SHEET OF DESCRIPTION N° 16

Profile N°: P2
Vegetation: Little developed Recru
Physiography - form: Slope (U.C.27)
Slope: 2- 5 %
Typology of the soil: Hardened colluvionné altered ferrallitic soil (6.22 IV)

Description
00 - 18: " Dark reddish brown " into wet (5 YR 3/4), argilo-sandy, little gravillonnaire, (5 - 15 % of ferruginous and quartzose fine gravels), structure polyhedric subangulaire, very porous, not very compact, very many fine, very fine, average and coarse roots.
18 - 48: " Reddish brown " (5 YR 4/4), argilo-sandy, fairly gravillonnaire (30 - 50 % of ferruginous and quartzose fine gravels), structure polyhedric subangulaire, very porous, compact, very many very fine, fine and average roots.
48 - 93: " Yellowish red " into wet, (5 YR 4/6), little gravillonnaire (15 - 30% of ferruginous and quartzose fine gravels), structure polyhedric subangulaire, porous, compact, many fine roots and very fines.
> 93: CARAPACE.

Physicochemical results

Horizon (cm)	Particle size (% of weight dried with the air)					Acidity		Hydrodynamic Characteristic			
	Clay Silt	fine Silt	Large. Sand	Fine Sand	Coarse Sand	pH Water	pH Kcl	pF 2,5	pF 4,2	Available Water	C.E.E
00 – 18	40.4	7.5	5.2	19.3	28.0	4.8	3.8	24.5	17.1	7.4	20
18 – 48	47.5	19.9	3.8	10.4	28.3	4.7	3.8	28.2	20.2	8.0	26
48 - 93	57.5	12.5	3.0	9.5	17.3	4.6	3.8	35.6	23.2	13.4	28

Horizon (cm)	Organic Matter				PHOSPHORUS ppm		Cation Exchangeable Meq/100 G of Soil				Complexes Absorbent		
	M.O (%)	C (%)	N (°/°°)	C/N	Assim	Tota	Ca^{++}	Mg^{++}	K^{+}	Na^{+}	T (C.E)	S	V (S/T)
00 – 18	2,34	1,36	1,12	12,1	14,8	266	0,92	0,82	0,08	0,10	7,84	1,92	24,5
18 – 48	1,48	0,86	0,98	8,8	7,2	174	0,78	0,64	0,06	0,10	6,40	1,58	24,7
48 - 93	1,17	0,68	0,70	9,7	3,4	133	0,66	0,64	0,06	0,10	7,86	1,46	18,6

L.3 Water Quality Analysis

L.3.1 Scope of Analysis

(1) Purpose of the Water Quality Analyses

The water quality analyses was carried out to grasp the present conditions of water quality of the river water as well as the groundwater in the Study Area. The analyses were conducted for the samples taken in the rainy and in the dry seasons to compare each other.

(2) Sampling

The sampling was carried out on June 24, 1998 for the rainy season and on January 1, 1999 for the dry season as stated below.

1) 1st Sampling on June 24, 1998 for the Rainy Season
The sampling was made considering only the surface water of the San-Pédro river, and the following five (5) sites were selected for sampling.

- The reservoir of the San-Pédro dam
- The site just upstream of the junction with the Kre river, where the intake weir construction was proposed as an alternative
- The existing pumping station site for the irrigation of the San-Pédro Paddy Irrigation Project
- The SODECI pumping station site for supplying municipal water to the San-Pédro city
- The bridge of the San-Pédro - Soubré national road

Three samples were taken at each site, and the above locations are indicated in Fig. L.3.1.

2) 2nd Sampling on January 12, 1999 for the Dry Season
The sampling were carried out at three (3) sites for surface water of the San-Pédro river and at five (5) existing shallow wells for groundwater. Three (3) samples were collected at each site as stated below.

(a) Surface Water of the San-Pédro River
- Fahé (reservoir of the San-Pédro dam)
  Sample No.1: Water collected on the water surface
  Sample No.2: Water collected at 2m depth from the water surface
  Sample No.3: Water collected at 4m depth from the water surface
- Bridge of the San-Pédro - Soubré national road
  Sample No.1: Water collected at 8m depth from the bridge
  Sample No.2: Water collected at 10m depth from the bridge
  Sample No.3: Water collected at bottom of 12m depth from the bridge
  (The water level was at 8m depth from the bridge.)
- SODECI pumping station
  Sample No.1: Water collected at 6m depth from the tower top
  Sample No.2: Water collected at 7m depth from the tower top
  Sample No.3: Water collected at bottom of 8m depth from the tower top
  (The water level in the well was at 6m depth from the tower top.)

(b) Groundwater of the Existing Shallow Wells
- Cpt. Colonel Djoropo
  Sample No.1: Water collected at 5m depth (water surface)
  Sample No.2: Water collected at 6m depth
  Sample No.3: Water collected at 7m depth
  (The water level in the well was at 5m depth.)

- Campus I
  Sample No.1: Water collected at 2m depth
  Sample No.2: Water collected at 3m depth
  Sample No.3: Water collected at bottom of 4m depth
  (The water level in the well was at 2m depth.)
- Grand Gabo
  Sample No.1: Water collected at 2m depth
  Sample No.2: Water collected at 4m depth
  Sample No.3: Water collected at bottom of 5.80m depth
  (The water level in the well was at 2m depth.)
- Campus II (Soro)
  Sample No.1: Water collected at 7m depth
  Sample No.2: Water collected at 7.75m depth
  Sample No.3: Water collected at bottom of 8.50m depth
  (The water level in the well was at 7m depth.)
- Campus II (Ali)
  Sample No.1: Water collected at 3m depth
  Sample No.2: Water collected at 4m depth
  Sample No.3: Water collected at bottom of 5m depth
  (The water level in the well was at 3m depth.)

(3) Parameters for Analyses

The following parameters were considered for the laboratory analyses.

- Physical Properties:	Color in unit Pt, Turbidity (NTU), Conductivity, pH, and Total Disolved Solid (TDS)
- Biological Ppoperties:	Total Coliform bacteria (44°C/48h), and General bacteria (37°C)
- Chemical Properties:	Disolved Oxygen (DO), Hardness (total $CaCO_3$), Sodium (Na), Magnesium (Mg), Aluminium (Al), Potassium (K), Fluoride (F), Calcium (Ca), Manganese (Mn), Iron (Fe), Boron (B), Ammonia (NH_4), Nitrate (NO_3^-), Nitrite (NO_2^-), Chloride (Cl^-), and Sulfate (SO_4^-)

L.3.2 Results of Analysis

The observed values for surface water of the San-Pédro river and the groundwater in the existing shallow wells in the Study Area are presented in Table L.3.1.

L.3.3 Findings and Evaluation

(1) Suitability of Water

1) Drinking Water

According to the physico-chemical and bacteriological results obtained, the river water needs a preliminary water treatment before its consumption due to the following reasons:

- The presence of a high amount of total germs (more than 10 germs/ml). The maximum value admitted by the CEE recommendation was 10 germs/ml.
- The acidity of water is very high for the sites No.2 to 6 with a pH between 4.8 and 5.9, OMS recommended a pH between 6.5 and 8.5. The conductive relatively weak because lower than 100 US/cm (water lightly mineralize).
- The conductivity is relatively weak, less than 100 μS/cm (water is less mineralized).
- The high residue of iron for the sites No.1, 2, 3, 4, 7 and 8 (0.60 to 1.60); the maximum value amitted recommended by the OMS is at 0.3 mg/l.
- With the exception of site No.1, the water turbidity, in general, is high (6 to 38 NTU); The limite value according to OMS recommendation is at 5 NTU.

2) Irrigation Water Supply

From the agricultural viewpoint, Sodium/Natrium is an element of alkaline and alkalino-soiled bases playing a role in maintaining the soil permeability for irrigation. For this reason, we often use a coefficient equal to the percentage of Sodium for fixing its maximum limite at 60% based on the appliciation of the following formula.

% Na=((Na + K)*100) /(Ca + Mg + (Na + K))

- The following table offers the values of Na % for the differents samples subjected to the present analysis.

Site	Sample	Na %	Site	Sample	Na %
	1	61.9		1	84.7
S1	2	60.7	S5	2	84.3
	3	67.2		3	84.5
	1	79.1		1	73.5
S2	2	92.9	S6	2	31.3
	3	93.8		3	73.8
	1	77.2		1	65.9
S3	2	90.3	S7	2	66.9
	3	91.5		3	85.8
	1	82.4		1	63.4
S4	2	85.4	S8	2	69.8
	3	85.6		3	70.0

In the whole, the figures are more than 60 %.

(2) Samples of San-Pédro Bridge

Regarding the samples of San-Pédro Bridge, the figures of some parameters (especially the conductivity,the total solids, the water turbility, Sodium, Magnesium, Calcium, Chlorine and Sulfates) are higher in river bottom than on river surface; this would explain by the accumulation of minerals in the sampling from river bottom.

(3) Comparison of Analysis Results for 3 Sampling Sites of San-Pédro River

Parameter	San-Pédro Dam (Fahé)	SODECI Pumping Station	Bridge of the San-Pédro - Soubré National Road
Color	5	45.0	95
Turbidity	4	11 to 13	8 to 12
Conductivity	90	108 to 124	129.9 to 3710.0
PH	6.80	7.0	7.0
Total Solids - TDS	91	108 to 124	130 to 3700
Coliforms, Thermo-tolerant	0	0	0
Mesophil Bacterial Germ	> 150	> 150	> 150
Dissolved Oxygen	5	5 to 6	3.8 to 7.0
Water Crudity	19	19.2 to 26	24.5 to 286.5
Sodium	5.40 to 6.90	8.8 to 10.6	11.3 to 440
Magnesium	2.40	2.5 to 2.6	2.8 to 54.0
Aluminium	< 0.50	< 0.50	< 0.50
Potassium	4.10 to 4.80	4.50 to 5.10	4.20 to 36.10
Flour	< 0.01	< 0.01	< 0.01
Calcium	3.30 to 3.70	3.40 to 6.10	4.80 to 24.60
Manganese	< 0.05	< 0.05	< 0.05
Iron	0.90 to 1.20	1.3 to 1.6	1.20 to 1.50
Borium	< 0.02	< 0.02	< 0.02
Ammonium	0.14 to 0.18	0.18 to 0.20	0.14 to 0.30
Nitrat	1.14	0.83 to 0.96	1.92 to 2.05
Nitrite	< 0.01	0.01	0.16
Chlorine	6.00 to 14.20	7.10 to 13.50	17.75 to 1192.8
Sulfate	11.20 to 12.70	55.70 to 67.00	62.10 to 115.70

In general, the parameter figures obtained in San-Pédro river were observed increasing from the dam site to the bridge of national road, or from upstream to downstream. The streaming towards the river mouth where sediments and marine salts are found high would have an influence on these figures.

(4) Comparison of Results Dry and Rainy Seasons in San-Pédro River

Parameter	San-Pédro Dam (Fahé)		SODECI Pumping Station		Bridge of the San-Pédro - Soubré National Road	
	SP	SS	SP	SS	SP	SS
Color	> 80	5	> 80	45	> 80	45.0
Turbidity	28	4	34	13.0	34.3	12.0
Conductivity	75	91	79.9	124.3	77.7	129.9
PH	6	6.60	6.3	7.0	5.8	6.8
Total Solids - TDS	74	91	80	124	77.7	130.0
Coliforms, Thermo-tolerant	0	0	0	0	0	0
Mesophil Bacterial Germ	>300	>150	>300	>150	>300	> 150
Dissolved Oxygen	5.40	5.0	5.5	5.8	5.5	7.0
Water Crudity	5.70	19.1	5.5	26.1	5.87	24.5
Sodium	4.80	5.75	5.1	10.6	5.46	11.3
Magnesium	1.91	2.35	1.98	2.60	1.98	2.8
Aluminium	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Potassium	4.50	4.10	4.50	4.50	4.50	4.20
Flour	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Calcium	2.30	3.70	2.2	6.10	2.35	5.20
Manganese	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Iron	2.10	0.90	2.15	1.30	2.20	1.20
Borium	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Ammonium	0.27	0.18	0.22	0.18	0.27	0.14
Nitrat	5.95	1.14	5.11	0.96	3.98	1.92
Nitrite	<0.01	<0.01	<0.01	0.01	<0.01	0.16
Chlorine	4.61	6.0	7.1	13.5	5.90	17.75
Sulfate	4.60	12.70	4.6	67.0	4.87	62.10

Note: SP: Rainy season SS: Dry season

This table shows that, for the samples collected on water surface, no general tendency of variation in increases or decreases of the figures measured in the 2 periods of samplings.

L.4 Geodetic Survey

L.4.1 Scope of Investigation

(1) In-situ Test

1) Along the Irrigation Canal
- 15 Tests performed by dynamic penetrometer between 5 and 9m deep, of which 2 have been kept for refusal checking : these tests were based on the standard of NFP94-114 of december 1990.
- 15 Borings by hand auger (H.A) at 5m deep, associated with the aforementioned Tests

2) In the Borrowed Sites
- 3 Wells (manual operation) of 1.5m deep
- 2 Borings by hand auger (H.A) of 2.60m and 2.80m deep

The boring sites selected for the tests are indicated in Fig. L.4.1.

(2) Laboratory Tests

20 soil-samples were taken from the borings for the following tests:

Tests	Standards
Granulometric Analysis	NFP 040 of October 93
Natural water Content	NFP 94-050 of October 91
Limits of Atterberg	NFP94-051 of March 93
Specific weight of Grains	NFP94—054 of October 91

5 soil-samples were subjected to the following tests:

Tests	Standards
Modified proctor	NFP 94 093 of December 93
Consolidated straight Cutting	NFP 94 071 of August 94
Simple compressing	Method of LCPC Test
Tests of permeability	Method of LCPC Test

L.4.2 Results of the Survey

(1) Borings along Irrigation Canals

The obtained soil sections from the borings along the Irrigation Canal and the corresponding penetrometrical graphics are shown in Fig. L.4.2.

1) Nature of the Soils

The borings of GS 1 to GS 5 showed the existence of clay or clayey sand under a layer of about 0.10m - 0.20m depth of vegetable soil. Sporadically the following kinds of soils were found:

- Clean sand or a little clayey sand from the borings : GS1 (3.50/5.00), GS2 (1.50/5.00), GS3 (2.50/5.00), GS5 (1.00/1.80), GS8 (3.10/5.00), GS9 (0.10/1.50 and 3.00/5.00), GS14 (1.95/3.30)
- Peat soil from the borings GS10 GS10 from 3.95m to 4.20m. The boring was stopped at 4.20m depth in this kind of soil.

