

No. 1

REPUBLIC OF THE PHILIPPINES

DETAIL DESIGN REPORT

ON

TRIAL FARM

FOR

DIVERSIFIED CROPS IRRIGATION ENGINEERING PROJECT

(D. C. I. E. P)

APPENDIX

AUGUST 1987

JAPAN INTERNATIONAL COOPERATION AGENCY

ADT
87-37

JICA LIBRARY



1038863[5]

REPUBLIC OF THE PHILIPPINES

DETAIL DESIGN REPORT

ON

TRIAL FARM

FOR

DIVERSIFIED CROPS IRRIGATION ENGINEERING PROJECT

(D.C.I.E.P)

APPENDIX

AUGUST 1987

JAPAN INTERNATIONAL COOPERATION AGENCY

国際協力事業団		
受入 月日	87.9.29	118
登録 No.	16751	83.3
		ADT

APENDIX

CONTENTS

Appendix - 1	Page
1. Soil Survey and Analysis	1
1-1. General	1
1-2. Soil Drainage	2
1-3. Figure	4
1-4. Analysis Data	12
 Appendix - 2	
2. Top Survey	52
2-1. Top Survey Map	52
2-2. Field Note	53

APPENDIX - 1

1. Soil Survey and Analysis

1-1 General

The proposed trial farm is formed by two distinct physiographic landform. These are the alluvial terrace and the low-lying erosional remnant or active flood plain. The formation of these landforms is due to subsequent cutting of the adjacent Angat River through alternating process of lateral and vertical erosion and sedimentation.

The soils of the project area is divided into three major soil types, namely: Quingua Sandy Clay Loam, Quingua Silty Clay Loam and Quingua Silt Loam. These soil types are mainly fine loamy to loamy characterized by deep to very deep moderately drained soils. A modified Soil Map of the area reflecting the different test sites, sampling sites and extent of each soil type is presented in Figure 1.

Assessment of the soil physical characteristics was made by examining 35 soil profiles from auger borings and open pits dug at a depth of 100-120 centimeters. Soil samples were collected in six (6) typical sites for moisture retention and other related analysis. These samples were submitted for analysis at the NIA, Soils Laboratory at Muñoz, Nueva Ecija. Figure 2 summarizes the columnar soil profile description of 25 typical sites.

1. Soil Texture

Results compiled from the pedological survey showed a limited range of textural classes in the different soil types. The low lying flood plain which is typical for Quingua Silt Loam is charac-

terized by subsoils varying from sandy clay loam and fine sandy loam to very fine sandy loam. This covers an approximate area of about 0.45 hectares. Whereas, the predominantly alluvial terrace of about 1.9 hectares is classified as Quingua Silty Clay Loam. The subsoils were found to have finer texture varying from sandy clay loam to clay loam.

The area covered by the highest ground surface is typical of the Quingua Sandy Clay Loam. It is characterized by sandy loam subsoil underlain by gravelly loamy sand. Presence of gravel noted at varying depths from 40 to 85 centimeters from the surface and also depending on the slope and elevation. This soil type covers a total area of about 1.0 hectare.

1-2 Soil Drainage

The surface and subsurface drainage condition is directly related to the slope, soil texture, depth of water table and to some extent the physiographic position of the land. The low-lying flood plain with a very low slope gradient have extremely slower surface and internal drainage. This is the area delineated to be highly suitable for wetland rice production both during the wet and dry season. The intermediate alluvial terrace is characterized by restricted subsurface drainage.

In the determination of the soil permeability and the water storage capacity of the soil, a number of field test were conducted. This includes the following: Field Infiltration (Intake Rate) Test; Percolation Test and Field Hydraulic Conductivity Test. These parameters are vital importance in the analysis and evaluation of the

present and future drainage problem. It also serve as initial design data in planning the desired irrigation and future drainage system.

(i) Field Infiltration Test was conducted using cylinder infiltrometer method to determine the rate at which water enters into the soil surface. Result of field measurement revealed that the basic intake rate obtained under saturated condition varies from 9.61 mm to 12.63 mm per hour in the elevated alluvial terraces and 6.0 mm per hour in the low lying flood plain. These intake rates are considered slow to moderate, thus, indicating an unfavorable subsurface drainage condition. Table 1 shows the summary result of field infiltration test conducted in the different soil types. A graph showing the integrating intake rate is shown in Figure 3.

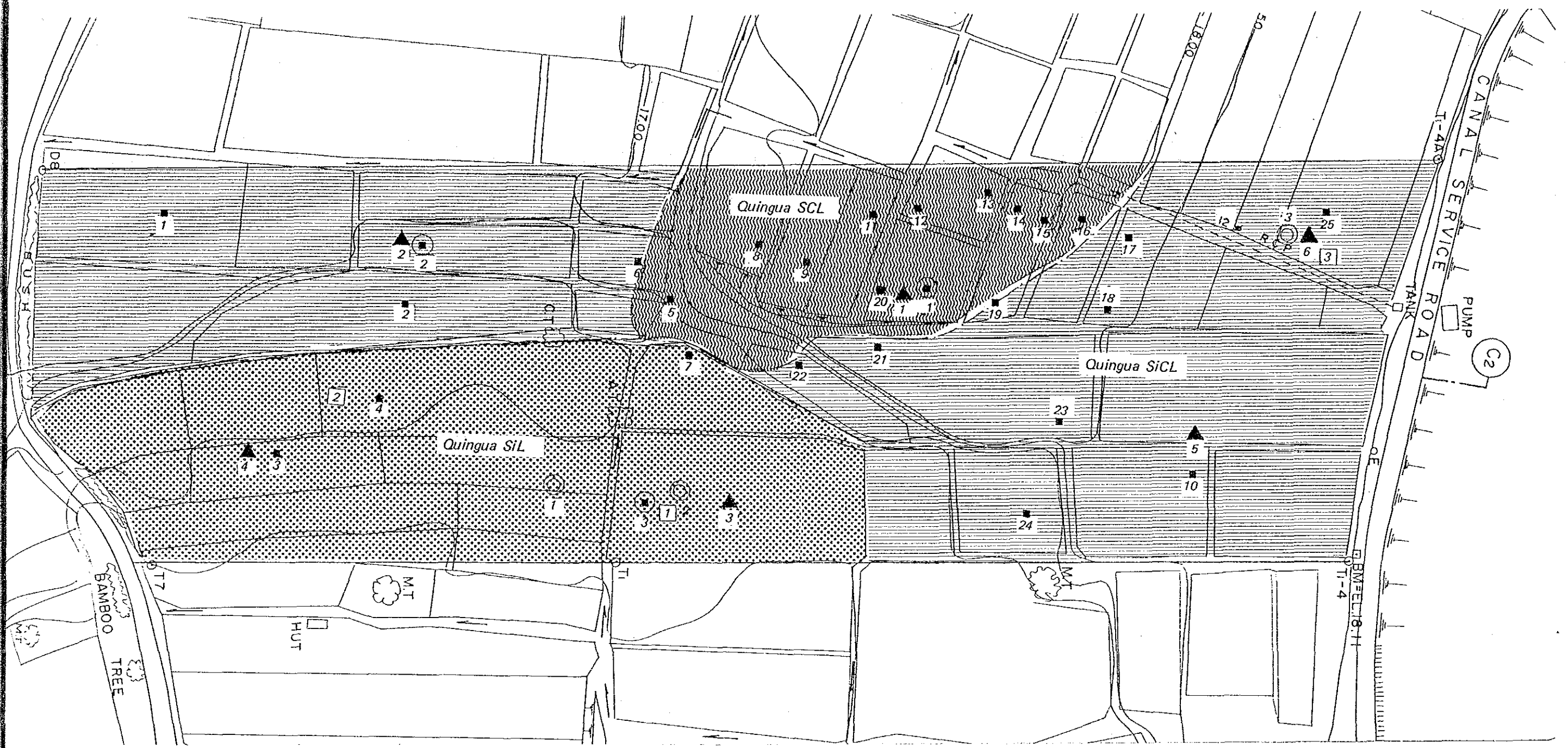
(ii) Percolation Test

Percolation test is use to measure the vertical movement of water in the soil per unit of time through a horizontal unit area in a saturated soil. This test is conducted using the TODAI instrument. Result of three percolation test is shown in Table 2. The percolation rates ranges from 1.7 mm to 1.8 mm per day in the low-lying flood plan and 1.1 mm/day in the alluvial terraces. These rates are moderate values considering the predominance of medium textural soils.

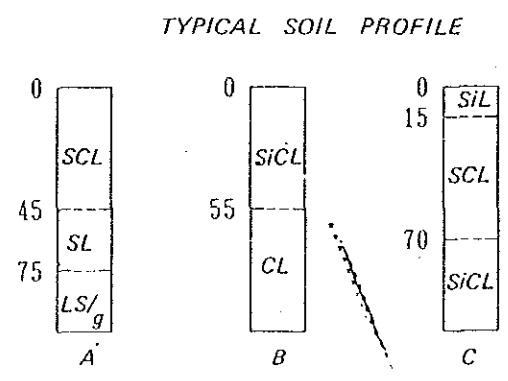
(iii) Hydraulic Conductivity Test

The hydraulic conductivity test represents the average water transmitting property of the soil. This is measured using the inverse auger hole method. Test values showed a hydraulic rate of 0.91 meter to 1.0 meter per day in the flood plain and 1.26 meter per day in the alluvial terraces, These results indicates a favorable or moderate subsurface intake rate. Result of the hydraulic test is summarized in Table 3

FIGURE 1 SOIL MAP OF THE PROPOSED TRIAL FARM SHOWING THE SAMPLING AND OTHER TEST SITE



- LEGEND
- ▲ Soil Sampling Site
 - Infiltration (Intake Rate) Test
 - Percolation Test
 - 1 Hydraulic Conductivity Test
 - Auger Boring Site



