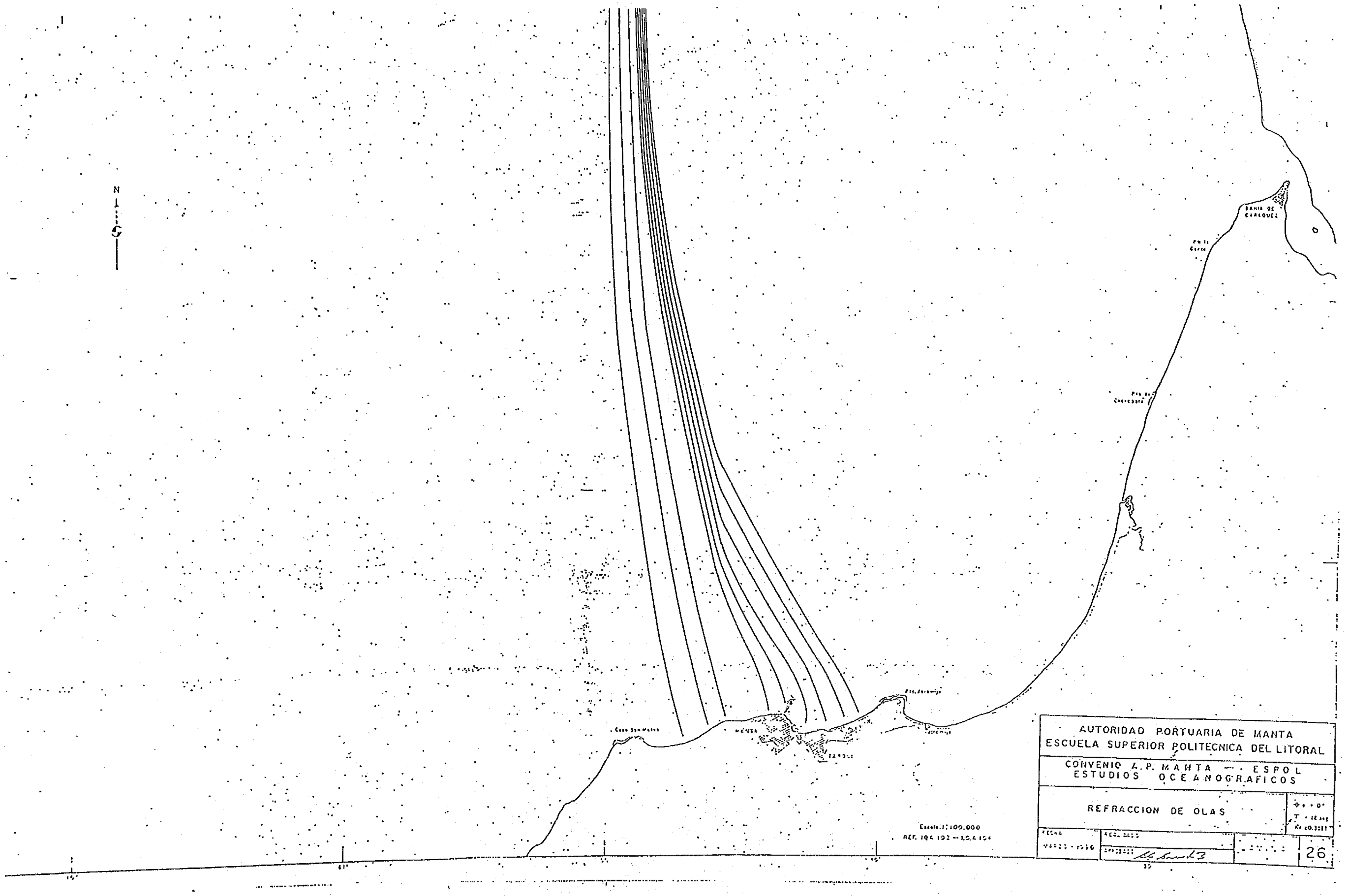
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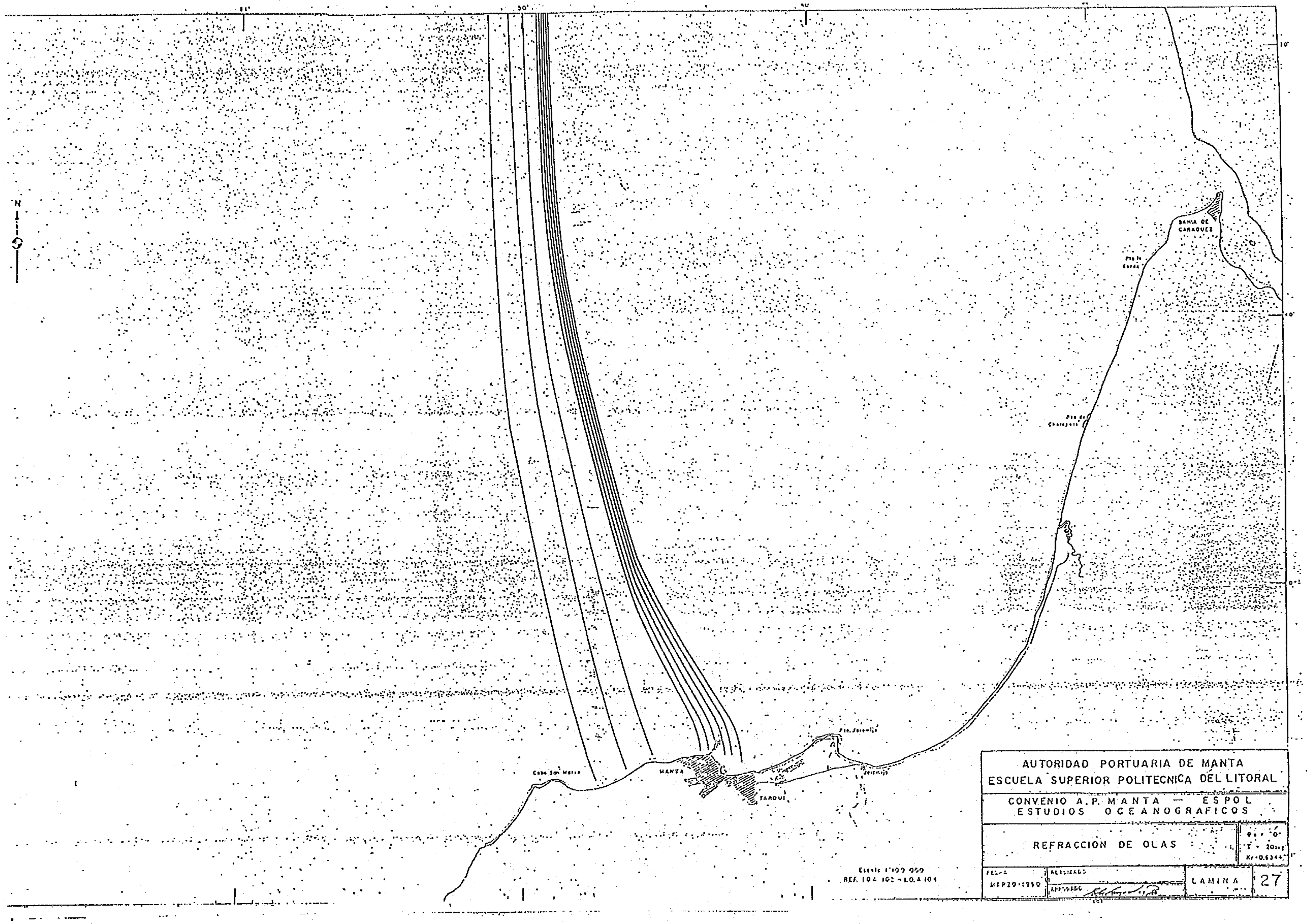
AUTORIDAD PORTUARIA DE MANTA
ESCUELA SUPERIOR POLITECNICA DEL LITORAL
CONVENIO A.P. MANTA — ESPOL
ESTUDIOS OCEANOGRAFICOS
REFRACCION DE OLAS
26


MANTA
TARQUI
AUTORIDAD PORTUARIA DE MANTA
ESCUELA SUPERIOR POLITECNICA DEL LITORAL
CONVENIO A.P. MANTA — ESPOL
ESTUDIOS OCEANOGRAFICOS
REFRACCION DE OLAS
LAMINA
27

1.3 Geology

(1) Geological Map at Manta

Fig 2-5 shows the geological map of the selected site and transverse section as well. This figure is carried out for Cysica-Scamdic consultant. These materials consist of clays and sedimentation sand. Manta area has at least three quarry. These material has a very good performance so is used extensively on breakwater construction. Those reserves will be more than one hundred millions cubic meter. It is possible to get 7-8 ton rock.

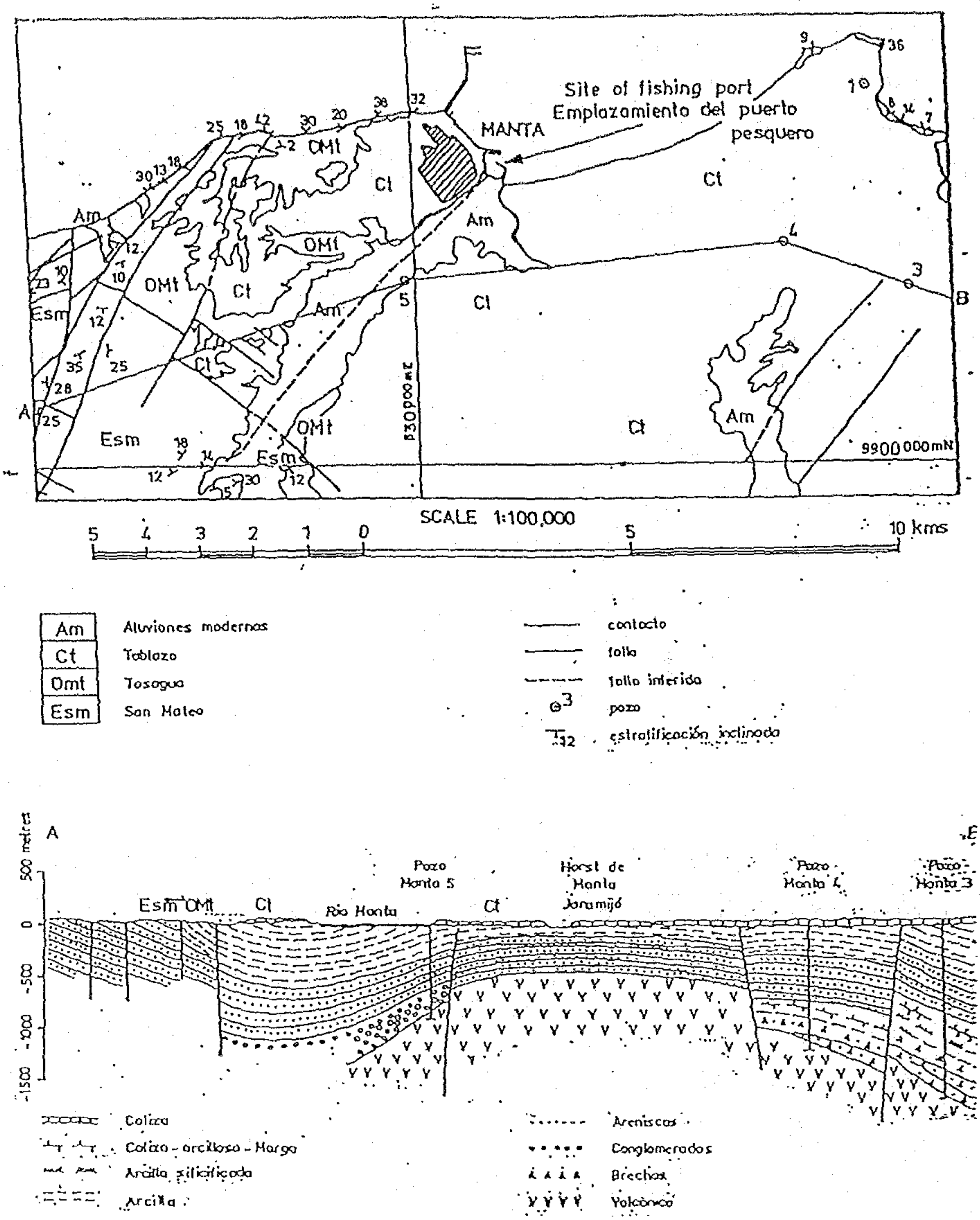
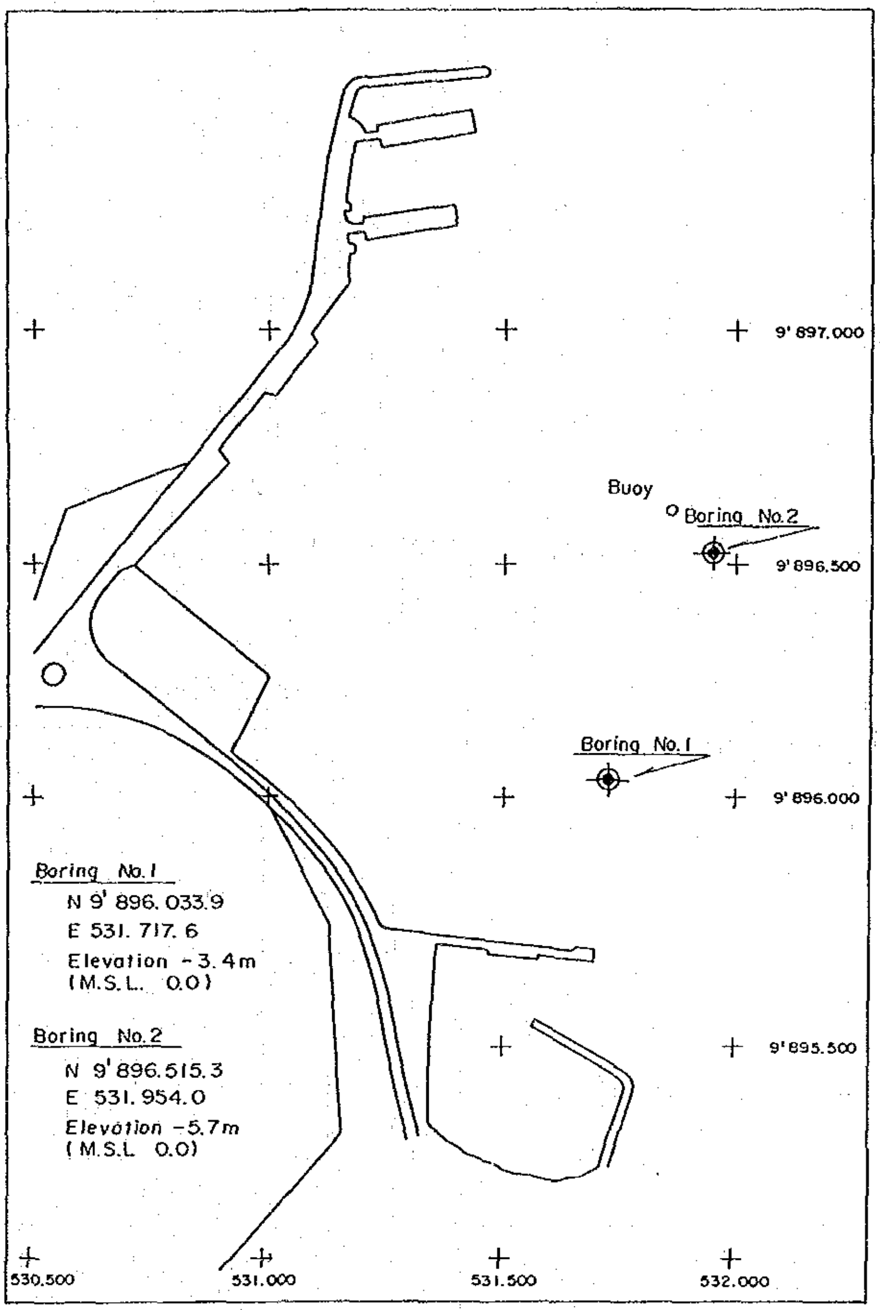


Fig 2-5 Geological Map at Manta

(2) Soil Investigation
1) Soil Survey by the JICA Study Team



Location of Boreholes

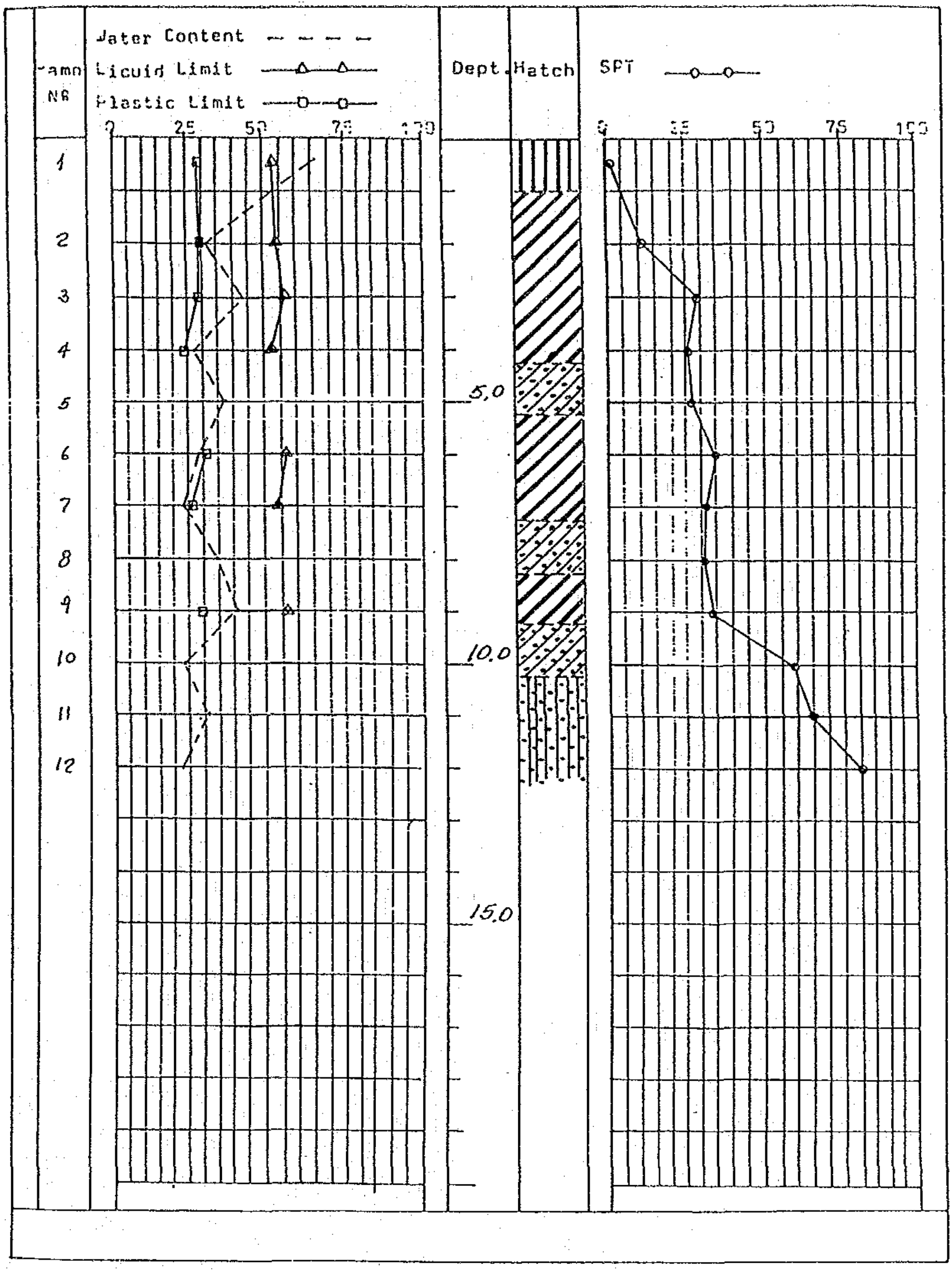
Soil Survey Results at Manta

BORING LOG 1

Dept.	Hatch	Samp N°	SPT	W %	LL %	IP %	Gradation #4	#10	#20	#40	#200	Soil Description and Identification
		1	1	66.9	52.9	23.6		100	99.6	99.5	98.2	Very loose grey silt with fine sand (MH)
		2	11	32.0	54.6	25.0	100	99.6	98.5	97.6	85.6	Stiff green clay of high plasticity with shells (CH)
		3	28	43.6	56.4	27.9			100	99.4	95.4	Very stiff tan clay of high plasticity (CH)
		4	26	27.3	52.8	23.7		100	99.5	98.6	91.7	Very stiff tan clay of high plasticity with fine sand (CH)
5.0		5	27	37.7	N.	P.	100	99.8	98.9	96.5	27.8	Medium density grey clayed sand (SC)
		6	35	28.3	56.2	25.5		100	98.7	97.7	89.4	Hard grey clay of high plasticity with fine sand (CH)
		7	32	24.2	54.5	28.9		100	99.2	98.9	85.9	Hard grey clay of high plasticity with fine sand (CH).
		8	31	34.4	N.	P.	100	99.3	97.7	90.3	15.9	Dense grey clayed sand with shells (SC)
		9	34	41.1	56.2	26.4	100	99.8	98.5	97.3	90.7	Hard grayed clay of high plasticity with fine sand (CH)
10.0		10	58	23.9	N.	P.	100	99.0	98.3	97.6	38.1	Very dense yellowish clayed sand (SC)
		11	65	31.3	N.	P	100	95.5	93.4	92.4	35.8	Very dense fine grey silty sand (SM)
		12	80	22.9	N.	P.	100	99.3	98.0	96.2	30.9	Very dense fine brown silty sand (SM).
15.0												
20.0												