The groundwater layer was found from 2m depth of the land level except for the borings GS5 (2.10m), GV6 (1.30m) GS9 (0.30m) and GS14 (1.50m). The groundwater layer was found from 5m depth for the borings GS12 and GS15. The characteristics of soils found in the survey are notified in Fig. L.4.3. The different natures of soils with reasons for choosing tested samples are notified as follows:

Soil Characteristics

Boring	Nature of soil at 0 to 5 m	Tested sample	Classification LCPC for the tested sample
GS 1	0.10 m of vegetable soil 3.40 m of clay 1.50 m of clean sand	1 sample of clay which compaction is weaker than the soil in depth was taken at 0.90 to 2.10 m	At
GS 2	0.10 m of vegetable soil 1.10 m of clayey sand 0.30 m of clay 1.50 m of clean sand	1 sample of very weak top soil was taken at 0.10 to 1.20 m for checking the supporting property in land filling	SL
GS 3	0.10 m of vegetable soil 2.40 m clay 1.50 m of sand a bit clayey	1 sample of clay with a relatively weak compaction was taken at 0.10 to 1.90 m	At
GS 4	0.10 m of vegetable soil 4.90 m clay	1 sample of clay of a relatively weak compaction was taken at 1.75 to 2.75 m	At
GS 5	0.20 m vegetable soil 0.80 m clayey sand 0.80 m of clean sand 3.20 m of clay	2 samples of two relatively weak top soil types were taken for checking the supporting property in land filling - 0.20/1.00 clayey sand - 1.00/1.50 clean sand	SL Sm
GS 6	0.10 m of vegetable soil 0.90 m of clay 0.30 m of clayey sand 2.90 m of clay	1 sample of clayey sand was taken at 1.00 to 1.30 for checking its sand-witch nature in the clays	SL
GS 7	0.30 m of vegetable soil 4.70 m of soil	1 sample of reddish clay was taken at depth between 1 and 3.15 m for more Important thickness	AP
GS 8	0.20 m vegetable soil 1.70 m of sandy clay 1.20 m of clayey sand 1.90 m of clean sand	2 samples of different natures were taken at: - 1.00 to 1.90 m (sandy clay) - 1.90 to 3.10 m (clayey sand) for checking the supporting property	AP SA
GS 9	0.10 m of vegetable soil 1.40 m of sand a bit clayey 1.50 m of clayey sand 2 m of sand a bit clayey	1 sample of clayey sand was taken between 1.50 and 3 m for the granulometry of soil between two horizons of homogenous soils	SA
GS 10	0.10 m of vegetable soil 3.85 m of clay 0.25 m of alluvial pit	1 sample of clay with a relatively weak compaction was taken between 1.30 and 3 m	

Soil Characteristics

Boring	Nature of soil at 0 to 5 m	Tested sample	Classification LCPC for the tested sample
GS 11	0.10 m of vegetable sand 1.50 m of clay 0.60 m clayey sand 2.80 m of clay	1 sample of clay was taken at 1.20/1.60 m: Weak top soils for checking its supporting property in land filling	At
GS 12	0.10 m of vegetable soil 1.90 m of clayey lateritic sand 0.90 m of clay 2.10 m of clayey sand	1 sample of clayey lateritic sand was taken between 0.10 and 2 m to analyze the granulometry (compact soil)	SA
GS 13	0.10 m of vegetable soil 1.10 m of clay 0.80 m clayey sand 3.00 m of clay	1 sample of clayey sand was taken at 1.20 to 2 m, between two levels of clay for checking in granulometry	GA
GS 14	0.10 m of vegetable soil 1.85 m of sandy clay 1.35 m of clean sand 0.30 m of clayey sand	2 samples of two types of soils found in this boring: - 0.90/1.95 m (sandy clay) weak top soil - 1.95/3.00 m (clean sand)	At SA
GS 15	0.15 m of vegetable soil 1.05 m of clayey sand 1.80 m of clay 2.00 m of clayey sand	1 sample of clayey sand was taken between 0.80 and 1.20 m: Very weak top soil for checking its supporting property	

Note: Meanings of the symbols used in the classification LCPC

At : Clay, very plastic Ap : Clay, a little plastic Lt : Loam, very plastic
Lp : Loam, a little plastic GA : Clayey gravel GL : Loam gravel
Gb : Clean gravel in even form Gm : Clean gravel in uneven form Sb : Clean sand in even form
Sm : Clean sand in uneven form SL : Alluvium sand SA : Clayey sand

2) Resistances to the Dynamic Penetration

Results from the dynamic penetration tests showed a graphic pointing out the dynamic resistance Rp of the tested soils according to their depths. The apparatus used in the tests is a heavy dynamic penetrometer of BORRO type with a drop hammer (heavy weight) of 50 kg of weight. The obtained graphics are notified in Fig. L.4.2. The compaction evaluation of the soils based on the resistance ranges is generally carried out as follows:

- Rp < 20 bars: little compact soils
- 20 < Rp < 50 bars: fairly compact soils
- 50 < Rp < 100 bars: compact soils
- Rp > 100 bars: very compact soils

For the embankment, the acceptable constraint for foundation with a safety coefficient of 1.5 is generally applied as Rp/10. However, in general, the acceptable constraint (qa) to be made under a superficial foundation is between 1/20 and 1/15 of the resistance figure btained on the dynamic penetrometer.

The following table shows, as indicators, the figures of acceptable constraints (qa) under embankment and superficial foundation conditions of construction works at different points of borings.

Results of Dynamic Penetoration Tests

Boring	Compaction	For Embankment	For Superficial Foundation of Construction Works
GS 1	- from 0 to 2 m : a little compact soils - from 2 to 3m: average compact soils - from 3 to 5.5 m compact soils	Cleaning 0.50m qa = 0.1 MPa	Excavation bottom at 2.50m qa = 0.1 MPa
GS 2	- form 0 to 1.25 m: a little compact soils - from 1.25 to 3 m: average compact soils - from 3 to 5 m: a little compact soils	Cleaning 0.50m qa = 0.1 MPa	Excavation bottom at .1.50m qa = 0.1 Mpa
GS 3	- from 0 to 2.50 m: a little compact soils - from 2.50 to 5 m: average compact soils	Cleaning 0.10m qa = 0.1 Mpa	Excavation bottom at 1.50m qa = 0.05 Mpa
GS 4	- from 0 to 2.50m : a little compact soils - from 2.50 to 3.50 m: average compact soils - from 3.50 to 5m: compact soils	Cleaning 0.50m qa = 0.2 Mpa	Excavation bottom at 1m qa = 0.1 Mpa
GS 5	- from 0 to 0.75m : a little compact soils - from 0.75 to 2 m: average compact soils - from 2 to 3.50m: compact soils - from 3.50 to 5.5m: average compact soils	Cleaning 0.75m qa = 0.2 Mpa	Excavation bottom at 1m qa = 0.1 Mpa
GS 6	- from 0 to 2.50m : a little compact soils - from 2.50 to 3 m: average compact soils - from 3 to 5m: compact soils	Cleaning 0.50m qa = 0.1 Mpa	Excavation bottom at 1m qa = 0.05 Mpa
GS 7	- from 0 to 1m : a little compact soils - from 1 to 4 m: average compact soils - from 4 to 5.50m: compact soils	Cleaning 0.50m qa = 0.1 Mpa	Excavation bottom at 1m qa = 0.07 Mpa
GS 8	- from 0 to 2m : a little compact soils - from 2 to 5.50 m: average compact soils - from 5.50 to 7m: a little compact soils - from 7 to 8 m: average compact soils	Cleaning 0.50m qa = 0.1 Mpa	Excavation bottom at 1m qa = 0.1 Mpa
GS 9	- from 0 to 1m : a little compact soils - from 1 to 2 m: average compact soils - from 2 to 5.50m: compact soils	Cleaning 0.50m qa = 0.2 Mpa	Excavation bottom at 1m qa = 0.1 Mpa
GS 10	- from 0 to 3m average compact soils - from 3 to 5.50 m: a little compact soils - from 5.50 to 7m: average compact soils - from 7 to 8.50m: compact soil	Cleaning 0.75m qa = 0.2 Mpa	Excavation bottom at 1m qa = 0.1 Mpa
GS 11	- from 0 to 1m : a little compact soils - from 1 to 2 m: average compact soils - from 2 to 3.50m: a little compact soils - from 3.50 to 4.50m: average compact soils - from 4.50 to 5.50m: compact soil	Cleaning 0.50m qa = 0.1 Mpa	Excavation bottom at 1m qa = 0.1 Mpa
GS 12	- from 0 to 1m : a little compact soils - from 1 to 1.75 m: compact soils - from 1.75 to 3m: very compact soils - from 3 to 4m: compact soils - from 4 to 9m: average compact soil	Cleaning 0.10m qa = 0.2 Mpa	Excavation bottom at 1m qa = 0.2 Mpa
GS 13	- from 0 to 1m : compact soils - from 1 to 3 m: average compact soils - from 3 to 5m: compact soils	Cleaning 0.1m qa = 0.1 Mpa	Excavation bottom at 1.5m qa = 0.1 Mpa
GS 14	- from 0 to 1.25m : a little compact soils - from 1.25 to 3 m (refusal): compact soils	Cleaning 0.50m qa = 0.1 Mpa	Excavation bottom at 1.25m qa = 0.1 Mpa
GS 15	- from 0 to 1m : a little compact soils - from 1 to 1.50m: average compact soils - from 1.50 to 5.50m: compact soils	Cleaning 0.75m qa = 0.1 Mpa	Excavation bottom at 1.50m qa = 0.2 Mpa

(2) Tests on Borrowed Materials

The boring sections in the borrowed sites are reported in Fig. L.4.2. The materials found in these sites are, globally speaking, clayey sand and or sandy clays. The vegetable top soil is about 0.10m to 0.20m depth.

The results of laboratory tests on the materials (tests of identification and modified proctor test on the materials, mechanical tests and permeability test on the materials compacted by 95% of the OPM) are presented below.

Results of Laboratory Tests

Parameters	PE 1 0.50 m	PE 1 1.00 m	PE 1 1.50 m	PE 2 0.50 m	PE 2 1.50 m	PE 3 0.50 m	Pe 3 1.0 m	PE 3 1.50 m
1. Description								
Nature	Sandy Clay	Sandy Clay	Clayey Sand	Clayey Sand	Sandy Clay	Sandy Clay	Sandy Clay	Sandy Clay
Color	Brownish	Brownish	Redish	Greyish	Yellowish	Yellowish	Yellowish	Redish
Consistency	Very Consistent	Very Consistent	Very Consistent	Consistent	Very Consistent	Consistent		Very Consistent
2. Physical Properties								
Water Content W %	26	20	24	19	13	35		36
Specific Gravity of Grains γs	2.55	2.59	2.50	2.57	2.61	2.59	2.59	2.60
Atterberg Limits								
Wl	60	59	61	44	42	60		62
Wp	32	41	38	18	18	35		40
IP	28	18	23	26	24	25		22
Grain Size Analysis % < 80 μ	54	53	33	27	23	61		75
3. Mechanical Properties								
Sharing Resistivity								
Internal Friction (degree)		26	37	26	35			34
Cohesion (Mpa)		0.04	0.01	0.04	0.01			0.01
Compression Resistivity Rc (Mpa)		0.16	0.36	0.25	0.16			0.47
4. Permeability								
K (cm/s)		1.12×10^{7}	7.72×10^{8}	1.14×10^{7}	3.67×10^{7}			9.2×10^{8}
5. Properties for Compaction								
γd_{OPM} (T/m^3)	1.66	1.63	1.67	1.97	20.2		1.56	1.59
W %OPM	22.6	24.7	24.7	9.8	9.1		24.6	22.5

According the results obtained, for an implementation in embankment by compacting, the characteristics of compaction are weak in the borings PE1 and PE3 where the following characteristics are noted:

- γd OPM: 1.56 to 1.67
- W % OPM: 22.5 to 24.7

On the contrary, the results of the boring PE2 could be suitable to γd OPM equal to 1.97 or 2.02 and W % OPM equal to 9.8 or 9.1.

For the materials to be used in structures of dykes for irrigation canals, the borrowed lateritic clay or lateritic gravel very clayey are recommended.

Table L.3.1 Results of Water Quality Analysis - River Water - (1/2)