- LEGEND :
- Quingua SCL
 - Quingua SiCL
 - Quingua SiL

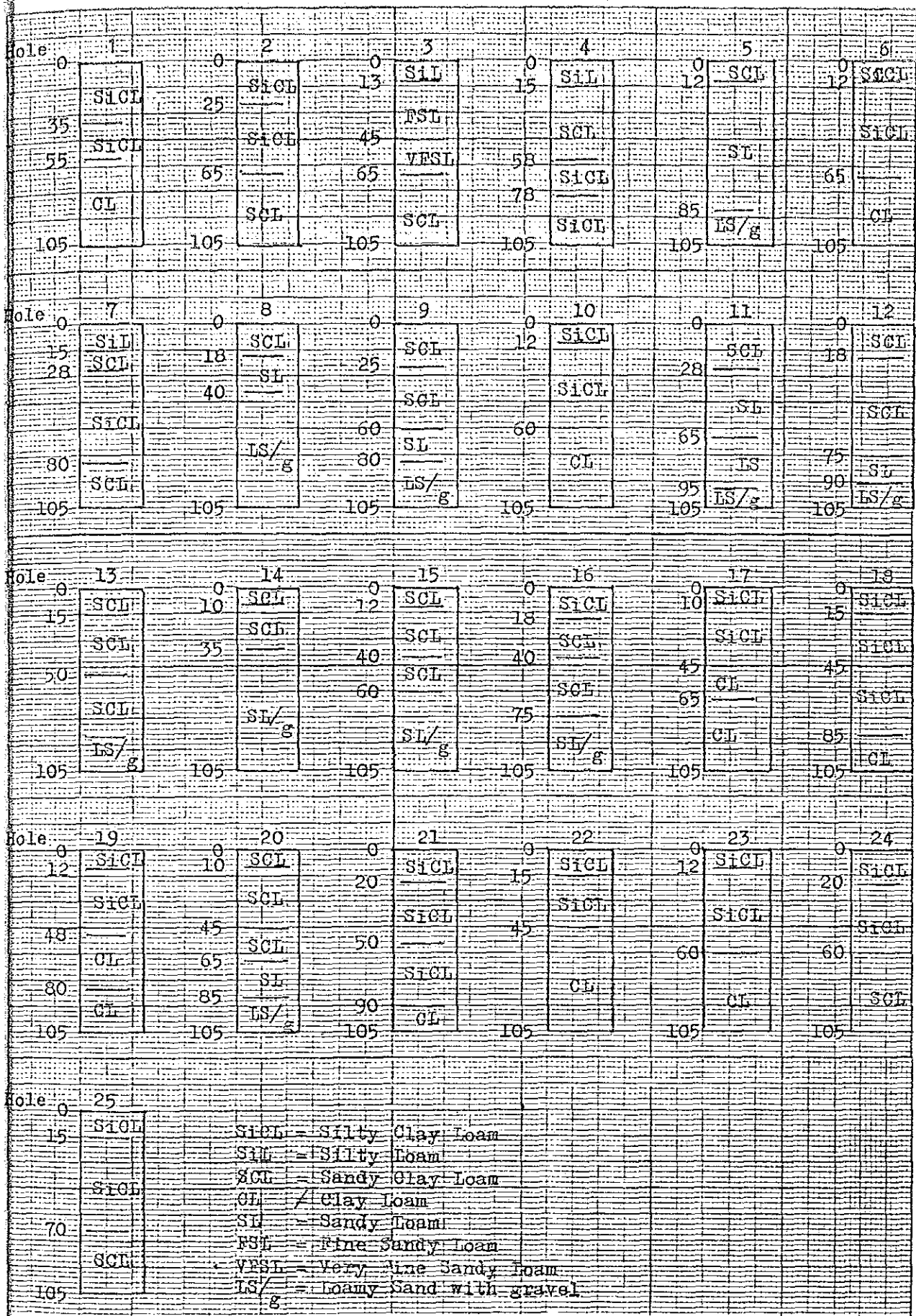


Figure 2 . Columnar Soil Profiles Showing the Textural Classes

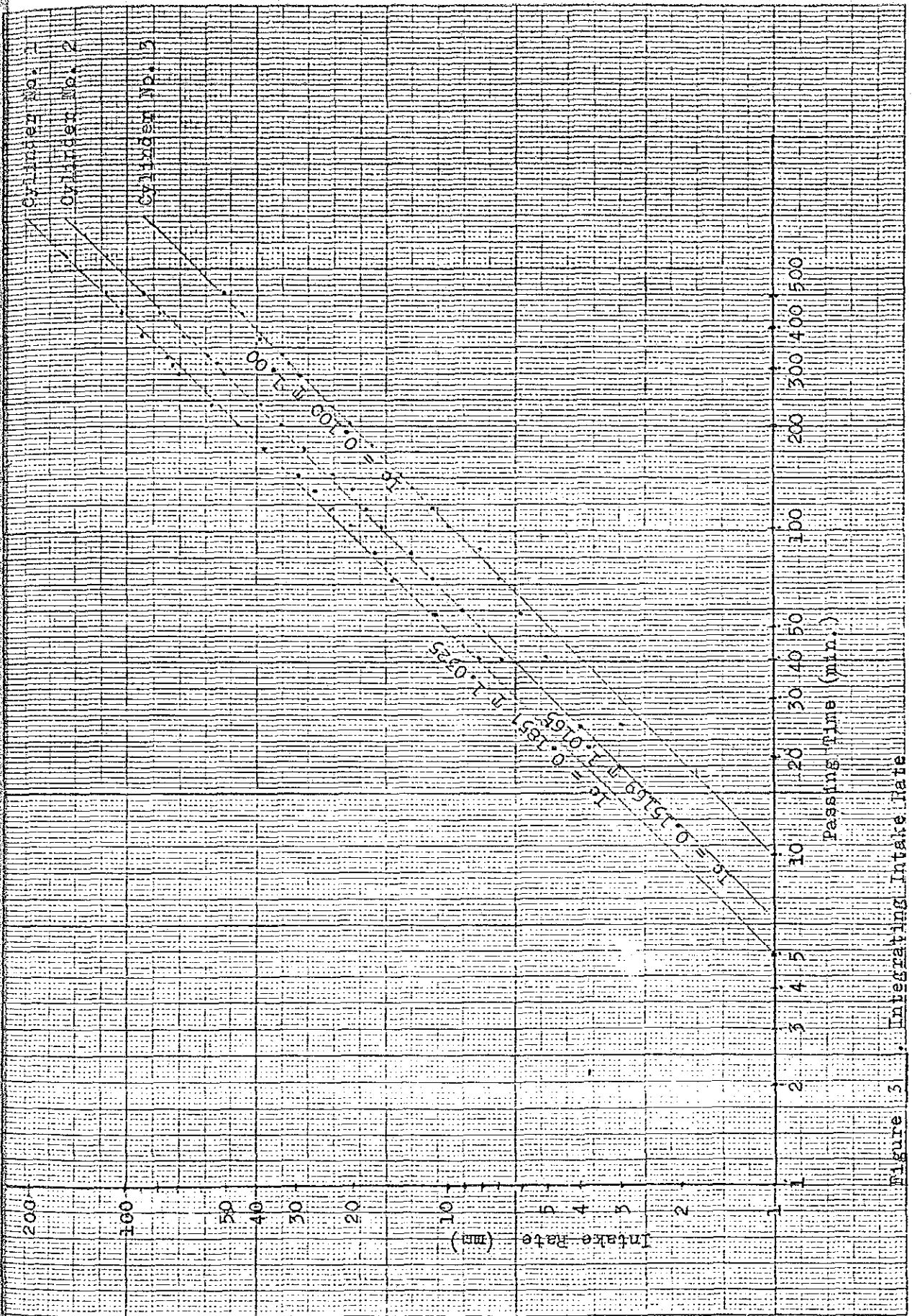


Figure 3. Integrating Intake Rate

Table 1. Summary Result of Infiltration (Intake Rate) Test

Project: Diversified Crops Irrigation Engineering Project

Site: DCIEP Trial Farm

Soil Moisture: Wet

Date Performed: June 15-17, 1987

Observation No.	Location	Texture		Infiltration Rate (mm/hr)	
		Surface	Subsurface	Cummulative (Ic)	Basic (Ib)
1	Upland	SOL	SL	0.1851 T 1.0325	12.63
2	Upland	S1CL	S1CL/CL	0.1516 T 1.0165	9.61
3	Paddy Field	S1L	S1CL/ FSL	0.1000 T 1.0000	6.00

Table 2 + Result of Percolation Test

Project : Diversified Crops Irrigation Engineering Project

Site : DCIEP Trial Farm

Soil Moisture: Wet

Date Performed: June 9-11, 1987 Slope: level to nearly level

Observation No.	Location	Texture		Passing Time (min.)	Reading (mm)		Rate (mm/day)
		Surface	Subsoil		Initial	Final	
1	Paddy Field	sIL	SCL/SL	10	0.8	2.6	1.8
2	Paddy Field	sIL	SCL/FSL	10	0.6	2.3	1.7
3	Upland Field	SiCL	SCL/CL	10	0.3	1.4	1.1

Table 3. Result of Hydraulic Conductivity Test

Project: Diversified Crops Irrigation Engineering Project

Site: DCIEP Trial Farm Soil Moisture: Wet

Date Performed: June 18, 1987

Observation No.	Location	Soil		Test Zone (cm)	Passing Time (min)	Water Level (cm)	Intake (cm) Reading	Hydraulic Conductivity (m/day)
		Depth	Texture					
1	Paddy Field	0 - 28	SiL	30.7 - 220	-	34.7	-	1.0
		28 - 130	SoL		2	46.0	11.3	
		130 - 190	LFS		5	61.9	27.2	
		190 - 220	VPS		10	82.0	47.3	
(A)	Paddy Field	0 - 25	SiL	18.9 - 120	-	22.9	-	0.22
		25 - 105	SoL		2	24.9	2.0	
		105 - 155	SiL		5	27.8	4.9	
		155 - 180	FSL		10	31.1	8.2	
(B)	Paddy Field	0 - 25	SiL	22.6 - 180	-	26.6	-	0.91
		25 - 105	SoL		2	36.1	9.8	
		105 - 155	SiL		5	51.7	25.1	
		155 - 180	FSL		10	72.4	45.8	
(A)	Upland	0 - 70	SiOL	77.2 - 120	-	81.2	-	0.59
		70 - 110	SoL		2	83.7	2.5	
		110 - 145	OL		5	85.7	2.0	
		145 - 180	SiO		10	90.0	8.8	
(B)	Upland	0 - 70	SiOL	68.9 - 180	-	72.9	-	1.26
		70 - 110	SoL		2	80.5	2.5	
		110 - 145	OL		5	95.2	22.3	
		145 - 180	SiO		10	115.0	42.1	

Table 4. Summary Result of Moisture Ratio Analysis.