Casing: φ 4" ; 5 m. drived

BORING LOG 1



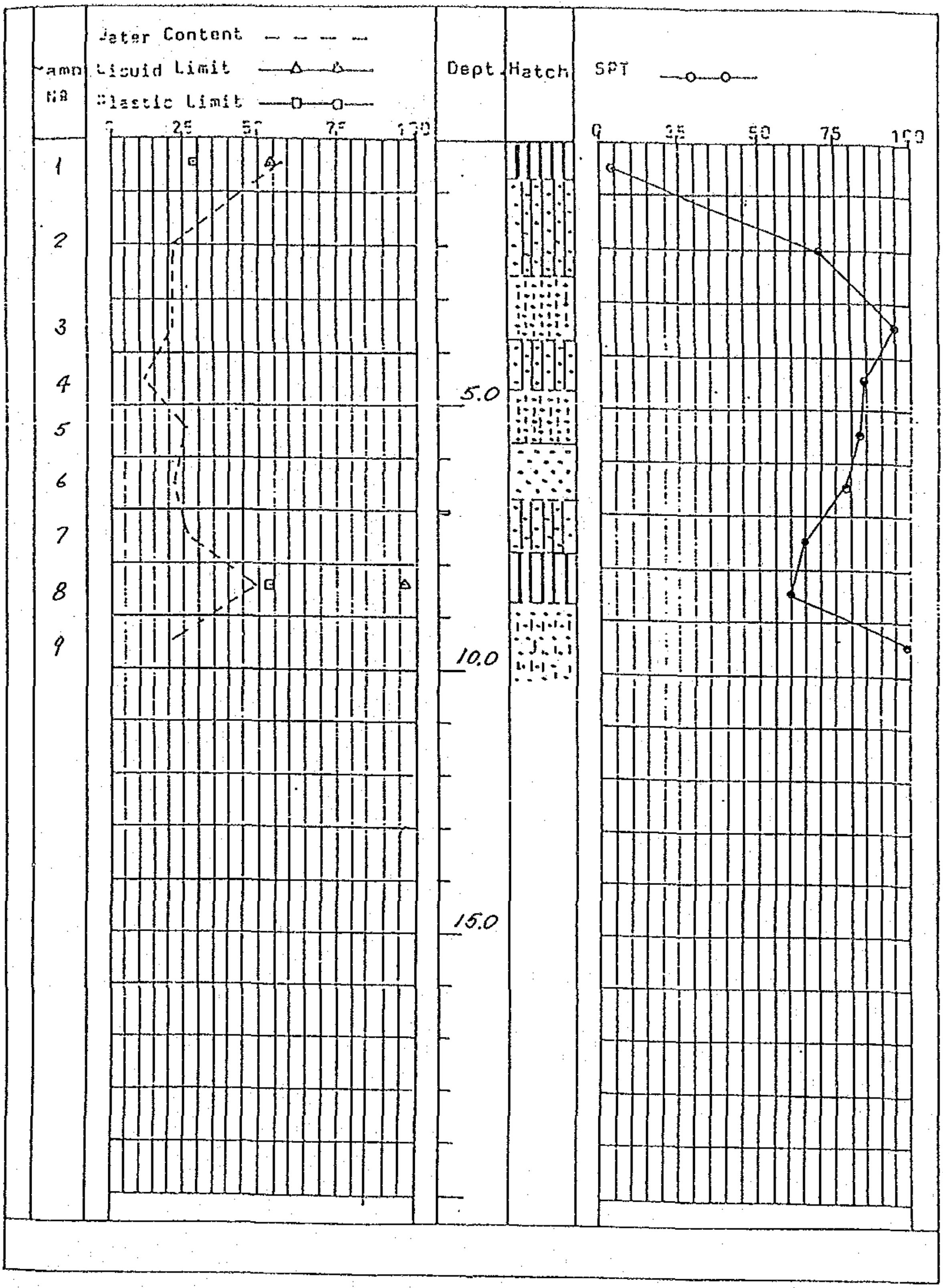
Samp No
Water Content
Liquid Limit
Plastic Limit
0 25 50 75 100
Dept.
Hatch
SPT
0 25 50 75 100
1
2
3
4
5
6
7
8
9
10
11
12
5.0
10.0
15.0

BORING LOG 2

Dept	Hatch	Samp No	SPT	W %	LL %	IP %	GRADATION #4	#10	#20	#40	#200	Soil Description and Identification
		1	8	57.8	53.4	24.5		100	99.0	98.4	96.2	Very loose grey silt with fine sand (MH).
		2	69	21.3	N.	P	91.6	84.5	77.5	69.2	15.0	Very dense coarse gray sand with shells (SM).
		3	95	21.0	N.	P	99.9	98.3	93.7	79.8	9.7	Very dense medium to fine gray sand (SM-SP)
		4	84	10.8	N.	P	91.5	71.8	62.0	51.8	23.4	Very dense medium to coarse tan silty sand (SM).
5.0		5	83	26.7	N.	P	100	98.7	96.4	90.8	5.7	Very dense medium to fine gray sand (SM-SP).
		6	78	22.6	N.	P.	100	99.9	88.8	53.8	2.0	Very dense coarse to medium brown sand (SP)
		7	65	25.5	N.	P.		100	94.9	92.2	28.3	Very dense medium to fine grey silty sand (SM).
		8	55	49.9	96.4	42.0	96.8	93.0	91.5	90.5	85.3	Very dense tan silt with coarse sand (MH).
		9	98	20.2	N.	P.	64.1	55.5	46.9	41.4	11.1	Very dense coarse to medium gray sand with fine gravel (SM-SP).
10.0												
15.0												

Casing: φ4"; 7m, drived.

BORING LOG 2


Samp No
Water Content
Liquid Limit
Plastic Limit
0 25 50 75 100
Dept.
Hatch
SPT
0 25 50 75 100
1
2
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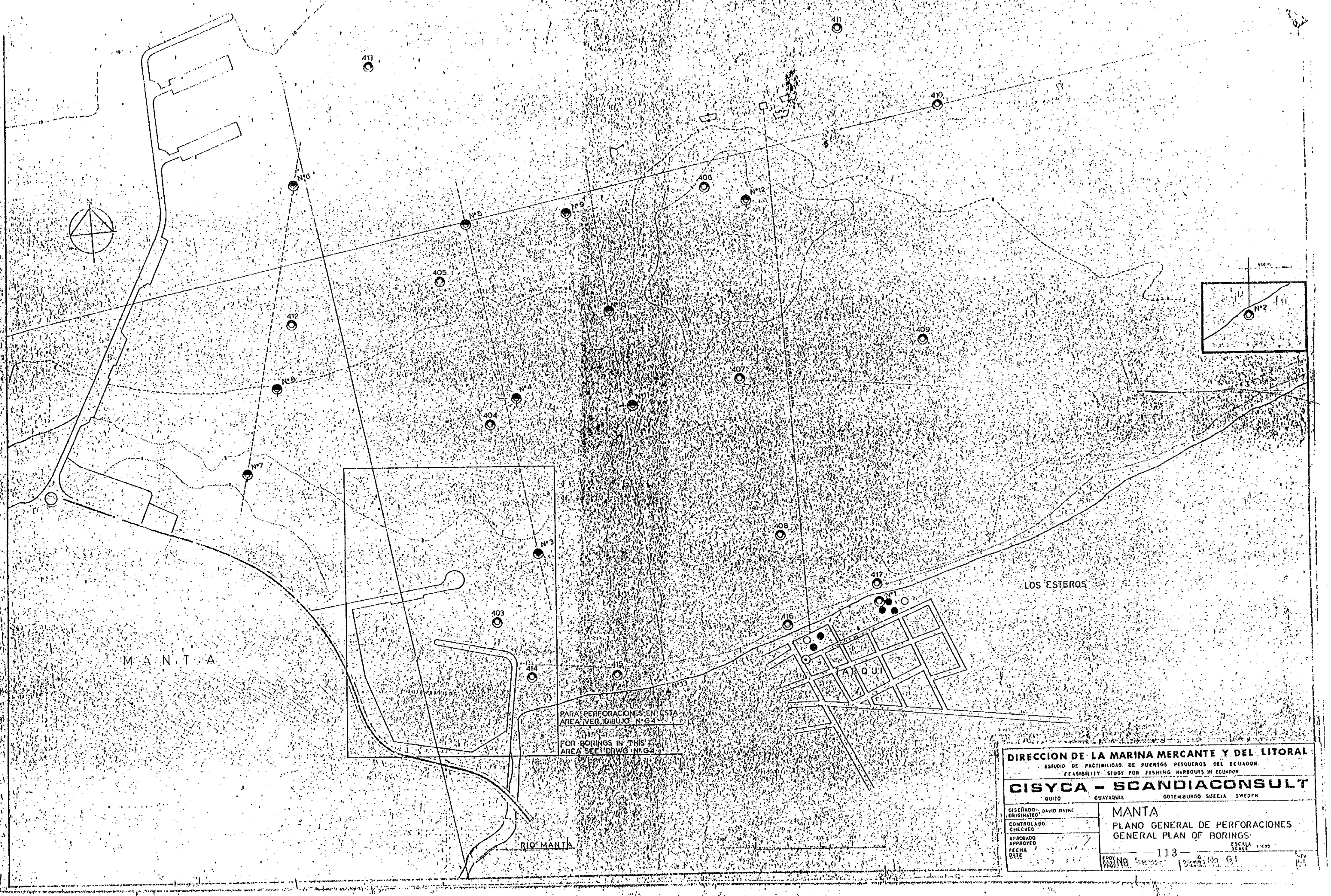
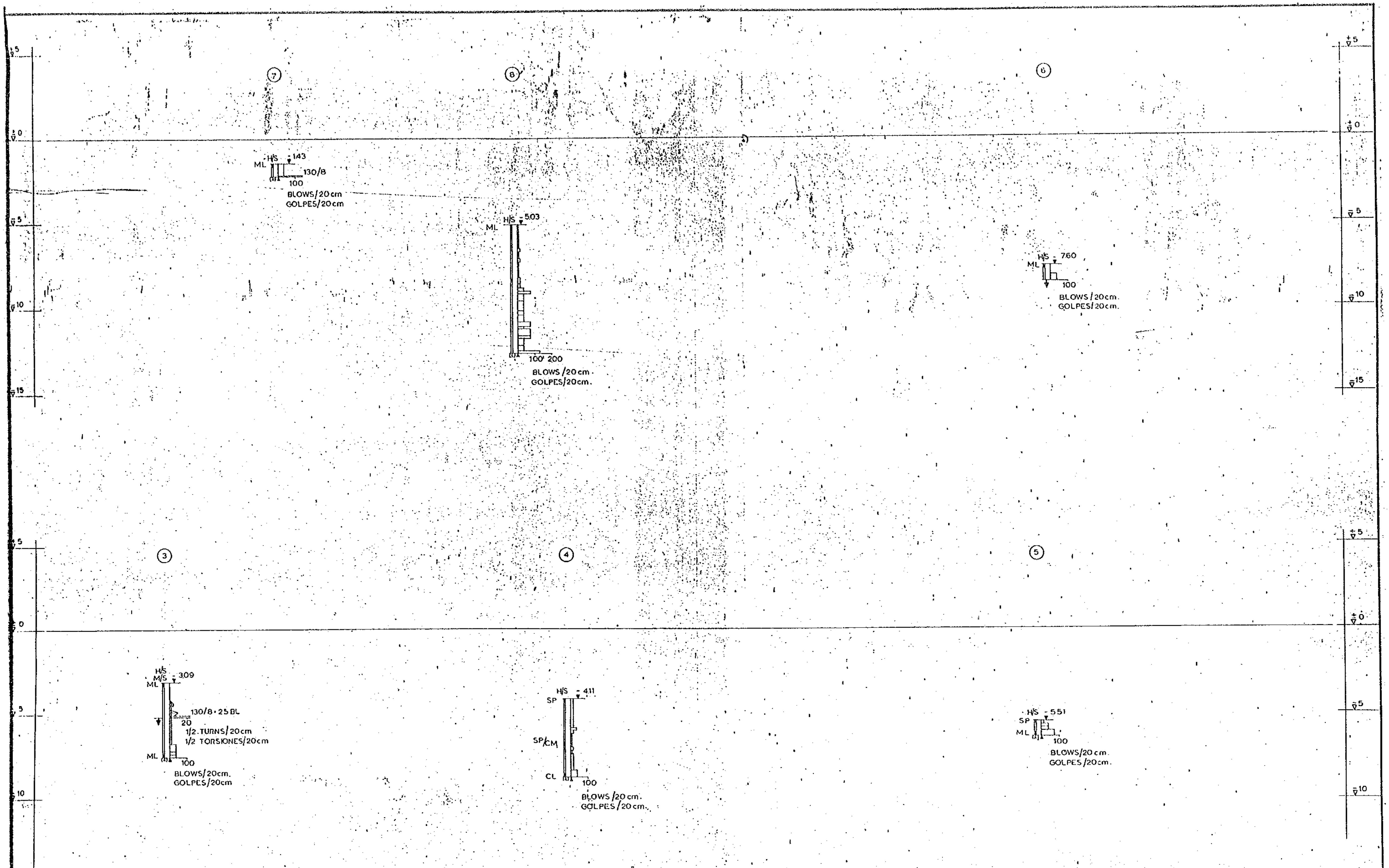
8
9
5.0
10.0
15.0

2) Existing Boring Data at Manta





DIRECCION DE LA MARINA MERCANTE Y DEL LITORAL

ESTUDIO DE FACTIBILIDAD DE PUERTOS PESQUEROS DEL ECUADOR

FEASIBILITY STUDY FOR FISHING HARBOURS IN ECUADOR

CISYCA - SCANDIACONSULT

QUITO GUAYAQUIL GOTEMBURGO SUECIA (SWEDEN)

DISEÑADO / ORIGINATED: DAVID BAYNE

CONTROLADO / CHECKED

APROBADO / APPROVED

FECHA / DATE

MANTA

PERFORACIONES

BOREHOLE — 115 — 8

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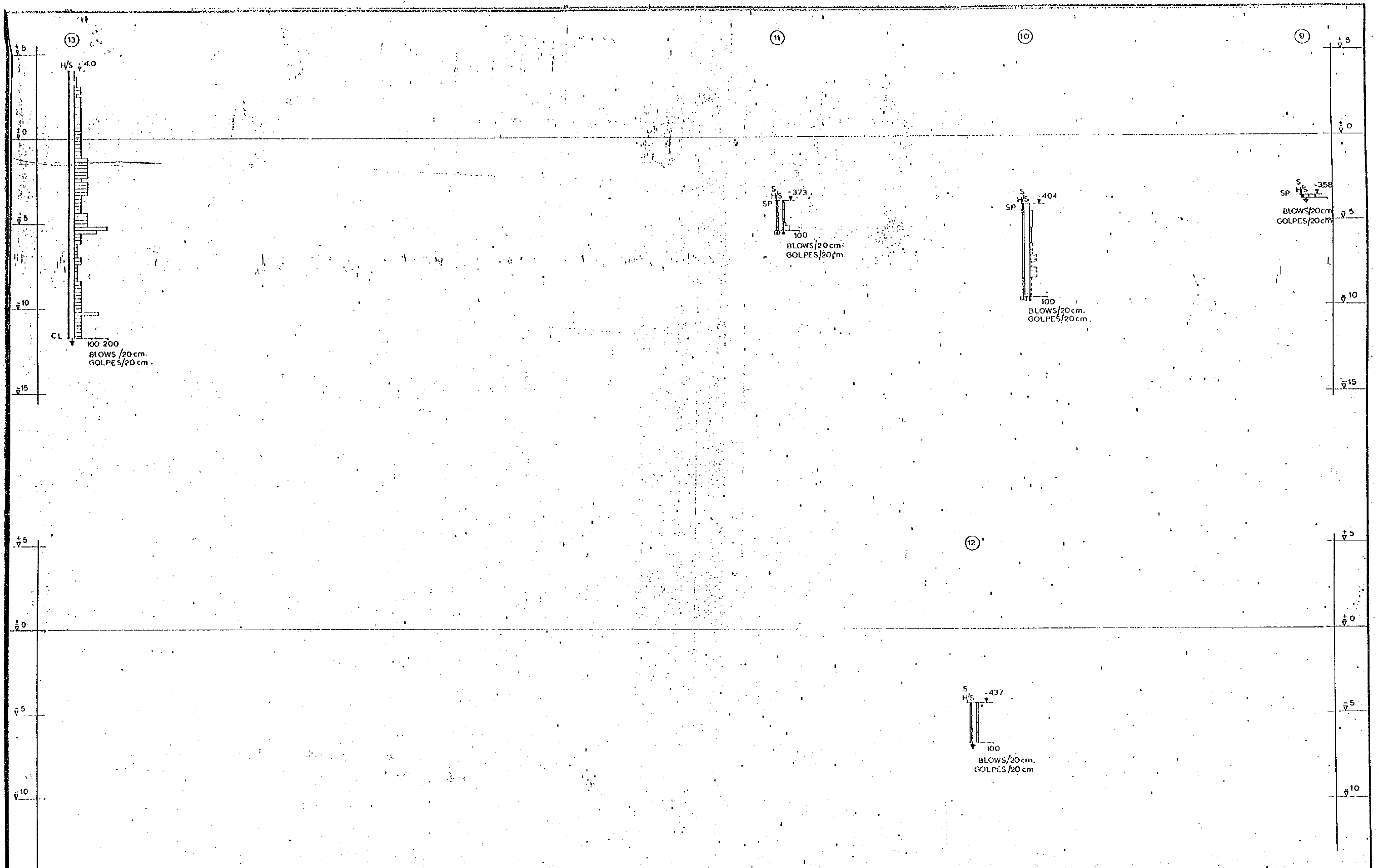
ESCALA V 1:100

NUMERO DEL PROYECTO

G 2

REV. / ALT.



DIRECCIÓN DE LA MARINA MERCANTE Y DEL LITORAL

ESTUDIO DE FACTIBILIDAD DE PUERTOS PESQUEROS DEL ECUADOR

CIS CA - SCANDIACONSULT

GUAYAQUIL

SUECIA (SWEDEN)

DISEÑADO

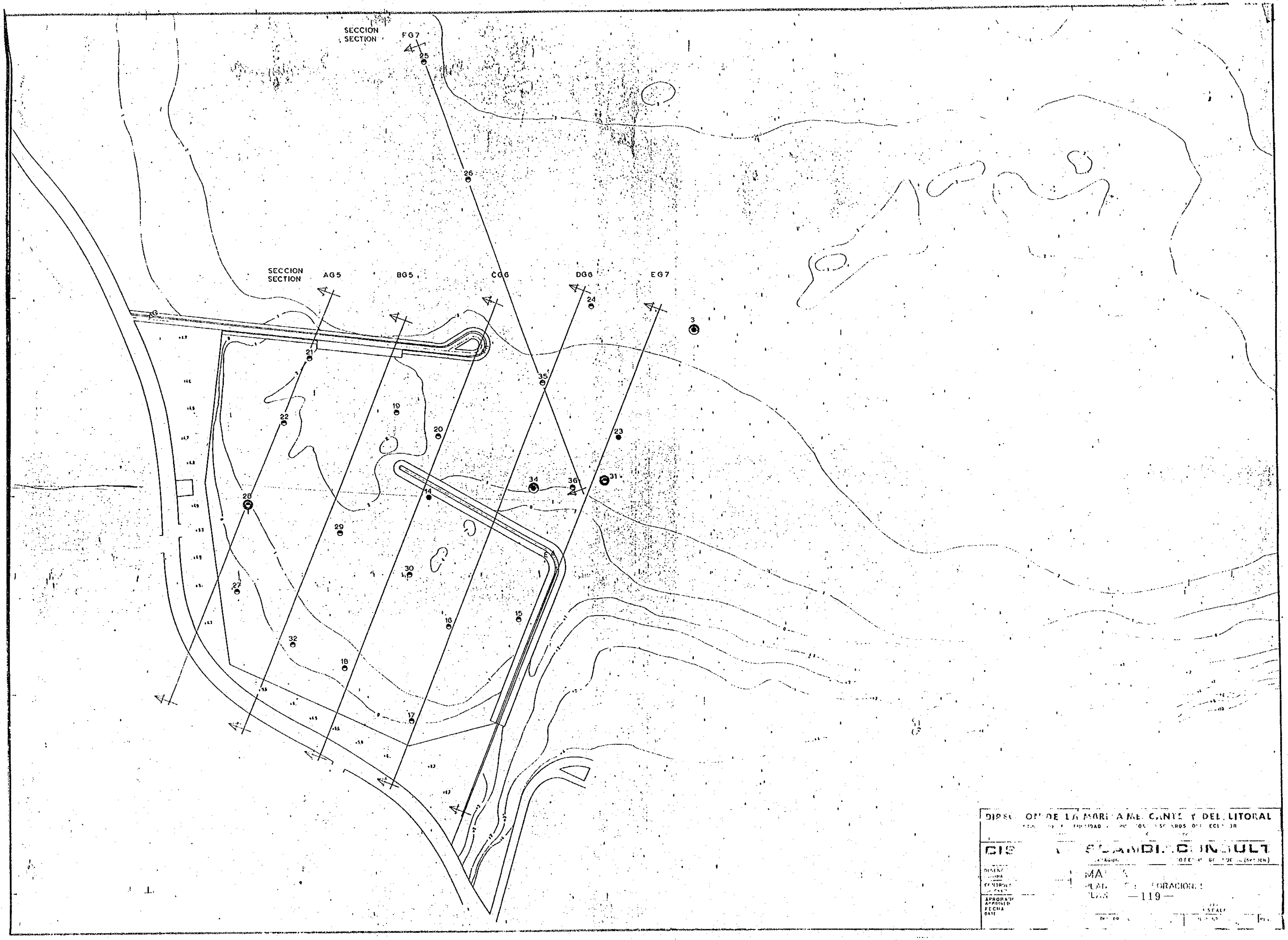
CONTROLA

FECHA

MANTA

PERFORACIONES

ESCALA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AG5
BG5
CG6
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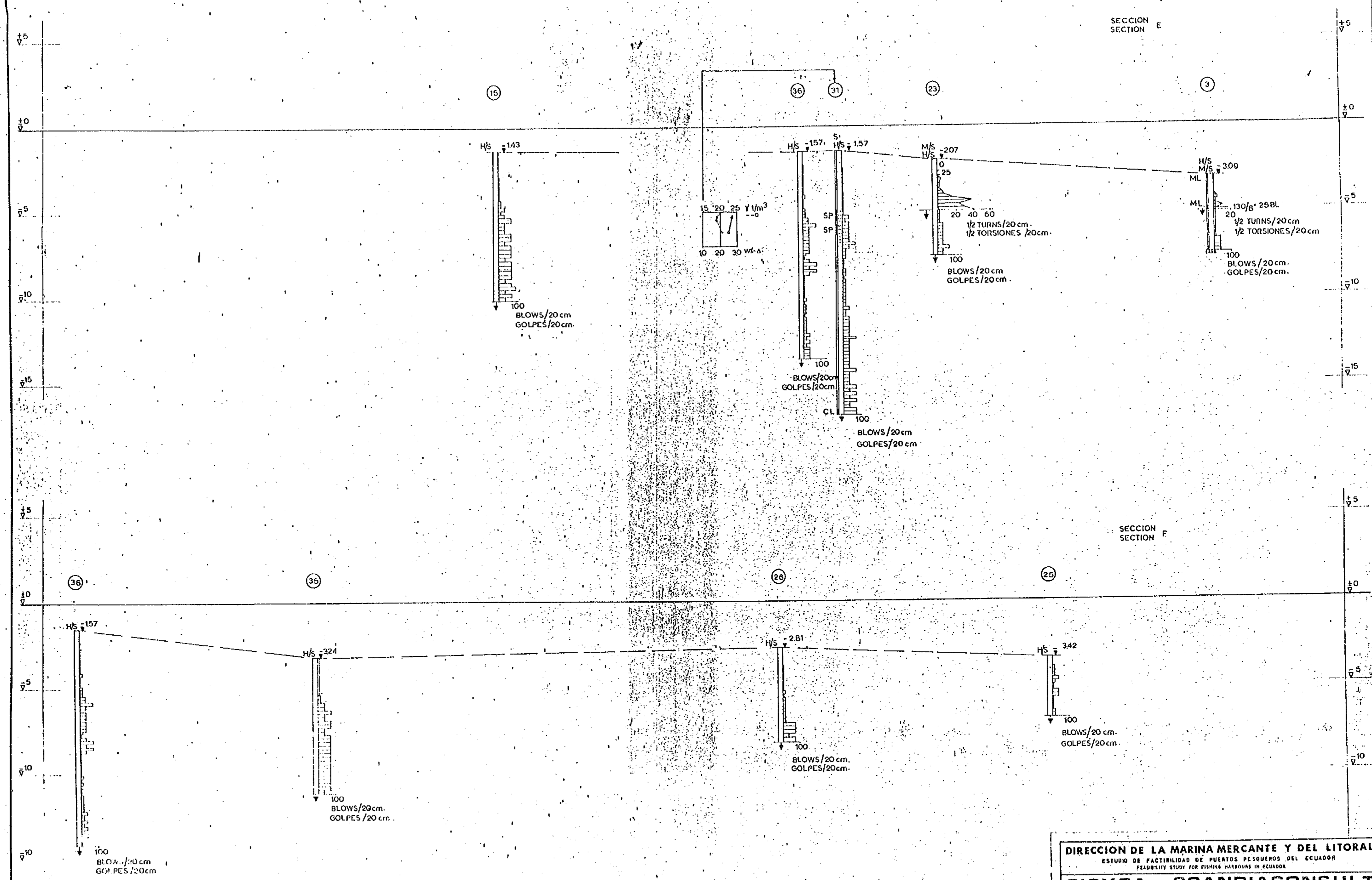
APROBADO
APPROVED
FECHA
DATE
ESCALA