I. Wet Season

No	Parameters	Unit	San-Pedro Reservoir No. 11	No. 12	No. 13	Avg.	Petit Oaho No. 21	No. 22	No. 23	Avg.	Ex-SODERIZ Pumping Station No. 31	No. 32	No. 33	Avg.	SODECI San-Pedro Intake No. 41	No. 42	No. 43	Avg.	San-Pedro Bridge No. 51	No. 52	No. 53	Avg.	Min.	Avg.	Max.
1	Physical Analysis																								
	P1 Color in unit Pt	(mg/l)	> 80	> 80	> 80	> 80	> 80	> 80	> 80	> 80	> 80	> 80	> 80	> 80	> 80	> 80	> 80	> 80	> 80	> 80	> 80	> 80	> 80	> 80	> 80
	P2 Turbidity	(NTU)	28.0	28.0	24.0	26.7	37.0	27.0	24.0	29.3	29.0	27.0	27.0	27.7	40.0	32.0	30.0	34.0	44.0	29.0	30.0	34.3	24.0	30.4	44.0
	P3 Conductivity (25oC)	(mS/cm)	76.00	74.90	73.60	74.83	73.00	75.00	77.60	75.20	76.50	77.60	75.10	76.40	76.60	79.10	83.90	79.87	78.00	77.40	77.70	77.70	73.00	76.80	83.90
	P4 pH		5.85	6.00	6.00	5.95	6.00	6.00	5.90	5.97	5.80	5.80	6.10	5.97	6.00	6.10	6.00	6.03	6.00	5.60	5.90	5.83	5.60	5.95	6.10
	P5 Total Dissolved Solid (TDS)	(mg/l)	76.0	75.0	71.0	74.0	73.0	75.0	78.0	75.3	77.0	78.0	76.0	77.0	77.0	79.0	84.0	80.0	78.0	77.0	78.0	77.7	71.0	76.8	84.0
2	Biological Analysis																								
	B1 Total Coliform bacteria (44oC/48h)	(UFC/100ml)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	B2 General bacteria (37oC)	(UFC/ml)	> 300	> 300	> 300	> 300	> 300	> 300	> 300	> 300	> 300	> 300	> 300	> 300	> 300	> 300	> 300	> 300	> 300	> 300	> 300	> 300	> 300	> 300	> 300
3	Chemical Analysis																								
	C1 Dissolved oxygen (DO)	(mgO2/l)	5.4	5.1	5.8	5.4	6.1	5.0	5.4	5.5	5.6	6.1	6.0	5.9	5.8	5.2	5.6	5.5	6.1	5.6	4.8	5.5	4.8	5.6	6.1
	C2 Hardness (total CaCO3)	(mg/l)	6.3	5.3	5.6	5.7	5.5	5.5	6.5	5.8	5.8	7.5	5.3	6.2	5.3	5.9	5.3	5.5	6.3	6.0	5.4	5.9	5.3	5.8	7.5
	C3 Sodium (Na)	(mgNa/l)	5.00	4.74	4.80	4.85	4.40	5.50	5.04	4.98	4.80	4.95	4.10	4.62	5.30	4.70	5.20	5.07	5.90	5.60	4.90	5.47	4.10	5.00	5.90
	C4 Magnesium (Mg)	(mg/Mg/l)	1.90	1.90	1.94	1.91	1.84	1.80	1.90	1.85	1.94	2.00	1.95	1.96	1.92	1.96	2.05	1.98	2.00	2.00	1.93	1.98	1.80	1.94	2.05
	C5 Aluminium (Al)	(mgAl/l)	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	C6 Potassium (K)	(mgK/l)	4.60	4.40	4.50	4.50	4.50	4.40	4.30	4.40	4.30	4.50	4.50	4.43	4.40	4.50	4.70	4.53	4.50	4.70	4.40	4.53	4.30	4.48	4.70
	C7 Fluoride (F)	(mgF/l)	< 0.01	< 0.01	< 0.01	<0.01	< 0.01	< 0.01	< 0.01	<0.01	< 0.01	< 0.01	< 0.01	<0.01	< 0.01	< 0.01	< 0.01	<0.01	< 0.01	< 0.01	< 0.01	<0.01	< 0.01	< 0.01	<0.01
	C8 Calcium (Ca)	(mgCa/l)	2.50	2.20	2.25	2.32	2.20	2.20	2.60	2.33	2.30	3.00	2.10	2.47	2.10	2.35	2.20	2.22	2.50	2.40	2.15	2.35	2.10	2.34	3.00
	C9 Manganese (Mn)	(mgMn/l)	< 0.05	< 0.05	< 0.05	<0.05	< 0.05	< 0.05	< 0.05	<0.05	< 0.05	< 0.05	< 0.05	<0.05	< 0.05	< 0.05	< 0.05	<0.05	< 0.05	< 0.05	< 0.05	<0.05	< 0.05	< 0.05	<0.05
	C10 Iron (Fe)	(mgFe/l)	1.80	2.20	2.20	2.10	2.15	2.00	1.19	1.78	1.85	1.18	2.10	1.75	2.10	2.20	2.16	2.15	2.25	2.20	2.16	2.20	1.19	2.00	2.25
	C11 Boron (B)	(mgB/l)	< 0.02	< 0.02	< 0.02	<0.02	< 0.02	< 0.02	< 0.02	<0.02	< 0.02	< 0.02	< 0.02	<0.02	< 0.02	< 0.02	< 0.02	<0.02	< 0.02	< 0.02	< 0.02	<0.02	< 0.02	< 0.02	<0.02
	C12 Ammonia (NH4)	(mgNH4+/l)	0.40	0.18	0.22	0.27	0.26	0.17	0.23	0.22	0.30	0.25	0.24	0.26	0.24	0.23	0.20	0.22	0.30	0.26	0.26	0.27	0.17	0.25	0.40
	C13 Nitrate (NO3-)	(mgNO3-/l)	1.90	7.44	8.52	5.95	4.30	2.46	7.86	4.87	3.10	7.74	8.46	6.43	2.80	8.94	4.38	5.37	1.80	4.98	5.16	3.98	1.80	5.32	8.94
	C14 Nitrite (NO2-)	(mgNO2-/l)	< 0.01	0.06	< 0.01	<0.01	< 0.01	< 0.01	< 0.01	<0.01	< 0.01	< 0.01	< 0.01	<0.01	< 0.01	0.06	< 0.01	<0.01	< 0.01	< 0.01	< 0.01	<0.01	< 0.01	-	0.06
	C15 Chloride (Cl-)	(mgCl-/l)	4.25	5.32	4.26	4.61	5.70	6.04	7.81	6.52	5.70	7.81	6.39	6.43	7.80	6.04	7.45	7.10	6.00	6.39	5.32	5.90	4.25	6.15	7.81
	C16 Sulfate (SO4=)	(mgSO42-/l)	5.00	4.80	4.00	4.60	1.40	4.00	4.00	3.13	4.00	3.60	3.00	3.53	5.00	4.80	4.00	4.60	3.60	5.20	5.80	4.87	1.40	4.15	5.80
Sodium Absorption Ratio (SAR)			58.2%	56.7%	56.9%	57.3%	53.2%	66.9%	82.0%	67.4%	56.6%	54.5%	56.4%	55.8%	63.9%	55.0%	60.9%	59.9%	67.7%	64.9%	58.7%	63.8%	53.2%	60.8%	82.0%

II. Dry Season

No	Parameters	Unit	San-Pedro Reservoir No. 11	No. 12	No. 13	Avg.	Petit Oaho -	-	-	-	Ex-SODERIZ Pumping Station -	-	-	-	SODECI San-Pedro Intake No. 81	No. 82	No. 83	Avg.	San-Pedro Bridge No. 71	No. 72	No. 73	Avg.	Min.	Avg.	Max.
1	Physical Analysis																								
	P1 Color in unit Pt	(mg/l)	5.0	5.0	5.0	5.0	-	-	-	-	-	-	-	-	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	> 80	> 80	> 80
	P2 Turbidity	(NTU)	4.0	4.0	4.0	4.0	-	-	-	-	-	-	-	-	13.0	12.0	11.0	12.0	12.0	9.0	8.0	9.7	4.0	8.6	13.0
	P3 Conductivity (25oC)	(mS/cm)	90.90	90.90	89.00	90.27	-	-	-	-	-	-	-	-	124.30	108.00	109.00	113.8	129.90	140.90	3,710	1,327	89.00	510.32	3710.00
	P4 pH		6.60	6.80	6.60	6.67	-	-	-	-	-	-	-	-	7.00	6.90	6.90	6.93	6.80	7.00	6.60	6.87	6.60	6.82	7.00
	P5 Total Dissolved Solid (TDS)	(mg/l)	91.0	91.0	90.0	90.7	-	-	-	-	-	-	-	-	124.0	108.0	109.0	113.7	130.0	141.0	3,700	1,324	90.0	509.3	3700.0
2	Biological Analysis																								
	B1 Total Coliform bacteria (44oC/48h)	(UFC/100ml)	0	0	0	0	-	-	-	-	-	-	-	-	0	0	0	0	0	0	0	0	0	0	0
	B2 General bacteria (37oC)	(UFC/ml)	>150	>150	>150	>150	-	-	-	-	-	-	-	-	>150	>150	>150	>150	>150	>150	>150	>150	>150	>150	>150
3	Chemical Analysis																								
	C1 Dissolved oxygen (DO)	(mgO2/l)	5.0	4.5	4.5	4.7	-	-	-	-	-	-	-	-	5.8	6.0	5.0	5.6	7.0	6.4	3.8	5.7	3.8	5.3	7.0
	C2 Hardness (total CaCO3)	(mg/l)	19.1	19.1	18.3	18.8	-	-	-	-	-	-	-	-	26.1	19.4	19.2	21.6	24.5	24.9	286.6	112.0	18.3	50.8	286.5
	C3 Sodium (Na)	(mgNa/l)	5.75	5.40	6.90	6.02	-	-	-	-	-	-	-	-	10.60	8.80	9.10	9.50	11.30	11.45	440.00	154.25	5.40	56.59	440.00
	C4 Magnesium (Mg)	(mg/Mg/l)	2.35	2.35	2.40	2.37	-	-	-	-	-	-	-	-	2.60	2.60	2.50	2.57	2.80	3.10	54.00	19.97	2.35	8.30	54.00
	C5 Aluminium (Al)	(mgAl/l)	<0.50	<0.50	<0.50	<0.50	-	-	-	-	-	-	-	-	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.5	<0.5	<0.5
	C6 Potassium (K)	(mgK/l)	4.10	4.50	4.80	4.47	-	-	-	-	-	-	-	-	4.50	5.10	4.90	4.83	4.20	4.50	36.10	14.95	4.10	8.08	36.10
	C7 Fluoride (F)	(mgF/l)	<0.01	<0.01	<0.01	<0.01	-	-	-	-	-	-	-	-	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	< 0.01	< 0.01	<0.01
	C8 Calcium (Ca)	(mgCa/l)	3.70	3.70	3.30	3.57	-	-	-	-	-	-	-	-	6.10	3.40	3.50	4.33	5.20	4.80	24.60	11.53	3.30	6.48	24.60
	C9 Manganese (Mn)	(mgMn/l)	<0.05	<0.05	<0.05	<0.05	-	-	-	-	-	-	-	-	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.20	<0.05	< 0.05	-	<0.20
	C10 Iron (Fe)	(mgFe/l)	0.90	0.90	1.20	1.00	-	-	-	-	-	-	-	-	1.30	1.60	1.40	1.43	1.20	1.60	1.30	1.33	0.90	1.26	1.60
	C11 Boron (B)	(mgB/l)	<0.02	<0.02	<0.02	<0.02	-	-	-	-	-	-	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	< 0.02	< 0.02	<0.02
	C12 Ammonia (NH4)	(mgNH4+/l)	0.18	0.18	0.14	0.17	-	-	-	-	-	-	-	-	0.18	0.20	0.18	0.19	0.14	0.17	0.30	0.20	0.14	0.19	0.30
	C13 Nitrate (NO3-)	(mgNO3-/l)	1.14	1.14	1.12	1.13	-	-	-	-	-	-	-	-	0.96	0.83	0.90	0.90	1.92	1.95	2.05	1.97	0.83	1.33	2.05
	C14 Nitrite (NO2-)	(mgNO2-/l)	<0.01	<0.01	<0.01	<0.01	-	-	-	-	-	-	-	-	0.01	0.01	<0.01	<0.05	0.16	<0.01	<0.05	<0.05	< 0.01	-	0.16
	C15 Chloride (Cl-)	(mgCl-/l)	6.00	10.65	14.20	10.28	-	-	-	-	-	-	-	-	13.50	7.10	10.65	10.42	17.75	17.75	1,183	409.43	6.00	143.38	1192.80
	C16 Sulfate (SO4=)	(mgSO42-/l)	12.70	12.70	11.20	12.20	-	-	-	-	-	-	-	-	67.00	35.70	56.50	49.73	62.10	62.50	115.70	80.10	11.20	50.68	115.70
Sodium Absorption Ratio (SAR)			61.9%	60.7%	67.2%	63.3%	-	-	-	-	-	-	-	-	63.4%	69.8%	70.0%	67.7%	65.9%	66.9%	85.8%	72.9%	60.7%	68.0%	85.8%

Table L.3.1 Results of Water Quality Analysis - Well Water - (2/2)

No	Parameters	Unit	Cpt. Colonel Djorogo				Campus I				Grand Gabo			
			No. 21	No. 22	No. 23	Avg.	No. 31	No. 32	No. 33	Avg.	No. 41	No. 42	No. 43	Avg.
1	Physical Analysis													
	P1 Color in unit Pt	(mg/l)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
	P2 Turbidity	(NTU)	13.0	14.0	16.0	14.3	9.0	8.0	19.0	12.0	38.0	37.0	38.0	37.7
	P3 Conductivity (25oC)	(mS/cm)	92.90	92.60	92.00	92.50	141.10	142.60	140.00	141.23	166.70	161.70	170.00	166.13
	P4 pH		6.30	6.60	6.30	5.37	6.10	6.10	6.10	5.10	6.10	4.80	4.90	4.93
	P5 Total Dissolved Solid (TDS)	(mg/l)	93.0	93.0	92.0	92.7	141.0	143.0	140.0	141.3	167.0	162.0	169.0	166.0
2	Biological Analysis													
	B1 Total Coliform bacteria (44oC/48h)	(UFC/100ml)	0	0	0	0	0	0	0	0	0	0	0	0
	B2 General bacteria (37oC)	(UFC/ml)	>160	>160	>160	>150	>160	>160	>160	>150	>160	>160	>160	>150
3	Chemical Analysis													
	C1 Dissolved oxygen (DO)	(mgO2/l)	6.5	6.0	4.0	3.5	5.4	6.0	3.6	5.0	6.0	5.6	5.4	5.7
	C2 Hardness (total CaCO3)	(mg/l)	11.40	4.70	4.70	6.93	9.00	10.00	9.60	9.53	13.50	13.00	14.70	14.40
	C3 Sodium (Na)	(mgNa/l)	13.10	13.50	15.50	13.97	13.10	13.30	15.50	13.97	18.70	18.40	22.00	19.70
	C4 Magnesium (Mg)	(mgMg/l)	0.05	0.05	0.05	0.05	0.50	0.50	0.50	0.50	2.10	2.10	2.20	2.13
	C5 Aluminium (Al)	(mgAl/l)	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	C6 Potassium (K)	(mgK/l)	1.10	1.10	1.30	1.17	1.10	1.10	1.30	1.17	3.80	3.90	4.20	3.97
	C7 Fluoride (F)	(mgF/l)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	C8 Calcium (Ca)	(mgCa/l)	3.70	1.05	1.05	1.93	3.70	1.05	1.05	1.93	2.70	1.70	2.20	2.20
	C9 Manganese (Mn)	(mgMn/l)	0.10	0.10	0.14	0.11	0.10	0.10	0.14	0.11	<0.05	<0.05	<0.05	<0.05
	C10 Iron (Fe)	(mgFe/l)	0.90	0.90	1.20	1.00	0.90	0.90	1.20	1.00	0.60	0.70	0.80	0.70
	C11 Boron (B)	(mgB/l)	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
	C12 Ammonia (NH4)	(mgNH4+/l)	0.14	0.17	0.70	0.34	0.18	0.20	0.24	0.21	0.20	0.10	0.20	0.17
	C13 Nitrate (NO3-)	(mgNO3-/l)	5.58	5.60	7.50	6.23	12.84	11.80	12.50	12.38	26.00	24.30	27.50	25.93
	C14 Nitrite (NO2-)	(mgNO2-/l)	0.05	0.05	0.03	0.04	<0.01	<0.01	<0.03	<0.01	0.05	0.05	0.08	0.06
	C15 Chloride (Cl-)	(mgCl-/l)	14.90	17.75	21.30	17.98	28.80	39.05	39.05	35.63	22.70	24.85	28.40	25.32
	C16 Sulfate (SO4-)	(mgSO42-/l)	18.40	18.40	17.70	18.17	28.96	29.45	28.80	29.07	52.20	52.10	57.20	53.83
Sodium Absorption Ratio (SAR)			79.1%	92.9%	93.8%	88.6%	77.2%	90.3%	91.5%	86.3%	82.4%	85.4%	85.6%	84.5%