Observation No.	S O I Layer	I Depth (cm)	Apparent Specific Gravity (g/cc)	Real Specific Gravity (g/cc)	Percent Porosity (%)	Moisture Ratio (%)
1	1	5	1.69	2.63	35.74	25.49
	2	15	1.71	2.62	34.65	25.72
	3	25	1.68	2.67	37.14	26.68
2	1	5	1.68	2.66	36.84	30.11
	2	15	1.63	2.68	38.87	29.57
	3	25	1.67	2.66	37.41	28.14
3	1	5	1.76	2.61	32.56	23.58
	2	15	1.64	2.65	38.29	23.25
	3	25	1.59	2.64	39.66	23.59
4	1	5	1.40	2.64	47.16	29.33
	2	15	1.52	2.64	42.62	27.87
	3	25	1.54	2.67	42.22	25.66
5	1	5	1.67	2.60	35.77	29.72
	2	15	1.66	2.64	37.12	28.34
	3	25	1.78	2.65	32.83	25.67
6	1	5	1.93	2.65	26.98	30.47
	2	15	1.93	2.67	32.77	23.47
	3	25	1.95	2.68	27.37	21.32

Table 5. Summary Result of Moisture Retention Test

Site No./Sample	Percent Moisture Field Capacity	Percent Moisture Wilting Point	Percent Available Moisture	pF
1	A	19.25	5.98	13.26
	B	18.75	6.33	12.42
	C	21.16	7.63	13.52
2	A	19.35	8.08	11.27
	B	21.54	8.54	13.00
	C	20.64	8.89	15.09
3	A	18.20	7.09	11.11
	B	18.67	6.58	11.63
	C	17.35	5.93	10.41
4	A	16.02	4.57	11.45
	B	16.15	3.21	12.93
	C	16.21	4.26	11.95
5	A	16.35	7.77	8.58
	B	17.86	7.96	9.89
	C	18.37	7.58	10.78
6	A	18.89	8.05	10.84
	B	19.35	7.61	11.74
	C	18.59	6.81	11.82

1-4. Analysis Data

Table 1a : Infiltration (Intake Rate) Test Data Sheet

Project : Diversified Cross Irrigation Engineering Project

Site : DCIEP Trial Farm Elevation : _____

Date Performed: June 16, 1987 Diameter of Cylinder: 30.2 cm

Observation No.: 1 Location: Diversified Cropland

T I M E	Passing Time (minute)	Water Level Reading (mm)	D r a w d o w n	
			Initial (mm)	Accum. (mm)
8:30	-	118	-	-
8:35	5	117	1	1
8:40	10	116	1	2
8:55	25	113	3	5
9:10	40	110	3	8
9:25	55	107	3	11
9:40	70	104	3	14
9:55	85	101	3	17
10:10	100	98	3	20
10:25	115	95	3	23
10:40	130	92	3	26
10:55	145	89	3	29
11:25	175	81	8	37
11:55	205	73	8	45
12:25	235	64	9	54
13:25	295	50	14	68
13:40	310	47	3	71
13:55	325	44	3	74
14:55	385	30	14	88
15:55	445	17/40	13	101
16:55	505	27	13	114

Table 1b : Infiltration (Intake Rate) Test Data Sheet

Project : Diversified Crops Irrigation Engineering Project

Site : DCIEP Trial Farm Elevation : _____

Date Performed: June 17, 1987 Diameter of Cylinder: 30.2 cm

Observation No. 2 Location : Diversified Cropland

T I M E	Passing Time (minute)	Water Level Reading (mm)	D r a w d o w n	
			Initial (mm)	Accum. (mm)
8:30	-	131	-	-
8:35	5	130	1	1
8:40	10	129	1	2
8:55	25	127	2	4
9:10	40	124	3	7
9:25	55	122	2	9
9:40	70	120	2	11
9:55	85	118	2	13
10:10	100	115	3	16
10:25	115	113	2	18
10:40	130	111	2	20
10:55	145	108	3	23
11:25	175	103	5	28
11:55	205	98	5	33
12:25	235	93	5	38
13:25	295	81	12	50
13:40	310	79	2	52
13:55	325	77	2	54
14:55	385	65	12	66
15:55	445	54	11	77
16:55	505	43	11	88

Table 1c : Infiltration (Intake Rate) Test Data Sheet

Project : Diversified Jrons Irrigation Engineering Project

Site : DCIEE Trial Farm Elevation : _____

Date Performed: June 18, 1987 Diameter of Cylinder: 30.2 cm

Observation No. 3 Location: Riceland

T I M E	Passing Time (minute)	Water Level Reading (mm)	D r a w d o w n	
			Initial (mm)	Accum. (mm)
8:30	-	129	-	-
8:35	5	128.5	0.5	0.5
8:40	10	128	0.5	1
8:55	25	126	2	3
9:10	40	124	2	5
9:25	55	123	1	6
9:40	70	122	1	7
9:55	85	121	1	8
10:10	100	119	2	10
10:25	115	118	1	11
10:40	130	116	2	13
10:55	145	115	2	14
11:25	175	112	3	17
11:55	205	109	3	20
12:25	235	106	3	23
13:25	295	100	6	29
13:40	310	99.8	2	31
13:55	325	97	1	32
14:55	385	91	6	38
15:55	445	86	5	43
16:55	505	80	6	49

ANNEX "A"

SOIL MOISTURE CALCULATION

Site No. 1-A

Required Item	Sample Test			Average
	1	2	3	
1. Soil + Cylinder (A)	206.5 (g)	206.1 (g)	205.2 (g)	206.0 (g)
2. Oven-dry Wt. of Soil (B)	178.9 (g)	176.6 (g)	177.6 (g)	177.7 (g)
3. Cylinder Weight (C)	81.0 (g)	81.3 (g)	81.5 (g)	81.3 (g)
4. Cylinder Capacity (V)	61.6 (cc)	61.6 (cc)	61.6 (cc)	61.6 (cc)
5. Soil (Solid phase) weight (Ws = B - C)	97.9 (g)	95.3 (g)	96.1 (g)	96.4 (g)
6. Liquid (Liquid phase) weight (Ww = A - B)	27.6 (g)	29.5 (g)	27.6 (g)	28.2 (g)
7. Apparent specific gravity of soil (Sa = Ws/V)	1.58 (g/cc)	1.54 (g/cc)	1.56 (g/cc)	1.56 (g/cc)
8. Real specific gravity of soil (Sr = $\frac{W_s}{V_a - V_w}$ or Pycnometer Method)	2.61 (g/cc)	2.62 (g/cc)	2.66 (g/cc)	2.63 (g/cc)
9. Real Capacity (Va)	(%)	(%)	(%)	(%)
10. Liquid phase rate (Vw = Ww)	(%)	(%)	(%)	(%)
11. Solid phase rate (Vs = Va - Vw)	(%)	(%)	(%)	(%)
12. Vapor phase rate (Vv = V - Va)	(%)	(%)	(%)	(%)
13. Porosity = $1 - \frac{S_a}{S_r} \times 100$	39.46 (%)	41.22 (%)	41.35 (%)	40.67 (%)
14. Moisture Ratio (MR = $\frac{W_w}{W_s} \times 100$)	28.19 (%)	30.95 (%)	28.72 (%)	29.28 (%)

ANNEX "A"

SOIL MOISTURE CALCULATION

Site No. I-B

Required Item	Sample Test			Average
	1	2	3	
1. Soil + Cylinder (A)	211.0 (g)	215.2* (g)	211.7 (g)	211.3 (g)
2. Oven-dry Wt. of Soil (B)	184.4 (g)	190.5* (g)	183.6 (g)	184.0 (g)
3. Cylinder Weight (C)	81.0 (g)	81.3 (g)	81.0 (g)	81.1 (g)
4. Cylinder Capacity (V)	61.6 (cc)	61.6 (cc)	61.6 (cc)	61.6 (cc)
5. Soil (Solid phase) weight (Ws = B - C)	103.4 (g)	109.3 (g)	102.6 (g)	103.0 (g)
6. Liquid (Liquid phase) weight (Ww = A - B)	26.6 (g)	24.7 (g)	28.1 (g)	27.3 (g)
7. Apparent specific gravity of soil (Sa = Ws/V)	1.68(g/cc)	1.77(g/cc)	1.67(g/cc)	1.67(g/cc)
8. Real specific gravity of soil Pycnometer (Sr = $\frac{Ws}{Va - Vw}$ or .Method)	2.63(g/cc)	2.61(g/cc)	2.68(g/cc)	2.65(g/cc)
9. Real Capacity (Va)	(%)	(%)	(%)	(%)
10. Liquid phase rate (Vw = Ww)	(%)	(%)	(%)	(%)
11. Solid phase rate (Vs = Va - Vw)	(%)	(%)	(%)	(%)
12. Vapor phase rate (Vv = V - Va)	(%)	(%)	(%)	(%)
13. Porosity = $1 - \frac{Sa}{Sr} \times 100$	36.12 (%)	32.18 (%)	37.68 (%)	36.90 (%)
14. Moisture Ratio (MR = $\frac{Ww}{Ws} \times 100$)	25.72 (%)	22.59 (%)	27.38 (%)	26.55 (%)

* INSIGNIFICANT

ANNEX "A"

SOIL MOISTURE CALCULATION

Site No. 1-C

Required Item	Sample Test			Average
	1	2	3	
1. Soil + Cylinder (A)	210.1 (g)	207.4 (g)	209.4 (g)	209.0 (g)
2. Oven-dry Wt. of Soil (B)	186.4 (g)	183.3 (g)	184.6 (g)	184.8 (g)
3. Cylinder Weight (C)	81.4 (g)	81.3 (g)	81.1 (g)	81.3 (g)
4. Cylinder Capacity (V)	61.6 (cc)	61.6 (cc)	61.6 (cc)	61.6 (cc)
5. Soil (Solid phase) weight ($W_s = B - C$)	105.0 (g)	102.0 (g)	103.5 (g)	103.5 (g)
6. Liquid (Liquid phase) weight ($W_w = A - B$)	23.7 (g)	24.1 (g)	24.8 (g)	24.2 (g)
7. Apparent specific gravity of soil ($S_a = W_s/V$)	1.70 (g/cc)	1.66 (g/cc)	1.68 (g/cc)	1.68 (g/cc)
8. Real specific gravity of soil ($S_r = \frac{W_s}{V_a - V_w}$ or Pycnometer Method)	2.63 (g/cc)	2.64 (g/cc)	2.65 (g/cc)	2.64 (g/cc)
9. Real Capacity (V_a)	(%)	(%)	(%)	(%)
10. Liquid phase rate ($V_w = W_w$)	(%)	(%)	(%)	(%)
11. Solid phase rate ($V_s = V_a - V_w$)	(%)	(%)	(%)	(%)
12. Vapor phase rate ($V_v = V - V_a$)	(%)	(%)	(%)	(%)
13. Porosity = $1 - \frac{S_a}{S_r} \times 100$	35.36 (%)	37.12 (%)	36.60 (%)	36.36 (%)
14. Moisture Ratio (MR = $\frac{W_w}{W_s} \times 100$)	22.57 (%)	23.62 (%)	23.96 (%)	23.38 (%)

ANNEX "A"

SOIL MOISTURE CALCULATION

Site No. 2-A

Required Item	Sample Test			Average
	1	2	3 *	
1. Soil + Cylinder (A)	213.7 (g)	212.5 (g)	209.5* (g)	213.1 (g)
2. Oven-dry Wt. of Soil (B)	185.1 (g)	184.3 (g)	183.9 (g)	184.7 (g)
3. Cylinder Weight (C)	81.1 (g)	80.9 (g)	81.2 (g)	81.0 (g)
4. Cylinder Capacity (V)	67.6 (cc)	67.6 (cc)	67.6 (cc)	67.6 (cc)
5. Soil (Solid phase) weight ($W_s = B - C$)	104.0 (g)	103.4 (g)	102.7 (g)	103.7 (g)
6. Liquid (Liquid phase) weight ($W_w = A - B$)	28.6 (g)	28.2 (g)	25.6 (g)	28.4 (g)
7. Apparent specific gravity of soil ($S_a = W_s/V$)	1.69 (g/cc)	1.68 (g/cc)	1.67 (g/cc)	1.68 (g/cc)
8. Real specific gravity of soil ($S_r = \frac{W_s}{V_a - V_w}$ or Pycnometer Method)	2.65 (g/cc)	2.67 (g/cc)	2.66 (g/cc)	2.66 (g/cc)
9. Real Capacity (V_a)	(%)	(%)	(%)	(%)
10. Liquid phase rate ($V_w = W_w$)	(%)	(%)	(%)	(%)
11. Solid phase rate ($V_s = V_a - V_w$)	(%)	(%)	(%)	(%)
12. Vapor phase rate ($V_v = V - V_a$)	(%)	(%)	(%)	(%)
13. Porosity = $1 - \frac{S_a}{S_r} \times 100$	36.22 (%)	37.07 (%)	37.22 (%)	36.83 (%)
14. Moisture Ratio ($MR = \frac{W_w}{W_s} \times 100$)	27.50 (%)	27.27 (%)	24.93 (%)	27.40 (%)