DIRECCION DE LA MARINA MERCANTE Y DEL LITORAL

ESTUDIO DE FACTIBILIDAD DE PUERTOS PESQUEROS DEL ECUADOR

FEASIBILITY STUDY FOR FISHING HARBOURS IN ECUADOR

CISYCA - SCANDIACONSULT

QUITO — GUAYAQUIL — GOTEMBURGO SUECIA (SWEDEN)

DISEÑADO / ORIGINATED: DAVID DAYNE	MANTA
CONTROLADO / CHECKED	SECCIONES DE PERFORACIONES E.F
APROBADO / APPROVED	BOREHO — 121 —
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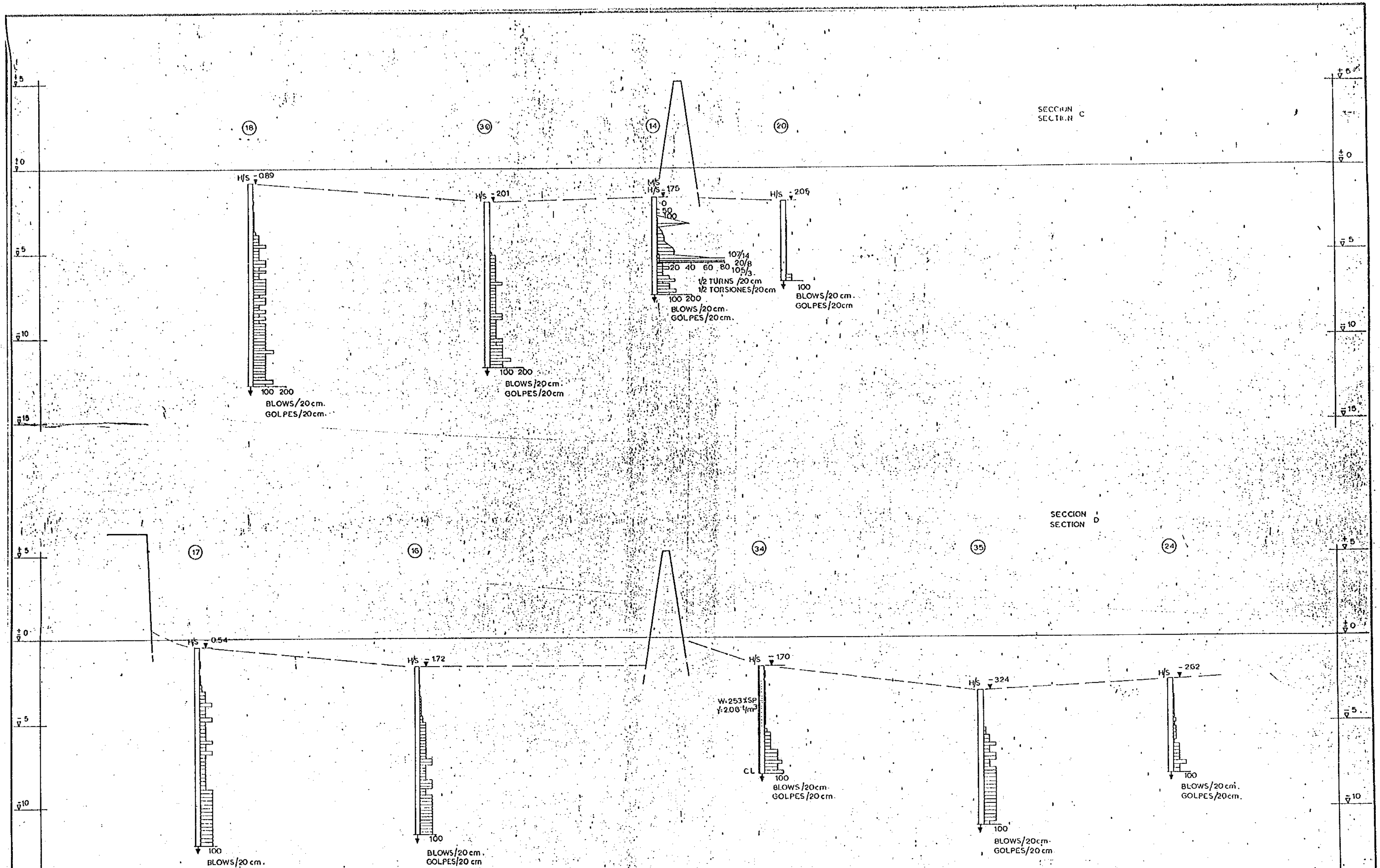

DIRECCION DE LA MARINA MERCANTE Y DEL LITORAL
ESTUDIO DE FACTIBILIDAD DE PUERTOS PESQUEROS DEL ECUADOR

CISYCA - SCANDIACONSULT
QUITO GUAYAQUIL GOTEMBURGO SUECIA (SWEDEN)

DISEÑADO: DAVID DAYNE

MANTA
SECCIONES DE PERFORACIONES C.D
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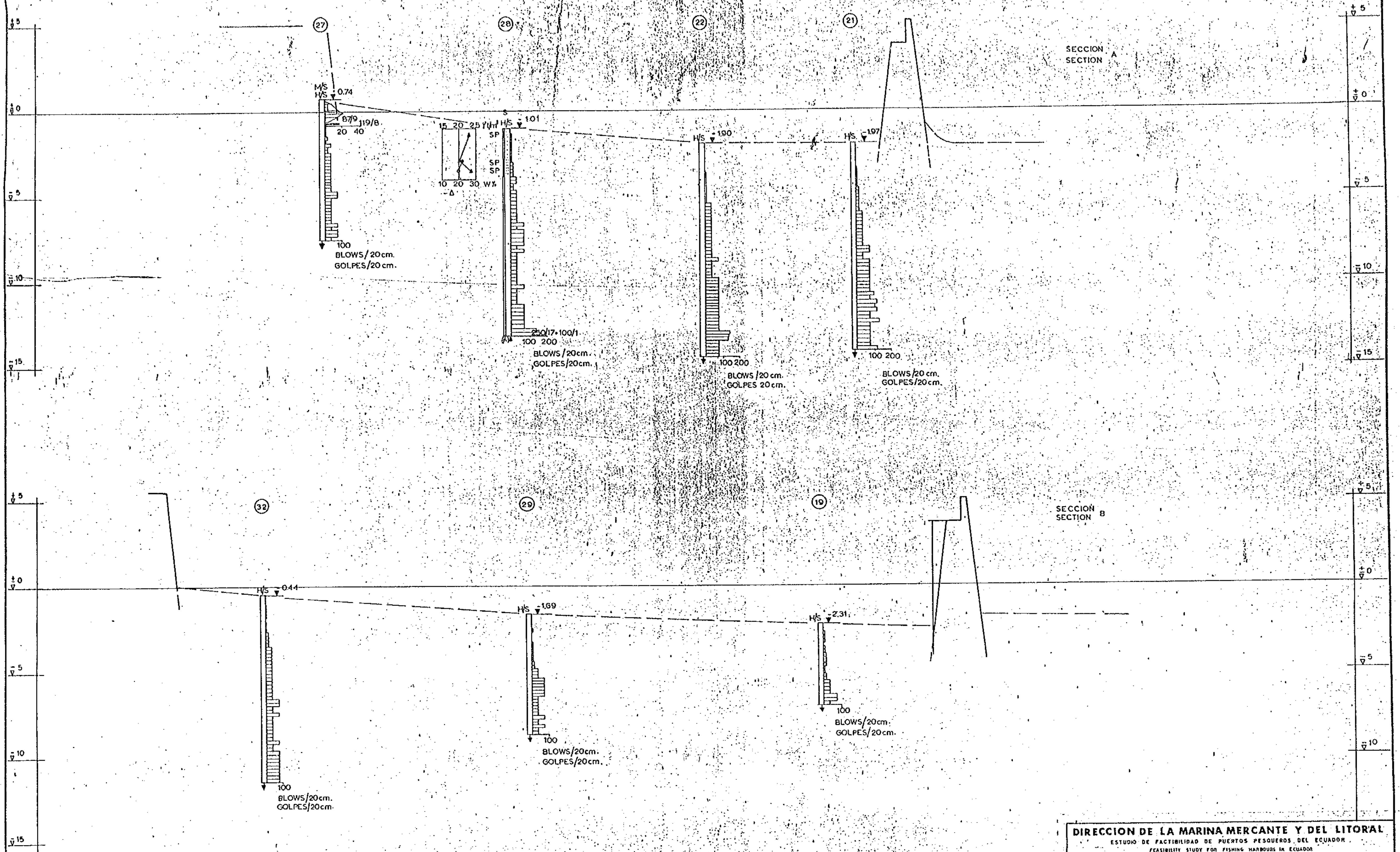

DIRECCION DE LA MARINA MERCANTE Y DEL LITORAL

ESTUDIO DE FACTIBILIDAD DE PUERTOS PESQUEROS DEL ECUADOR

FEASIBILITY STUDY FOR FISHING HARBOURS IN ECUADOR

CISYCA - SCANDIACONSULT

QUITO GUAYAQUIL GOTEMBURGO SUECIA (SWEDEN)

DISEÑADO / ORIGINATED: DAVID BAYNE	MANTA SECCIONES DE PERFORACIONES A.B BOREHOL — 125 —
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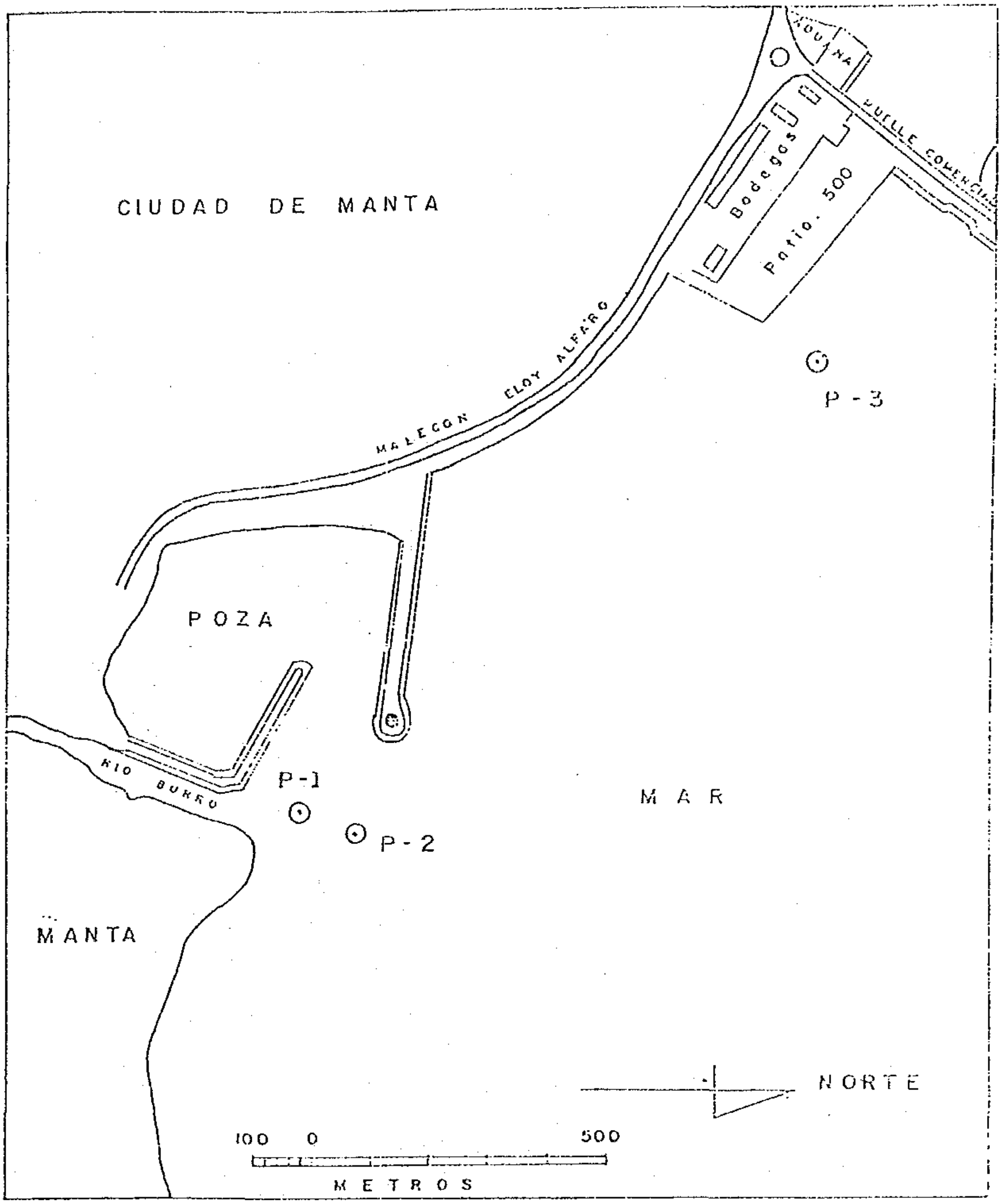


FIG. 1._ UBICACIONES DE LAS PERFORACIONES

Prof. m.	DESCRIPCION DEL MATERIAL	SUCS	N SPT	MUESTRA Nº	MUESTRA TIPO	ENSAYO DE LABORATORIO W %	LL %	LP %
	COTA: Lecho Marino SONDEO: P-1							
1		SP	7	1	CP	24	N	P
2		SW	8	2	CP	30	N	P
3	Arena fina con trazas de finos e intercalaciones de arena gruesa gravosa conchífera. Color gris y compacidad suelta.	SW SM	6	3	CP	25	N	P
4								
5		SP	8	4-A	CP	29	N	P
6		SP	8	4-B	CP	38	N	P
	6.50m.							
7								
		SW SP	75	5 A B	CP	42	N	P
8	IDEM. Compacidad muy densa							
		SW	60	6	CP	28	N	P
9								
10.00m.		SP	40	7	CP	21	N	P

MEDIDA DEL NIVEL PREATICO	METODO	EMPEZADO: 5/9/89
FECHA: 6/9/89	Percusión y lavado	TERMINADO: 7/9/89
HORA: 11h00		ESC. VERTICAL 1:50
NIVEL: Superficial		HOJA 1 DE 2

N = NUMERO DE GOLPES/PIES LL=LP: LIMITE LIQUIDO-PLASTICO Qu: COMPRENSION SIMPLE
W - HUMEDO NATURAL E : DEFORMACION n: PESO UNITARIO.

Prof. m.	DESCRIPCION DEL MATERIAL	SUCS	N	MUESTRA		ENSAYO DE LABORATORIO		P
	COTA: Lecho Marino SONDEO: P-1							
11		SP	120	8	CP	35	N	P
12								
13	Arena fina de color gris y de compacidad muy densa.	SP	170	9	CP	39	N	P
14								
15		SP	180	10	CP	42	N	P
	Fin de Perforación 15.25m.							
16								

MEDIDA DEL NIVEL PREATICO	METODO	
FECHA: 6/9/89	Percusión y lavado	EMPEZADO: 5/9/89 TERMINADO: 7/9/89
HORA: 11h00		ESC. VERTICAL 1:50
NIVEL: Superficial		HOJA: 2 DE 2

N = NUMERO DE GOLPES/PIES LI.=LP: LIMITE LIQUIDO-PLASTICO Qu: COMPRENSION SIMPLE
W - HUMEDO NATURAL E : DEFORMACION n: PESO UNITARIO

Prof. m.	DESCRIPCION DEL MATERIAL	SUCS	N SPT	MUESTRA Nº	MUESTRA TIPO	ENSAYO DE LABORATORIO W %	LL %	LP %
	COTA: Lecho Marino SONDEO: P-2	SP	7	1	CP	28	N	P
1								
2		SP	8	2	CP	23	N	P
3	Arena fina con trazas de fino e intercalaciones de grava arenosa conchífera. Color café grisaseo y compacidad de suelta a firme.	SP	6	3	CP	33	N	P
4								
		SP	8	4	CP	38	N	P
5		SW SP	15	5 A 5 B	CP	29	N	P
6	6.25m.	GW SP	18	6 A 6 B	CP	35	N	P
7		SP	45	7	CP	27	N	P
8		SP	50	8	CP	30	N	P
	Arena fina café de compacidad densa a muy densa.							
9		SP	58	9	CP	27	N	P
	9.95m.	SP	58	10	CP	32	N	P

MEDIDA DEL NIVEL PREATICO	METODO	EMPEZADO: 8/9/89
FECHA: 9/9/89	Percusión y lavado	TERMINADO: 10/9/89
HORA: 13h00		ESC. VERTICAL 1:50
NIVEL: Superficial		HOJA: 1 DE 2

N = NUMERO DE GOLPES/PIES LL=LP: LIMITE LIQUIDO-PLASTICO Qu: COMPRENSION SIMPLE
W - HUMEDO NATURAL E :DEFORMACION γ: PESO UNITARIO

Prof. m.	DESCRIPCION DEL MATERIAL	SUCS	N SPT	MUESTRA Nº	MUESTRA TIPO	ENSAYO DE LABORATORIO W %	LL %	LP %
	COTA: Lecho Marino SONDEO: P-2	SP	115	11	CP	38	N	P
11								
	Arena fina con trazas de finos. Color gris y compacidad muy densa.							
12		SP	110	12	CP	29	N	P
13		SP	130	13	CP	35	N	P
	Fin de Perforación 13.25m.							
14								

MEDIDA DEL NIVEL PREATICO	METODO	EMPEZADO: 8/9/89
FECHA: 9/9/89	Percusión y lavado	TERMINADO: 10/9/89
HORA: 13h00		ESC. VERTICAL 1:50
NIVEL: Superficial		HOJA: 2 DE 2

N = NUMERO DE GOLPES/PIES LL=LP: LIMITE LIQUIDO-PLASTICO Qu: COMPRENSION SIMPLE
W - HUMEDO NATURAL E : DEFORMACION γ: PESO UNITARIO

Prof. m.	DESCRIPCION DEL MATERIAL	SUCS	N SPT	MUESTRA Nº	MUESTRA TIPO	ENSAYO DE LABORATORIO W %	LL %	LP %
	COTA: Lecho Marino SONDEO: P-3	SP	6	1	CP	30	N	P
1								
2	Arena fina con trazas de finos e intercalaciones de arena gruesa conchífera. De color gris y compacidad suelta.	SP	27	2	CP	27	N	P
3		SP	30	3	CP	37	N	P
4	4.70m.							
5		SP	56	4	CP	26	N	P
6		SP	65	5	CP	35	N	P
7	Arena fina de color gris y compacidad muy densa.							
8		SP	70	6	CP	38	N	P
9		SP	100	7	CP	30	N	P
10								

MEDIDA DEL NIVEL PREATICO	METODO	
FECHA:	Percusión y lavado	EMPEZADO: 12/9/83
HORA:		TERMINADO: 14/9/83
NIVEL: Superficial		ESC. VERTICAL 1:50
		HOJA: 1 DE 2

N = NUMERO DE GOLPES / PIES   LL = LP: LIMITE LIQUIDO-PLASTICO   Qu: COMPRESION SIMPLE
W - HUMEDO NATURAL   E : DEFORMACION   n: PESO UNITARIO

Prof. m.	DESCRIPCION DEL MATERIAL	SUCS	N SPT	MUESTRA Nº	MUESTRA TIPO	ENSAYO DE LABORATORIO W %	LL %	LP %
	COTA: Lecho Marino SONDEO: P-3							
		SP	110	8	CP	37	N	P
	Fin de Perforación 10.55m.							

MEDIDA DEL NIVEL PREATICO	METODO	EMPEZADO: 12/9/89
FECHA:	Percusión y lavado	TERMINADO: 14/9/89
HORA:		ESC. VERTICAL 1:50
NIVEL: superficial		HOJA: 2 DE 2

N = NUMERO DE GOLPES/PIES LL = LP: LIMITE LIQUIDO-PLASTICO Qu: COMPRENSION SIMPLE
W = HUMEDO NATURAL E: DEFORMACION γ: PESO UNITARIO

1.4 Seismicity

Based on known seismicity conditions of the coastal region of Ecuador, is indispensable to have in account the potential earthquake effects before to initiate a port design. However, because of lack of information is very difficult to evaluate an earthquke risk for Manabi region and particularly for Manta. Therefore engineering design has to consider seismicity effects based on previous structural geology and seismic information of the site in order to reduce the risk for human belongings an properties.

Lommnitz (1974) prepared a seismic map for a period lasting from 1904 through 1952. Here a value report of 100-1000 ergs/Km/year of free energy for Manta area is observed.

Lommnitz also present additional information and includes epicenter sites and earthquakes magnitude. It worth of mention the lack of information regarding earthquake magnitude on coastal zone and Ecuatorian Territory before 1900; presumably some earthquake should be occurred by that time. Lommnitz reported the five biggest earthquake on Ecuador as follows:

DATE	EPICENTER	MAGNITUDE
January 7,1901	Guayaquil	---------
January 31,1906	North of Ecuador	8.9
May 14,1942	Outside Ecuador	8.3
August 5,1949	Ambato	6.8
January 19,1958	Colombia-Ecuador border	6.8

Except for 1949 earthquake above information is not enough for to determine land acceleration affecting every site of exposure. However that information will enable us to indicate a good possibility for the port to be affected.

Because of lack of published regulation about earthquake resistant design codes for Port constructions at Ecuador we have to consult the codes on resistant regulation against earthquakes (World relationship) published on 1975 for to stablish a Manta seismicity comparison with another existing zones with seismicity coefficient. Based on this it has been adopted an horizontal seismic design of 0.1 as a suitable minimun requirement to safeguard the Port design. To get a more precise definition of Manta seismic condition is indispensble to have the unknown parameters hence the earthquake factor of 0.1 on the planning design coul not neccesary avoid the risk of casualties in case an earthquake strikes this area.

1.5 El Nino Phenomenon

In the past century El Nino occurred in (1891), 1912, (1917), (1925-26), (1940-41), 1953, (1957-58), 1965, 1969, (1972-73), 1976, (1982-83), and 1986-87. The ( ) ones had the greatest effects.
Each El Nino has its own particularities, the effects are also somewhat different; for example, rainfall is not a constant parameter, the El Nino of 1982-83 being probably the wettest since 1925. The 1982-83 El Nino has been the strongest event of this century. In 1982-83 rainfall data reached 5-10 times values greater than the average values of ordinary year.
Fig 2-26 shows the annual rainfall for the city of Guayaquil lasting from 1920 until 1982. It also relates the annual rainfall
with El Nino occurrence; a good relationship is found. A very large positive deviation from the 20 year mean is also shown in Fig 2-27.
According to these data, medium El Nino occurred about every 5 years, but it is very difficult to make an appropriate prediction of next strong El Nino event.