No	Parameters	Campus II (Saro)				Campus II (Abi)				Min.	Avg.	Max.
		No. 51	No. 52	No. 53	Avg.	No. 61	No. 62	No. 63	Avg.			
1	Physical Analysis											
	P1 Color in unit Pt	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	5.0	7.0	10.0
	P2 Turbidity	6.00	6.00	9.00	7.0	16.00	10.00	10.00	11.7	6.0	16.5	38.0
	P3 Conductivity (25oC)	119.30	119.40	123.30	120.67	170.50	169.30	313.00	217.60	92.00	147.63	313.00
	P4 pH	6.8	4.8	6.7	5.30	5.9	6.4	4.9	5.53	4.80	5.25	5.90
	P5 Total Dissolved Solid (TDS)	119	119	123	120.3	171	169	314	218.0	92.0	147.7	314.0
2	Biological Analysis											
	B1 Total Coliform bacteria (44oC/48h)	0	0	0	0	0	0	0	0	0	0	0
	B2 General bacteria (37oC)	>160	>160	>160	>150	>160	>160	>160	>150	>150	>150	>150
3	Chemical Analysis											
	C1 Dissolved oxygen (DO)	6.6	4.0	6.6	5.7	5.8	5.0	5.4	5.4	3.6	5.5	6.6
	C2 Hardness (total CaCO3)	10.20	10.60	11.70	10.83	24.00	23.90	110.50	52.80	4.70	18.90	110.50
	C3 Sodium (Na)	14.30	14.30	17.20	15.27	14.90	14.60	12.85	14.12	12.85	15.40	22.00
	C4 Magnesium (Mg)	1.90	2.04	1.90	1.95	3.30	3.20	3.60	3.37	0.05	1.60	3.60
	C5 Aluminium (Al)	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	C6 Potassium (K)	1.20	1.20	1.30	1.23	5.70	6.30	6.20	6.07	1.10	2.72	6.30
	C7 Fluoride (F)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	C8 Calcium (Ca)	0.90	0.85	1.50	1.08	4.10	4.20	38.20	15.50	0.85	4.53	38.20
	C9 Manganese (Mn)	<0.05	<0.05	<0.05	<0.05	<0.08	<0.09	<0.05	<0.07	<0.05	-	0.14
	C10 Iron (Fe)	0.10	0.10	0.86	0.35	0.30	0.20	0.30	0.27	0.10	0.66	1.20
	C11 Boron (B)	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
	C12 Ammonia (NH4)	0.14	0.13	0.10	0.12	0.14	0.03	0.20	0.12	0.03	0.19	0.70
	C13 Nitrate (NO3-)	21.60	21.60	20.80	21.33	21.60	25.75	24.30	23.88	5.58	17.95	27.50
	C14 Nitrite (NO2-)	<0.02	<0.01	<0.01	<0.01	0.05	<0.01	0.05	0.05	<0.01	-	0.05
	C15 Chloride (Cl-)	18.80	28.40	31.95	26.38	16.70	24.85	24.85	22.13	14.90	25.49	39.05
	C16 Sulfate (SO4-)	45.20	45.20	48.75	46.38	56.30	55.70	57.50	55.83	17.70	40.66	57.50
Sodium Absorption Ratio (SAR)		84.7%	84.3%	84.5%	84.5%	73.5%	31.3%	73.8%	59.5%	31.3%	80.7%	93.8%

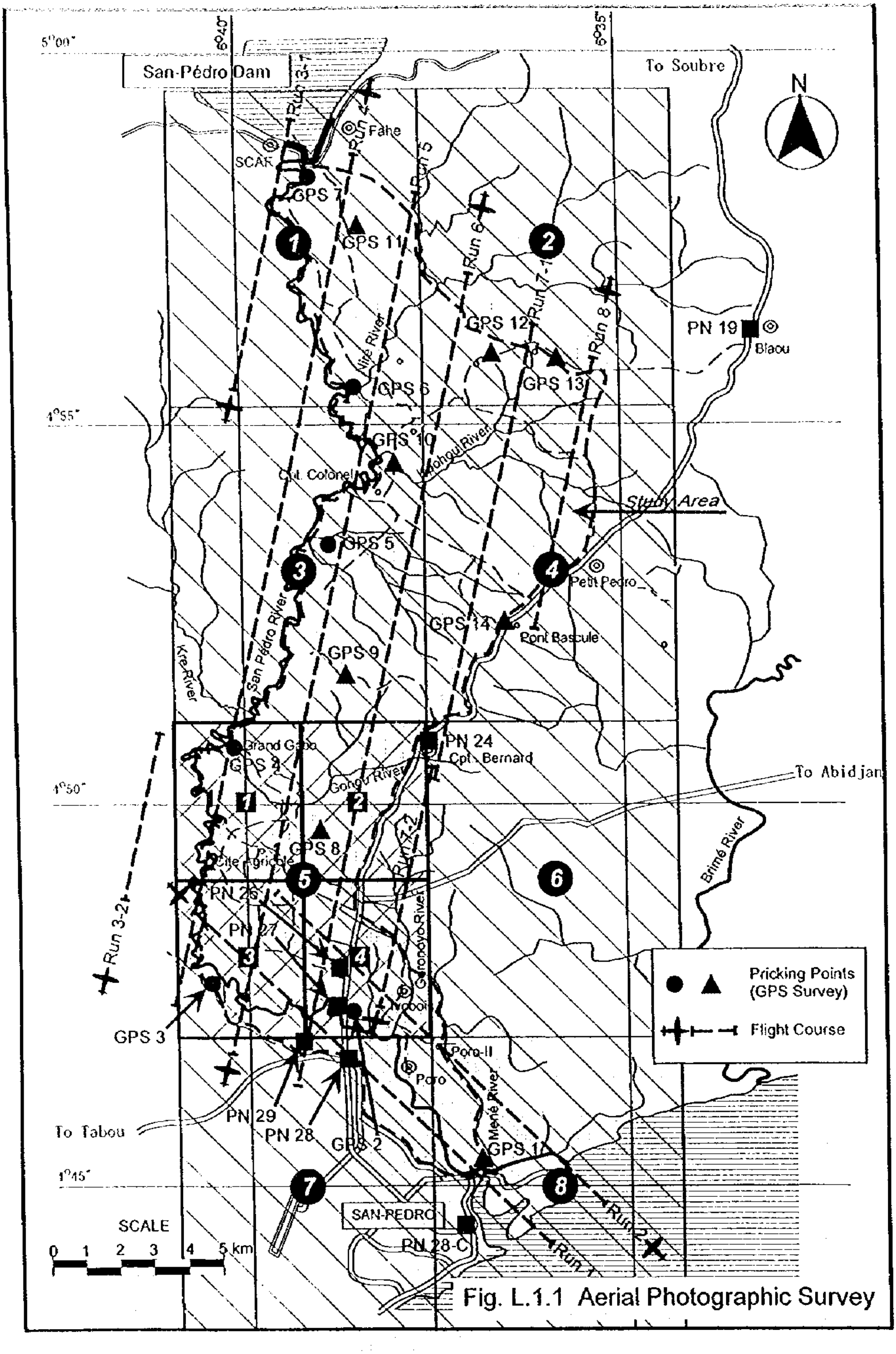


Fig. L.1.1 Aerial Photographic Survey

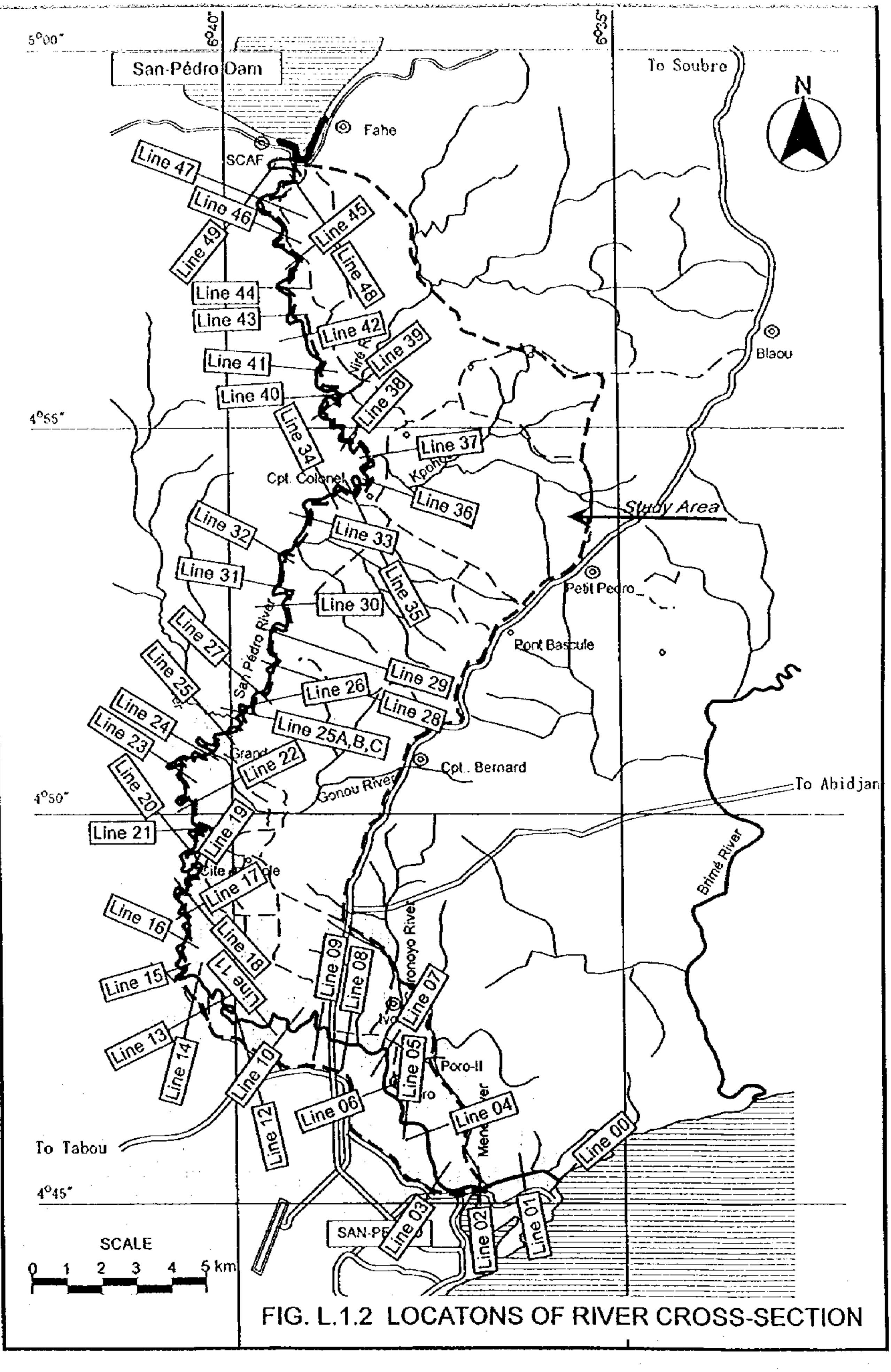


FIG. L.1.2 LOCATONS OF RIVER CROSS-SECTION

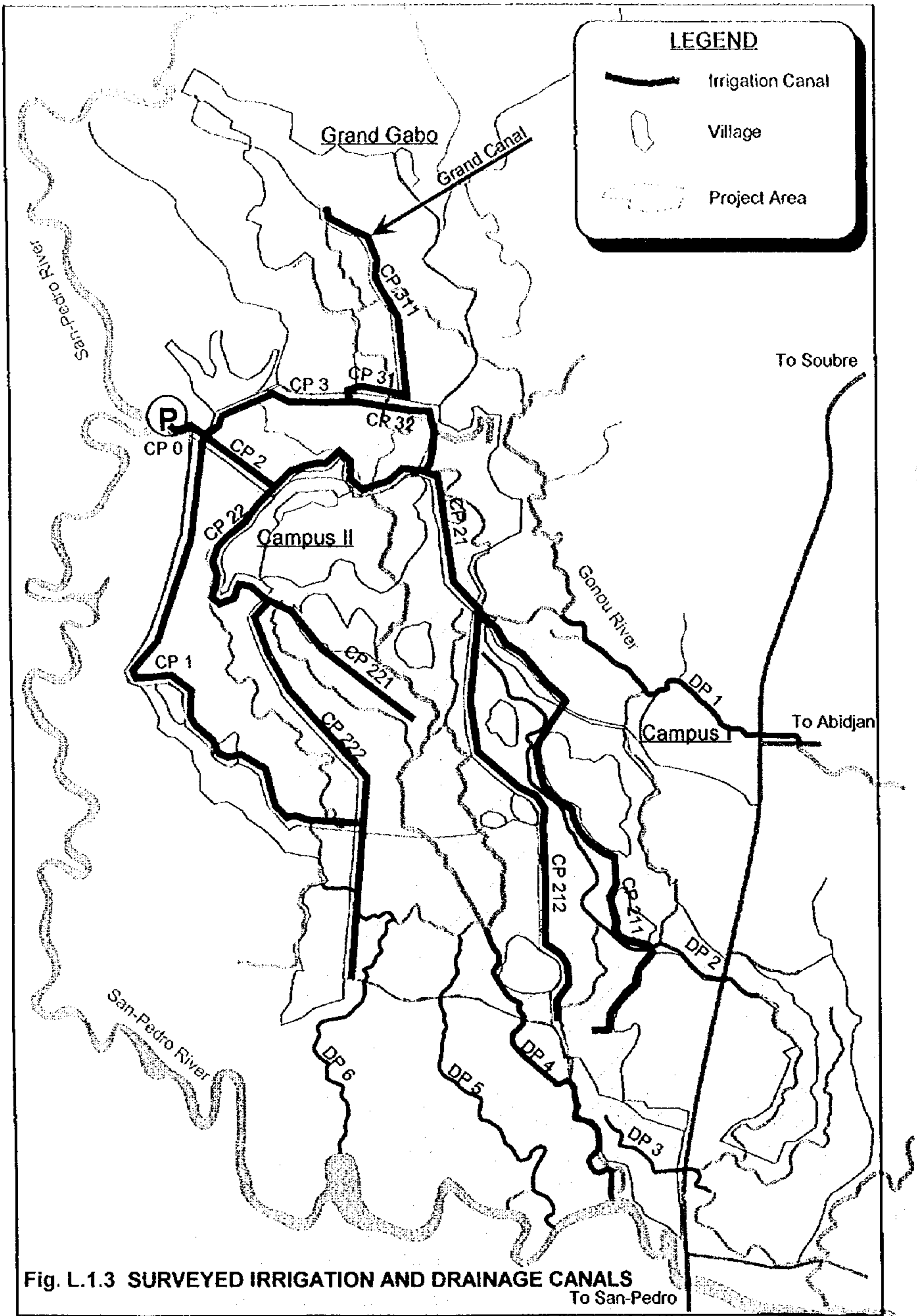
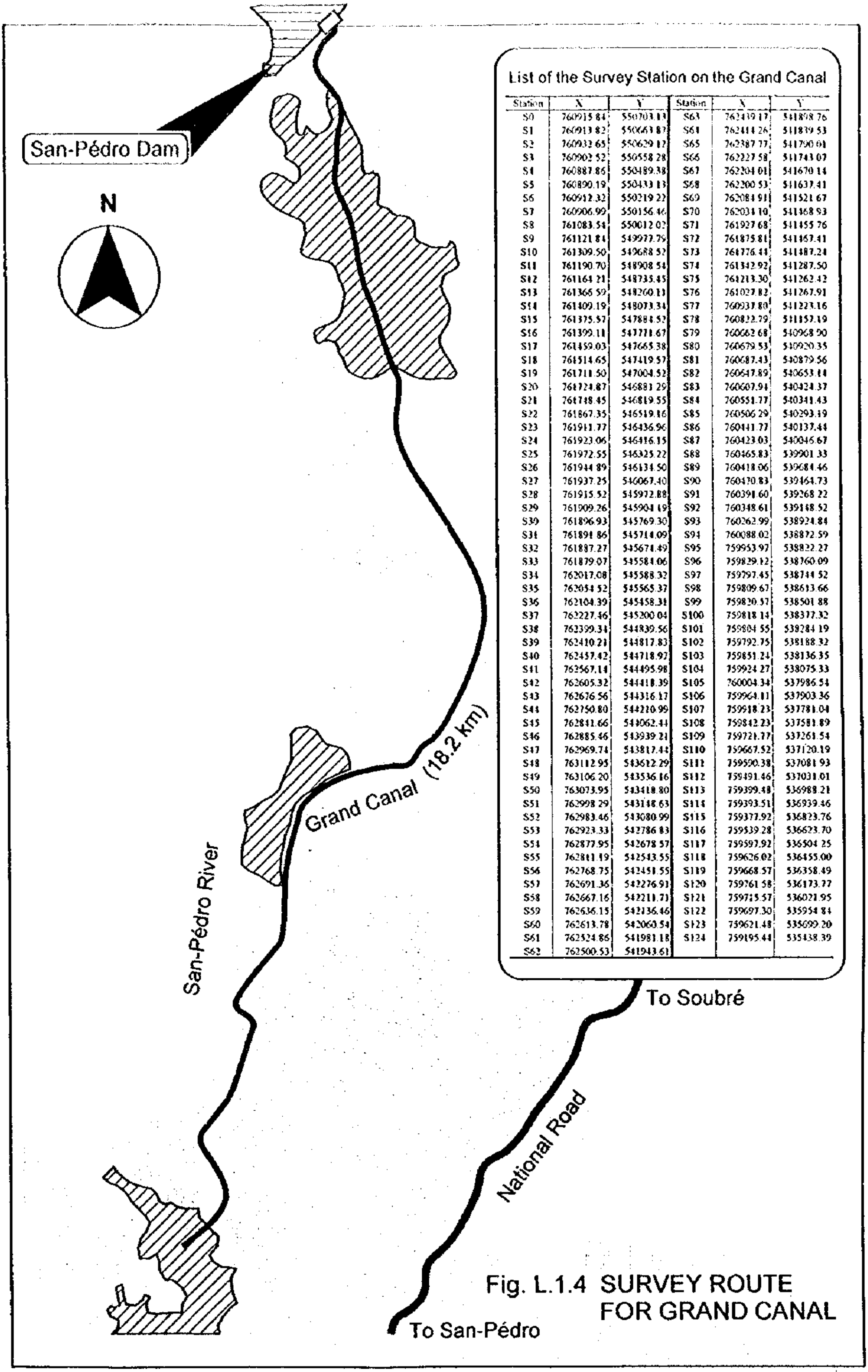