* INSIGNIFICANT

ANNEX "A"

SOIL MOISTURE CALCULATION

Site No. 2-B

Required Item	Sample Test			Average
	1	2	3	
1. Soil + Cylinder (A)	212.2 (g)	205.1 (g)	209.8 (g)	209.0 (g)
2. Oven-dry Wt. of Soil (B)	184.1 (g)	178.9* (g)	183.6 (g)	183.8 (g)
3. Cylinder Weight (C)	81.1 (g)	80.9 (g)	81.2 (g)	81.1 (g)
4. Cylinder Capacity (V)	61.6 (cc)	61.6 (cc)	61.6 (cc)	61.6 (cc)
5. Soil (Solid phase) weight (Ws = B - C)	103.0 (g)	98.0* (g)	102.4 (g)	102.5 (g)
6. Liquid (Liquid phase) weight (Ww = A - B)	28.1 (g)	26.2 (g)	26.2 (g)	27.1 (g)
7. Apparent specific gravity of soil (Sa = Ws/V)	1.67 (g/cc)	1.59* (g/cc)	1.66 (g/cc)	1.66 (g/cc)
8. Real specific gravity of soil (Sr = $\frac{Ws}{Va - Vw}$ or Pycnometer Method)	2.67 (g/cc)	2.68 (g/cc)	2.66 (g/cc)	2.67 (g/cc)
9. Real Capacity (Va)	(%)	(%)	(%)	(%)
10. Liquid phase rate (Vw = Ww)	(%)	(%)	(%)	(%)
11. Solid phase rate (Vs = Va - Vw)	(%)	(%)	(%)	(%)
12. Vapor phase rate (Vv = V - Va)	(%)	(%)	(%)	(%)
13. Porosity = $1 - \frac{Sa}{Sr} \times 100$	37.45 (%)	40.67* (%)	37.60 (%)	37.52 (%)
14. Moisture Ratio (MR = $\frac{Ww}{Ws} \times 100$)	27.28 (%)	26.73 (%)	25.59 (%)	26.53 (%)

* INSIGNIFICANT

ANNEX "A"

SOIL MOISTURE CALCULATION

Site No. 2-C

Required Item	Sample Test			Average
	1	2	3	
1. Soil + Cylinder (A)	202.1 (g)	203.9 (g)	202.5 (g)	202.8 (g)
2. Oven-dry Wt. of Soil (B)	170.3 (g)	172.3 (g)	171.7 (g)	171.4 (g)
3. Cylinder Weight (C)	80.9 (g)	81.3 (g)	80.9 (g)	81.0 (g)
4. Cylinder Capacity (V)	61.6 (cc)	61.6 (cc)	61.6 (cc)	61.6 (cc)
5. Soil (Solid phase) weight ($W_s = B - C$)	89.4 (g)	91.0 (g)	90.8 (g)	90.4 (g)
6. Liquid (Liquid phase) weight ($W_w = A - B$)	31.8 (g)	31.6 (g)	30.8 (g)	31.4 (g)
7. Apparent specific gravity of soil ($S_a = W_s/V$)	1.45 (g/cc)	1.47 (g/cc)	1.47 (g/cc)	1.46 (g/cc)
8. Real specific gravity of soil ($S_r = \frac{W_s}{V_a - V_w}$ or Pycnometer Method)	2.68 (g/cc)	2.67 (g/cc)	2.69 (g/cc)	2.68 (g/cc)
9. Real Capacity (V_a)	(%)	(%)	(%)	(%)
10. Liquid phase rate ($V_w = W_w$)	(%)	(%)	(%)	(%)
11. Solid phase rate ($V_s = V_a - V_w$)	(%)	(%)	(%)	(%)
12. Vapor phase rate ($V_v = V - V_a$)	(%)	(%)	(%)	(%)
13. Porosity = $1 - \frac{S_a}{S_r} \times 100$	45.89 (%)	44.94 (%)	45.35 (%)	45.39 (%)
14. Moisture Ratio ($MR = \frac{W_w}{W_s} \times 100$)	35.57 (%)	34.72 (%)	33.92 (%)	34.73 (%)

ANNEX "A"

SOIL MOISTURE CALCULATION

Site No. 3-4

Required Item	Sample Test			Average
	1	2	3	
1. Soil + Cylinder (A)	256.6 (g)	239.8 (g)	303.0* (g)	249.2 (g)
2. Oven-dry Wt. of Soil (B)	213.2 (g)	193.1 (g)	257.4* (g)	203.1 (g)
3. Cylinder Weight (C)	86.8 (g)	82.0 (g)	119.1* (g)	84.4 (g)
4. Cylinder Capacity (V)	72.0 (cc)	72.0 (cc)	97.1* (cc)	72.0 (cc)
5. Soil (Solid phase) weight (Ws = B - C)	126.4 (g)	111.1 (g)	138.3* (g)	118.7 (g)
6. Liquid (Liquid phase) weight (Ww = A - B)	45.4 (g)	46.7 (g)	45.6 (g)	45.9 (g)
7. Apparent specific gravity of soil (Sa = Ws/V)	1.76* (g/cc)	1.54 (g/cc)	1.42 (g/cc)	1.57 (g/cc)
8. Real specific gravity of soil (Sr = $\frac{Ws}{Va - Vw}$ or Pycnometer Method)	2.61 (g/cc)	2.63 (g/cc)	2.61 (g/cc)	2.62 (g/cc)
9. Real Capacity (Va)	(%)	(%)	(%)	(%)
10. Liquid phase rate (Vw = Ww)	(%)	(%)	(%)	(%)
11. Solid phase rate (Vs = Va - Vw)	(%)	(%)	(%)	(%)
12. Vapor phase rate (Vv = V - Va)	(%)	(%)	(%)	(%)
13. Porosity = $1 - \frac{Sa}{Sr} \times 100$	32.56*	41.44 (%)	45.59 (%)	43.51 (%)
14. Moisture Ratio (MR = $\frac{Ww}{Ws} \times 100$)	35.92 (%)	42.03*	32.97 (%)	34.44 (%)

* INSIGNIFICANT

ANNEX "A"

SOIL MOISTURE CALCULATION

Site No. 3-B

Required Item	Sample Test			Average
	1	2	3	
1. Soil + Cylinder (A)	282.5*	310.8 (g)	311.5 (g)	311.1 (g)
2. Oven-dry Wt. of Soil (B)	246.4*	268.8 (g)	274.8 (g)	271.8 (g)
3. Cylinder Weight (C)	89.1 (g)	87.3 (g)	119.2*	88.2 (g)
4. Cylinder Capacity (V)	72.0*	112.5 (cc)	97.1 (cc)	104.8 (cc)
5. Soil (Solid phase) weight (Ws = B - C)	157.4 (g)	181.5* (g)	155.6 (g)	156.5 (g)
6. Liquid (Liquid phase) weight (Ww = A - B)	36.1 (g)	42.0* (g)	36.7 (g)	36.4 (g)
7. Apparent specific gravity of soil (Sa = Ws/V)	2.18*	1.61 (g/cc)	1.60 (g/cc)	1.60 (g/cc)
8. Real specific gravity of soil (Sr = $\frac{Ws}{Va - Vw}$ or Pycnometer Method)	2.61*	2.65 (g/cc)	2.65 (g/cc)	2.65 (g/cc)
9. Real Capacity (Va)	(%)	(%)	(%)	(%)
10. Liquid phase rate (Vw = Ww)	(%)	(%)	(%)	(%)
11. Solid phase rate (Vs = Va - Vw)	(%)	(%)	(%)	(%)
12. Vapor phase rate (Vv = V - Va)	(%)	(%)	(%)	(%)
13. Porosity = $1 - \frac{Sa}{Sr} \times 100$	16.47*	39.24 (%)	39.62 (%)	39.43 (%)
14. Moisture Ratio (MR = $\frac{Ww}{Ws} \times 100$)	22.94 (%)	23.14 (%)	23.58 (%)	23.22 (%)

* INSIGNIFICANT

ANNEX "A"

SOIL MOISTURE CALCULATION

Site No. 3-C

Required Item	Sample Test			Average
	1	2	3	
1. Soil + Cylinder (A)	312.4 (g)	313.2 (g)	308.0* (g)	312.8 (g)
2. Oven-dry Wt. of Soil (B)	274.5 (g)	276.2 (g)	271.7* (g)	275.3 (g)
3. Cylinder Weight (C)	118.1 (g)	117.8 (g)	118.0 (g)	118.0 (g)
4. Cylinder Capacity (V)	72.0 (cc)	94.9 (cc)	97.1 (cc)	(cc)
5. Soil (Solid phase) weight (Ws = B - C)	156.4 (g)	158.4 (g)	153.7 (g)	156.2 (g)
6. Liquid (Liquid phase) weight (Ww = A - B)	37.9 (g)	37.0 (g)	36.2 (g)	37.0 (g)
7. Apparent specific gravity of soil (Sa = Ws/V)	2.17* (g/cc)	1.66 (g/cc)	1.58 (g/cc)	1.62 (g/cc)
8. Real specific gravity of soil (Sr = $\frac{Ws}{Va - Vw}$ or Pycnometer Method)	2.60 (g/cc)	2.61 (g/cc)	2.62 (g/cc)	2.61 (g/cc)
9. Real Capacity (Va)	(%)	(%)	(%)	(%)
10. Liquid phase rate (Vw = Ww)	(%)	(%)	(%)	(%)
11. Solid phase rate (Vs = Va - Vw)	(%)	(%)	(%)	(%)
12. Vapor phase rate (Vv = V - Va)	(%)	(%)	(%)	(%)
13. Porosity = $1 - \frac{Sa}{Sr} \times 100$	16.53* (%)	37.35 (%)	39.69 (%)	38.52 (%)
14. Moisture Ratio (MR = $\frac{Ww}{Ws} \times 100$)	24.23 (%)	23.36 (%)	23.58 (%)	23.72 (%)

* INSIGNIFICANT

ANNEX "A"