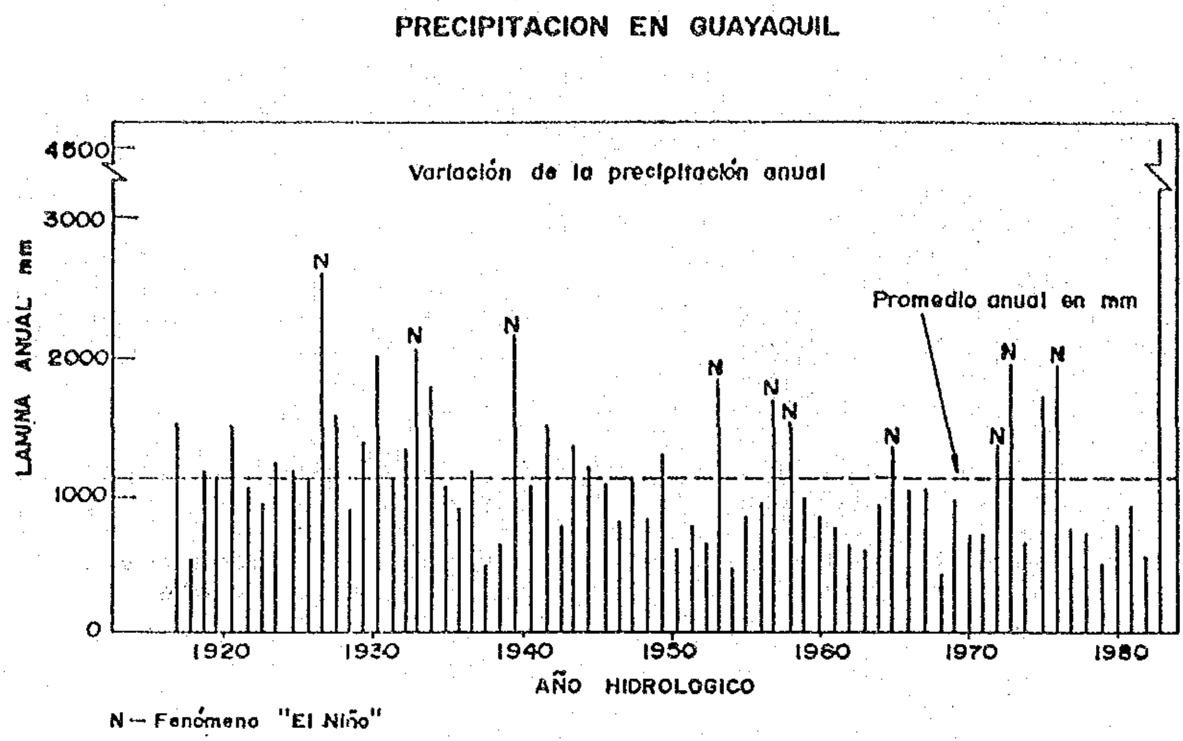


Fig 2.5.1 Annual variation of Rainfall at Guayaquil (1920 - 1983) N= EL NINO phenomenon years

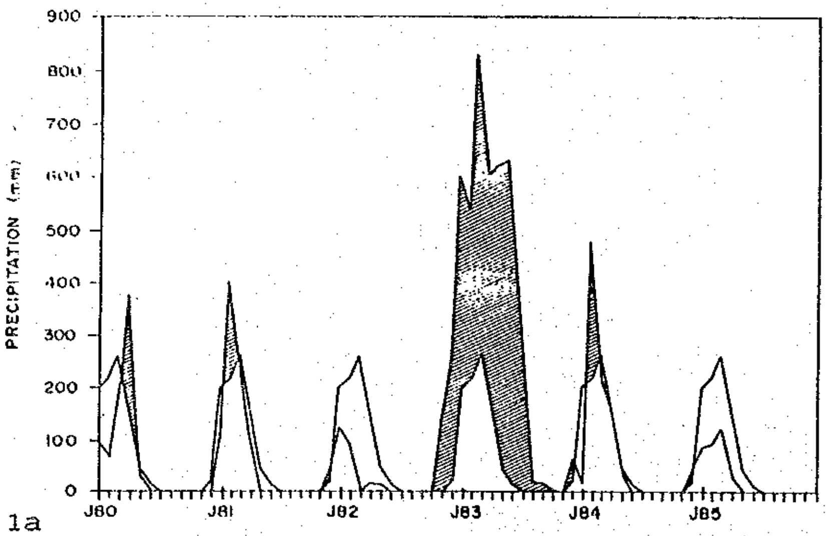


Fig 2.5.1a
Monthly rainfall (in millimeters) at Guayaquil (2°11'S, 79°52'W) from 1980 to 1985. Shaded areas indicate positive deviations from the 20-year mean.

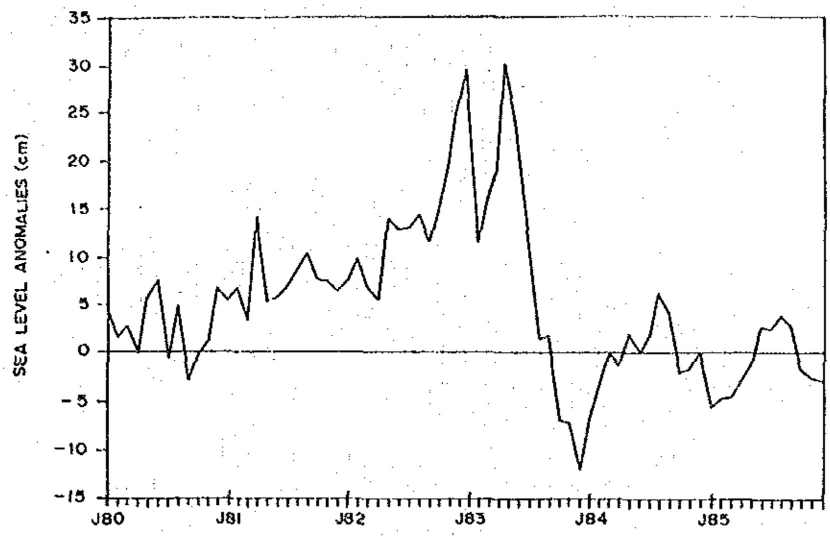


Fig 2.5.2 Time series of monthly sea level anomalies (in centimeters) at La Libertad (2°12'S. 80°59'W) from 1980 to 1985 relative to the 1975-1981 mean.

2. Analysis of Sand Drift

(1) Sand drift at Manta and Puerto Lopez

Manta site and Puerto Lopez site were evaluated as a best site in the chapter 8. Therefore, simulation of sand drift of two Manta sites(alternative-1 and alternative-2) and one Puerto Lopez site were carried out.

Procedure of simulation is shown in Fig 10-10. Results of simulation of alternative-1 and alternative-2 of Manta site are shown in Fig 10-11(1) and Fig 10-11(2).

Result of simulation of Puerto Lopez site are shown in Fig 10-12.

According to the results, after 50 years water depth in the Puerto Lopez fishing port will be not less than design water depth (3 m), but water depth of entrance of fishing ports (alternative-1 and alternative-2) at Manta sites will be less than 3 m. Therefore, maintenance dredging will be needed at Manta sites. (Reference figures : Fig 10-13(2)-(4)).

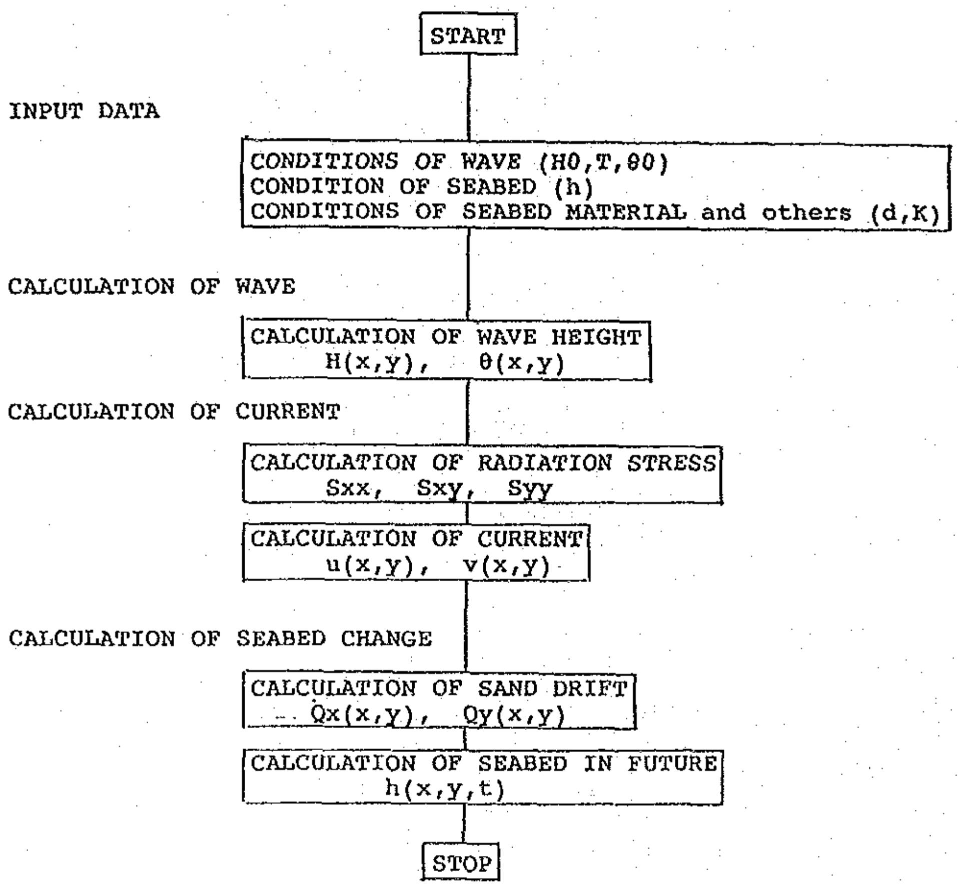


Fig 10-10 Flowchart of Simulation

(2) Sand drift at San Mateo and Machalilla

Character of San Mateo coast was described in chapter 2. Volume of alongshore drift is about 9,000 m3/year and direction of alongshore drift is east. Volume of sediment discharge from river is about 4,000 m3/year. If fishing port that was described in the section 10.3 will be constructed, sand drift will be deposited at right side of right breakwater. But, eastward alongshore drift is strong, therefore, after 30-50 years, water depth in the fishing port will not be less than design water depth (-3.0m).

Character of Machalilla coast was described in chapter 2. Volume of alongshore drift is about 3,000 m3/year and direction of alongshore drift is north-east. Volume of sediment discharge from two rivers is about 13,000 m3/year. If fishing port that was described in the section 10.3 will be constructed, sand drift will be deposited at right side of right breakwater. And sediment load from river will be deposited at left side of left breakwater. After 30-50 years, water depth in the fishing port will be less than design water depth (-3.0m). Therefore, maintenance dredging will be needed.

(3) Basic Equations

The mild slope equation presented by Berhhoff for a stationary wave field is given by

$$\Delta \cdot (C C_g \Delta \phi) + \sigma_2 \frac{C_g}{C} \phi = 0$$

where,

ϕ : amplitude of the velocity potential
C, Cg : phase velocity, the waves group velocity
σ : angular frequency

The equation of motion is written as (1), and the continuity equation is written as (2):

$$\left.\begin{aligned} u \frac{\partial u}{\partial x} + v \frac{\partial u}{\partial y} + Fx + Mx + Lx + g \frac{\partial \eta}{\partial x} = 0 \\ u \frac{\partial v}{\partial x} + v \frac{\partial v}{\partial y} + Fy + My + Ly + g \frac{\partial \eta}{\partial y} = 0 \end{aligned}\right\} \quad (1)$$

$$\frac{\partial u (h+\eta)}{\partial x} + \frac{\partial V (h+\eta)}{\partial y} = 0 \quad (2)$$

where,

Rx, Ry : radiation stress terms
Fx, Fy : bottom friction terms
Mx, My : lateral mixing terms
U, V : corresponding velocity components of the nearshore current
η : water surface elevation
h : still water depth

The change in local bottom elevation can readily be computed, once the spatial distribution of sediment transport rate is given, by solving the conservation equation for sediment mass:

$$(1-\varepsilon) \frac{\partial \eta}{\partial t} + \frac{\partial qx}{\partial x} + \frac{\partial qy}{\partial y} = 0$$

where,

η : water surface elevation
ε : void for sediment particles comprising the bottom
qx, qy : components of the sediment transport rate per unit width in the x- and y-directions

The sediment transport rate is calculated using the formula by Brown.

$Q = 0 \quad (\phi \leqq \phi_c)$
$Q = 40*w*d*\phi^3 \quad (\phi \geqq \phi_c)$

where,

d : grain size
w : fall velocity of sediment particles

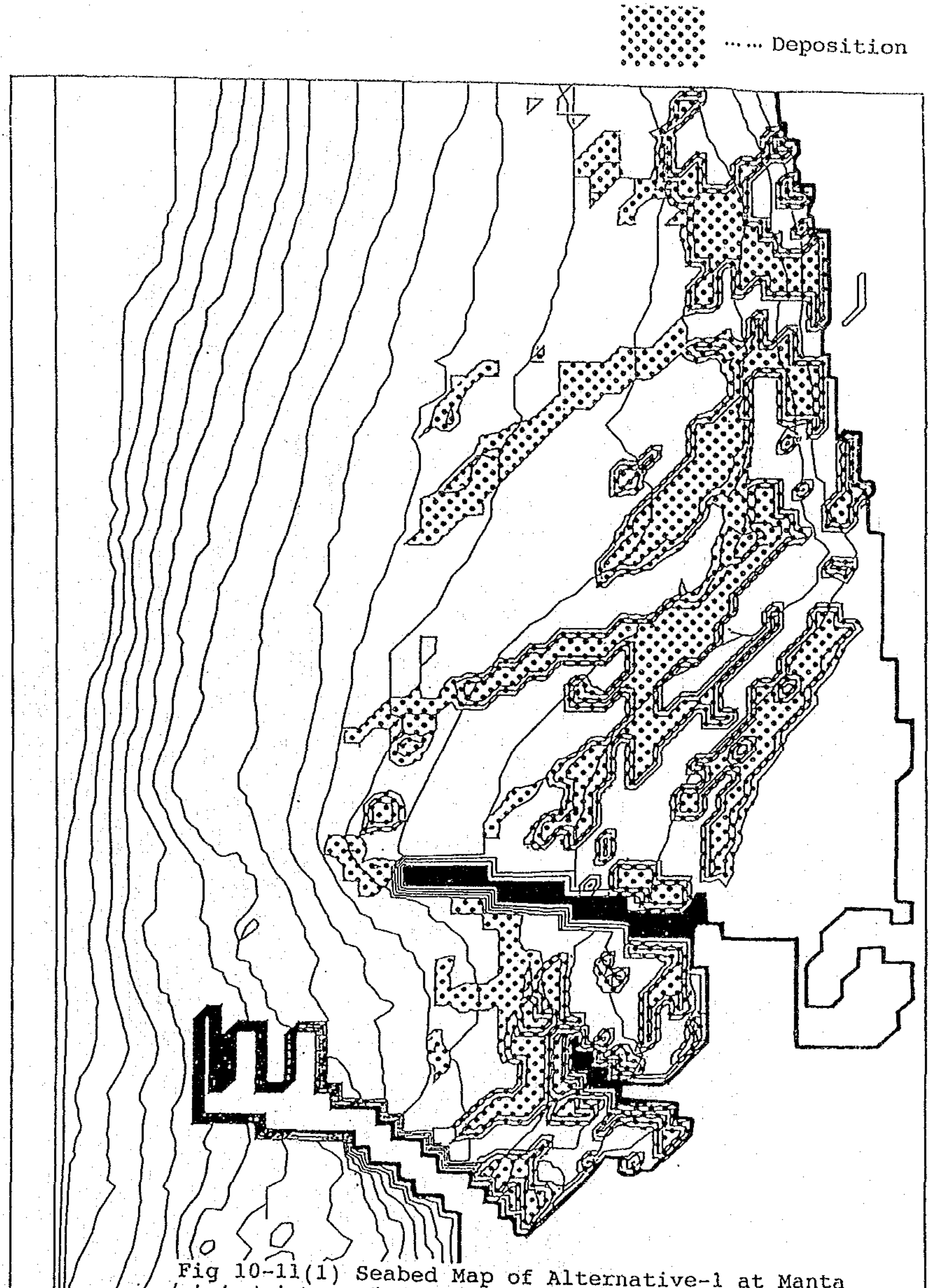


Fig 10-11(1) Seabed Map of Alternative-1 at Manta
(after 50 years)

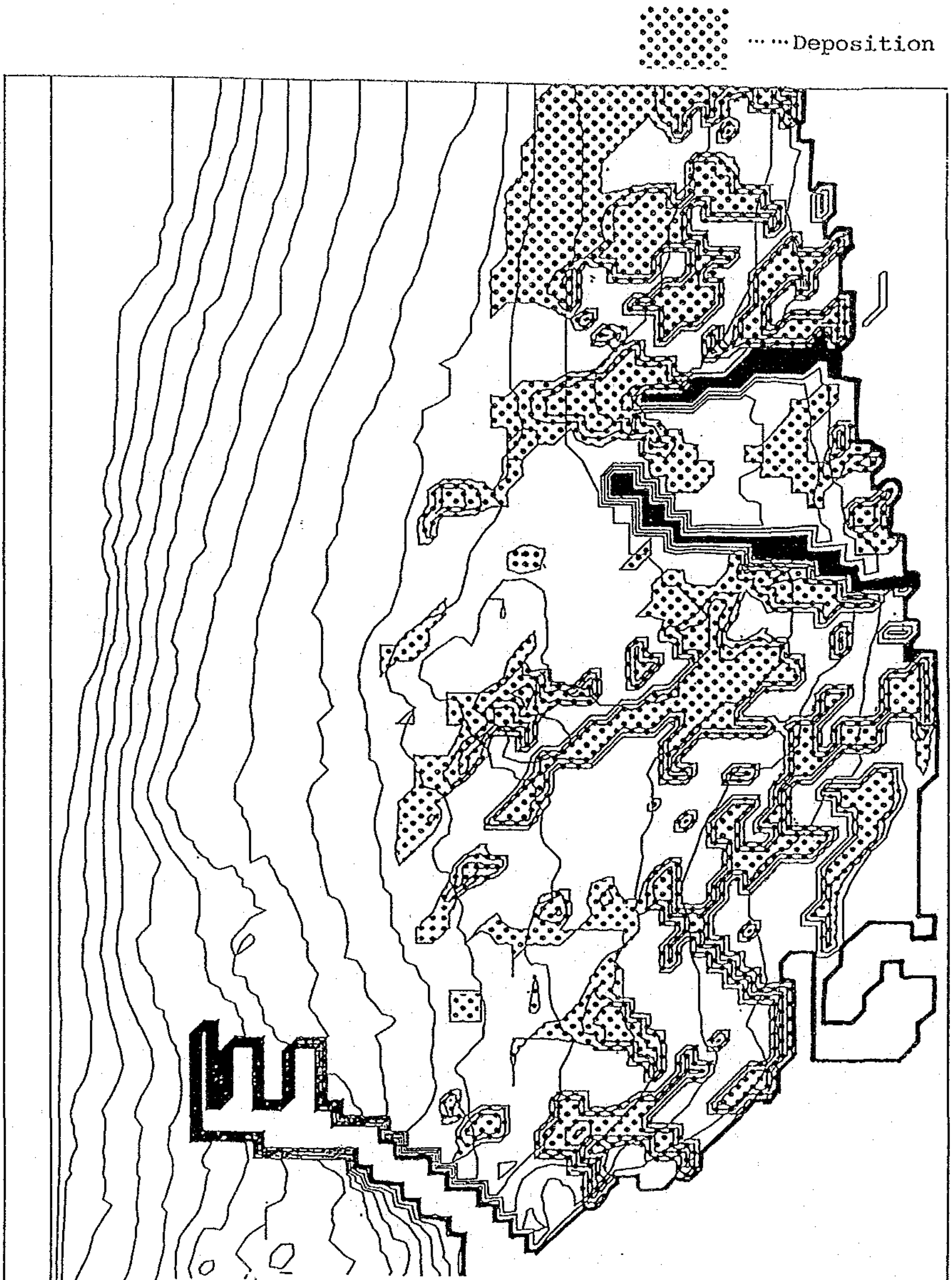


Fig 10-11(2) Seabed Map of Alternative-2 at Manta
(after 50 years)