Fig. L.1.3 SURVEYED IRRIGATION AND DRAINAGE CANALS



List of the Survey Station on the Grand Canal

Station	X	Y	Station	X	Y
S0	760915.84	550703.13	S63	762439.17	541898.76
S1	760913.82	550663.87	S64	762414.26	541839.53
S2	760932.65	550629.12	S65	762387.77	541790.01
S3	760902.52	550558.28	S66	762227.58	541743.07
S4	760887.86	550489.38	S67	762204.01	541670.14
S5	760890.19	550433.13	S68	762200.53	541637.41
S6	760912.32	550219.22	S69	762084.91	541521.67
S7	760906.99	550156.46	S70	762034.10	541468.93
S8	761083.54	550012.02	S71	761927.68	541455.76
S9	761121.84	549977.79	S72	761875.81	541467.41
S10	761309.50	549688.52	S73	761776.44	541487.24
S11	761190.70	548908.54	S74	761342.92	541287.50
S12	761164.21	548735.45	S75	761213.30	541262.42
S13	761365.59	548260.13	S76	761027.82	541267.91
S14	761409.19	548073.34	S77	760937.80	541223.16
S15	761375.57	547884.52	S78	760822.79	541157.19
S16	761399.11	547771.67	S79	760662.68	540968.90
S17	761459.03	547665.38	S80	760679.53	540920.35
S18	761514.65	547419.57	S81	760687.43	540879.56
S19	761711.50	547004.52	S82	760647.89	540653.44
S20	761724.87	546881.29	S83	760607.94	540424.37
S21	761748.45	546819.55	S84	760551.77	540341.43
S22	761867.35	546519.16	S85	760506.29	540293.19
S23	761911.77	546436.96	S86	760441.77	540137.44
S24	761923.06	546416.15	S87	760423.03	540046.67
S25	761972.55	546325.22	S88	760465.83	539901.33
S26	761944.89	546134.50	S89	760418.06	539684.46
S27	761937.25	546067.40	S90	760470.83	539464.73
S28	761915.52	545972.88	S91	760391.60	539268.22
S29	761909.26	545904.19	S92	760348.61	539148.52
S30	761896.93	545769.30	S93	760262.99	538924.84
S31	761891.86	545714.09	S94	760088.02	538872.59
S32	761887.27	545671.49	S95	759953.97	538822.27
S33	761879.07	545584.06	S96	759829.12	538760.09
S34	762017.08	545588.32	S97	759797.45	538744.52
S35	762054.52	545565.37	S98	759809.67	538613.66
S36	762104.39	545458.31	S99	759820.57	538501.88
S37	762227.46	545200.04	S100	759818.14	538377.32
S38	762399.34	544839.56	S101	759804.55	538284.19
S39	762410.21	544817.83	S102	759792.75	538188.32
S40	762457.42	544718.97	S103	759851.24	538136.35
S41	762567.14	544495.98	S104	759924.27	538075.33
S42	762605.32	544418.39	S105	760004.34	537986.54
S43	762676.56	544316.17	S106	759964.11	537903.36
S44	762750.80	544210.99	S107	759918.23	537781.04
S45	762841.66	544062.44	S108	759842.23	537581.89
S46	762885.46	543939.21	S109	759721.77	537261.54
S47	762969.74	543817.44	S110	759667.52	537120.19
S48	763112.95	543612.29	S111	759590.38	537081.93
S49	763106.20	543536.16	S112	759491.46	537031.01
S50	763073.95	543418.80	S113	759399.48	536988.21
S51	762998.29	543148.63	S114	759393.51	536939.46
S52	762983.46	543080.99	S115	759377.92	536823.76
S53	762923.33	542786.83	S116	759539.28	536623.70
S54	762877.95	542678.57	S117	759597.92	536504.25
S55	762811.19	542543.55	S118	759626.02	536455.00
S56	762768.75	542451.55	S119	759668.57	536358.49
S57	762691.36	542276.91	S120	759761.58	536173.77
S58	762667.16	542211.71	S121	759715.57	536021.95
S59	762636.15	542136.46	S122	759697.30	535954.84
S60	762613.78	542060.54	S123	759621.48	535699.20
S61	762524.86	541981.18	S124	759195.44	535438.39
S62	762500.53	541943.61			