SOIL MOISTURE CALCULATION

Site No. 4-A

Required Item	Sample Test			Average
	1	2	3	
1. Soil + Cylinder (A)	245.5 (g)	262.0 (g)	209.8 (g)	(g)
2. Oven-dry Wt. of Soil (B)	204.0 (g)	222.5 (g)	184.2 (g)	(g)
3. Cylinder Weight (C)	71.6 (g)	81.3 (g)	81.0 (g)	(g)
4. Cylinder Capacity (V)	90.4 (cc)	91.6 (cc)	66.2 (cc)	(cc)
5. Soil (Solid phase) weight (Ws = B - C)	132.4 (g)	141.2 (g)	103.1* (g)	136.8 (g)
6. Liquid (Liquid phase) weight (Ww = A - B)	41.5 (g)	39.5 (g)	25.6* (g)	40.5 (g)
7. Apparent specific gravity of soil (Sa = Ws/V)	1.46* (g/cc)	1.54 (g/cc)	1.56 (g/cc)	1.55 (g/cc)
8. Real specific gravity of soil (Sr = $\frac{Ws}{Va - Vw}$ or Pycnometer Method)	2.64 (g/cc)	2.65 (g/cc)	2.65 (g/cc)	2.65 (g/cc)
9. Real Capacity (Va)	(%)	(%)	(%)	(%)
10. Liquid phase rate (Vw = Ww)	(%)	(%)	(%)	(%)
11. Solid phase rate (Vs = Va - Vw)	(%)	(%)	(%)	(%)
12. Vapor phase rate (Vv = V - Va)	(%)	(%)	(%)	(%)
13. Porosity = $1 - \frac{Sa}{Sr} \times 100$	44.69 (%)	41.89 (%)	41.13 (%)	42.57 (%)
14. Moisture Ratio (MR = $\frac{Ww}{Ws} \times 100$)	31.34 (%)	27.97 (%)	24.83 (%)	28.04 (%)

* INSIGNIFICANT

ANNEX "A"

SOIL MOISTURE CALCULATION

Site No. 4-B

Required Item	Sample Test			Average
	1	2	3	
1. Soil + Cylinder (A)	217.2 (g)	217.7 (g)	218.1 (g)	217.6 (g)
2. Oven-dry Wt. of Soil (B)	195.6 (g)	196.5 (g)	196.9 (g)	196.3 (g)
3. Cylinder Weight (C)	81.2 (g)	81.0 (g)	81.4 (g)	81.2 (g)
4. Cylinder Capacity (V)	86.0* (cc)	86.2 (cc)	86.2 (cc)	86.2 (cc)
5. Soil (Solid phase) weight (Ws = B - C)	114.4 (g)	115.5 (g)	115.5 (g)	115.1 (g)
6. Liquid (Liquid phase) weight (Ww = A - B)	21.6 (g)	21.2 (g)	22.0 (g)	21.4 (g)
7. Apparent specific gravity of soil (Sa = Ws/V)	1.33 (g/cc)	1.74 (g/cc)	1.74 (g/cc)	1.74 (g/cc)
8. Real specific gravity of soil (Sr = $\frac{Ws}{Va - Vw}$ or Pycnometer Method)	2.64 (g/cc)	2.65 (g/cc)	2.66 (g/cc)	2.65 (g/cc)
9. Real Capacity (Va)	(%)	(%)	(%)	(%)
10. Liquid phase rate (Vw = Ww)	(%)	(%)	(%)	(%)
11. Solid phase rate (Vs = Va - Vw)	(%)	(%)	(%)	(%)
12. Vapor phase rate (Vv = V - Va)	(%)	(%)	(%)	(%)
13. Porosity = $1 - \frac{Sa}{Sr} \times 100$	49.62* (%)	34.33 (%)	34.58 (%)	34.45 (%)
14. Moisture Ratio (MR = $\frac{Ww}{Ws} \times 100$)	18.88 (%)	18.35 (%)	19.05 (%)	18.76 (%)

* INSIGNIFICANT

ANNEX "A"

SOIL MOISTURE CALCULATION

Site No. 4-C

Required Item	Sample Test			Average
	1	2	3	
1. Soil + Cylinder (A)	206.4 (g)	207.7 (g)	210.0 (g)	208.0 (g)
2. Oven-dry Wt. of Soil (B)	179.6 (g)	180.2 (g)	183.0 (g)	180.9 (g)
3. Cylinder Weight (C)	81.5 (g)	81.2 (g)	81.1 (g)	81.2 (g)
4. Cylinder Capacity (V)	86.0* (cc)	86.2 (cc)	86.2 (cc)	86.2 (cc)
5. Soil (Solid phase) weight ($W_s = B - C$)	98.1 (g)	99.0 (g)	101.9 (g)	99.6 (g)
6. Liquid (Liquid phase) weight ($W_w = A - B$)	26.8 (g)	27.5 (g)	27.0 (g)	27.1 (g)
7. Apparent specific gravity of soil ($S_a = W_s/V$)	1.14* (g/cc)	1.49 (g/cc)	1.53 (g/cc)	1.51 (g/cc)
8. Real specific gravity of soil ($S_r = \frac{W_s}{V_a - V_w}$ or Pycnometer Method)	2.63 (g/cc)	2.63 (g/cc)	2.69 (g/cc)	2.65 (g/cc)
9. Real Capacity (V_a)	(%)	(%)	(%)	(%)
10. Liquid phase rate ($V_w = W_w$)	(%)	(%)	(%)	(%)
11. Solid phase rate ($V_s = V_a - V_w$)	(%)	(%)	(%)	(%)
12. Vapor phase rate ($V_v = V - V_a$)	(%)	(%)	(%)	(%)
13. Porosity = $1 - \frac{S_a}{S_r} \times 100$	56.65* (%)	43.34 (%)	43.12 (%)	43.23 (%)
14. Moisture Ratio ($MR = \frac{W_w}{W_s} \times 100$)	27.32 (%)	27.78 (%)	26.50 (%)	27.20 (%)

* INSIGNIFICANT

ANNEX "A"

SOIL MOISTURE CALCULATION

Site No. 5-A

Required Item	Sample Test			Average
	1	2	3	
1. Soil + Cylinder (A)	270.4 (g)	267.4 (g)	264.9 (g)	267.5 (g)
2. Oven-dry Wt. of Soil (B)	229.1 (g)	228.7 (g)	223.6 (g)	227.1 (g)
3. Cylinder Weight (C)	91.6 (g)	92.8 (g)	91.1 (g)	91.8 (g)
4. Cylinder Capacity (V)	82.2 (cc)	83.4 (cc)	83.6 (cc)	83.0 (cc)
5. Soil (Solid phase) weight (Ws = B - C)	137.5 (g)	135.9 (g)	132.5 (g)	135.3 (g)
6. Liquid (Liquid phase) weight (Ww = A - B)	41.3 (g)	38.7* (g)	41.3 (g)	41.3 (g)
7. Apparent specific gravity of soil (Sa = Ws/V)	1.67 (g/cc)	1.63 (g/cc)	1.58 (g/cc)	1.62 (g/cc)
8. Real specific gravity of soil (Sr = $\frac{W_s}{V_a - V_w}$ or Pycnometer Method)	2.60 (g/cc)	2.62 (g/cc)	2.64 (g/cc)	2.62 (g/cc)
9. Real Capacity (Va)	(%)	(%)	(%)	(%)
10. Liquid phase rate (Vw = Ww)	(%)	(%)	(%)	(%)
11. Solid phase rate (Vs = Va - Vw)	(%)	(%)	(%)	(%)
12. Vapor phase rate (Vv = V - Va)	(%)	(%)	(%)	(%)
13. Porosity = $1 - \frac{S_a}{S_r} \times 100$	35.77 (%)	37.79 (%)	40.15 (%)	37.90 (%)
14. Moisture Ratio (MR = $\frac{W_w}{W_s} \times 100$)	30.03 (%)	28.47 (%)	31.17 (%)	29.89 (%)

* INSIGNIFICANT

ANNEX "A"

SOIL MOISTURE CALCULATION

Site No. 5-B

Required Item	Sample Test			Average
	1	2	3	
1. Soil + Cylinder (A)	271.3 (g)	271.5 (g)	273.0 (g)	271.9 (g)
2. Oven-dry Wt. of Soil (B)	230.6 (g)	232.4 (g)	235.4 (g)	232.8 (g)
3. Cylinder Weight (C)	92.2 (g)	93.8 (g)	89.3 (g)	91.7 (g)
4. Cylinder Capacity (V)	82.7 (cc)	84.3 (cc)	81.1 (cc)	82.7 (cc)
5. Soil (Solid phase) weight (Ws = B - C)	138.4 (g)	138.6 (g)	146.1* (g)	138.5 (g)
6. Liquid (Liquid phase) weight (Ww = A - B)	40.7 (g)	39.1 (g)	37.6 (g)	39.1 (g)
7. Apparent specific gravity of soil (Sa = Ws/V)	1.67 (g/cc)	1.64 (g/cc)	1.8* (g/cc)	1.65 (g/cc)
8. Real specific gravity of soil (Sr = $\frac{Ws}{Va - Vw}$ or Pycnometer Method)	2.60 (g/cc)	2.65 (g/cc)	2.65 (g/cc)	2.63 (g/cc)
9. Real Capacity (Va)	(%)	(%)	(%)	(%)
10. Liquid phase rate (Vw = Ww)	(%)	(%)	(%)	(%)
11. Solid phase rate (Vs = Va - Vw)	(%)	(%)	(%)	(%)
12. Vapor phase rate (Vv = V - Va)	(%)	(%)	(%)	(%)
13. Porosity = $1 - \frac{Sa}{Sr} \times 100$	35.76 (%)	38.11 (%)	32.07 (%)	35.31 (%)
14. Moisture Ratio (MR = $\frac{Ww}{Ws} \times 100$)	29.47 (%)	28.21 (%)	25.74* (%)	28.81 (%)

* INSIGNIFICANT

ANNEX "A"

SOIL MOISTURE CALCULATION

Site No. 5-C

Required Item	Sample Test			Average
	1	2	3	
1. Soil + Cylinder (A)	273.5 (g)	271.1 (g)	269.3 (g)	271.3 (g)
2. Oven-dry Wt. of Soil (B)	235.5 (g)	234.0 (g)	232.6 (g)	234.0 (g)
3. Cylinder Weight (C)	90.5 (g)	90.6 (g)	89.3 (g)	90.1 (g)
4. Cylinder Capacity (V)	81.1 (cc)	81.8* (cc)	81.1 (cc)	81.1 (cc)
5. Soil (Solid phase) weight ($W_s = B - C$)	145.0* (g)	143.4 (g)	143.3 (g)	143.4 (g)
6. Liquid (Liquid phase) weight ($W_w = A - B$)	38.0 (g)	37.1 (g)	36.7 (g)	37.2 (g)
7. Apparent specific gravity of soil ($S_a = W_s/V$)	1.78 (g/cc)	1.75 (g/cc)	1.76 (g/cc)	1.76 (g/cc)
8. Real specific gravity of soil ($S_r = \frac{W_s}{V_a - V_w}$ or Pycnometer Method)	2.59* (g/cc)	2.65 (g/cc)	2.65 (g/cc)	2.65 (g/cc)
9. Real Capacity (V_a)	(%)	(%)	(%)	(%)
10. Liquid phase rate ($V_w = W_w$)	(%)	(%)	(%)	(%)
11. Solid phase rate ($V_s = V_a - V_w$)	(%)	(%)	(%)	(%)
12. Vapor phase rate ($V_v = V - V_a$)	(%)	(%)	(%)	(%)
13. Porosity = $1 - \frac{S_a}{S_r} \times 100$	31.27 (%)	35.47 (%)	33.58 (%)	33.44 (%)
14. Moisture Ratio (MR = $\frac{W_w}{W_s} \times 100$)	26.21 (%)	25.87 (%)	25.61 (%)	25.89 (%)