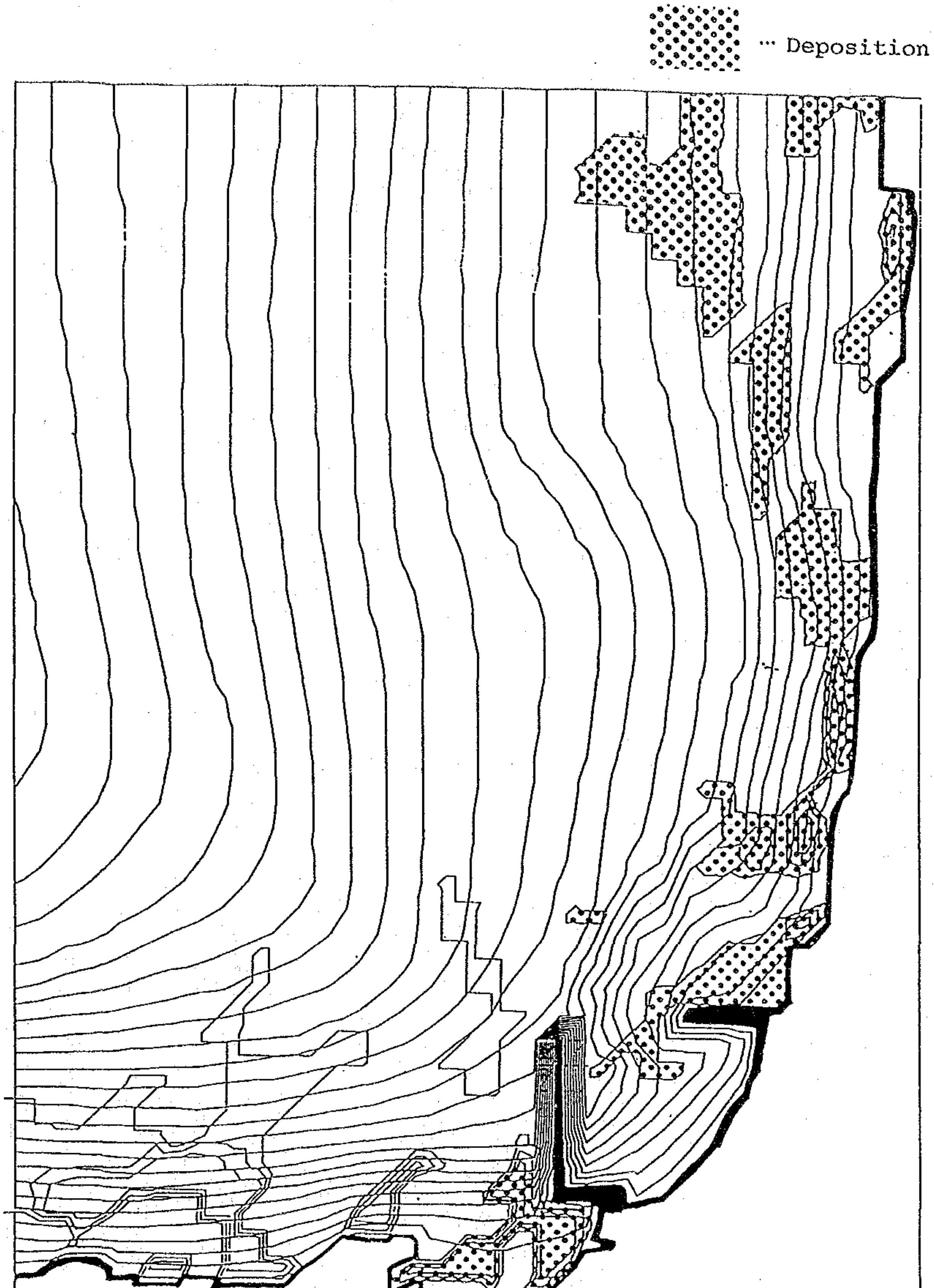
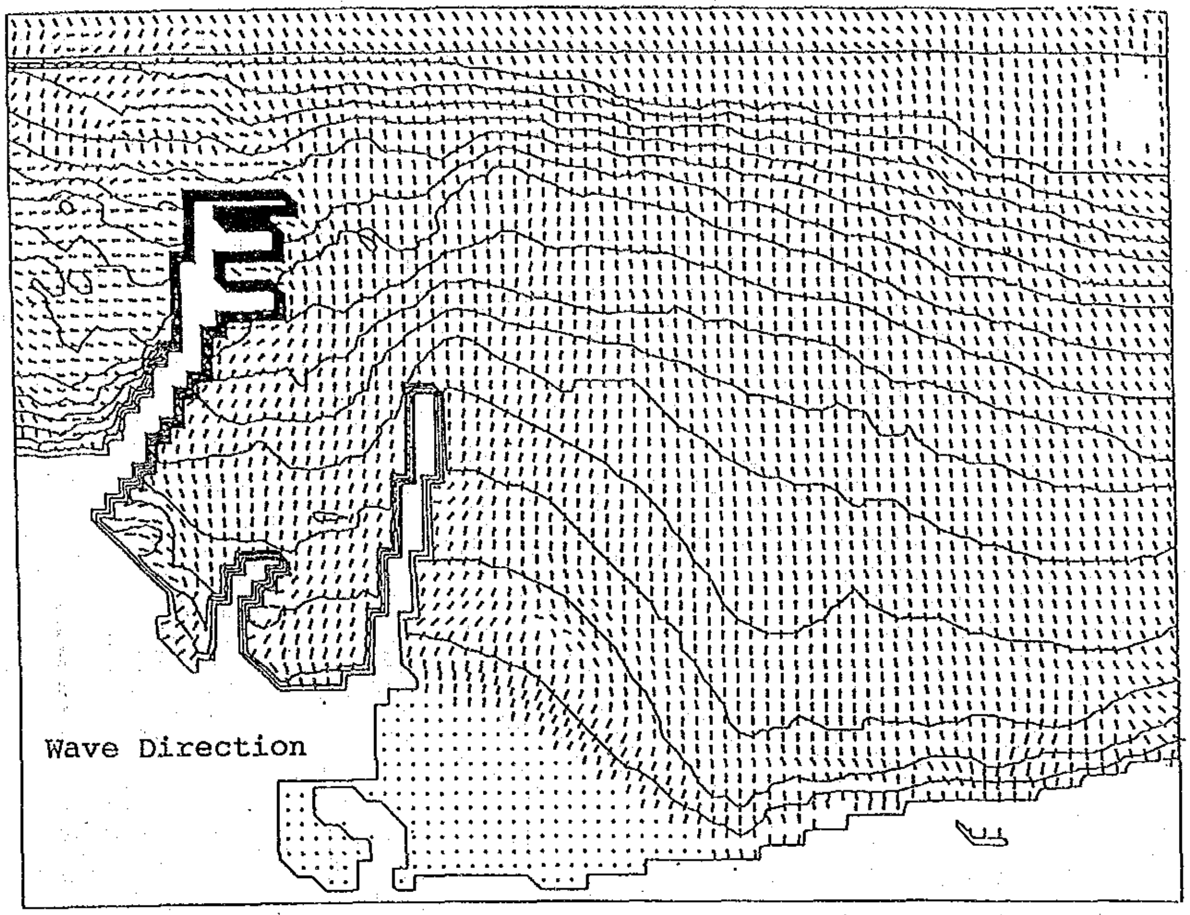


Fig 10-12 Seabed Map at Puerto Lopez (after 50 years)



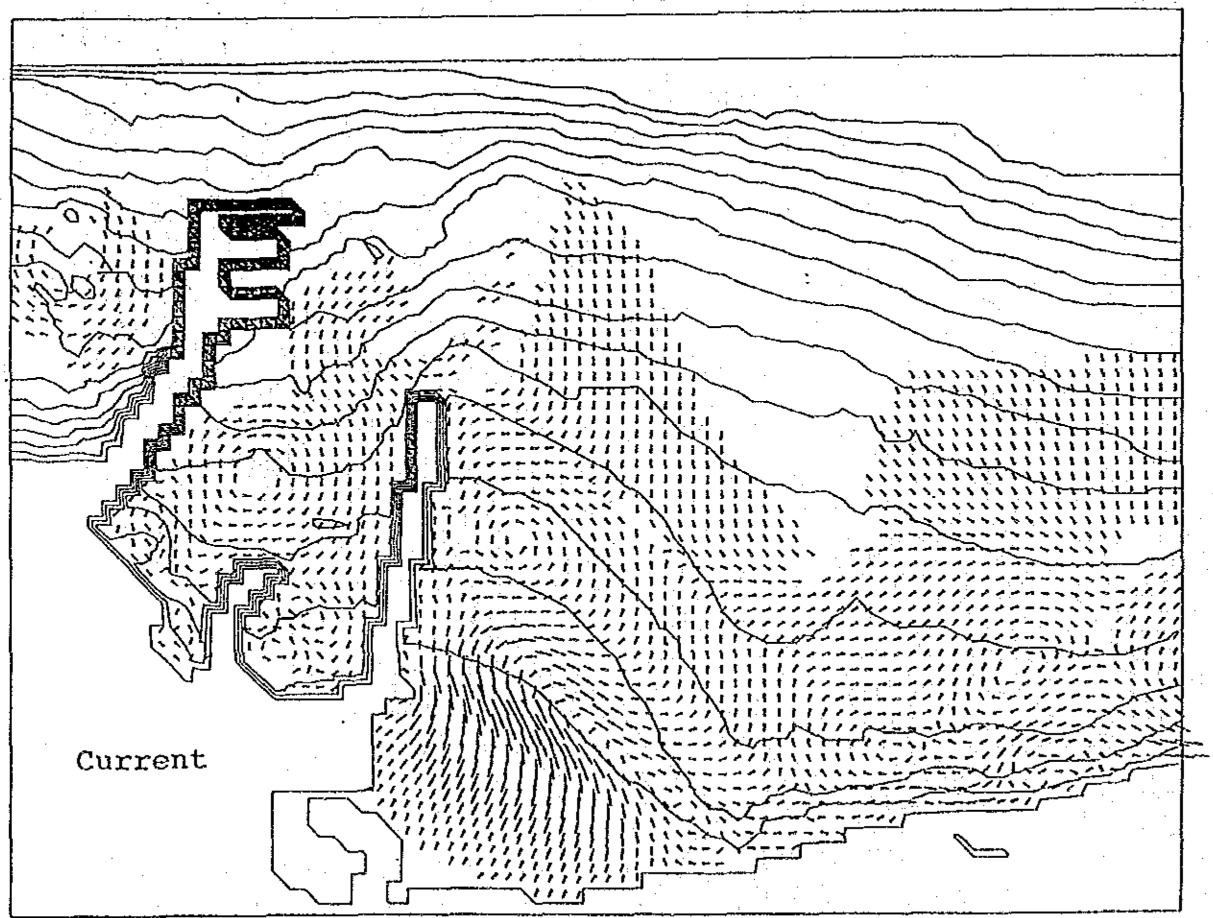
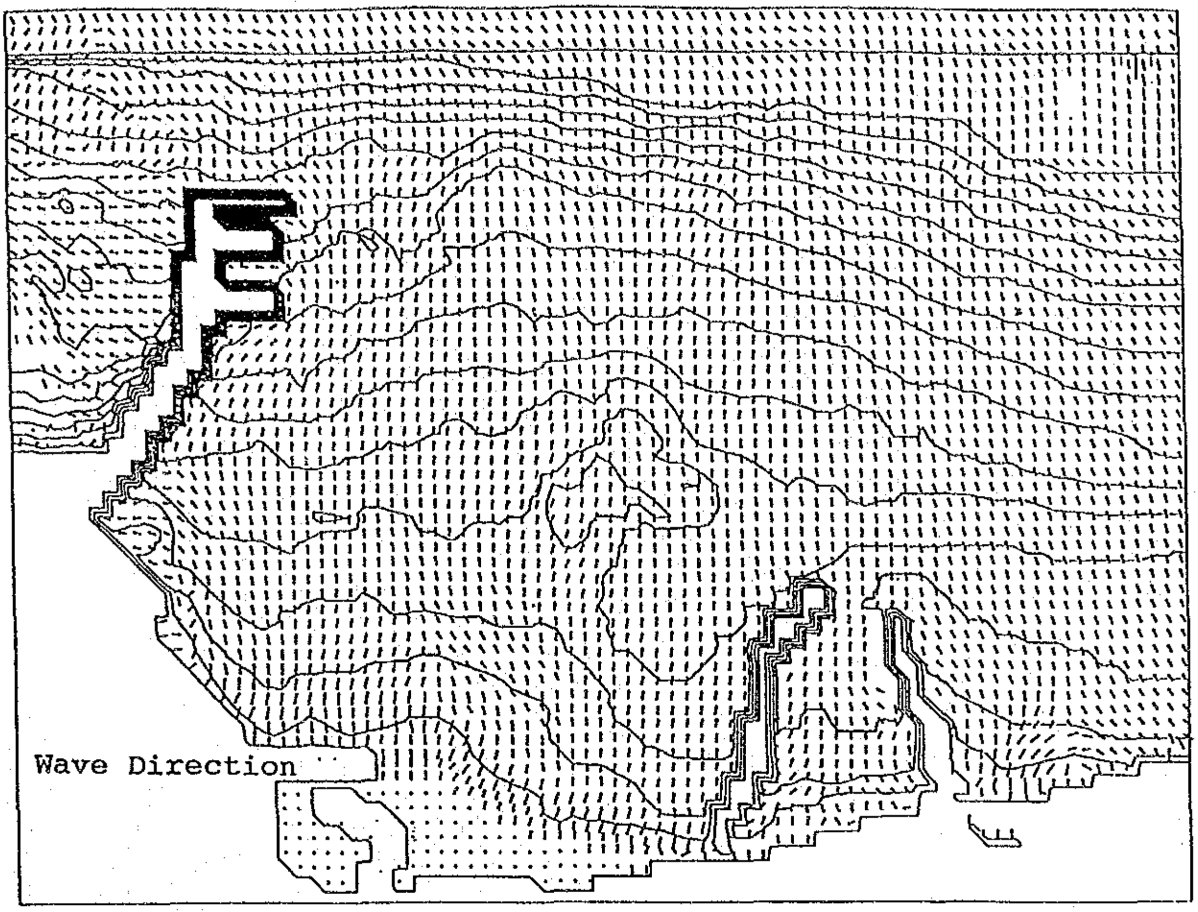


Fig 10-13(2) Wave Direction and Current Maps
at Manta (Alternative-1)



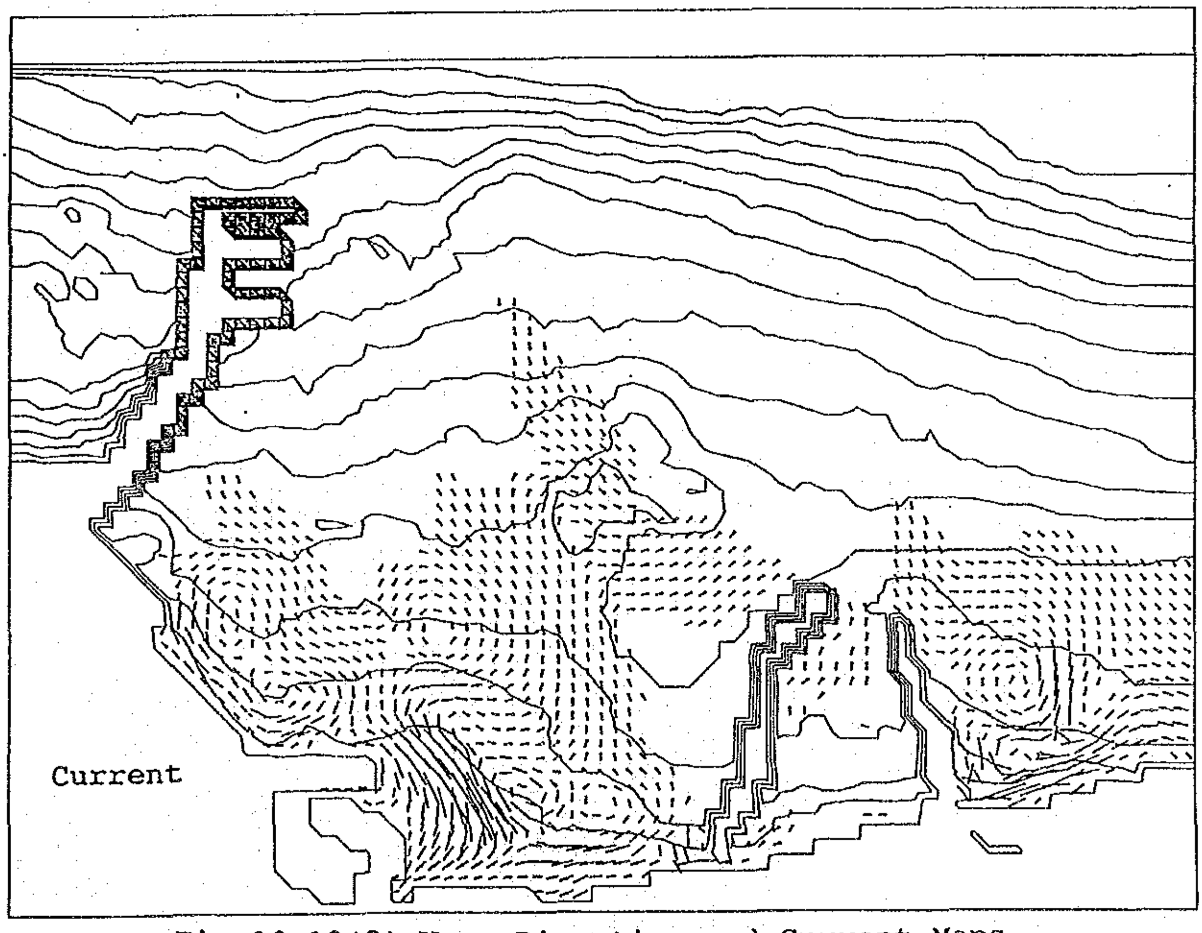
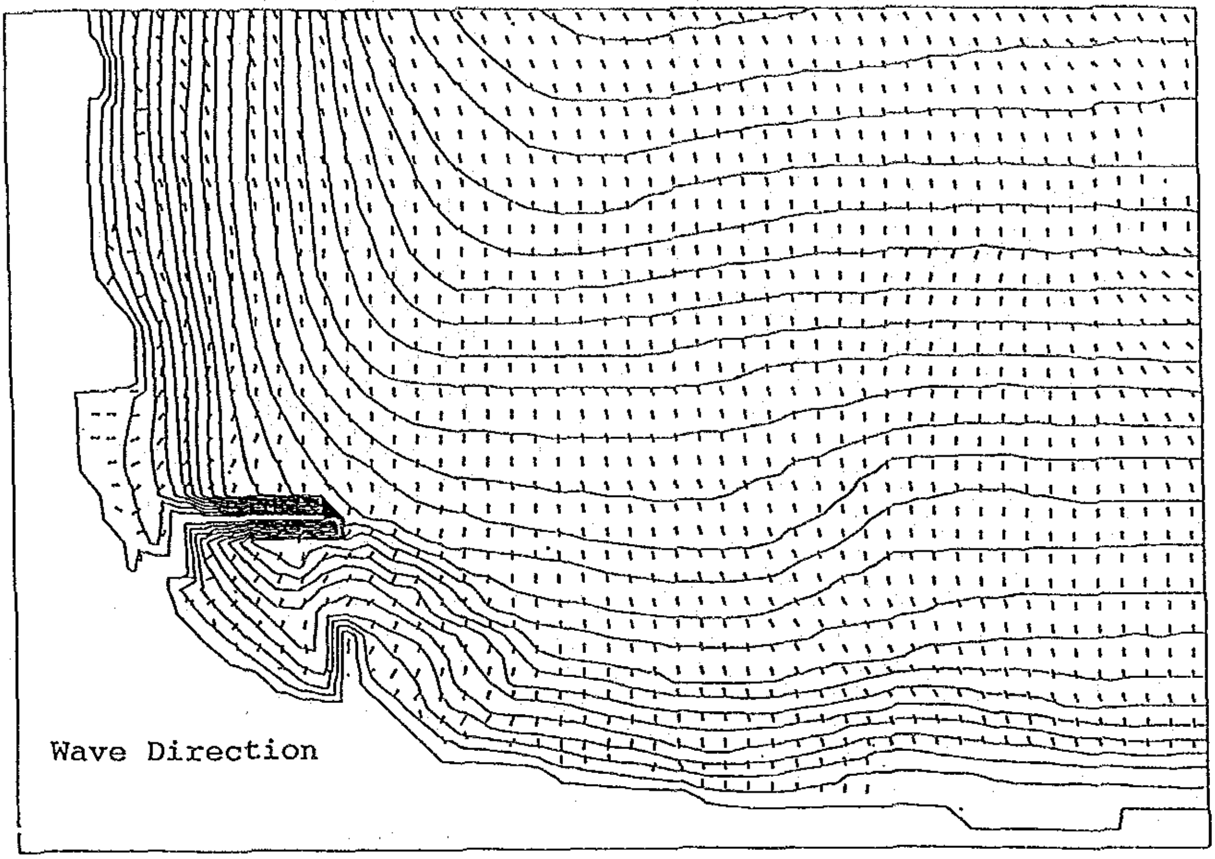


Fig 10-13(3) Wave Direction and Current Maps
at Manta (Alternative-2)



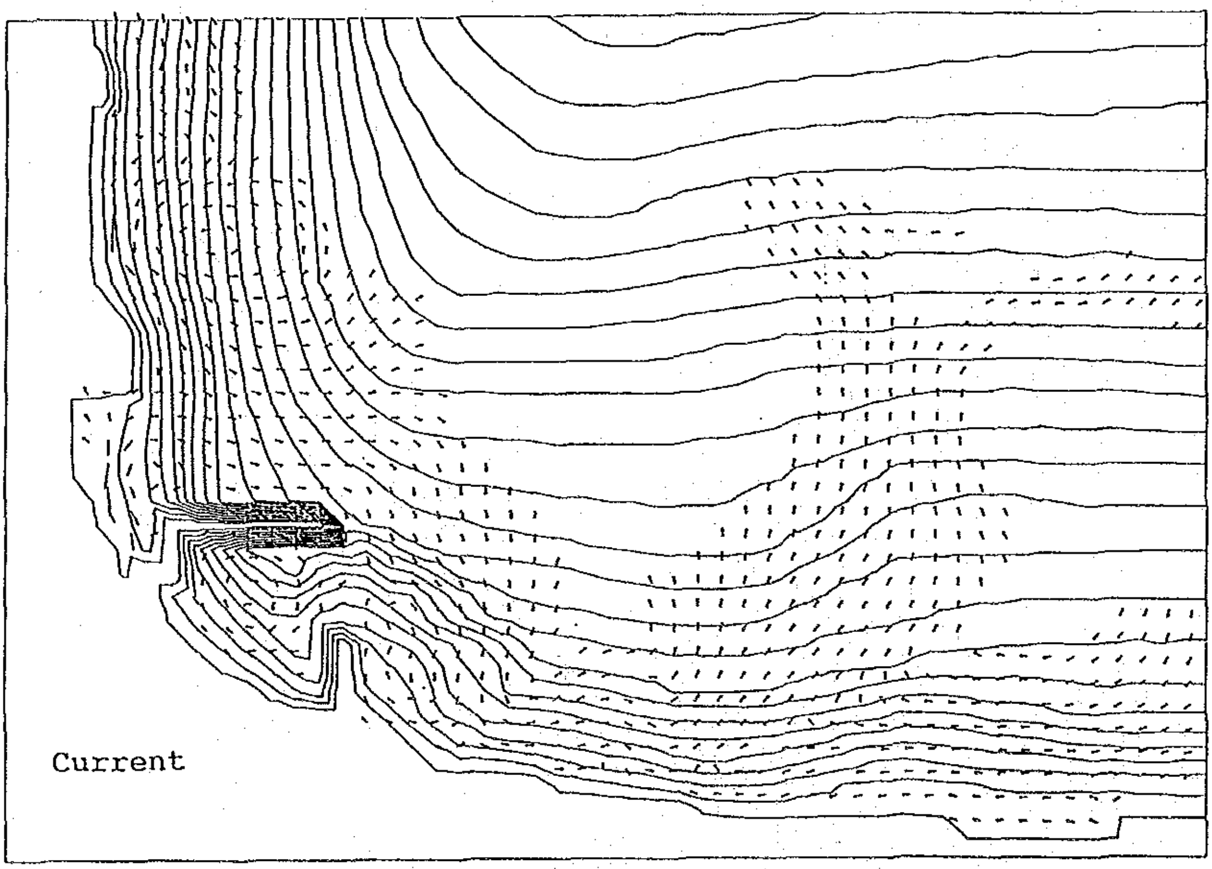


Fig 10-13(4) Wave Direction and Current Maps
at Puerto Lopez

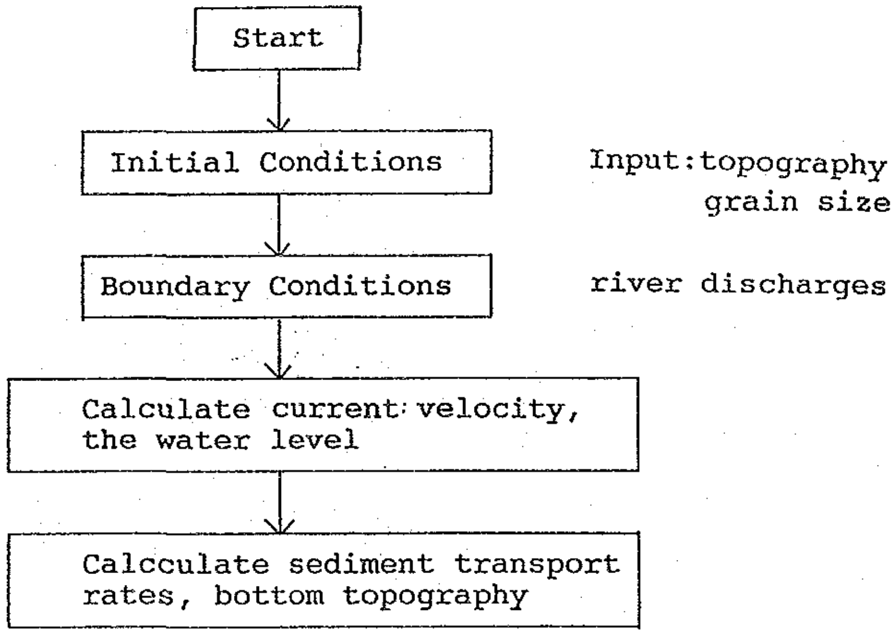
3. Calculation of Sedimentation by River Flood

(1) Objectives

Sand drift and sedimentation discharges from rivers affect the shoaling of the fishing port. Of these factors, the sedimentation discharges are expected to cause the shoaling largely comparing the sedimentation discharges volume, 46,000 m3/year with the sand drift 3,000m3/year. Therefore, the simulation is carried out to examine the effect of the shoaling by the sedimentation discharges.