Fig. L.1.4 SURVEY ROUTE FOR GRAND CANAL

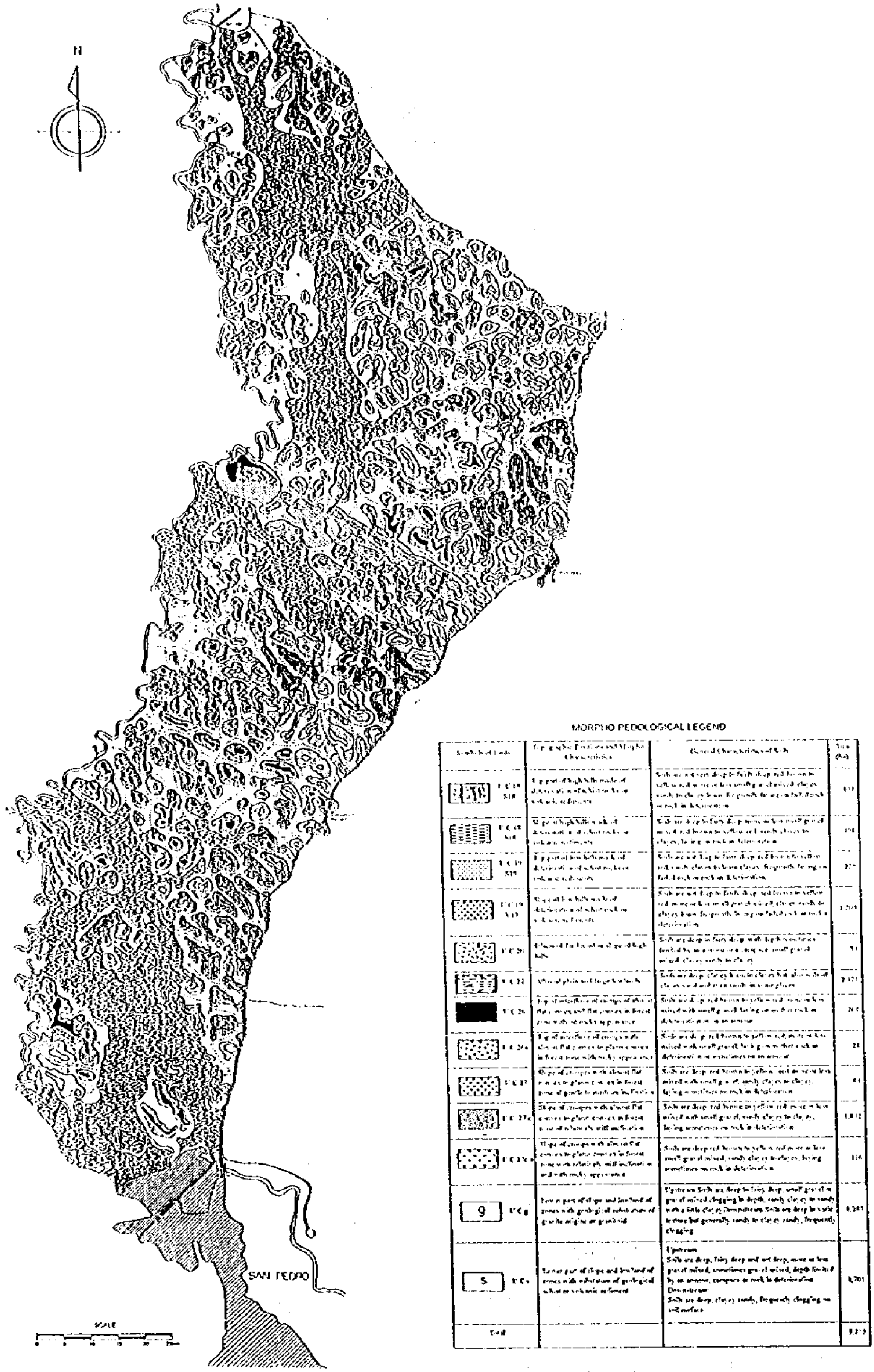


Fig. L.2.1 MORPHO – PEDROLOGICAL MAP FOR THE STUDY AREA

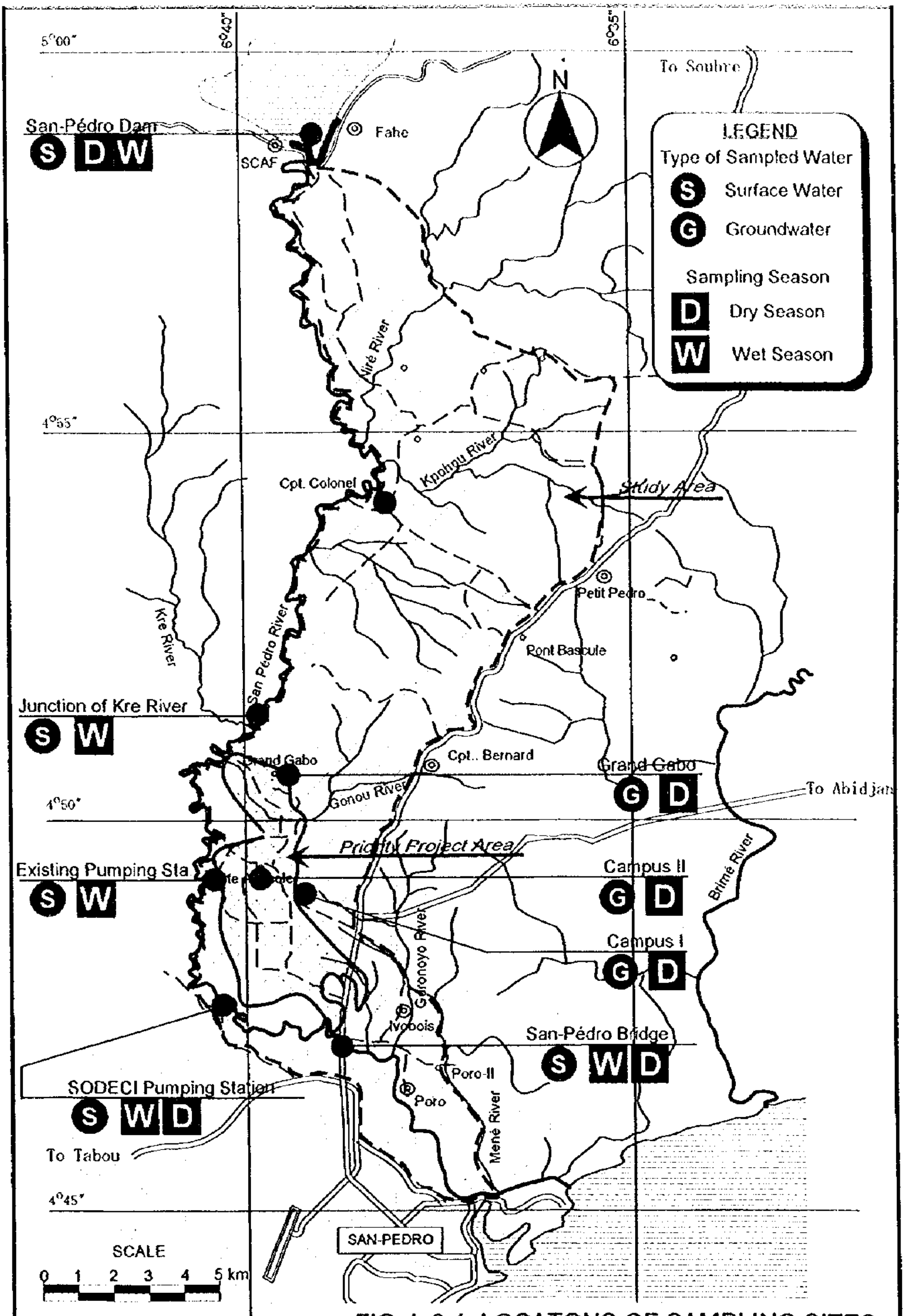


FIG. L.3.1 LOCATONS OF SAMPLING SITES

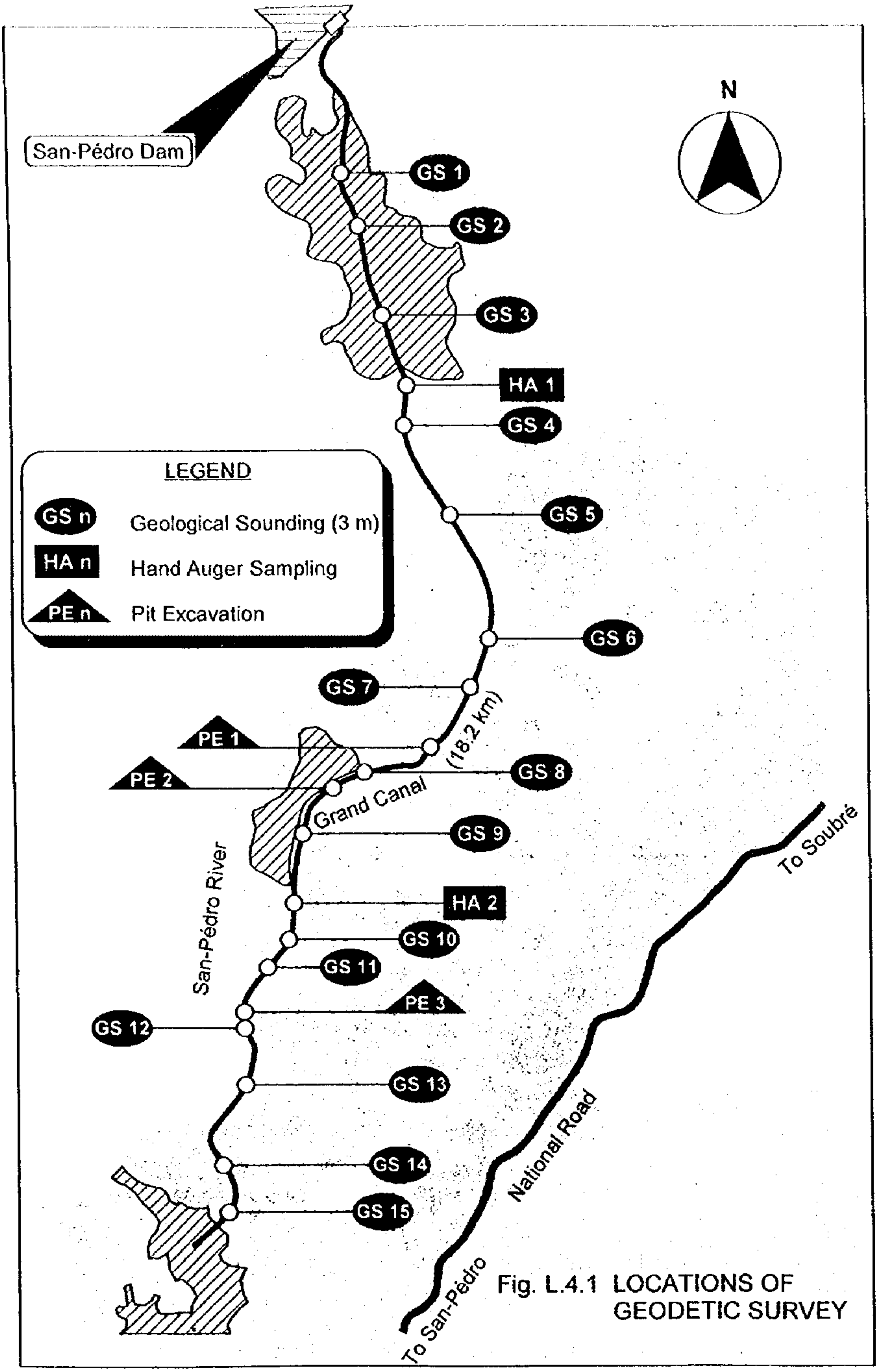


Fig. L.4.1 LOCATIONS OF GEODETIC SURVEY

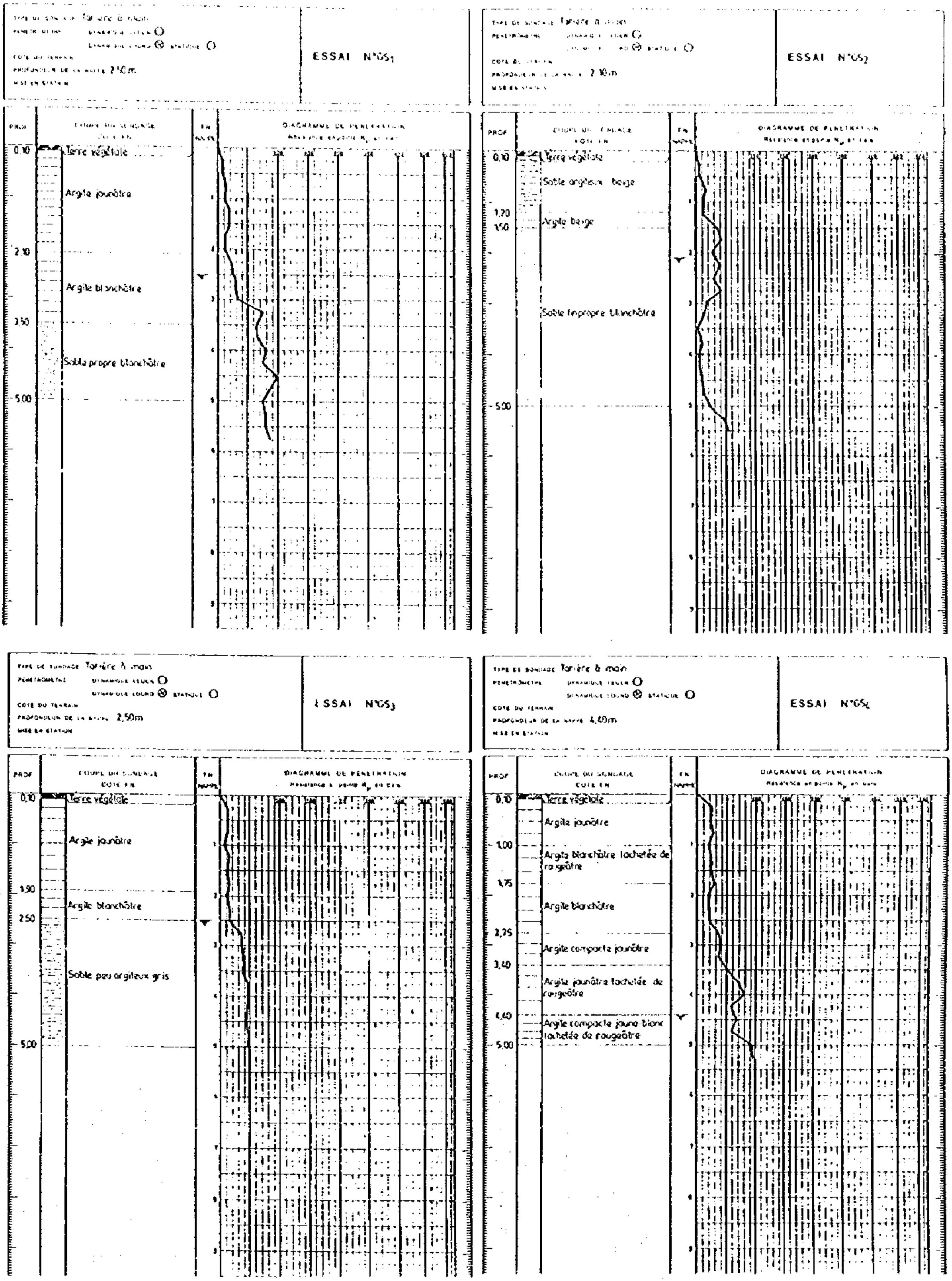


Fig. L.4.2 SOIL PROFILES (1/5)

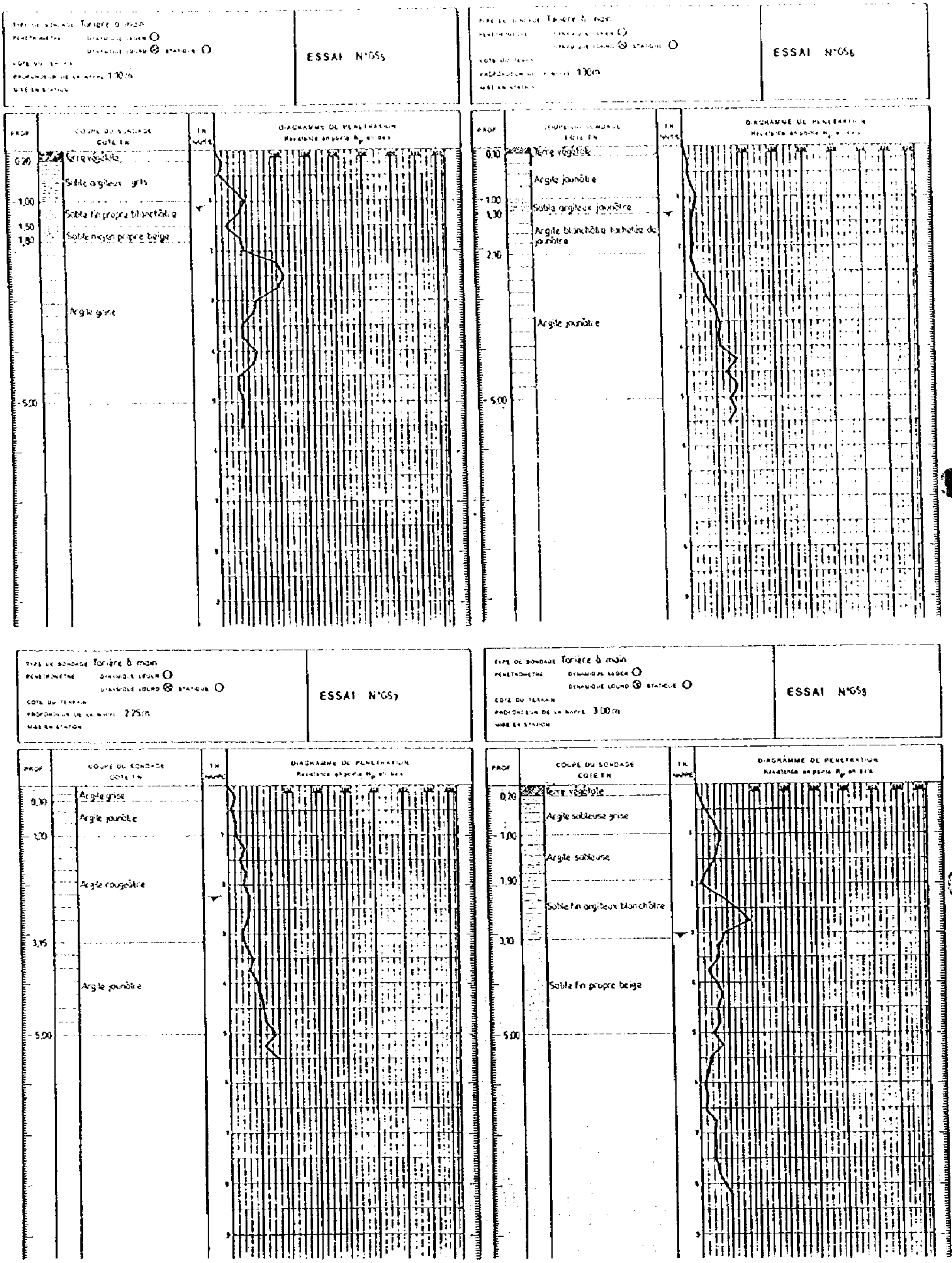


Fig. L.4.2 SOIL PROFILES (2/5)