* INSIGNIFICANT

ANNEX "A"

SOIL MOISTURE CALCULATION

Site No. 6-A

Required Item	Sample Test			Average
	1	2	3	
1. Soil + Cylinder (A)	261.4 (g)	259.05 (g)	281.2* (g)	260.2 (g)
2. Oven-dry Wt. of Soil (B)	220.2 (g)	217.9 (g)	248.8* (g)	218.9 (g)
3. Cylinder Weight (C)	89.0 (g)	89.1 (g)	89.5 (g)	89.2 (g)
4. Cylinder Capacity (V)	80.8 (cc)	81.1 (cc)	80.8 (cc)	80.9 (cc)
5. Soil (Solid phase) weight ($W_s = B - C$)	131.0 (g)	128.8 (g)	159.3* (g)	129.9 (g)
6. Liquid (Liquid phase) weight ($W_w = A - B$)	41.4 (g)	41.1 (g)	32.4* (g)	41.2 (g)
7. Apparent specific gravity of soil ($S_a = W_s/V$)	1.62 (g/cc)	1.59 (g/cc)	1.97* (g/cc)	1.60 (g/cc)
8. Real specific gravity of soil ($S_r = \frac{W_s}{V_a - V_w}$ or Pycnometer Method)	2.66 (g/cc)	2.68 (g/cc)	2.69 (g/cc)	2.68 (g/cc)
9. Real Capacity (V_a)	(%)	(%)	(%)	(%)
10. Liquid phase rate ($V_w = W_w$)	(%)	(%)	(%)	(%)
11. Solid phase rate ($V_s = V_a - V_w$)	(%)	(%)	(%)	(%)
12. Vapor phase rate ($V_v = V - V_a$)	(%)	(%)	(%)	(%)
13. Porosity = $1 - \frac{S_a}{S_r} \times 100$	39.09 (%)	40.67 (%)	26.76* (%)	39.88 (%)
14. Moisture Ratio ($MR = \frac{W_w}{W_s} \times 100$)	31.60 (%)	31.90 (%)	20.34* (%)	31.79 (%)

* INSIGNIFICANT

ANNEX "A"

SOIL MOISTURE CALCULATION

Site No. 6-B

Required Item	Sample Test			Average
	1	2	3	
1. Soil + Cylinder (A)	279.7 (g)	283.1 (g)	280.3 (g)	281.1 (g)
2. Oven-dry Wt. of Soil (B)	244.6 (g)	246.5 (g)	245.5 (g)	245.5 (g)
3. Cylinder Weight (C)	89.4 (g)	89.3 (g)	89.5 (g)	89.4 (g)
4. Cylinder Capacity (V)	80.8 (cc)	80.8 (cc)	80.8 (cc)	80.8 (cc)
5. Soil (Solid phase) weight (Ws = B - C)	155.2 (g)	157.2 (g)	156.0 (g)	156.1 (g)
6. Liquid (Liquid phase) weight (Ww = A - B)	47.0* (g)	36.6 (g)	34.8 (g)	35.7 (g)
7. Apparent specific gravity of soil (Sa = Ws/V)	1.92 (g/cc)	1.94 (g/cc)	1.93 (g/cc)	1.93 (g/cc)
8. Real specific gravity of soil (Sr = $\frac{Ws}{Va - Vw}$ or Pycnometer Method)	2.65 (g/cc)	2.67 (g/cc)	2.68 (g/cc)	2.66 (g/cc)
9. Real Capacity (Va)	(%)	(%)	(%)	(%)
10. Liquid phase rate (Vw = Ww)	(%)	(%)	(%)	(%)
11. Solid phase rate (Vs = Va - Vw)	(%)	(%)	(%)	(%)
12. Vapor phase rate (Vv = V - Va)	(%)	(%)	(%)	(%)
13. Porosity = $1 - \frac{Sa}{Sr} \times 100$	27.54 (%)	27.34 (%)	27.98 (%)	27.62 (%)
14. Moisture Ratio (MR = $\frac{Ww}{Ws} \times 100$)	30.28*	23.28 (%)	22.31 (%)	22.79 (%)

* INSIGNIFICANT

ANNEX "A"

SOIL MOISTURE CALCULATION

Site No. 6-C

Required Item	Sample Test			Average
	1	2	3	
1. Soil + Cylinder (A)	280.6 (g)	280.6 (g)	280.4 (g)	280.5 (g)
2. Oven-dry Wt. of Soil (B)	247.0 (g)	244.1 (g)	245.2 (g)	245.4 (g)
3. Cylinder Weight (C)	89.2 (g)	89.8 (g)	89.5 (g)	89.5 (g)
4. Cylinder Capacity (V)	80.1 (cc)	81.1 (cc)	81.1 (cc)	81.1 (cc)
5. Soil (Solid phase) weight ($W_s = B - C$)	157.8 (g)	154.3 (g)	155.7 (g)	155.9 (g)
6. Liquid (Liquid phase) weight ($W_w = A - B$)	36.6 (g)	36.5 (g)	35.2 (g)	36.1 (g)
7. Apparent specific gravity of soil ($S_a = W_s/V$)	1.95 (g/cc)	1.90 (g/cc)	1.91 (g/cc)	1.92 (g/cc)
8. Real specific gravity of soil (Pycnometer) ($S_r = \frac{W_s}{V_a - V_w}$ or Method)	2.65 (g/cc)	2.67 (g/cc)	2.66 (g/cc)	2.66 (g/cc)
9. Real Capacity (V_a)	(%)	(%)	(%)	(%)
10. Liquid phase rate ($V_w = W_w$)	(%)	(%)	(%)	(%)
11. Solid phase rate ($V_s = V_a - V_w$)	(%)	(%)	(%)	(%)
12. Vapor phase rate ($V_v = V - V_a$)	(%)	(%)	(%)	(%)
13. Porosity = $1 - \frac{S_a}{S_r} \times 100$	26.41 (%)	28.83 (%)	28.20 (%)	27.81 (%)
14. Moisture Ratio (MR) = $\frac{W_w}{W_s} \times 100$	23.19* (%)	23.66 (%)	22.61 (%)	23.15 (%)

ANNEX "B"

MOISTURE RETENTION ANALYSIS

Site No. 1-A

Required Item	Sample No.			Average
	1	2	3	
1. Weight of moist soil (Wm)	29.00 (g)	29.10 (g)	28.99 (g)	29.03 (g)
2. Weight of oven-dry soil	24.41 (g)	24.27 (g)	24.35 (g)	24.34 (g)
3. Weight of water	4.59 (g)	4.83 (g)	4.64 (g)	4.68 (g)
4. Moisture Content at F. Capacity (1/3 Bar)	18.80 (%)	19.90 (%)	19.06 (%)	19.25 (%)
5. Weight of Moist Soil	25.76 (g)	25.71 (g)	25.74 (g)	25.73 (g)
6. Oven-dry weight of Soil	24.35 (g)	24.15 (g)	24.35 (g)	24.28 (g)
7. Weight of Water	1.41 (g)	1.56 (g)	1.39 (g)	1.45 (g)
8. Moisture Content at wilting point (15 bar)	5.79 (%)	6.46* (%)	5.71 (%)	5.98 (%)
9. Percent available water	13.01 (%)	13.44 (%)	13.35 (%)	13.26 (%)
10. pF value				

* INSIGNIFICANT

ANNEX "B"

MOISTURE RETENTION ANALYSIS

Site No. 1-B

Required Item	Sample No.			Average
	1	2	3	
1. Weight of moist soil (Wm)	28.91 (g)	28.34 (g)	28.97 (g)	28.74 (g)
2. Weight of oven-dry soil	24.35 (g)	23.90 (g)	24.35 (g)	24.20 (g)
3. Weight of water	4.56 (g)	4.44 (g)	4.62 (g)	4.54 (g)
4. Moisture Content at F. Capacity (1/3 Bar)	18.72 (%)	18.57 (%)	18.97 (%)	18.75 (%)
5. Weight of Moist Soil	25.90 (g)	25.99 (g)	25.82 (g)	25.90 (g)
6. Oven-dry weight of Soil	24.28 (g)	24.44 (g)	24.36 (g)	24.36 (g)
7. Weight of Water	1.62 (g)	1.55 (g)	1.46 (g)	1.54 (g)
8. Moisture Content at wilting point (15 bar)	6.67 (%)	6.34 (%)	5.99 (%)	6.33 (%)
9. Percent available water	12.05 (%)	12.24 (%)	12.98 (%)	12.42 (%)
10. pF value				

ANNEX "B"

MOISTURE RETENTION ANALYSIS

Site No. 1-C

Required Item	Sample No.			Average
	1	2	3	
1. Weight of moist soil (Wm)	29.17 (g)	29.33 (g)	29.32 (g)	29.27 (g)
2. Weight of oven-dry soil	24.16 (g)	24.17 (g)	24.15 (g)	24.16 (g)
3. Weight of water	5.01 (g)	5.16 (g)	5.17 (g)	5.11 (g)
4. Moisture Content at F. Capacity (1/3 Bar)	20.73 (%)	21.34 (%)	21.41 (%)	21.16 (%)
5. Weight of Moist Soil	26.15 (g)	26.05 (g)	26.04 (g)	26.08 (g)
6. Oven-dry weight of Soil	24.24 (g)	24.24 (g)	24.21 (g)	24.23 (g)
7. Weight of Water	1.91 (g)	1.81 (g)	1.83 (g)	1.85 (g)
8. Moisture Content at wilting point (15 bar)	7.87 (%)	7.47 (%)	7.56 (%)	7.63 (%)
9. Percent available water	12.86 (%)	13.87 (%)	13.85 (%)	13.52 (%)
10. pF value				

ANNEX "B"

MOISTURE RETENTION ANALYSIS

Site No.2-A

Required Item	Sample No.			Average
	1	2	3	
1. Weight of moist soil (Wm)	29.06 (g)	28.73 (g)	28.74 (g)	28.84 (g)
2. Weight of oven-dry soil	24.12 (g)	23.95 (g)	24.43 (g)	24.16 (g)
3. Weight of water	4.94 (g)	4.78 (g)	4.31 (g)	4.67 (g)
4. Moisture Content at F. Capacity (1/3 Bar)	20.48 (%)	19.95 (%)	17.64 (%)	19.35 (%)
5. Weight of Moist Soil	25.65 (g)	26.85 (g)	26.50 (g)	26.33 (g)
6. Oven-dry weight of Soil	24.11 (g)	24.76 (g)	24.22 (g)	24.36 (g)
7. Weight of Water	1.54* (g)	2.09 (g)	2.28 (g)	1.97 (g)
8. Moisture Content at wilting point (15 bar)	6.39* (%)	8.44 (%)	9.41 (%)	8.08 (%)
9. Percent available water	14.09 (%)	11.51 (%)	8.23 (%)	11.27 (%)
10. pF value				

* INSIGNIFICANT

ANNEX "B"