(2) Method

The flowchart of the calculaton model is shown.



1) Calculation of the current velocity, the water level

Basic equations:

The continuity equation

$$\frac{\partial \zeta}{\partial t} + \frac{\partial}{\partial x}[(\zeta + h)u] \frac{\partial}{\partial y}[(\zeta + h)v] = 0$$

The equation of motion

$$\frac{\partial u}{\partial t} + u\frac{\partial u}{\partial x} + v\frac{\partial u}{\partial y} + g\frac{\partial \zeta}{\partial x} - Ah\left(\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2}\right) + \frac{gv\sqrt{u^2+v^2}}{(\zeta + h)c^2} = 0$$

$$\frac{\partial v}{\partial t} + u\frac{\partial v}{\partial x} + v\frac{\partial v}{\partial y} + g\frac{\partial \zeta}{\partial x} - Ah\left(\frac{\partial^2 v}{\partial x^2} + \frac{\partial^2 v}{\partial y^2}\right) + \frac{gv\sqrt{u^2+v^2}}{(\zeta + h)c^2} = 0$$

Where,

x, y : the Cartesian coordinates in a horizontal plane
t : time
ζ : the water surface elevation
h : the still water depth
g : acceleration of gravity
u, v : the corresponding velocity components x- and y-directions
c : coefficient of seabottom roughness
Ah : coefficient of lateral mixing

2) Calculationof the sediment transport rates
(Einstein-Brown equation)

$$Qb = 40.0\ F(d)\quad \tau *$$

Where,

$\tau *$: intensity of bed shear, U*2/(sgd)

$$F(d) = \sqrt{\frac{2}{3} + \frac{36v2}{sgd3}} - \sqrt{\frac{36v2}{sgd3}}$$

Where,

v : kinematic velocity, 0.01 cm^2/sec
s : submerged unit weight of soil particle
d : grain size

3) Calculation of the bottom topography change

$$\frac{\partial z}{\partial c} = - \left(\frac{\partial q x}{\partial x} + \frac{\partial q y}{\partial y} \right)$$

Where,

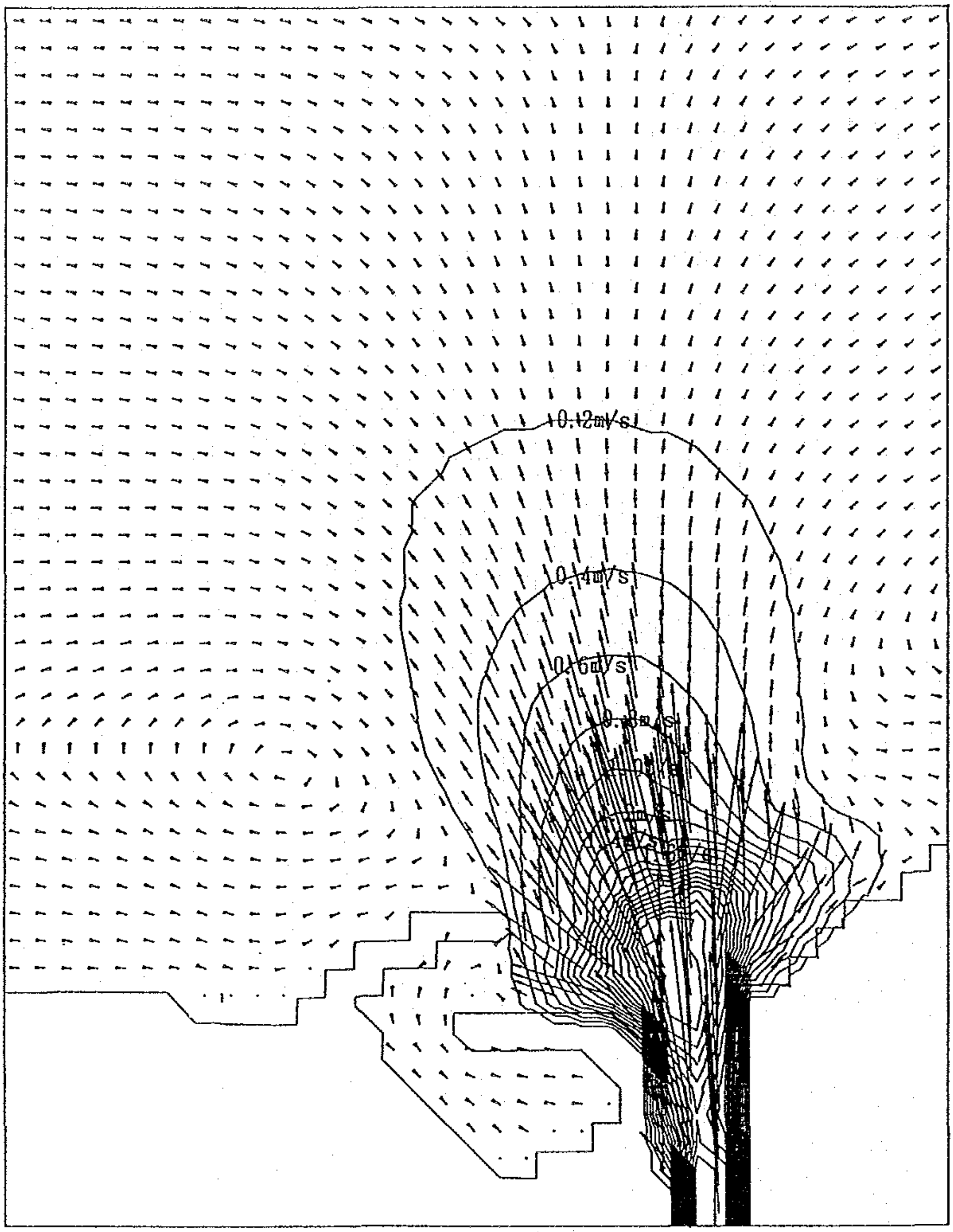
z : bottom topography change
q : sediment transport rates

4) Calculatin conditions

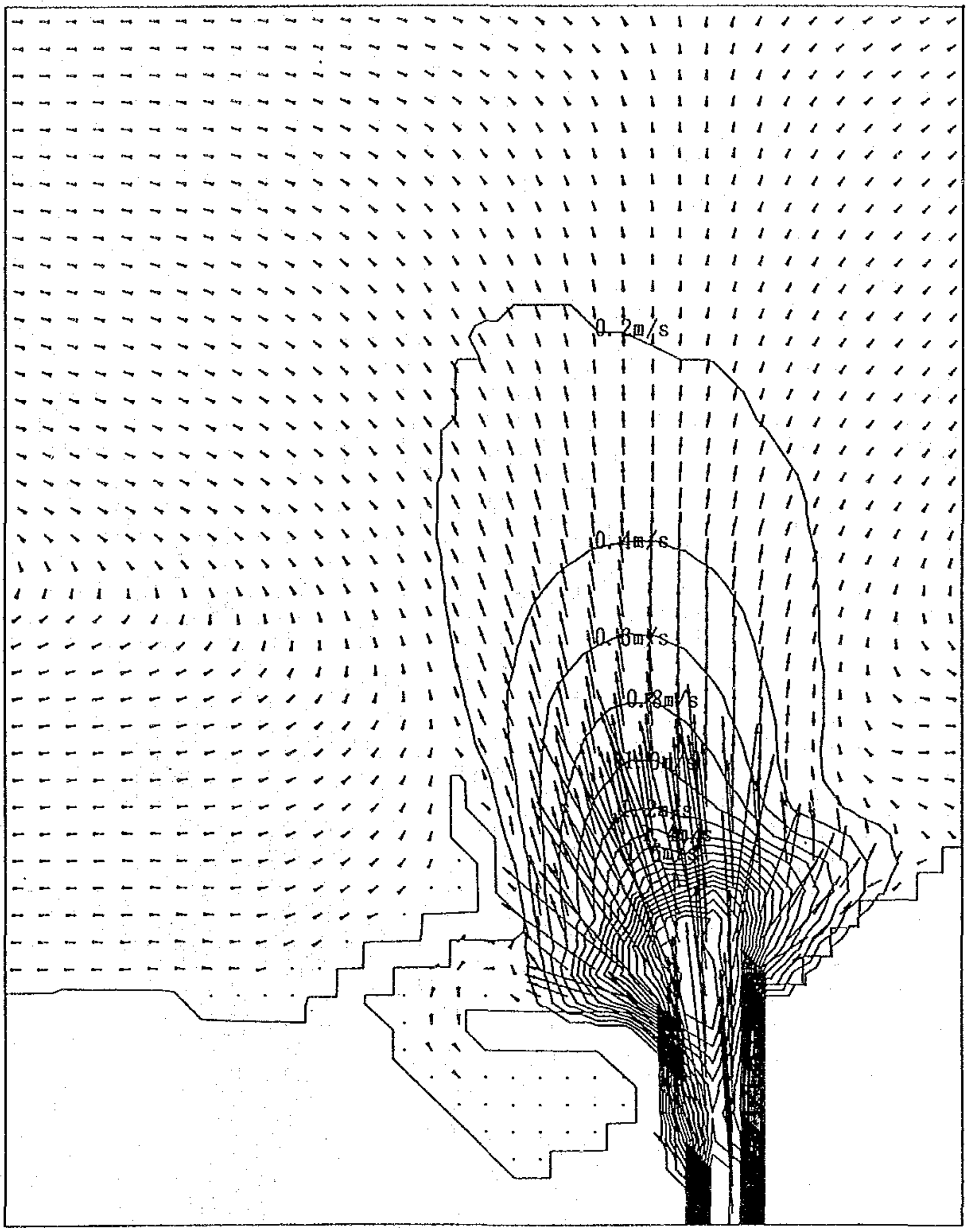
bottom materials d : 0.2mm
river discharges : Q = 278.3 m3/sec
(provability for 50 years)

5) Calculation case

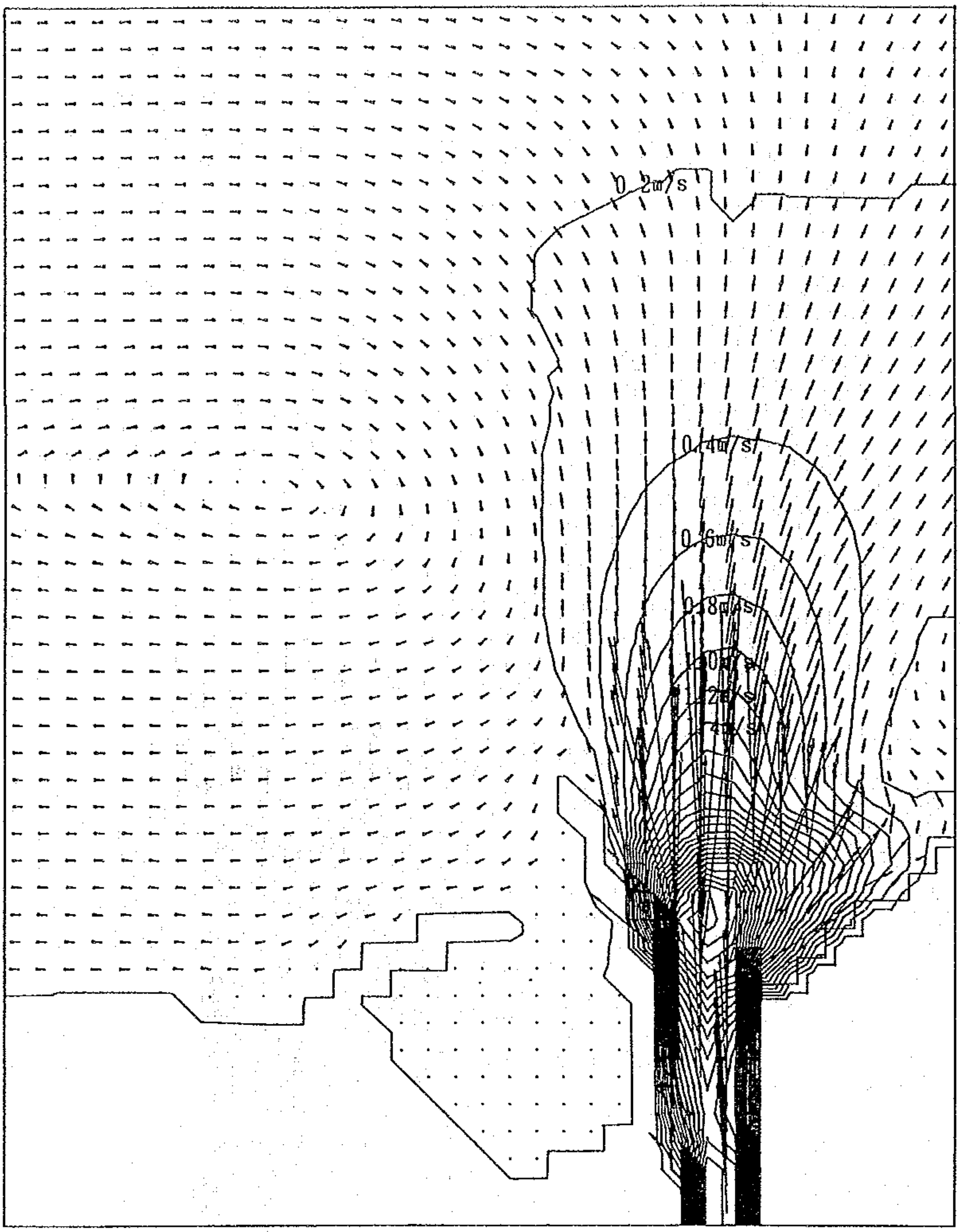
Recurrence model of present codition:
Planned model:
Case A-1 (extension of the training jetty up to the -2.5m depth from the existing east breakwater)
Case B-1 (extension of the training jetty up to the -2.5m depth from the existing west breakwater)



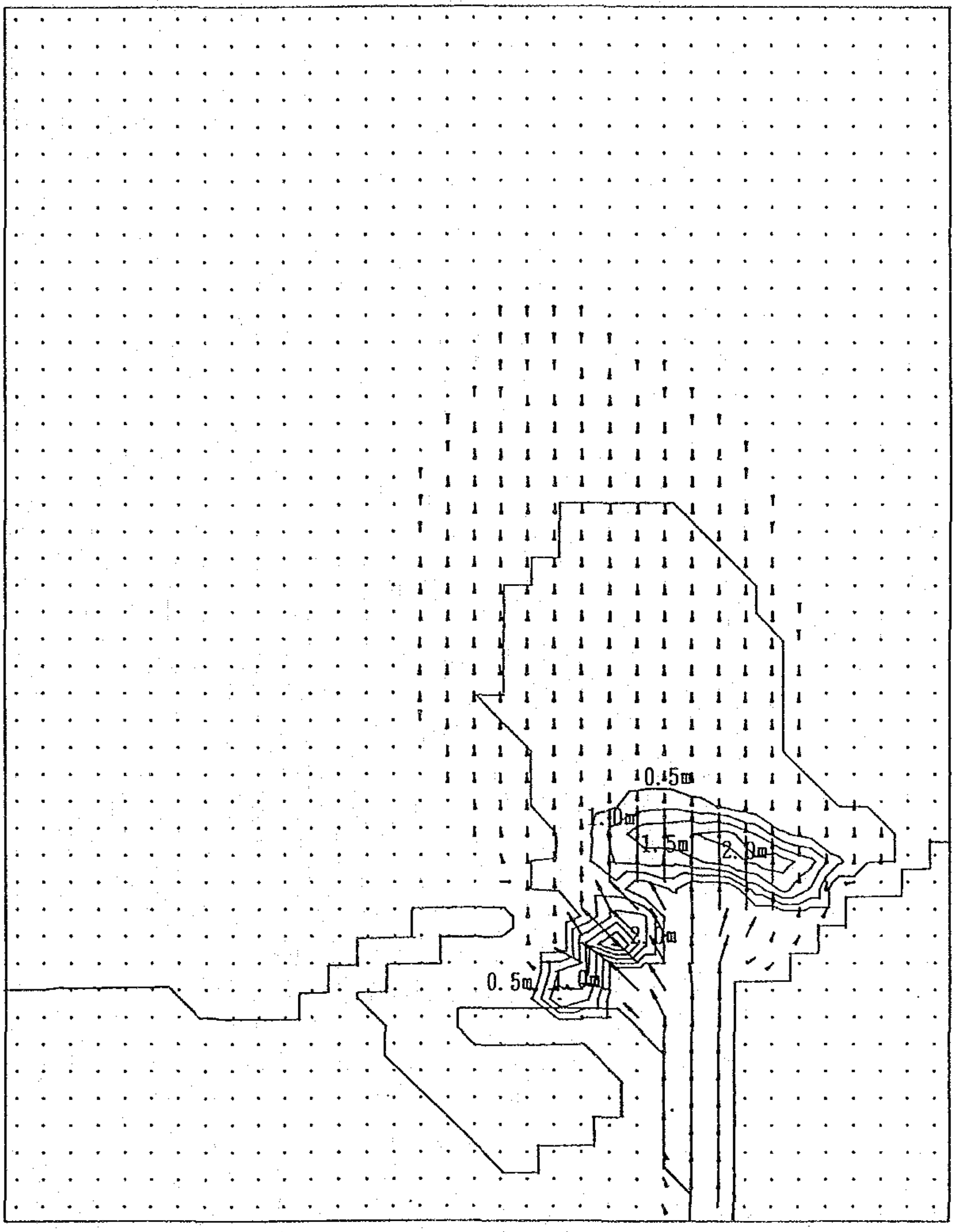
流線ベクトル （ 現況 ）



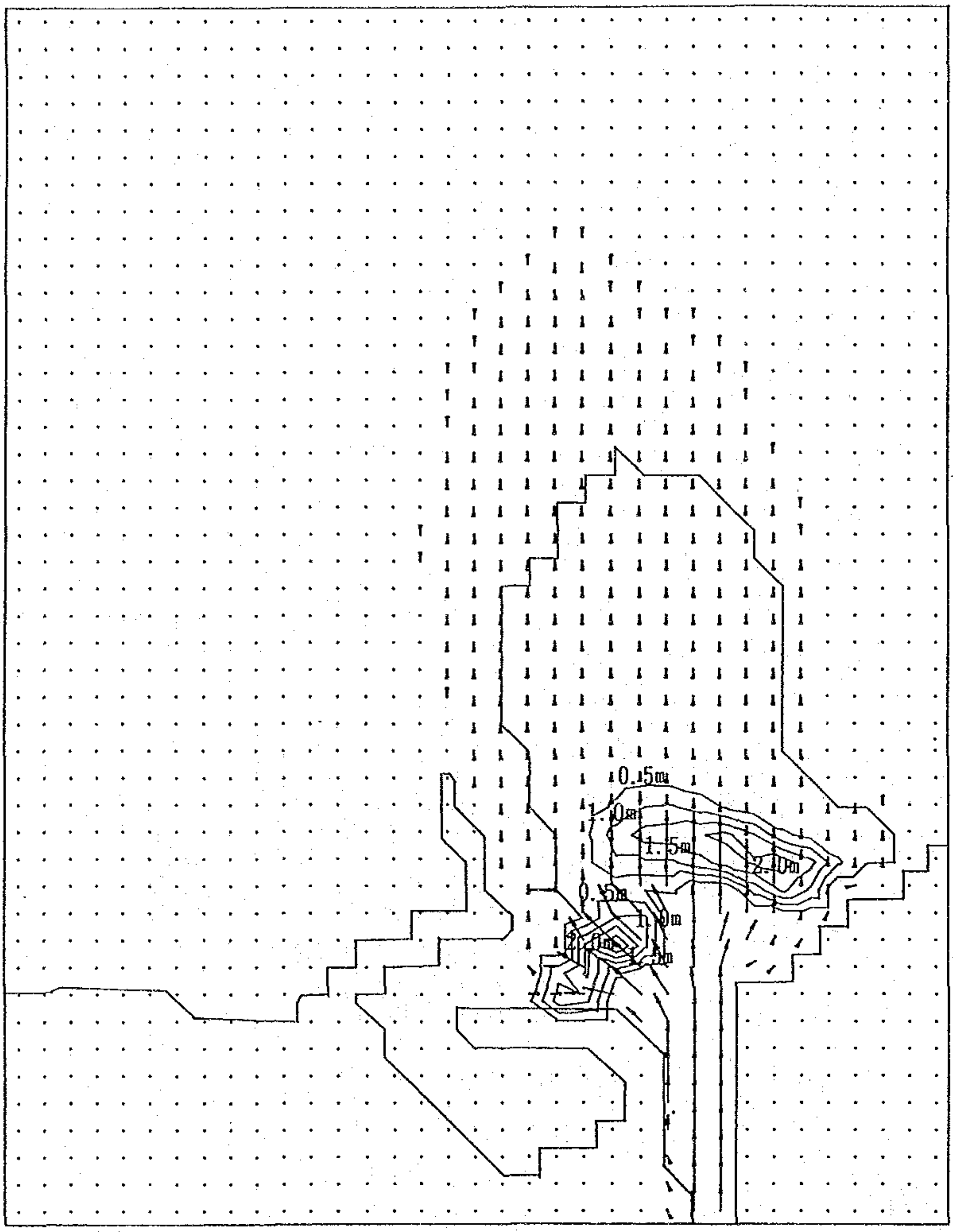
流線ベクトル　(CASE A-1)