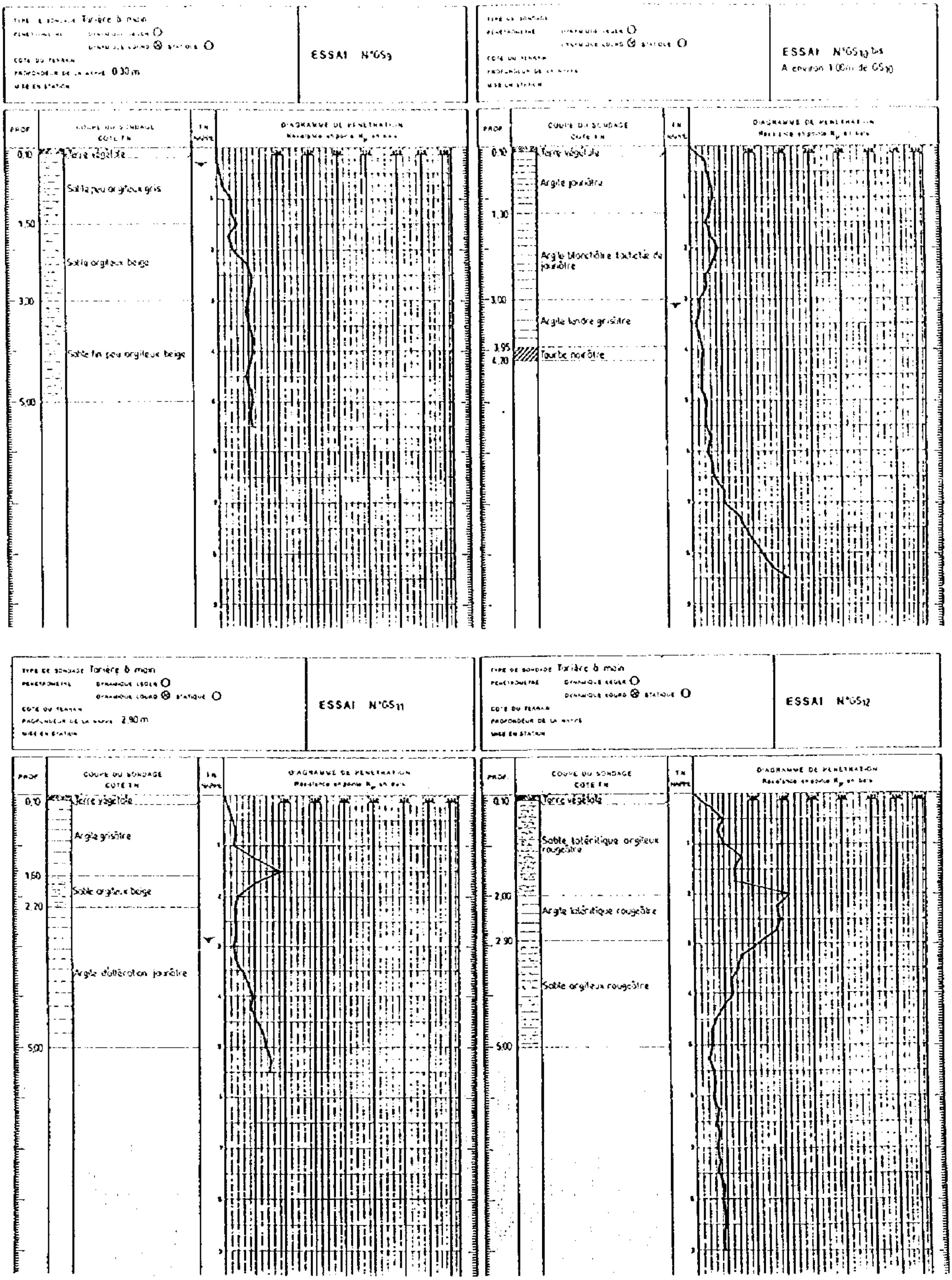
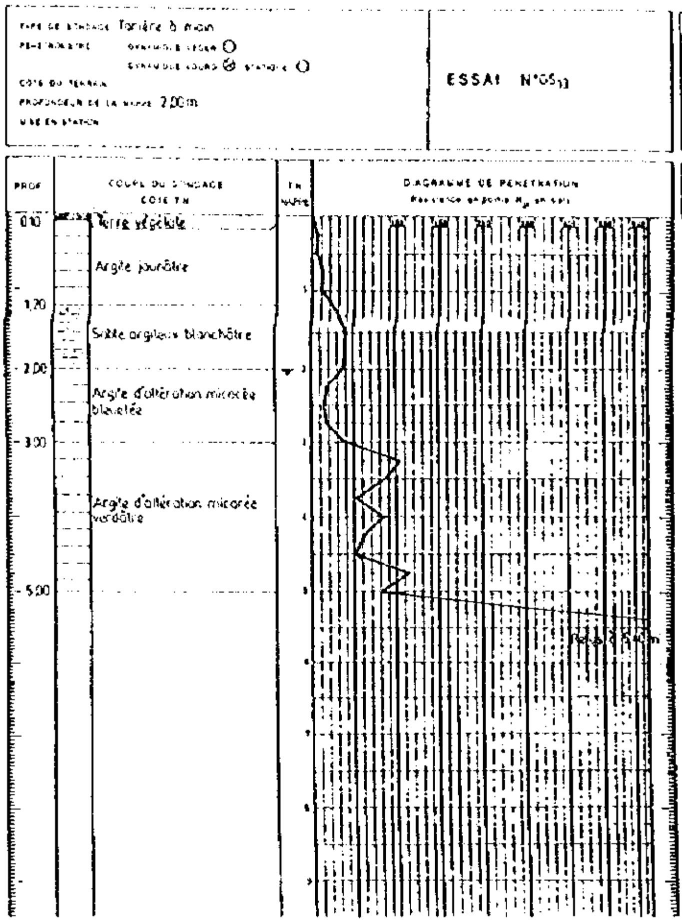
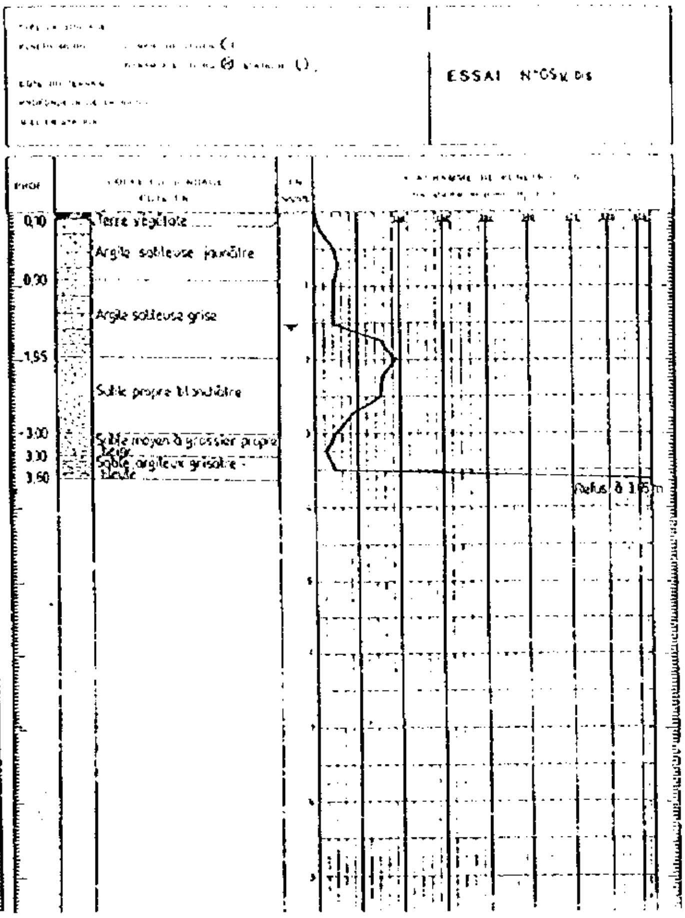


Fig. L.4.2 SOIL PROFILES (3/5)





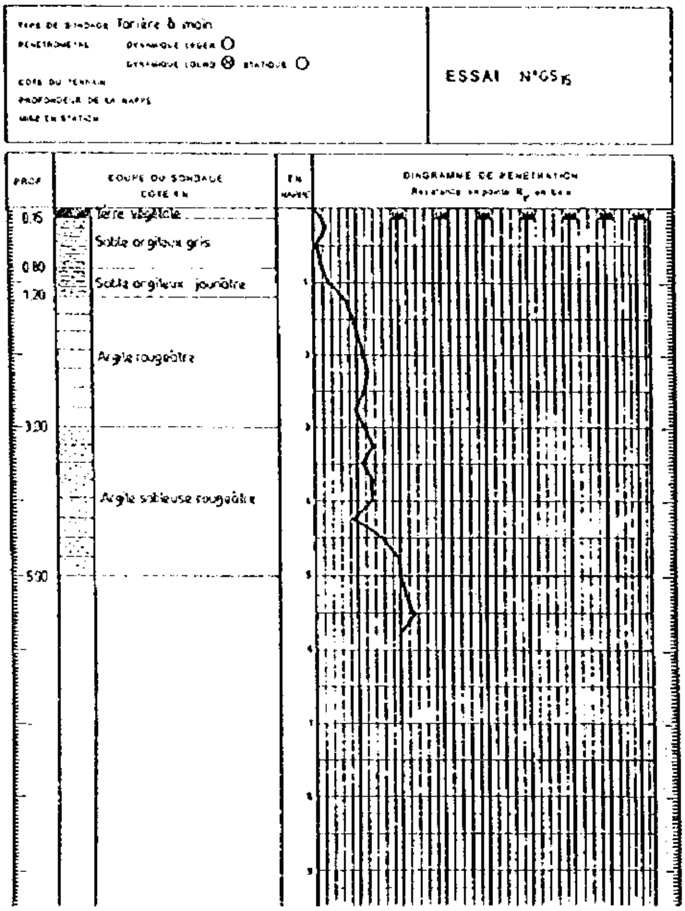


Fig. L.4.2 SOIL PROFILES (4/5)

Type de sondage : Tarière à main
Cote du terrain naturel
Profondeur de la nappe
Description du site

N° HA1

COTE	Profondeur en m	DESCRIPTION DES SOLS	Echantillons	OBSERVATIONS
	0,00 – 0,20	Terre végétale		
	0,20 – 0,95	Sable latéritique argileux jaunâtre		
	0,95 – 2,60	Argile latéritique rougeâtre		

Type de sondage : Tarière à main
Cote du terrain naturel
Profondeur de la nappe
Description du site

N° HA2

COTE	Profondeur en m	DESCRIPTION DES SOLS	Echantillons	OBSERVATIONS
	0,00 – 0,10	Terre végétale		
	0,10 – 1,10	Sable argileux jaunâtre		
	1,10 – 2,80	Argile sableuse rougeâtre		

Type de sondage : Puits manuel
Cote du terrain naturel
Profondeur de la nappe
Description du site

N° PE1

COTE	Profondeur en m	DESCRIPTION DES SOLS	Echantillons	OBSERVATIONS
	0,00 – 0,10	Terre végétale		
	0,10 – 1,40	Argile sableuse brunâtre		
	1,40 – 1,50	Sable argileux rougeâtre		

Type de sondage : Puits manuel
Cote du terrain naturel
Profondeur de la nappe
Description du site

N° PE2

COTE	Profondeur en m	DESCRIPTION DES SOLS	Echantillons	OBSERVATIONS
	0,00 – 0,10	Terre végétale		
	0,10 – 0,60	Sable argileux grisâtre		
	0,60 – 1,50	Sable argileux jaunâtre		

Type de sondage : Puits manuel
Cote du terrain naturel
Profondeur de la nappe
Description du site

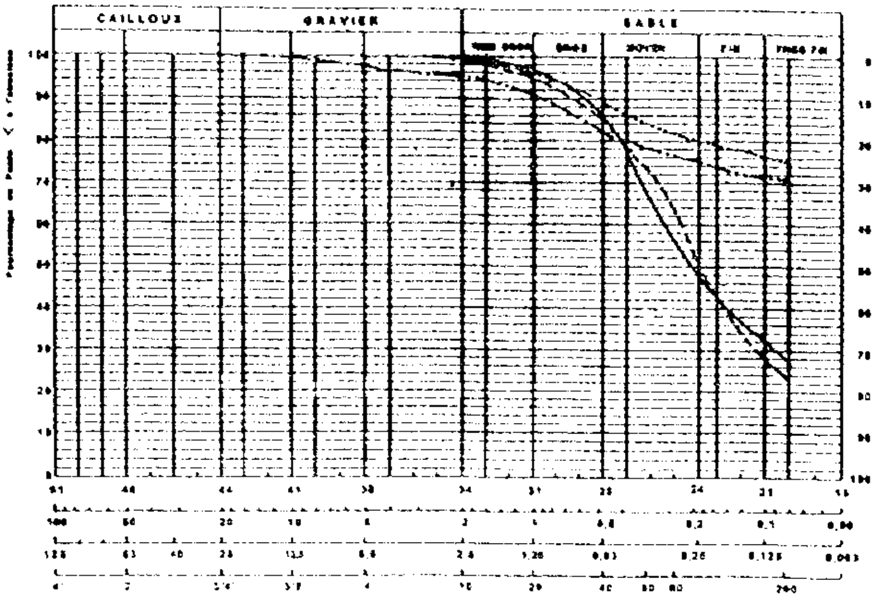
N° PE3

COTE	Profondeur en m	DESCRIPTION DES SOLS	Echantillons	OBSERVATIONS
	0,00 – 0,75	Argile sableuse marron		
	0,75 – 1,15	Argile sableuse jaunâtre		
	1,15 – 1,50	Argile sableuse rougeâtre		

Fig. L.4.2 SOIL PROFILES (5/5)

Représentations graphiques	Numéros des échantillons	Profondeurs de prélèvement	Lieux de prélèvement	Dates de prélèvement	OBSERVATIONS
	1	0,50 m			
	2	1,50	PE_2		
	3	0,50	PE_3		
	4	1,50			

ANALYSES GRANULOMETRIQUES

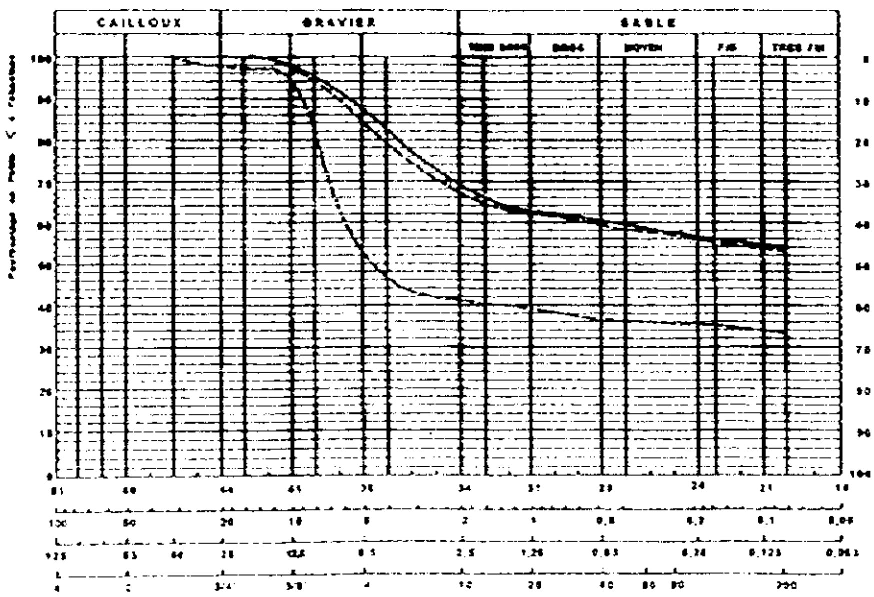


**LIMITES D'ATTERBERG
EQUIVALENTS DE SABLE
CLASSIFICATION H. R. B**

N° Echant.	1	2	3	4
LL %	44	42	60	62
LP %	18	18	35	40
IP %	26	24	25	22
ES %	27	23	61	75
W %	19	13	35	35
γ_s	2,57	2,61	2,59	2,60
Classe LCPC	SA	SA	Lt	Lt

Représentations graphiques	Numéros des échantillons	Profondeurs de prélèvement	Lieux de prélèvement	Dates de prélèvement	OBSERVATIONS
	1	0,50 m	PE_1		
	2	1,00			
	3	1,50			

ANALYSES GRANULOMETRIQUES



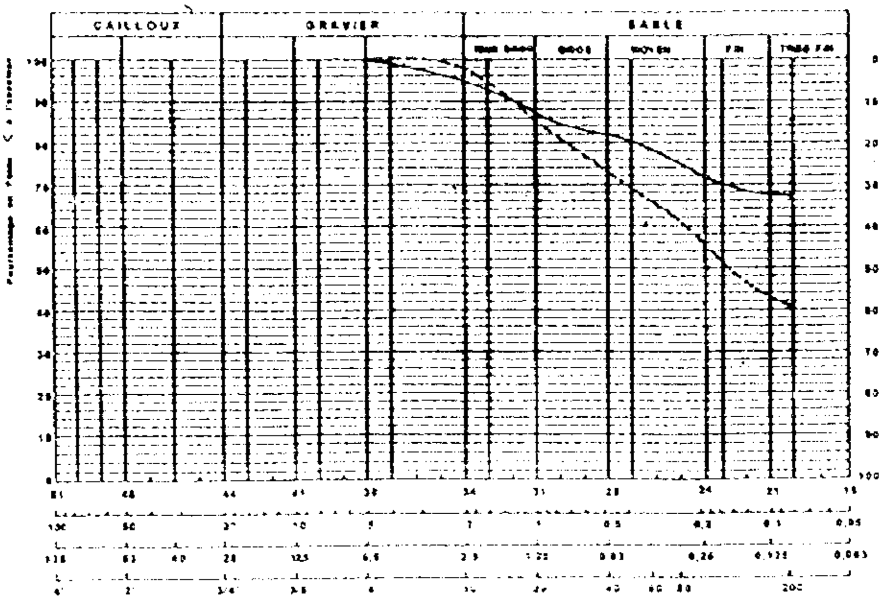
**LIMITES D'ATTERBERG
EQUIVALENTS DE SABLE
CLASSIFICATION H. R. B**

N° Echant.	1	2	3	
LL %	60	59	61	
LP %	32	41	38	
IP %	28	18	23	
ES %	54	53	33	
W %	26	25	29	
γ_s	2,55	2,53	2,50	
Classe LCPC	Lt	Lt	GA	