MOISTURE RETENTION ANALYSIS

Site No. 2-B

Required Item	Sample No.			Average
	1	2	3	
1. Weight of moist soil (Wm)	28.77 (g)	29.02 (g)	28.96 (g)	28.91 (g)
2. Weight of oven-dry soil	23.44 (g)	23.81 (g)	24.13 (g)	23.79 (g)
3. Weight of water	5.33 (g)	5.21 (g)	4.83 (g)	5.12 (g)
4. Moisture Content at F. Capacity (1/3 Bar)	22.74 (%)	21.88 (%)	20.01 (%)	21.54 (%)
5. Weight of Moist Soil	24.94 (g)	25.86 (g)	26.97 (g)	25.92 (g)
6. Oven-dry weight of Soil	23.32 (g)	24.02 (g)	24.29 (g)	23.87 (g)
7. Weight of Water	1.62 (g)	1.84 (g)	2.68* (g)	2.05 (g)
8. Moisture Content at wilting point (15 bar)	6.94 (%)	7.66 (%)	11.03* (%)	8.54 (%)
9. Percent available water	15.80 (%)	14.22 (%)	8.98* (%)	13.00 (%)
10. pF value				

* INSIGNIFICANT

ANNEX "B"

MOISTURE RETENTION ANALYSIS

Site No. 2-C

Required Item	Sample No.			Average
	1	2	3	
1. Weight of moist soil (Wm)	28.46 (g)	29.08 (g)	27.96 (g)	28.50 (g)
2. Weight of oven-dry soil	23.15 (g)	23.86 (g)	23.87 (g)	23.62 (g)
3. Weight of water	5.31 (g)	5.22 (g)	4.09* (g)	4.88 (g)
4. Moisture Content at F. Capacity (1/3 Bar)	22.93 (%)	21.88 (%)	17.13* (%)	20.64 (%)
5. Weight of Moist Soil	24.95 (g)	25.68 (g)	26.79 (g)	25.80 (g)
6. Oven-dry weight of Soil	23.51 (g)	23.81 (g)	23.77 (g)	23.69 (g)
7. Weight of Water	1.44 (g)	1.87 (g)	3.02* (g)	2.11 (g)
8. Moisture Content at wilting point (15 bar)	6.12 (%)	7.85 (%)	12.70* (%)	8.89 (%)
9. Percent available water	16.81 (%)	14.03 (%)	14.43 (%)	15.09 (%)
10. pF value				

* INSIGNIFICANT

ANNEX "B"

MOISTURE RETENTION ANALYSIS

Site No. 3-A

Required Item	Sample No.			Average
	1	2	3	
1. Weight of moist soil (Wm)	28.63 (g)	30.12 (g)	27.70 (g)	28.81 (g)
2. Weight of oven-dry soil	24.35 (g)	24.04 (g)	24.46 (g)	24.28 (g)
3. Weight of water	4.28 (g)	5.78 (g)	3.25 (g)	4.43 (g)
4. Moisture Content at F. Capacity (1/3 Bar)	17.57 (%)	23.74 (%)	13.29 (%)	18.20 (%)
5. Weight of Moist Soil	26.45 (g)	26.78 (g)	25.18 (g)	26.20 (g)
6. Oven-dry weight of Soil	24.49 (g)	24.46 (g)	24.45 (g)	24.46 (g)
7. Weight of Water	2.16 (g)	2.32 (g)	0.73* (g)	1.74 (g)
8. Moisture Content at wilting point (15 bar)	8.81 (%)	9.48 (%)	2.98* (%)	7.09 (%)
9. Percent available water	8.76 (%)	14.26* (%)	10.31 (%)	11.11 (%)
10. pF value				

* INSIGNIFICANT

ANNEX "B"

MOISTURE RETENTION ANALYSIS

Site No. 3-B

Required Item	Sample No.			Average
	1	2	3	
1. Weight of moist soil (Wm)	29.09 (g)	29.58 (g)	27.68 (g)	28.78 (g)
2. Weight of oven-dry soil	24.14 (g)	24.38 (g)	24.24 (g)	24.25 (g)
3. Weight of water	4.95 (g)	5.20 (g)	3.44 (g)	4.53 (g)
4. Moisture Content at F. Capacity (1/3 Bar)	20.50 (%)	21.32 (%)	14.19* (%)	18.67 (%)
5. Weight of Moist Soil	25.94 (g)	26.01 (g)	25.00 (g)	25.65 (g)
6. Oven-dry weight of Soil	24.35 (g)	24.39 (g)	24.41 (g)	24.38 (g)
7. Weight of Water	1.59 (g)	1.62 (g)	0.59* (g)	1.26 (g)
8. Moisture Content at wilting point (15 bar)	6.52 (%)	6.64 (%)	2.41* (%)	6.58 (%)
9. Percent available water	13.98 (%)	14.68 (%)	6.23* (%)	11.63 (%)
10. pF value				

* INSIGNIFICANT

ANNEX "B"

MOISTURE RETENTION ANALYSIS

Site No. 3-C

Required Item	Sample No.			Average
	1	2	3	
1. Weight of moist soil (Wm)	28.48 (g)	29.96 (g)	27.68 (g)	28.70 (g)
2. Weight of oven-dry soil	24.42 (g)	24.39 (g)	24.59 (g)	24.46 (g)
3. Weight of water	4.06 (g)	5.57 (g)	3.10 (g)	4.24 (g)
4. Moisture Content at F. Capacity (1/3 Bar)	16.62 (%)	22.83 (%)	12.61 (%)	17.35 (%)
5. Weight of Moist Soil	25.76 (g)	25.66 (g)	24.83 (g)	25.41 (g)
6. Oven-dry weight of Soil	24.32 (g)	24.22 (g)	24.23 (g)	24.25 (g)
7. Weight of Water	1.44 (g)	1.44 (g)	0.60 (g)	1.16 (g)
8. Moisture Content at wilting point (15 bar)	5.92 (%)	5.94 (%)	2.48*	5.93 (%)
9. Percent available water	10.70 (%)	16.89*	10.13 (%)	10.41 (%)
10. pF value				

*: INSIGNIFICANT

ANNEX "B"

MOISTURE RETENTION ANALYSIS

Site No. 4-A

Required Item	Sample No.			Average
	1	2	3	
1. Weight of moist soil (Wm)	28.67 (g)	28.06 (g)	25.90* (g)	28.33 (g)
2. Weight of oven-dry soil	23.95 (g)	24.48 (g)	22.72 (g)	23.71 (g)
3. Weight of water	4.66 (g)	3.58 (g)	3.18 (g)	3.80 (g)
4. Moisture Content at F. Capacity (1/3 Bar)	19.45* (%)	14.62 (%)	13.99 (%)	16.32 (%)
5. Weight of Moist Soil	26.09 (g)	25.00 (g)	25.42 (g)	25.50 (g)
6. Oven-dry weight of Soil	24.44 (g)	24.19 (g)	24.53 (g)	24.38 (g)
7. Weight of Water	1.65 (g)	0.81 (g)	0.89 (g)	1.11 (g)
8. Moisture Content at wilting point (15 bar)	6.75 (%)	3.34 (%)	3.62 (%)	4.57 (%)
9. Percent available water	12.70 (%)	11.28 (%)	10.37 (%)	11.45 (%)
10. pF value				

* INSIGNIFICANT

ANNEX "B"

MOISTURE RETENTION ANALYSIS

Site No. 4-B

Required Item	Sample No.			Average
	1	2	3	
1. Weight of moist soil (Wm)	29.42 (g)	27.90 (g)	27.93 (g)	28.41 (g)
2. Weight of oven-dry soil	24.10 (g)	24.71 (g)	24.61 (g)	24.47 (g)
3. Weight of water	5.32* (g)	3.19 (g)	3.32 (g)	3.94 (g)
4. Moisture Content at F. Capacity (1/3 Bar)	22.07 (%)	12.91 (%)	13.49 (%)	16.15 (%)
5. Weight of Moist Soil	25.53 (g)	25.46 (g)	25.30 (g)	25.43 (g)
6. Oven-dry weight of Soil	24.71 (g)	24.62 (g)	24.58 (g)	24.63 (g)
7. Weight of Water	0.82 (g)	0.84 (g)	0.72 (g)	0.79 (g)
8. Moisture Content at wilting point (15 bar)	3.31 (%)	3.41 (%)	2.92 (%)	3.21 (%)
9. Percent available water	18.76 (%)	9.50 (%)	10.55 (%)	12.93 (%)
10. pF value				

ANNEX "B"

MOISTURE RETENTION ANALYSIS

Site No. 4-C

Required Item	Sample No.			Average
	1	2	3	
1. Weight of moist soil (Wm)	29.58 (g)	27.62 (g)	27.91 (g)	28.37 (g)
2. Weight of oven-dry soil	24.31 (g)	24.50 (g)	24.43 (g)	24.41 (g)
3. Weight of water	5.27 (g)	3.12 (g)	3.48 (g)	3.96 (g)
4. Moisture Content at F. Capacity (1/3 Bar)	21.67 (%)	12.73 (%)	14.24 (%)	16.21 (%)
5. Weight of Moist Soil	25.82 (g)	25.37 (g)	25.34 (g)	25.51 (g)
6. Oven-dry weight of Soil	24.53 (g)	24.40 (g)	24.47 (g)	24.46 (g)
7. Weight of Water	1.29 (g)	0.97 (g)	0.87 (g)	1.05 (g)
8. Moisture Content at wilting point (15 bar)	5.26 (%)	3.97 (%)	3.56 (%)	4.26 (%)
9. Percent available water	16.41 (%)	8.75 (%)	10.68 (%)	11.95 (%)
10. pF value				

ANNEX "B"

MOISTURE RETENTION ANALYSIS

Site No. 5-A

Required Item	Sample No.			Average
	1	2	3	
1. Weight of moist soil (Wm)	28.97 (g)	27.10 (g)	28.88 (g)	28.31 (g)
2. Weight of oven-dry soil	24.48 (g)	24.22 (g)	24.30 (g)	24.33 (g)
3. Weight of water	4.49 (g)	2.88 (g)	4.58 (g)	3.98 (g)
4. Moisture Content at F. Capacity (1/3 Bar)	18.34 (%)	11.89 (%)	18.84 (%)	16.35 (%)
5. Weight of Moist Soil	26.30 (g)	25.50 (g)	26.49 (g)	26.09 (g)
6. Oven-dry weight of Soil	24.17 (g)	24.03 (g)	24.44 (g)	24.21 (g)
7. Weight of Water	2.13 (g)	1.47 (g)	2.05 (g)	1.88 (g)
8. Moisture Content at wilting point (15 bar)	8.81 (%)	6.12 (%)	8.38 (%)	7.77 (%)
9. Percent available water	9.53 (%)	5.77 (%)	10.46 (%)	8.58 (%)
10. pF value				

ANNEX "B"