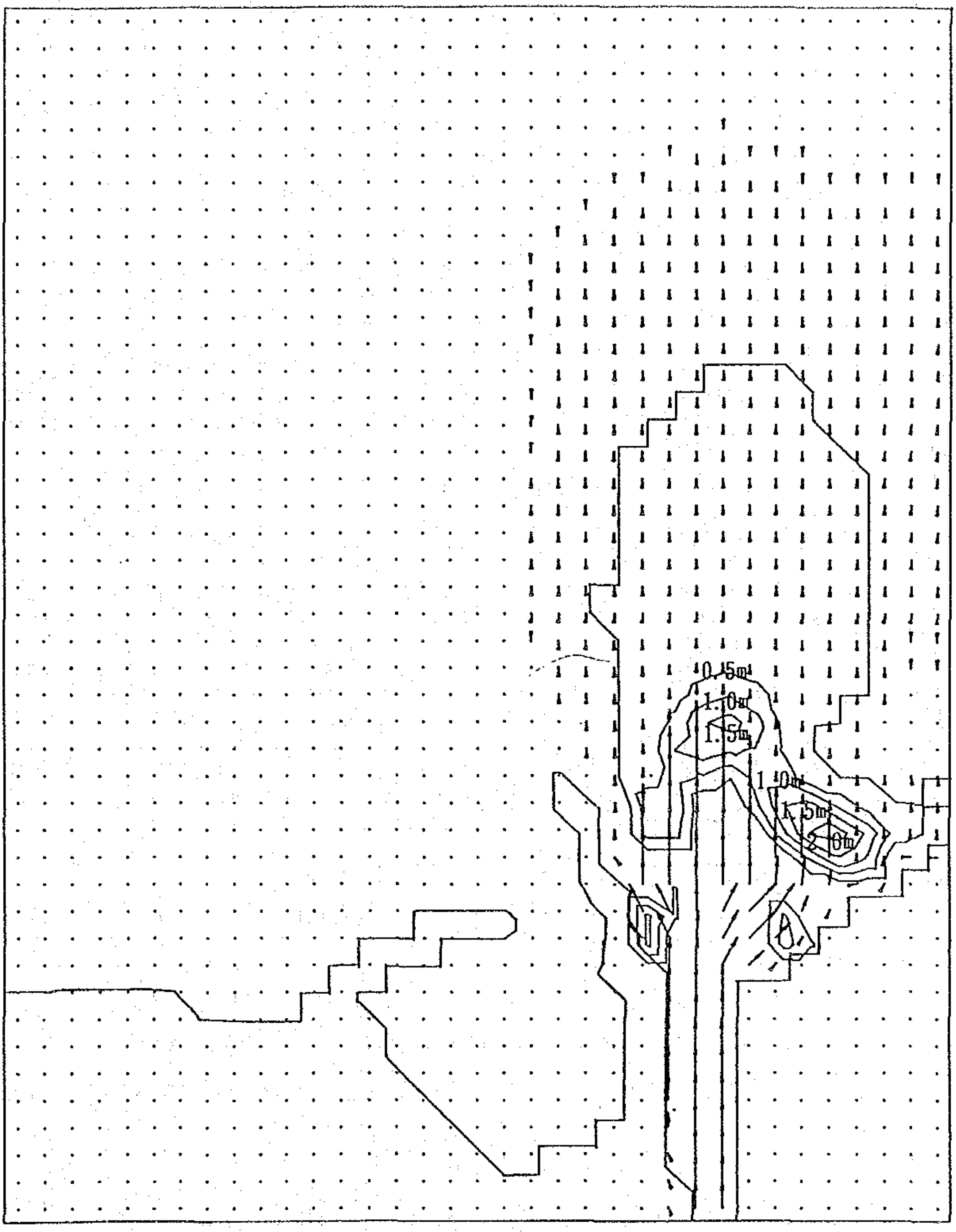
流線ベクトル （ CASE B-1 ）



地形変化量 （ 現況 ）



地形変化量 (CASE A-1)



地形変化量 （ CASE B-1 ）

4. Cost Estimate Factors

Construction costs estimated carefully on the basis of preliminary design, construction methods and work schedule of the project, and after a comprehensive study of site conditions such as land utilization, conditions of construction equipment and machinery, materials that must be taken to the site and the appropriate method of construction, etc.

The cost estimate is further affected by the following conditions:

1)The cost is estimated on the condition that the work of construction will be carried out in accordance with international tender regulations.

2)The unit prices of labor, materials, equipment and machinery, etc., are calculated on the basis of market prices in local and CIF prices at Guayaquil or Manta Port of imported goods in 1991.

Basic labor cost per day is shown in Table 11-8, unit cost of materials are shown in Table 11-9, and hire charges of road materials are shown in Table 11-10.

3)The exchange rate of foreign currency will be assumed as an average value in July 1991.

4)Construction costs are divided into foreign portion (indicated as SC) and a local portion (indicated as SC).

The foreign and local currency portions of the unit prices of construction are considered basically in accordance with the following categories:

<Breakdown of foreign portion>

*Imported construction equipment, imported materials, supplied goods.

*Machinery.

*Imported goods procured in the local market.

*Salary allowance and indirect cost for foreign staff members.

<Breakdown of local portion>

*Construction equipment and machinery procured locally

*Construction materials and Supplied goods procured locally.

Condition of Cost Estimate

(1) Natural Condition for Construction

Details will be carried out in the further study.

(2) Construction Materials

Cement will be available from the local Cement Factory, located in Guayaquil, these produce portland cement in 50kg.bags. Factory is operated by the private company.

Boulders can be obtained from the Montecristi and Picoaza. Distance from Manta to Resources of Boulders is approximately 20 or 40 km. on the road.

Sand and filling soil are available in the Manta city and Manabi Province.

Steel materials are supplied from local steel company, Andes Ecuador, Company located at Quito. It produces rods, plain sheets, flat bars, angles, Zbars, formed bars, etc.

(3) Construction Equipment and Machinery

Standard-sized construction equipment such as road equipment are available at the site.

(4) Labour Force for Construction Works.

Common Labourers are available at any time, but slingers, high-grade sailors, divers and special technicians will be brought in from aboard.

(5) Social Conditions

Fiscal year starts at the beginning of January and finishes at the end of December of the calendar year. The numbers of normal working days per year are 245 days. The normal working hours of every day for business men are as follows:

Monday to Friday

Beginning time: 8:30 hrs

Rest time: 12:00 hrs to 15:00 hrs

Finishing time: 19:00 hrs.

Saturday and Sunday: rest

*Salary allowance and indirect cost for local labor.

*Taxes/Duties.

5)The unit price of each aspect of the construction work consists of the cost of labor, materials and charges for construction machinery.

6)Major materials are, cement, timber, stone for structures, aggregate for concrete, sand for fill,etc.

7)Taxes/Duties on the imported material and machinery are excluded from the cost estimate.

8)The cost of land acquisition is estimated on the unit price indicated by the Government of Ecuador in 1991.

9)Others.
Details will be carried out in the further study.

Table 11-8
Basic labor cost per day

Unit:S/.

	Kind of Work	Direct cost per day
1	Foreman	4,500
2	Carpenter	4,500
3	Concrete finisher	4,500
4	Steel fixer	4,500
5	Labor	3,000
6	Plant operator	4,000
7	Driver	5,000
8	Plumber	4,500
9	Scaffolder	3,000
10	Piling crew	3,000
11	Slinger	3,000
12	Banksman	3,000
13	Captain	5,000
14	Sailor	4,000

Ref.: Autoridad Portuaria de Manta.

Table 11-9

Unit cost of materials

	Name		Local Portion (S/.)	
1	Petroleum	litre	101.33	
2	Light oil	litre	1,666.00	
3	Heavy oil	litre	1,466.00	
4	Asphalt	ton	--	
5	Sand (Rio Tachi)	cu-m.	20,000.	
6	Sand (sea)	cu-m.	1,333	
7	Crushed sand	cu-m.	6,000	
8	Fine aggregate	cu-m.	8,000	
9	Brick	no	3.2	(burrito)
10	Brick	no	4.0	(maleta)
11	Local cement	ton.	60,000	
12	Steel Pipe Pile	ton.	360,000	
13	Fill materials	cu-m.	6,000	
14	Quarry rum 1-500kg.	cu-m.	8,000	
15	Armour stone 500kg.-3t.	cu-m.	9,500	
16	Coarse aggregate 40 mm.	cu-m.	8,000	
17	Gravel	cu-m.	9,000	
18	Crushed stone	cu-m.	6,000	
19	Angle steel	ton.	260,000	
20	Steel bar 16-25 mm.	ton.	360,000	
21	Asphalt	m2.	20,000	

Ref.: Autoridad Portuaria de Manta.

Table 11-10

Rental cost of construction equipments

Name	Type	Unit	Cost
(Earth/Rock Moving)			
1. bulldozer	150-425ps.	hour	30,000
2. grader	160 ps.	hour	18,000
3. road roller	8-16t.	hour	16,000
4. backhoe	0.7-1.2cu-m	day	8,000
5. power shovel	0.7-1.2cu-m	day	8,000
(Truck)			
6. dump truck	11-15t.	day	120,000
7. platform truck	6t.	day	80,000
8. tractor trailer	20t.	day	140,000
(Crane)			
9. mobile crane	16-35t.	day	80,000
10. crawler crane	100-150t.	day	150,000
(Concrete Work)			
11. concrete batch plant *1			
12. concrete pump			
13. agitator car			
(Asphaltic Work)			
14. asphalt mixing plant *2			
15. asphalt distributor			
16. asphalt paver			
(Offshore Equipments)			
17. cutter suction dredger			
18. grab dredger *3			
19. tug boat			
20. barge			
21. floating crane *4			
22. pontoon and other.			

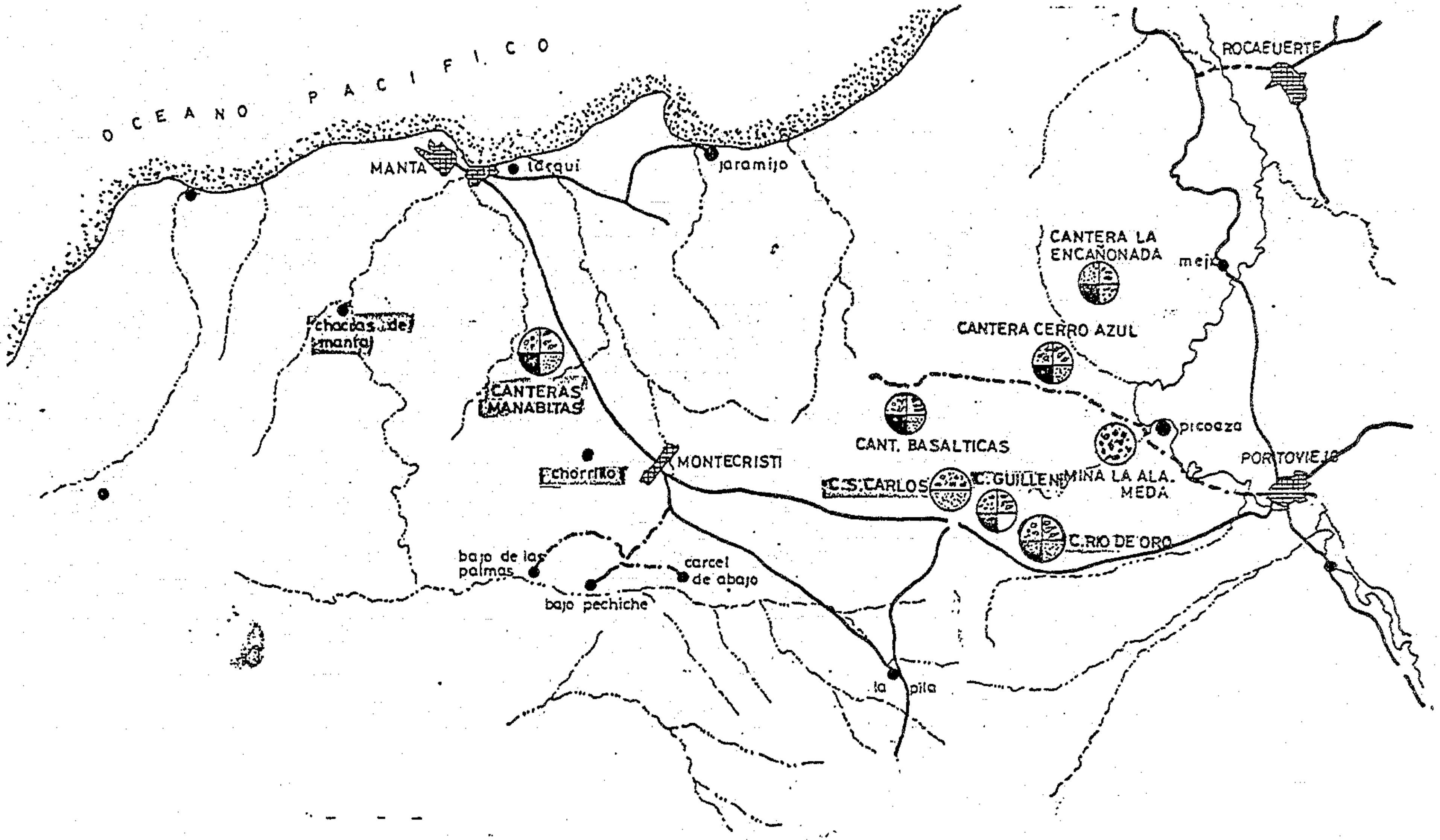
Note:

*1. concrete mixture is paid by cubic meter in situ.

*2. asphalt concrete is sold in mixed conditions.

*3. dredgers have been owned only by Navy of Ecuador.

*4. Details will be studied in the future.



UBICACION CANTERAS - SECTOR MANTA - PORTOVIEJO

CUADRO RESUMEN DE ENSAYOS

PROYECTO:
ESTUDIO DE "CANTERAS MANABITAS"

Fecha (del informe) NOVIEMBRE 1988

No DE ENSAYOS	GRANULOMETRIA (% QUE PASA) MALLAS 3"	2 1/2"	2"	1 1/2"	1"	3/4"	1/2"	3/8"	4	8	10	30	40	50	100	200	L.L. POLVO DE ABRASION	I.P.	DENSIDAD MAXIMA	HUMEDAD OPTIMA	HUMEDAD NATURAL	C.B.R.	ABRASION	DESGASTE SULFATOS	PELADURA
1 X			100	100	63	36	16	4	0	(MATERIAL TRITURADO)							21.2	6.0					18	9.3	<5 % RC-2 <5 % AP-3
2 X					100	99	13	3	0	(MATERIAL TRITURADO)							21.9	7.0					13	7.6	<5 % RC-2 <5 % AP-3
3 *							(FRENTE DE EXPLOTACION)										26.3	6.6					12	8.4	<5 % RC-2 <5 % AP-3
4 *							FRENTE DE EXPLOTACION										21.5	6.8					16.1	7.2	<5 % RC-2 <5 % AP-3
5																									
Con Asfáltico				100	80-100	70-90		55-75	45-62	35-50		19-30		13-23	7-15	0-8							40	12	
Carp. Asfáltica 1"						100	80-100	70-90	50-70	35-50		18-29		13-23	8-16	4-10							40	12	
Carp. Asfáltica 2"					100	80-100		60-80	48-65	35-50		19-30		13-23	7-15	0-8							40	12	
Base FP-61 B-1			100	70-100	55-85	50-80		40-70	30-60		20-50		10-30			5-15	25max	6max					50		
Base MOP-73 B-1			100	85-100	65-90	50-85		35-65	25-45		15-35		8-22			2-10	25max	6max				80min	50		
Sub-base FP-61 A	100								30-70							0-15		6max							
MOP-73	100																35max	9max				30min			

LA GRANULOMETRIA SE REALIZO CON LA MUESTRA

ORIGINAL DE LA MINA [ ]

LUEGO DE CRIBADA [ ]

LUEGO DE TRITURADA [X]

* ORIGINAL DE LA CANTERA

CUADRO RESUMEN DE ENSAYOS

PROYECTO:
ESTUDIO DE CANTERAS GUILLEN

Fecha (del informe) NOVIEMBRE 1989

No DE ENSAYOS	GRANULOMETRIA (% QUE PASA) MALLAS 3"	2 1/2"	2"	1 1/2"	1"	3/4"	1/2"	3/8"	4	8	10	30	40	50	100	200	L.L. POLVO DE ABRASION	I.P. POLVO DE ABRASION	DENSIDAD MAXIMA	HUMEDAD OPTIMA	HUMEDAD NATURAL	C.B.R.	ABRASION	DESGASTE SULFATOS	PELADURA
1 *		DEL FRENTE DE EXPLOTACION															N.P.	N.P.					16.8	0.86	<5 % RC-2 <5 % AP-3
2 *		DEL FRENTE DE EXPLOTACION															N.P.	N.P.					21.2	2.5	<5% RC-2 <5% AP-3
3																									
4																									
5																									
Con Asfaltico				100	80-100	70-90		55-75	45-62	35-50		19-30		13-23	7-15	0-8							40	12	
Carp. Asfaltica 1"						100	80-100	70-90	50-70	35-50		18-29		13-23	8-16	4-10							40	12	
Carp. Asfaltica 2"					100	80-100		60-80	48-65	35-50		19-30		13-23	7-15	0-8							40	12	
Base FP-61 B-1			100	70-100	55-85	50-80		40-70	30-60		20-50		10-30			5-15	25max	6max					50		
Base MOP-73 B-1			100	85-100	65-90	50-85		35-65	25-45		15-35		8-22			2-10	25max	6max				80min	50		
Sub-Base FP-61 A	100								30-70							0-15		6max							
MOP-73	100																35max	9max				30min			

LA GRANULOMETRIA SE REALIZO CON LA MUESTRA

- ORIGINAL DE LA MINA ☐
- LUEGO DE CRIBADA ☐
- LUEGO DE TRITURADA ☐

* ORIGINAL DE LA CANTERA

CUADRO RESUMEN DE ENSAYOS

PROYECTO:
ESTUDIO DE CANTERA RIO DE ORO

Fecha (del informe) DICIEMBRE 1988

No DE ENSAYOS	GRANULOMETRIA (% QUE PASA) MALLAS																								
	3"	2 1/2"	2"	1 1/2"	1"	3/4"	1/2"	3/8"	4	8	10	30	40	50	100	200	LL. POLVO	LP. DE ABRASION	DENSIDAD MAXIMA	HUMEDAD OPTIMA	HUMEDAD NATURAL	C.B.R.	ABRASION	DESGASTE SULFATOS	PELADURA
1 *				FRENTE DE EXPLOTACION													(•) 24.5	(•) 4.1					23.6	5.1	<5 % RC-2 <5 % AP-3
2 *				FRENTE DE EXPLOTACION													(•) 25.5	(•) 5.1					34.9	5.7	<5 % RC-2 <5 % AP-3
3 X				100	97	25	1	0		STOCK 3/4" (TRITURADO)							27.7	3.2					18	10.0	<5 % RC-2
4																									
5																									
Cpa Asfáltica				100	80-100	70-90		55-75	45-62	35-50		19-30		13-23	7-15	0-8							40	12	
Carp. Asfaltica 1"						100	80-100	70-90	50-70	35-50		18-29		13-23	8-16	4-10							40	12	
Carp. Asfaltica 2"					100	80-100		60-80	48-65	35-50		19-30		13-23	7-15	0-8							40	12	
Base FP-61 B-1			100	70-100	55-85	50-80		40-70	30-60		20-50		10-30			5-15	25 max	6 max					50		
Base MOP-73 B-1			100	85-100	65-90	50-85		35-65	25-45		15-35		8-22			2-10	25 max	6 max				80 min	50		
Sub-Base FP-61 A	100								30-70							0-15		6 max							
MOP-73	100	-															35 max	9 max				30 min.			

LA GRANULOMETRIA SE REALIZO CON LA MUESTRA

ORIGINAL DE LA MINA ☐

LUEGO DE CRIBADA ☐

LUEGO DE TRITURADA ☒

* ORIGINAL DE LA CANTERA

INVENTARIO NACIONAL DE FUENTES DE MATERIALES

PROVINCIA: MANABI　　　　HOJA No_____ DE _____

	No	CLAVE	NOMBRE	UBICACION (CARRETERA)	DESCRIPCION DEL MATERIAL	USOS S.B.	USOS B.	USOS A.C.	USOS A.A.	USOS S.S.	VOLUMEN	ACTIVA	AGOTADA	OBSERVACIONES
H	1	C	CANTERAS GUILLEN	PORTOVIEJO MONTECRISTI	ROCA VOLCANICA DIABASA.	X	X	X	X		ILIMITADO			Se debe realizar controles periodicos.
	2	C	CANTERAS GUILLEN	PORTOVIEJO MONTECRISTI	ROCA VOLCANICA TIPO DIABASA	X	X	X	X	X	ILIMITADO			
I	1	C	CANTERAS MANABITAS	MONTECRISTI – MANTA	ROCA VOLCANICA TIPO DIABASA	X	X	X	X		ILIMITADO			Se debe realizar controles periodicos.
	2	C	CANTERAS MANABITAS	MONTECRISTI – MANTA.	ROCA VOLCANICA TIPO DIABASA.	X	X	X	X		ILIMITADO			
	3	C	CANTERAS MANABITAS	MONTECRISTI – MANTA.	ROCA VOLCANICA TIPO DIABASA.	X	X	X	X		ILIMITADO			
	4	C	CANTERAS MANABITAS	MONTECRISTI MANTA.	ROCA VOLCANICA TIPO DIABASA	X	X	X	X		ILIMITADO			
J	1	C	MINA RIO AYAMPE	JIPIJAPA – MANGLARALTO	DEPOSITOS ALUVIALES	X_R	X_R	X_R	X_R		150.000 m^3			El uso en B,A,C y A.A. es en lo referente a arena (material fino.)
	2	C	MINA RIO AYAMPE	JIPIJAPA MANGLARALTO	DEPOSITOS ALUVIALES	X_R	X_R	X_R	X_R		De arena			

C = CANTERA　　SB = SUBBASE　　AC = AGREGADOS PARA CEMENTO　　SS = SUELO SELECCIONADO

M = MINA　　B = BASE　　AA = AGREGADOS PARA ASFALTO

NOTA:

GRANULOMETRIA

Lugar MANTA Material ARENA R. PORTOVIEJO Fecha ABRIL /89

TAMIZ	PESO RETENIDO		% RETENIDO		% PASA	ESPECIFICAC.
4	6		2.88	2.88		
8	19		9.13	12.01		
16	20		9.62	21.63		
30	28		13.46	35.09		
50	24		11.54	46.63		
100	47		22.60	69.23		
P 100	64		30.77			
				MF = 1.87		
TOTAL	208 gramos					

Observaciones

Realizado por

NOTA:

Lavado por tamiz No 200 = 184 gramos

Peso muestra seca sin lavar = 139 gramos

Peso muestra seca lavada por tamiz No 200 = 45 gramos

% Peso tamiz No 200 = 24.46 %

GRANULOMETRIA

Lugar MANTA Material ARENA RIO PORTOVIEJO - No 3 Fecha ABRIL /89

TAMIZ	PESO RETENIDO		% RETENIDO		% PASA	ESPECIFICAC.
4	0		0	0		
8	8		4.00	4.00		
16	65		32.50	36.50		
30	23		11.50	48.00		
50	48		24.00	72.00		
100	30		15.00	87.00		
P 100	26		13.00			
				MF = 2.475		
TOTAL	200 gramos					

Observaciones

Realizado por

NOTA:

Lavado por tamiz No 200 = 100 gramos

Peso muestra seca sin lavar = 89 gramos

Peso muestra seca lavada por tamiz No 200 = 11 gramos

% Peso tamiz No 200 = 11 %

GRANULOMETRIA

Lugar MANTA Material ARENA DE PLAYA TARQUI Fecha MAYO /89

TAMIZ	PESO RETENIDO		% RETENIDO		% PASA	ESPECIFICAC.
4	0		0			
8	0		0			
16	0		0			
30	2		1.00	1.00		
50	16		8.00	9.00		
100	169		84.50	93.50		
P 100	15		6.50			
			M.F = 1.035			
TOTAL	200 gramos					

