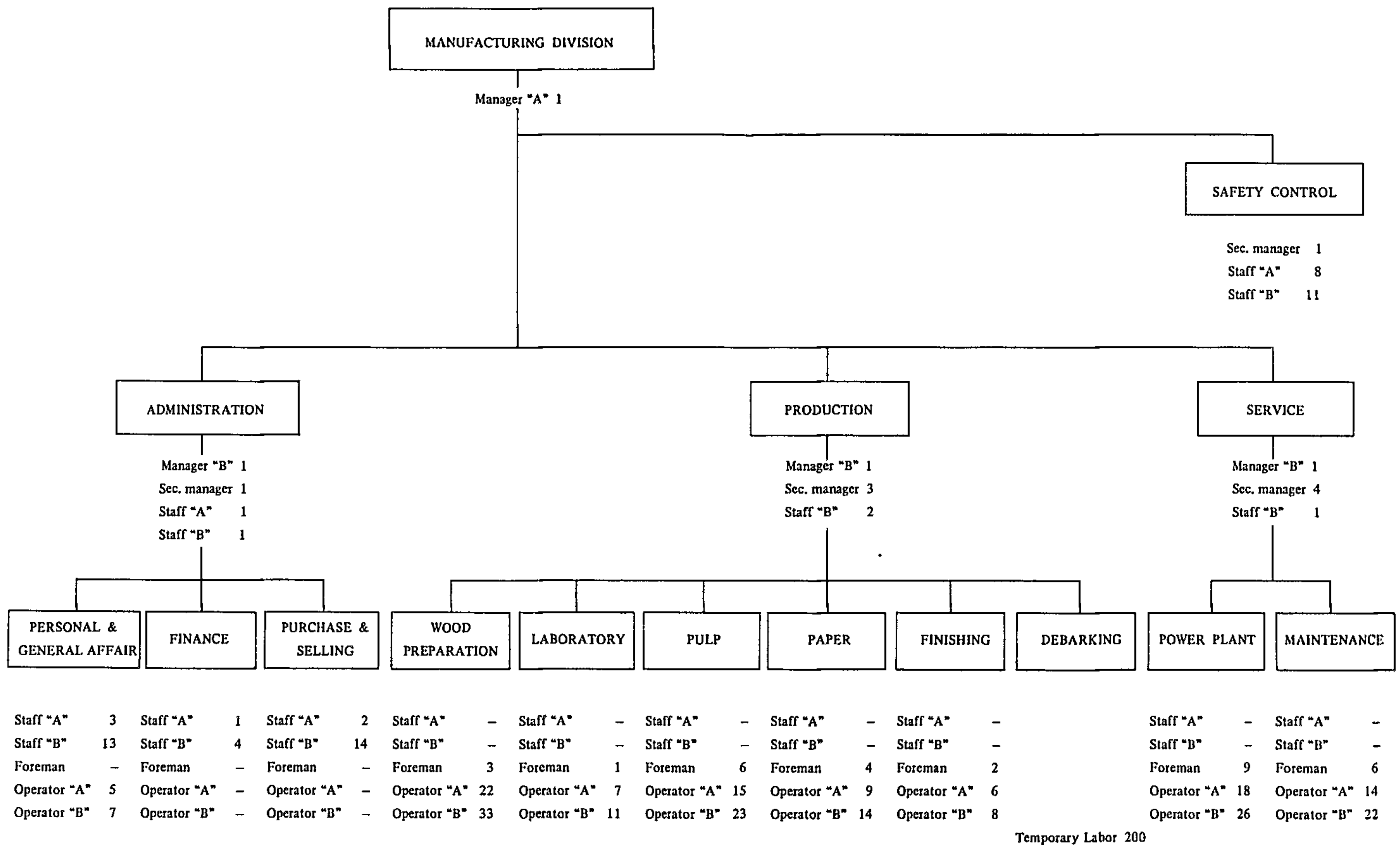


Table 10-3. Organization and Manpower for Printing/writing Paper Plant

- **MANUFACTURING DIVISION** — Manager "A" 1
  - **SAFETY CONTROL** — Sec. manager 1, Staff "A" 8, Staff "B" 11
  - **ADMINISTRATION** — Manager "B" 1, Sec. manager 1, Staff "A" 1, Staff "B" 1
    - PERSONAL & GENERAL AFFAIR
    - FINANCE
    - PURCHASE & SELLING
  - **PRODUCTION** — Manager "B" 1, Sec. manager 3, Staff "B" 2
    - WOOD PREPARATION
    - LABORATORY
    - PULP
    - PAPER
    - FINISHING
    - DEBARKING
  - **SERVICE** — Manager "B" 1, Sec. manager 4, Staff "B" 1
    - POWER PLANT
    - MAINTENANCE