MOISTURE RETENTION ANALYSIS

Site No. 5-B

Required Item	Sample No.			Average
	1	2	3	
1. Weight of moist soil (Wm)	29.39 (g)	27.53 (g)	28.67 (g)	28.53 (g)
2. Weight of oven-dry soil	24.31 (g)	24.45 (g)	23.87 (g)	24.21 (g)
3. Weight of water	5.08 (g)	3.08 (g)	4.80 (g)	4.32 (g)
4. Moisture Content at F. Capacity (1/3 Bar)	20.90 (%)	12.59 (%)	20.10 (%)	17.86 (%)
5. Weight of Moist Soil	26.54 (g)	25.83 (g)	26.46 (g)	26.27 (g)
6. Oven-dry weight of Soil	24.26 (g)	24.30 (g)	24.45 (g)	24.33 (g)
7. Weight of Water	2.28 (g)	1.53 (g)	2.01 (g)	1.94 (g)
8. Moisture Content at wilting point (15 bar)	9.39 (%)	6.29 (%)	8.22 (%)	7.96 (%)
9. Percent available water	11.51 (%)	6.30 (%)	11.88 (%)	9.89 (%)
10. pF value				

ANNEX "B"

MOISTURE RETENTION ANALYSIS

Site No. 5-C

Required Item	Sample No.			Average
	1	2	3	
1. Weight of moist soil (Wm)	29.24 (g)	27.99 (g)	29.24 (g)	28.82 (g)
2. Weight of oven-dry soil	24.36 (g)	24.41 (g)	24.28 (g)	24.35 (g)
3. Weight of water	4.88 (g)	3.58 (g)	4.96 (g)	4.47 (g)
4. Moisture Content at F. Capacity (1/3 Bar)	20.03 (%)	14.66 (%)	20.42 (%)	18.37 (%)
5. Weight of Moist Soil	26.07 (g)	25.95 (g)	26.43 (g)	26.15 (g)
6. Oven-dry weight of Soil	24.14 (g)	24.51 (g)	24.27 (g)	24.30 (g)
7. Weight of Water	1.93 (g)	1.44 (g)	2.16 (g)	1.84 (g)
8. Moisture Content at wilting point (15 bar)	7.99 (%)	5.88 (%)	8.89 (%)	7.58 (%)
9. Percent available water	12.04 (%)	8.78 (%)	11.53 (%)	10.78 (%)
10. pF value				

ANNEX "B"

MOISTURE RETENTION ANALYSIS

Site No. 6-A

Required Item	Sample No.			Average
	1	2	3	
1. Weight of moist soil (Wm)	27.22 (g)	29.06 (g)	29.64 (g)	28.64 (g)
2. Weight of oven-dry soil	23.64 (g)	24.25 (g)	24.35 (g)	24.08 (g)
3. Weight of water	3.58 (g)	4.81 (g)	5.29 (g)	4.56 (g)
4. Moisture Content at F. Capacity (1/3 Bar)	15.14 (%)	19.83 (%)	21.72 (%)	28.89 (%)
5. Weight of Moist Soil	25.92 (g)	25.97 (g)	26.46 (g)	26.17 (g)
6. Oven-dry weight of Soil	24.00 (g)	24.31 (g)	24.20 (g)	24.17 (g)
7. Weight of Water	1.92 (g)	1.60 (g)	2.26 (g)	1.94 (g)
8. Moisture Content at wilting point (15 bar)	8.00 (%)	6.82 (%)	9.33 (%)	8.05 (%)
9. Percent available water	7.14 (%)	13.01 (%)	12.39 (%)	10.84 (%)
10. pF value				

ANNEX "B"

MOISTURE RETENTION ANALYSIS

Site No. 6-B

Required Item	Sample No.			Average
	1	2	3	
1. Weight of moist soil (Wm)	28.92 (g)	28.78 (g)	29.03 (g)	28.91 (g)
2. Weight of oven-dry soil	23.95 (g)	24.30 (g)	24.42 (g)	24.42 (g)
3. Weight of water	4.97 (g)	4.48 (g)	4.61 (g)	4.48 (g)
4. Moisture Content at F. Capacity (1/3 Bar)	20.75 (%)	18.43 (%)	18.87 (%)	19.35 (%)
5. Weight of Moist Soil	25.35 (g)	26.19 (g)	26.02 (g)	25.85 (g)
6. Oven-dry weight of Soil	23.72 (g)	24.29 (g)	24.06 (g)	24.02 (g)
7. Weight of Water	1.63 (g)	1.90 (g)	1.96 (g)	1.83 (g)
8. Moisture Content at wilting point (15 bar)	6.87 (%)	7.82 (%)	8.14 (%)	7.61 (%)
9. Percent available water	13.88 (%)	10.61 (%)	10.73 (%)	11.74 (%)
10. pF value				

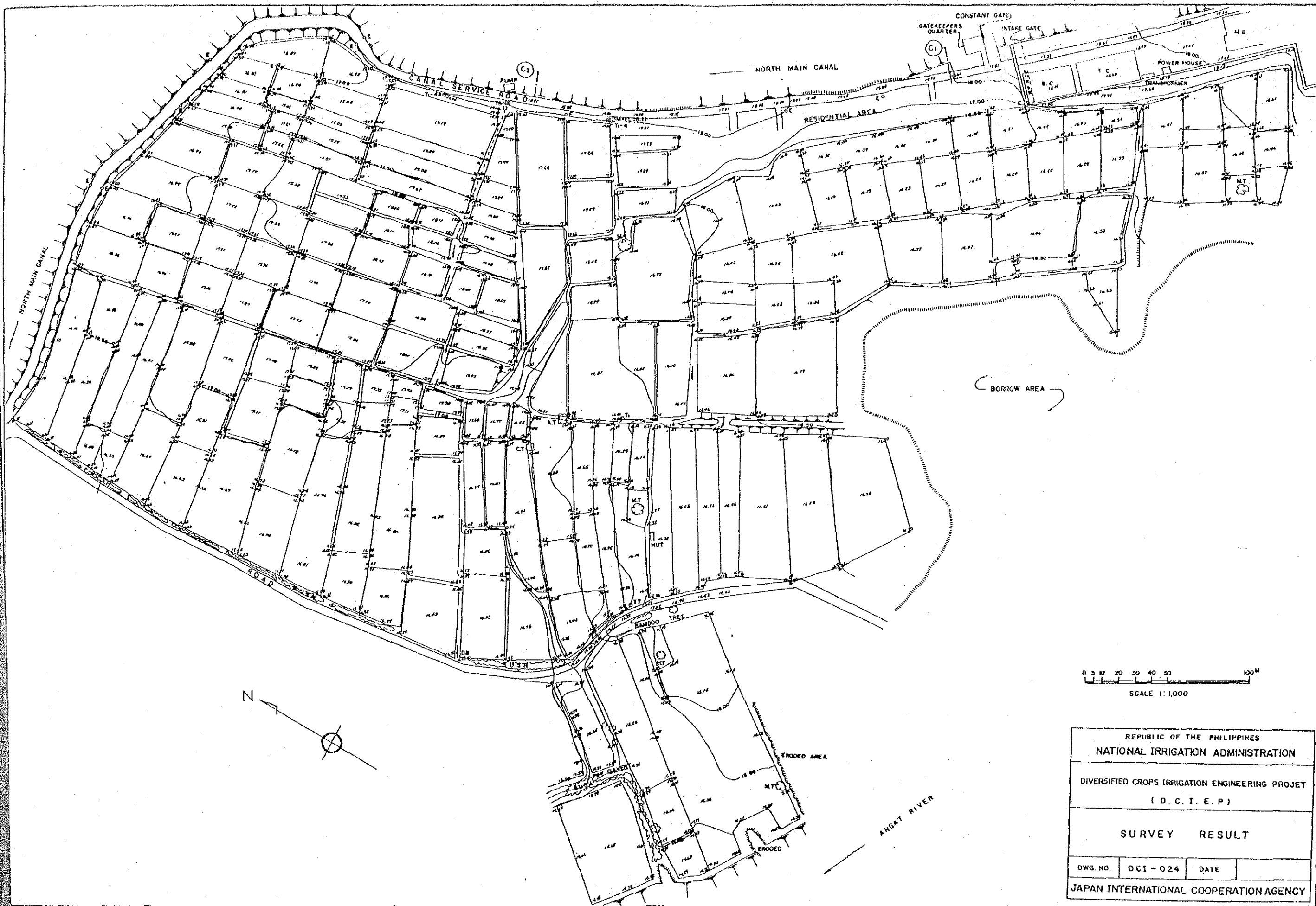
ANNEX "B"

MOISTURE RETENTION ANALYSIS

Site No. 6-C

Required Item	Sample No.			Average
	1	2	3	
1. Weight of moist soil (Wm)	28.93 (g)	28.62 (g)	28.78 (g)	28.77 (g)
2. Weight of oven-dry soil	24.28 (g)	24.24 (g)	24.25 (g)	24.25 (g)
3. Weight of water	4.65 (g)	4.38 (g)	4.53 (g)	4.52 (g)
4. Moisture Content at F. Capacity (1/3 Bar)	19.15 (%)	18.06 (%)	18.68 (%)	18.59 (%)
5. Weight of Moist Soil	25.96 (g)	25.89 (g)	25.92 (g)	25.92 (g)
6. Oven-dry weight of Soil	24.18 (g)	24.35 (g)	24.28 (g)	24.27 (g)
7. Weight of Water	1.78 (g)	1.54 (g)	1.64 (g)	1.65 (g)
8. Moisture Content at wilting point (15 bar)	7.36 (%)	6.32 (%)	6.75 (%)	6.81 (%)
9. Percent available water	11.79 (%)	11.74 (%)	11.93 (%)	11.82 (%)
10. pf value				

APPENDIX - 2



0 5 10 20 30 40 50 100M
SCALE 1:1,000

REPUBLIC OF THE PHILIPPINES		
NATIONAL IRRIGATION ADMINISTRATION		
DIVERSIFIED CROPS IRRIGATION ENGINEERING PROJECT (D. C. I. E. P)		
SURVEY RESULT		
DWG. NO.	DCI - 024	DATE
JAPAN INTERNATIONAL COOPERATION AGENCY		

Bench Mark Survey

DATE <u>June 9/07</u> TRIAL FARM PAGE 1						DATE TRIAL FARM PAGE 1					
THE BENCHMARK SURVEY IS YOURS TO USE PLEASE DON'T LOSE IT						FLY and FREE					
STA	BS	HI	FS	RI	ELEV.	LICO, SAN RAFAEL, BULACAN					
BM	1.730	14.715			17.985	top of retaining wall - constant gate					
E-1	1.364	19.079	2.002		17.713						
B-1	1.628	20.589	0.108		18.971						
BMTF	1.197	19.304	2.482		18.107	TRIAL FARM					
W-1	0.997	17.288	3.013		16.241	(TP)					
WL-1			3.048		14.240	(w/s) MC					
BMTF	2.462	20.575			18.107						
E-2	0.058	19.029	1.604		18.971	(TD)					
E-1	1.944	19.659	1.314		17.715						
BM			1.674		17.937	(17.985) closure					
WL-2			3.932		16.271	(w/s)					
	0.718	18.377	2.00		17.659	Top of cartage gate ←					
STA	BS	HI	FS	RI	ELEV.						
			0.327		18.050	Top of TD (inlet) Turbine pen					
			0.872		17.521	Top of outlet Turbine pen					
WL-3			4.127		14.250	Downstream of cartage gate					

JICA