Observacjones

Realizado por

NOTA:

Lavado por tamiz No 200
Peso muestra seca sin lavar
Peso muestra seca lavada por tamiz No 200
% Peso tamiz No 200

GRANULOMETRIA

LUGAR MANTA MATERIAL AGREGADO FINO FECHA AGOSTO 1989

TAMIZ	PESO RETENIDO		% RETENIDO		% PASA	ESPECIFICACIONES
3/8	0 0		0.000	0.00	100.00	100
# 4	0 59		0 4088	4.88	95.12	95 100
3/8	0 06		0 8.97	13.65		
16	3.153		7 8.60	23.16	76.84	45 80
#30	1 005		24.81	47.97	52.03	
50	4 90		40.53	88.50	11.50	10. 30
100	11 03		9.10	97.60	2.40.	2 10
P 100	292		2.40	275.76		
50	2		0.04	MF = 2.76		
100	4		0.10			
P 100	3		0.07			
TOTAL	1.209		100.00			
TOTAL	4.641		100.00			

OBSERVACIONES ____________________

REALIZADO POR ____________________ VISTO. BUENO ____________________

GRANULOMETRIA

LUGAR MANTA MATERIAL AGREG. PARA CONCRETO FECHA AGOSTO 1988

TAMIZ	PESO RETENIDO		% RETENIDO		% PASA	ESPECIFICACIONES	
	A	B	C				
2"	0.00	0.00	0.00	0.00	100.00	100	
1 1/2	0.00	0.00	0.00	0.00	100.00	93.52	- 100.00
3/4	29.34	0.00	0.00	29.34	70.66	54.64	80.58
3/8	5.30	21.48	0.00	26.78	43.88	38.44	61.12
# 4	0.28	8.37	1.71	10.36	33.52	33.44	38.44
8	0.02	0.06	3.07	3.15	30.37	24.64	34.27
16	0.01	0.02	3.33	3.36	27.01	15.84	28.34
30	0.01	0.01	8.68	8.70	18.31	8.8	20.66
50	0.01	0.01	14.19	14.21	4.10	3.52	11.20
100	0.01	0.03	3.19	3.23	0.87	0.7	3.7
P. 100	0.02	0.02	0.83	0.87			
TOTAL							

OBSERVACIONES

REALIZADO POR VISTO BUENO

CALCULO DE LAS PROPIEDADES DE LAS MEZCLAS DE ASFALTO

Informe: DISEÑO   Proyecto: PUERTO DE MANTA   Descripción de la mezcla: CARPETA ASFALTICA   Fecha: 1989

MUESTRA Nº.	CEMENTO ASFALTO %	ESPESOR PULG. CORRECCION	FACTOR DE CORRECCION	MUESTRA EN AIRE GR.	MUESTRA EN AGUA GR.	VOLUMEN cc.	GRAVED. ESPECIFIC. ACTUAL Kg/m³	GRAVED. ESPECIFIC. TEORICA Kg/m³	CEMENTO ASFALTO POR VOL. %	VACIOS MEZ. TOT. %	VACIOS LLENADA %	ESTABILIDAD LECTURA DIAL	ESTABILIDAD TRANSF. LIBRAS	ESTABILIDAD CORREG. LIBRAS	FLUJO
A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
		MAXIMA DENSIDAD TEORICA 2.122 Kg/m3				E - F	E / G		B x H / Gr. Hz. de C. A.	100 − 100 H / I	J / (J + K)			D x N	
		% DE ASFALTO		5,69 %											
1	5,0		0,81	1.368	767	599	2.280	2.447				360	3.719	3.012	9
2	"		0,93	1.228	698	530	2.302	"				310	3.281	3.074	8
3	"		1,09	1.093	614	479	2.281	"				262	2.706	2.950	8
							2.288	"	11,20	6,50	63,28			3.012	8,3
4	5,50		1,09	1.153	658	495	2.329	2.420				316	3.264	3.558	9
5	"		0,89	1.270	719	551	2.305	"				303	3.956	3.521	10
6	"		1,04	1.158	658	500	2.316	"				322	3.326	3.459	9
							2.317	"	12,48	4,57	73,28			3.513	9,3
7	6,00		1,00	1.183	673	510	2.320	2.411				336	3.471	3.471	10
8	"		0,89	1.291	737	554	2.330	"				375	3.874	3.438	11
9	"		1,00	1.196	670	516	2.298	"				333	3.440	3.440	10
							2.316	"	13,61	3,94	77,55			3.153	10,3
10	6,50		0,93	1.244	704	540	2.304	2.394				285	2.944	2.738	11
11	"		0,93	1.247	701	546	2.284	"				294	3.037	2.824	13
12	"		1,09	1.105	624	481	2.297	"				247	2.552	2.781	10
							2.295	"	14,61	4,14	77,92			2.781	11,3

GRANULOMETRIA

LUGAR MANTA MATERIAL CONCRETO ASFALTICO FECHA AGOSTO 1988

TAMIZ	PESO RETENIDO		% RETENIDO		% PASA	ESPECIFICAC.
	A	B	C			
1"	0.00	0.00	0.00	0.00	100.00	100.00
3/4"	13.17	0.00	0.00	13.17	86.83	70 - 100
1/2"	15.47	0.00	0.00	15.43	71.00	55 90
3/8"	5.44	5.66	0.00	11.10	60.00	40 80
No 4	1.55	17.78	0.00	19.33	40.07	30 55
No 10	0.19	8.19	0.50	8.88	32.90	22 47
No 20	0.02	3.75	1.63	5.40	26.69	16 38
No 40	0.02	1.79	3.54	5.35	21.04	12 32
No 80	0.02	2.19	5.59	7.80	13.54	8 20
No 200	0.04	1.99	3.82	5.85	7.69	4 8
P. No 200	0.17	1.36	6.16	7.69		
	36.05 %	42.71 %	21.24 %			
TOTAL						

Observaciones ______________________________

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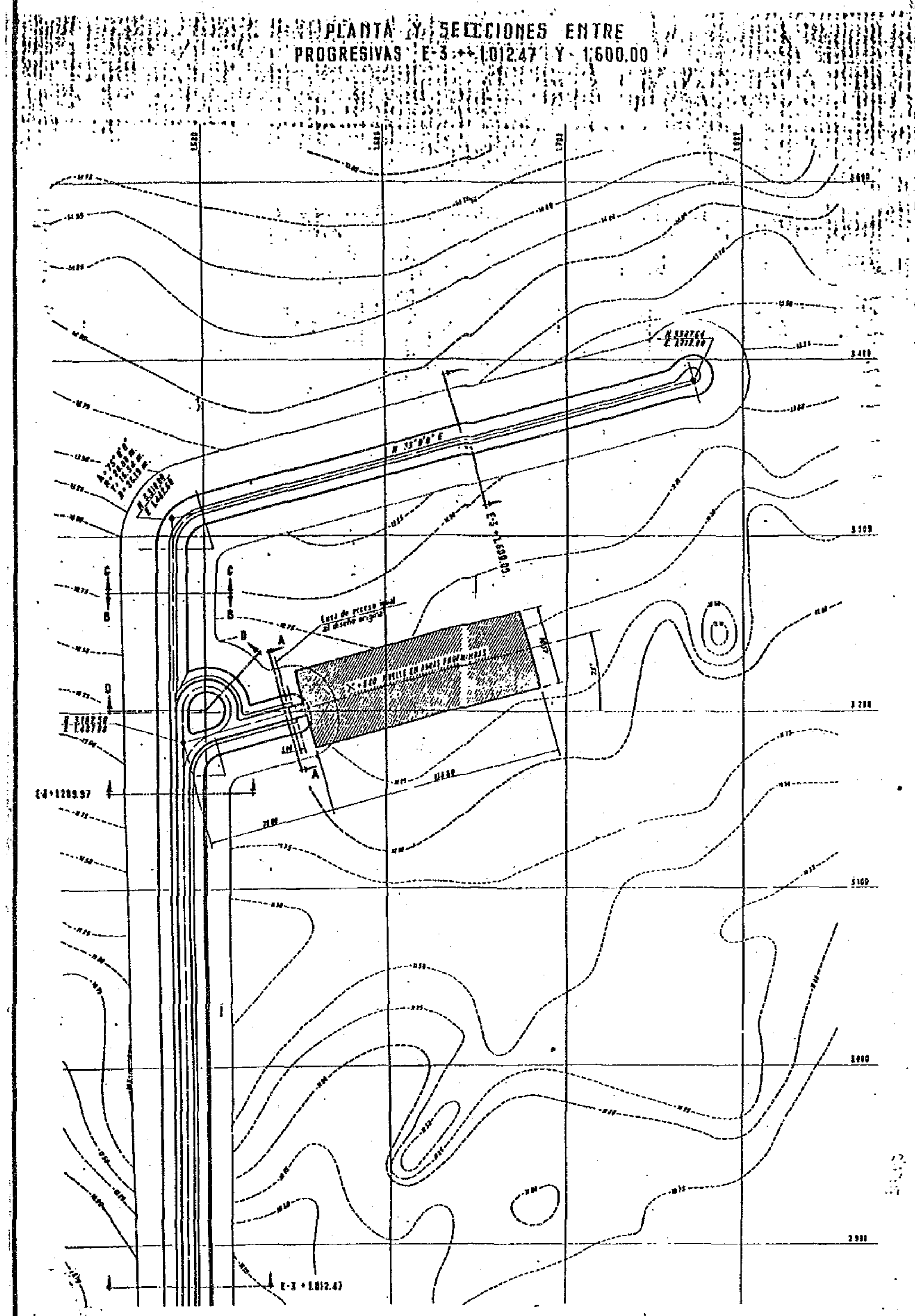
REALIZADO POR ______________ VISTO BUENO ______________

5. Standard Cross Section of Manta Commercial Port



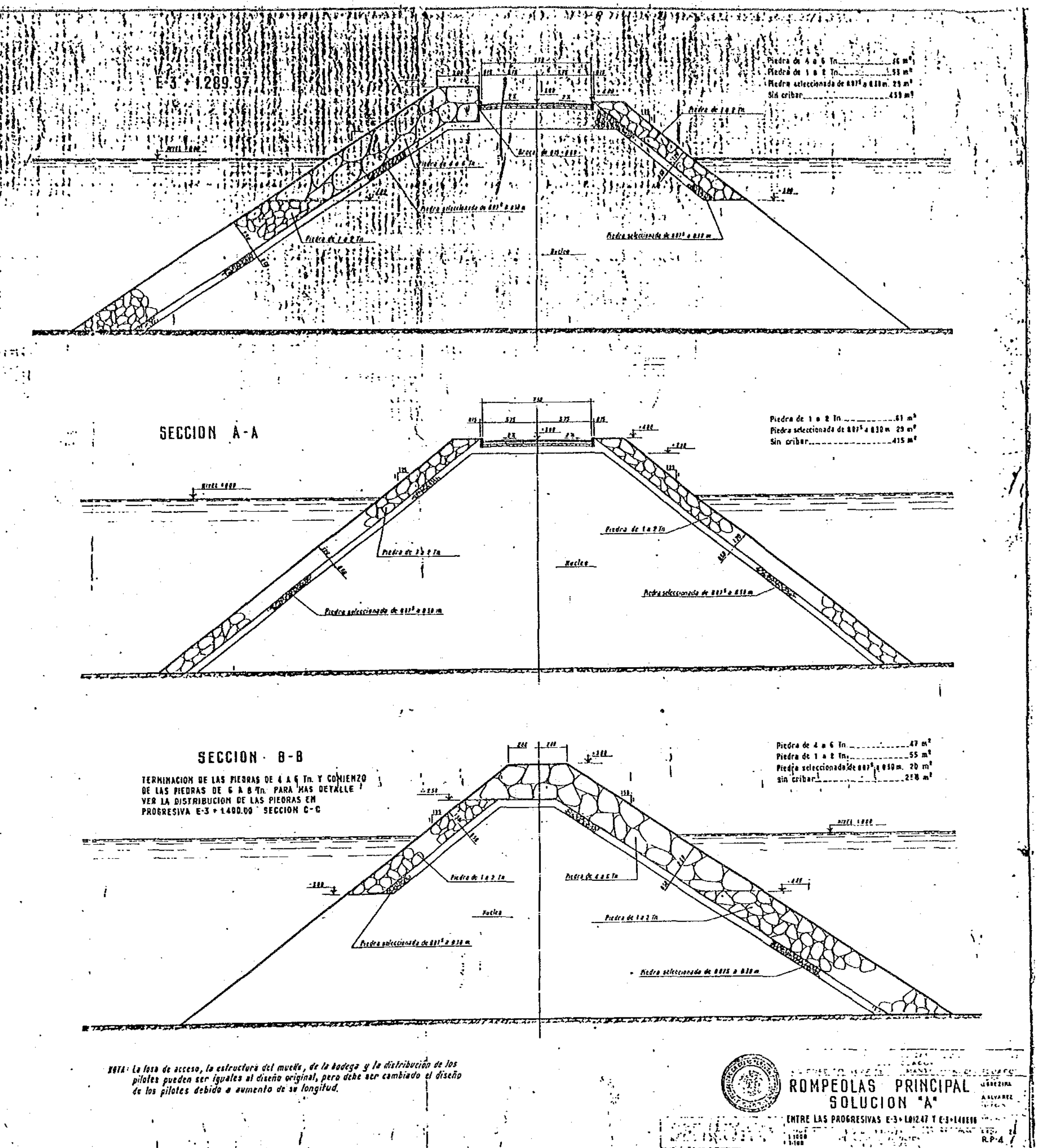


Fig. 11-3 (1) Standard Cross Sections of Port Facilites (Manta Commercial Port)

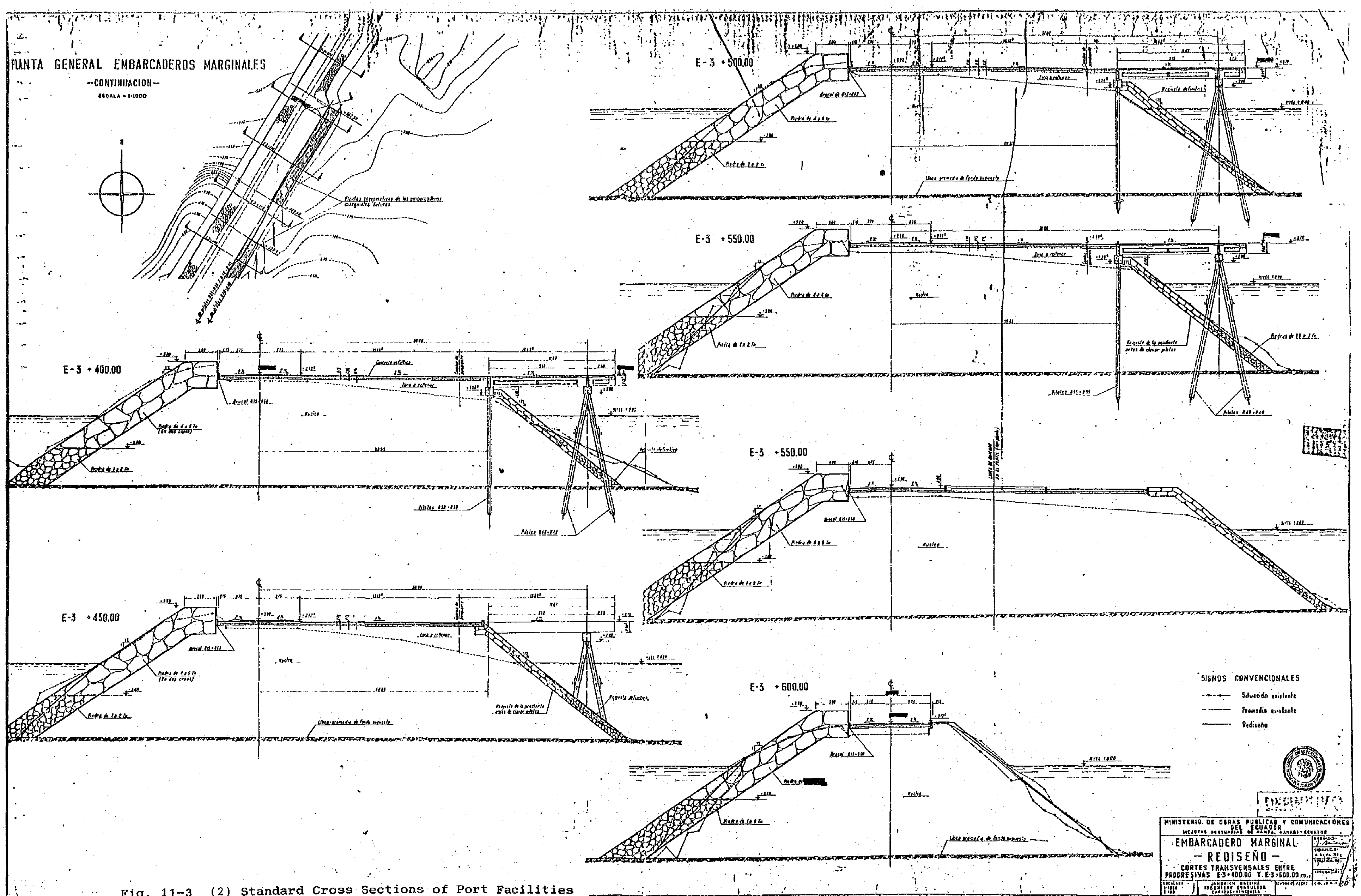


Fig. 11-3 (2) Standard Cross Sections of Port Facilities (Manta Commercial Port)

6. Relevant Development Plan and Limited Area at Manta

(1) Manta Commercial Port

The Manta Port is the only international port in Manabi. In 1987, freight in transit, both imports and exports, totaled 107,000 tons.

Principal freight was as follows.

Exports(tons)	
Frozentuna	25,300
Coffe	22,400
Frozen shrimp	2,200
Cod liver oil	1.900

Imports(tons)	
Newsprint	15,000
Steel tubes	6,600
Wire	6,300
Soy oil	3,028
Fat	2,000

The main port facilities are as follows.

Longitude and Draught of the Docks

Facility	Usage	Longitude	Draught*
Dock No.1	International	200 meters	31 feet
Dock No.2	International	200 meters	28 feet
Dock No.3	International	200 meters	25 feet
Dock No.4	International	200 meters	22 feet
Ramp No.1	International	5 meters	22 feet
Ramp No.2	International	5 meters	20 feet
Marginal dock	Coastal shipping	100 meters	18 feet
Marginal dock	Fishing	100 meters	15 feet
Marginal dock	Fishing	150 meters	12 feet

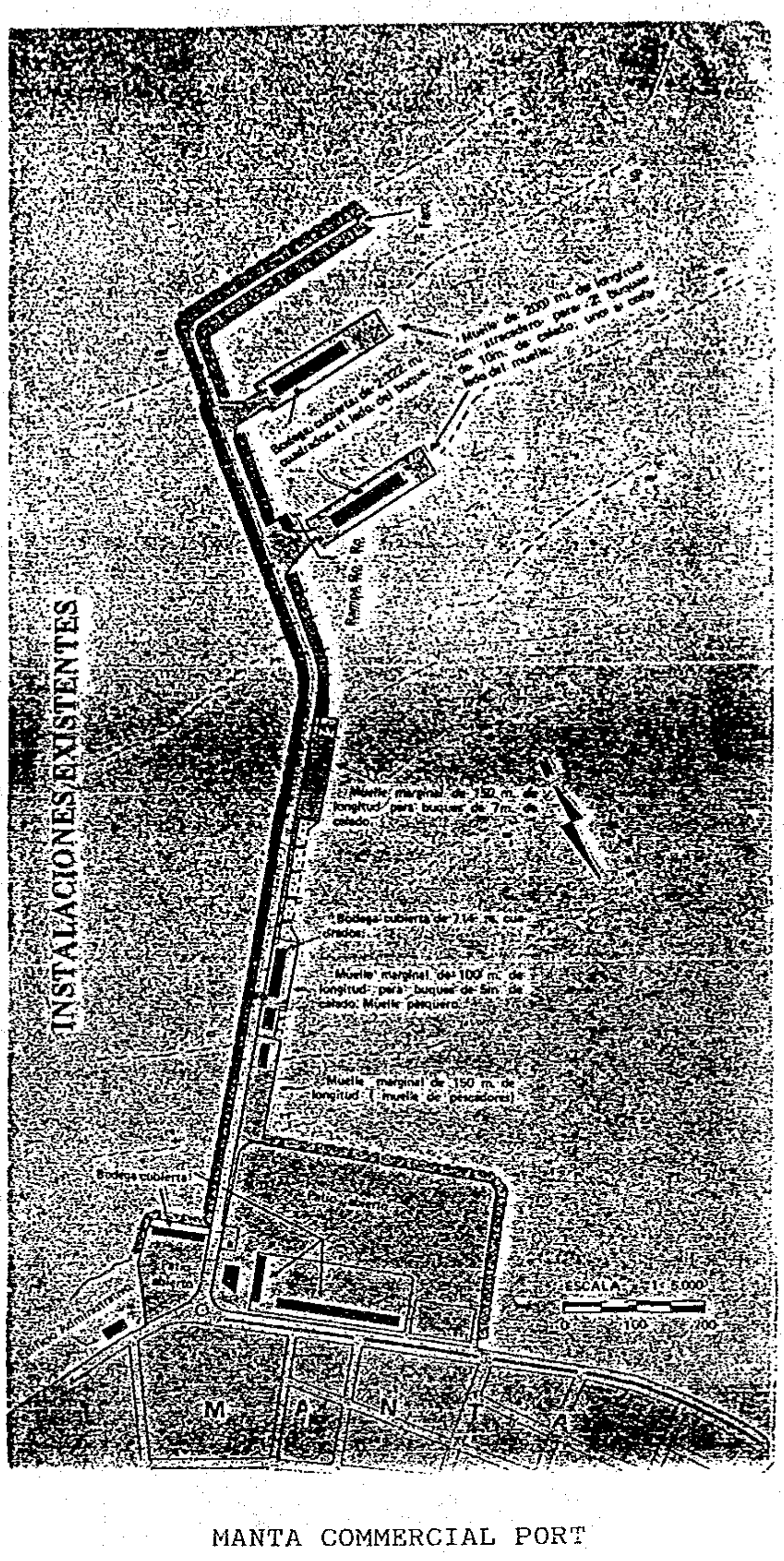
* at low tide

Open Patios

	Area
Patio 200	10,000 m^2
Patio 300	23,664 m^2
Patio 400	4,640 m^2
Patio 500	55,444 m^2
Patio 600	44,600 m^2
Patio 700	7,000 m^2
Total	135,348 m^2

Enclosed Warehouses

	Area
Deep sea dock No.1	2,232 m^2
Deep sea dock No.2	2,232 m^2
Marginal No.2 (fishing dock)	745 m^2
Dangerous freight warehouse in Patio 500	450 m^2
Warehouse in Patio 400	1,400 m^2
Interor Warehouses	3,353 m^2
Total	10,412 m^2



MANTA COMMERCIAL PORT