Fig. L.4.3 SOIL PROPERTIES (1/4)

Représentations graphiques	Numéros des échantillons	Profondeurs de prélèvement (m)	Lieux de prélèvement	Dates de prélèvement	OBSERVATIONS
	1	0.95/1.50 m	HA1		
	2	0.50/1.10	HA2		

ANALYSES GRANULOMETRIQUES



LIMITES D'ATTERBERG
EQUIVALENTS DE SABLE
CLASSIFICATION H. R. B

N° Echant	1	2		
LL %	57	33		
LP %	29	18		
IP %	28	15		
ES %	67	41		
W %	25	29		
γ_s	2.59	2.59		
Classe LCPC	At	SA		

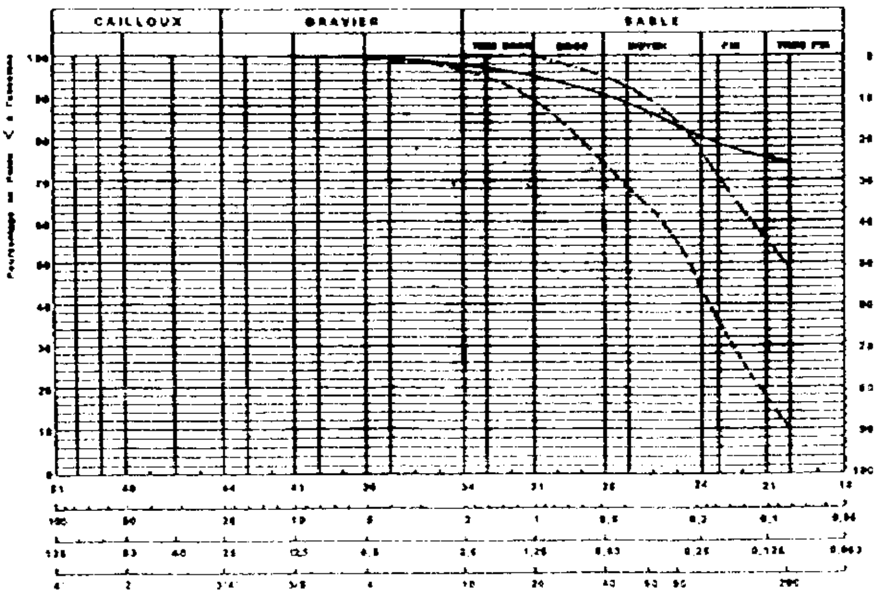
Module de la Série AFNOR

Dimensions en m/m

Désignation des Tamis A.S.T.M

Représentations graphiques	Numéros des échantillons	Profondeurs de prélèvement	Lieux de prélèvement	Dates de prélèvement	OBSERVATIONS
	1	0.90/1.95 m	GS14		
	2	1.95/3.00	GS14		
	3	0.80/1.20	GS15		

ANALYSES GRANULOMETRIQUES



LIMITES D'ATTERBERG
EQUIVALENTS DE SABLE
CLASSIFICATION H. R. B

N° Echant	1	2	3	
LL %	65	22	37	
LP %	32	12	19	
IP %	33	10	18	
ES %	74	10	45	
W %	24	12	19	
γ_s	2.59	2.68	2.60	
Classe LCPC	At	SA	SA	

Module de la Série AFNOR

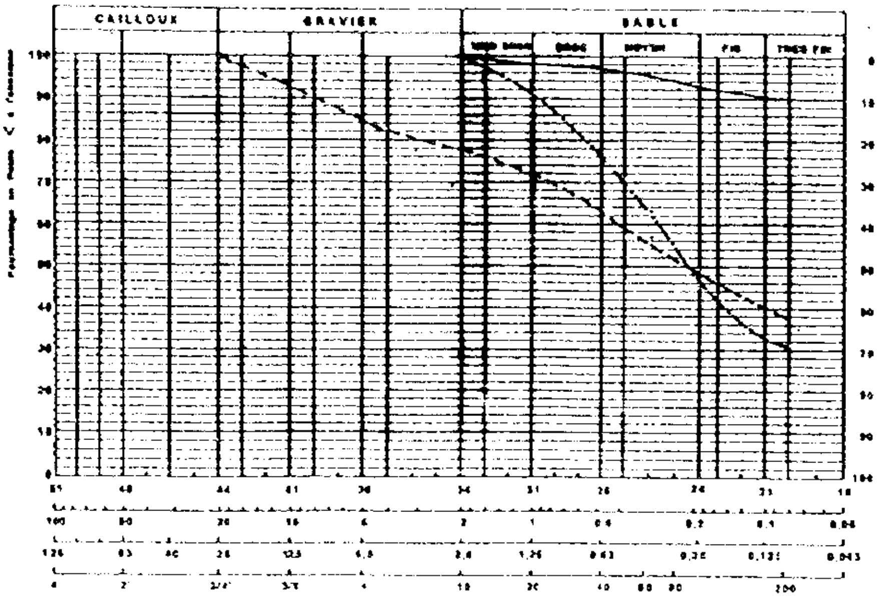
Dimensions en m/m

Désignation des Tamis A.S.T.M

Fig. L.4.3 SOIL PROPERTIES (2/4)

Représentations graphiques	Numéros des échantillons	Profondeurs de prélèvement	Lieux de prélèvement	Dates de prélèvement	OBSERVATIONS
———	1	1.20/1.60 m	GS_{11}		
— — —	2	0.10/2.00	GS_{12}		
—·—·—	3	1.20/2.00	GS_{13}		
········					

ANALYSES GRANULOMETRIQUES



**LIMITES D'ATTERBERG
EQUIVALENTS DE SABLE
CLASSIFICATION H. R. B**

N° Echant	1	2	3	
LL %	60	45	38	
LP %	31	22	20	
IP %	29	23	18	
F %	90	38	31	
W %	18	15	24	
γ_s	2,55	2,61	2,63	
Classe LCPC	At	SA	GA	

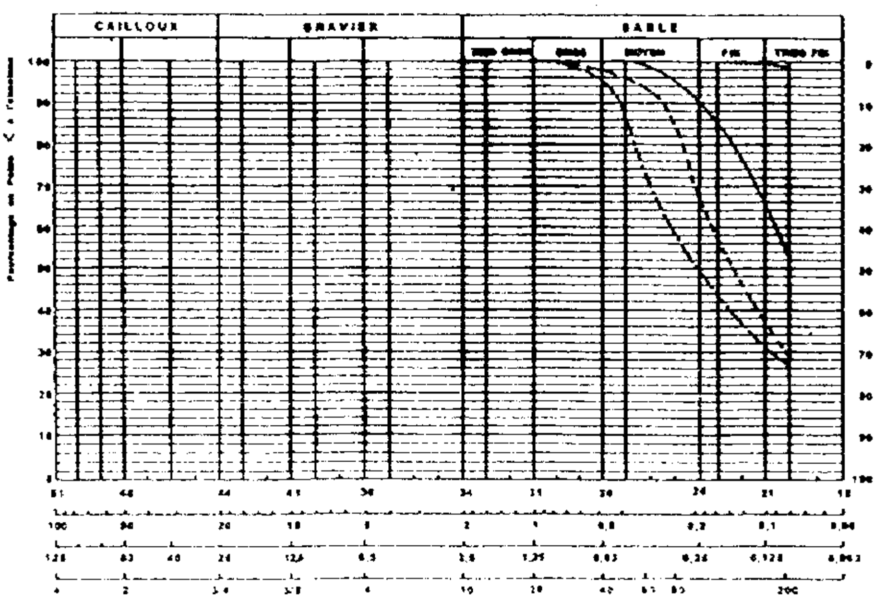
Module de la Série A.F.N.O.R

Dimensions en m/m

Désignation des Tamis A. S. T. M

Représentations graphiques	Numéros des échantillons	Profondeurs de prélèvement	Lieux de prélèvement	Dates de prélèvement	OBSERVATIONS
———	1	1,00/1,90 m	GS_8		
— — —	2	1,90/3,30	GS_8		
—·—·—	3	1,50/2,30	GS_9		
········	4	1,30/3,00	GS_{10}		

ANALYSES GRANULOMETRIQUES



**LIMITES D'ATTERBERG
EQUIVALENTS DE SABLE
CLASSIFICATION H. R. B**

N° Echant	1	2	3	4
LL %	38	26	24	78
LP %	19	11	11	37
IP %	19	15	13	41
F %	53	28	27	99
W %	25	15	47	27
γ_s	2,57	2,62	2,60	2,54
Classe LCPC	Ap	SA	SA	At

Module de la Série A.F.N.O.R

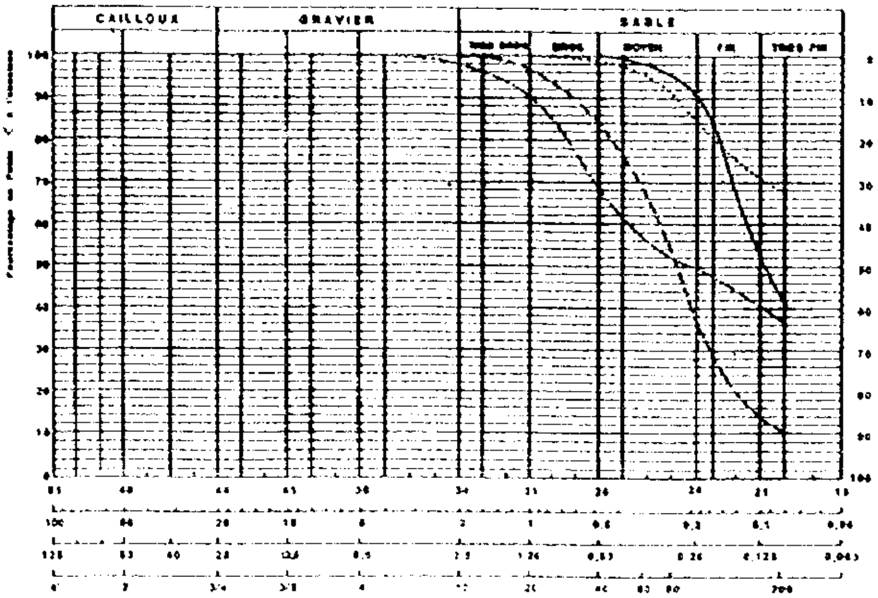
Dimensions en m/m

Désignation des Tamis A. S. T. M

Fig. L.4.3 SOIL PROPERTIES (3/4)

Représentations graphiques	Numéros des échantillons	Profondeurs de prélèvement	Lieux de prélèvement	Dates de prélèvement	OBSERVATIONS
— — — — —	1	0,20/1,00 m	GS_5		
-- — -- — --	2	1,00/1,50	GS_5		
--- ·-- ·---	3	[illegible]/1,30	GS_6		
· · · · · · · · · ·	4	1,00/3,15	GS_7		

ANALYSES GRANULOMETRIQUES



LIMITES D'ATTERBERG
EQUIVALENTS DE SABLE
CLASSIFICATION H. R. B

N° Echant	1	2	3	4
LL %	38	19	42	42
LP %	19	14	21	22
IP %	19	5	21	20
ES %	41	10	36	67
W %	28	40	29	40
γ_s	2,65	2,65	2,55	2,64
Classe LCPC	SL	Sm	SL	Ap

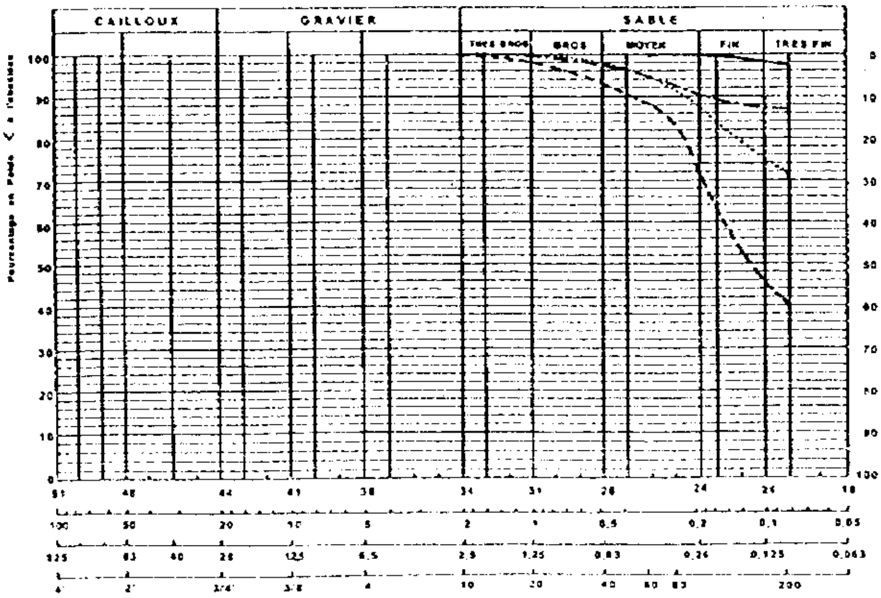
Module de la Série AFNOR

Dimensions en mm

Désignation des Tamis A S T M

Représentations graphiques	Numéros des échantillons	Profondeurs de prélèvement	Lieux de prélèvement	Dates de prélèvement	OBSERVATIONS
——— ———	1	0,90/2,10	GS_1		
— — — —	2	0,10/1,20	GS_2		
——·——·——	3	0,10/1,90	GS_3		
· · · · · · · · · ·	4	1,75/2,75	GS_4		

ANALYSES GRANULOMETRIQUES



LIMITES D'ATTERBERG
EQUIVALENTS DE SABLE
CLASSIFICATION H. R. B

N° Echant	1	2	3	4
LL %	60	40	62	57
LP %	28	21	29	24
IP %	32	19	33	33
ES %	97	40	87	71
W %	32	25	30	26
γ_s	2,51	2,62	2,52	2,54
Classe LCPC	At	SL	At	At

Module de la Série AFNOR

Dimensions en mm

Désignation des Tamis A S T M

Fig. L.4.3 SOIL PROPERTIES (4/4)