	PERSONAL & GENERAL AFFAIR	FINANCE	PURCHASE & SELLING	WOOD PREPARATION	LABORATORY	PULP	PAPER	FINISHING	DEBARKING	POWER PLANT	MAINTENANCE
Staff "A"	3	1	2	–	–	–	–	–		–	–
Staff "B"	13	4	12	–	–	–	–	–		–	–
Foreman	–	–	–	3	2	9	6	3		9	6
Operator "A"	5	–	–	22	8	23	15	39		18	19
Operator "B"	7	–	–	33	13	35	21	57		26	29

Temporary Labor 200

10.4 Personnel Required in the Pre-operational Period

The personnel requirements are as presented in the preceding Section 10.3. Part of this personnel should be recruited prior to plant commissioning, to take part in the construction operations, so as to let this staff become acqainted with the plant already from the construction stage, to prepare for commissioning and operation.

To this end, it is envisaged to have pre-operational personnel incorporated in the Project as set forth below. The relevant expenses have been accounted for in the pre-operating cost.

Category	Timing of Recruitment (Years/months before Commissioning)	Number of Persons	
		Corrugating Medium	Printing/writing Paper
Managers (A), (B)	3 years	5	5
Section managers	2 years	11	11
Staffs (A), foremen	6 months	64	71
Operators (A)	2 months	162	214

10.5 Operating Schedule

A very clear difference will result between the alternative cases of construction by platform-mounted and conventional piece-meal system of plant construction, and as described in detail in the Appendix 4, the platform-mounted system of construction will permit the plant to attain full capacity operation far more rapidly than with conventional system.

Previous experience with similar plants indicates the necessity of foreseeing 4 to 5 years between plant commissioning and attainment of full capacity production, but with platform-mounted system, actually constructed a pulp plant in the Amazon tributary, proved full operation to be possible within a period of only 2 years from startup.

Based on this actual achievement, the projected Plant is envisaged to be worked up to full capacity pursuant to the following program:

Year	Platform-mounted System (% plant capacity)	Conventional Piece-meal System (% plant capacity)
1st. year	65	60
2nd. year	95	85
3rd. year	100	95
4th. year and after	100	100

Chapter 11.

PROJECT IMPLEMENTATION

Chapter 11. PROJECT IMPLEMENTATION

11.1 General

Actual implementation of the Project within the above estimated period will be contingent upon effective administration and control at site of the civil and building work progress as well as of the technical aspects. To this end, it will be indispensable to establish a project team constituted of qualified members including foreign supervisors to undertake under the direction of the project manager throughgoing preliminary surveys and planning, in charge of their respective specialists in charge, throughgoing survey and plans for implementing the Project, including preliminary detailed site survey, and covering plans for:

(1) Construction of logging roads
(2) Felling sequence
(3) Logging implementation (including equipment for log conveyance)
(4) Carrying in auxiliary chemicals
(5) Recruiting and training skilled operators
(6) Dredging for accommodating the floating platform
(7) Foundation work for setting the platform
(8) Implementation of platform setting operation, with account taken of tides.

Certain of the above operations will require to start even prior to contract conclusion.

11.2 Organization

The most logical organization for implementing the envisaged Project would be let I.F.C be in charge of overall responsibility for the actual operations, under the general direction of C.F.N, which in turn reports to the MICEI.

11.3 Financial Coverage

To serve in drawing up plans for financing the Project, the following principles to be adopted in calculations were indicated by I.F.C.

11.3.1 Source of Funds

(1)	Equity	20%
(2)	Long-term borrowing	80%

11.3.2 Conditions for Long-term Borrowing

(1)	Annual interest	11.0%
(2)	Repayments	10 equal installments on capital in 10 years
(3)	Grace period	3 years after commissioning of Plant

11.3.3 Conditions for Short-term Borrowing

(1)	Annual interest	14.0%
(2)	Repayment	Lump-sum settlement in the following year

11.4 Form of Contract

The turn-key, lump-sum form is envisaged for the contract to implement the present Project.

11.5 Project Implementation Schedule

As shown in Fig. 11-1, the envisaged Plant would be completed construction in 30 months from contract conclusion, to which period 3 months would be added for trial operation, to total 33 months to commencement of commercial operation.

Fig. 11-1. Implementation Schedule