

TABLES



Table 1.3.1 Summary of Core Drilling with Tests

| SITE | HOLE No. | COORDINATES | | ELEVATION (m.a.s.l.) | DEPTH (m) | ELEVATION OF TUNNEL FORMATION (m.a.s.l.) | LUGEON FIELD PERMEABILITY TEST SECTION (m) | OPEN END FIELD PERMEABILITY TEST SECTION (m) | SPT QTTY (Times) | SAMPLING DEPTH FOR LABORATORY ROCK TEST (m) |
|---|-----------------------------------|-------------|--------|-------------------------|--------------|---|---|--|------------------------|--|
| | | N | E | | | | | | | |
| Deule Peripa- La Esperanza Diversion Tunnel | DP 93-1 (Mullatos Tributary) | 9906453 | 619388 | 83.56 | 30 | 60.17 | 20-25 25-30 | — | 1 | 21.30-21.80 |
| | DP 93-2 (Cabalet Tributary) | 9908206 | 624907 | 88.08 | 30 | 64.40 | 10-15 15-20 20-25 | — | - | 23.35 - 23.75 |
| | DP 93-3 (Conguillo Inlet) | 9909173 | 626541 | 89.68 | 30 | 64.60 | 15-20 20-25 25-30 | — | - | 22.00 - 22.57 |
| | SR 93-1 (Pumping Station) | 9892673 | 607600 | 95.87 | 55 | — | — | — | 2 | 48.34 - 48.92 |
| | SR 93-2 (Sub-Station) | 9892688 | 607727 | 107.06 | 25 | — | 5 - 10 | — | 3 | 18.26 - 18.84 |
| La Esperanza- Poza Honda Transbasin | SR 93-3 (Cafia Dulce Inlet) | 9888662 | 603634 | 128.85 | 30 | 107.30 | 15-20 20-25 25-30 | — | 4 | 20.36 - 20.72 |
| | SR 93-4 (Los Cuyuyes Outlet) | 9879191 | 597600 | 135.03 | 40 | 99.70 | 25-30 30-35 35-40 | — | 5 | 33.00 - 33.50 |
| | SR 93-5 (Head Tank) | 9892502 | 607595 | 118.96 | 25 | — | 10-15 15-20 20-25 | 2.00 - 5.00 5.00 - 7.80 | 4 | 9.38 - 9.77 |
| | MG 93-1 (Poza Honda Inlet) | 9878507 | 590569 | 117.62 | 35 | 90.21 | 17.5 - 22.5 22.5 - 27.5 27.5 - 32.5 | — | 12 | 24.1 - 24.55 |
| | MG 93-2 (Mancha Grande Outlet) | 9882195 | 589395 | 122.98 | 45 | 88.96 | 30-35 35-40 40-45 | — | 8 | 36.52 - 37.00 |
| Poza Honda - Mancha Grande Diversion Tunnel | MG 93-3 (Mancha Grande Outlet) | 9882339 | 589277 | 95.00 | 25 | 89.00 | — | 0.0 - 3.0 3.0 - 5.0 5.0 - 8.0 9.0 - 12.0 12.0 - 15.0 | 15 | 8.50 - 8.80 Soil 24.20 - 24.52 |
| | TOTAL QUANTITY | | | | 370 | | 31 sections | | 54 | 11 rock samples |

(*) PVC pipes installed for piezometer

Table 1.3.2 Summary of Sounding (1/3)

| Location | Sounding No. | Depth of Test Hole (m) | Depth of Rock Surface (m) | Quantity of S.P.T. (times) | Water Table (GL-m) | Soil Type |
|---|--------------|------------------------|---------------------------|----------------------------|--------------------|-----------|
| O P E N C H A N N E L | S-01 | 4.05 | 2.95 | 9 | 1.80 | |
| | S-02 | 3.60 | 1.95 | 8 | No | |
| | S-03 | 3.60 | 1.60 | 8 | No | |
| | S-04 | 2.20 | 1.00 | 4 | No | |
| | S-05 | 3.15 | 1.40 | 7 | No | |
| | S-06 | 2.50 | 1.50 | 6 | No | |
| | S-07 | 4.95 | 3.95 | 11 | No | |
| | S-08 | 4.95 | 4.25 | 11 | No | |
| | S-09 | 3.60 | 1.60 | 8 | 2.25 | |
| | S-10 | 3.15 | 1.30 | 7 | No | |
| | S-11 | 4.50 | 3.00 | 10 | No | |
| | S-12 | 4.05 | 2.80 | 9 | No | |
| | S-13 | 3.15 | 2.20 | 7 | No | |
| | S-14 | 4.05 | 3.40 | 9 | 1.50 | |
| | S-15 | 2.00 | 1.60 | 5 | No | |
| | S-16 | 2.40 | 1.70 | 6 | No | |
| | S-17 | 2.50 | 1.60 | 6 | No | |
| | S-18 | 4.95 | 3.80 | 11 | No | |
| | S-19 | 3.50 | 3.00 | 8 | No | |
| | S-20 | 3.60 | 2.80 | 8 | No | |

Table 1.3.2 Summary of Sounding (2/3)

| Location | Sounding No. | Depth of Test Hole (m) | Depth of Rock Surface (m) | Quantity of S.P.T. (times) | Water Table (GL-m) | Soil Type |
|---|--------------|------------------------|---------------------------|----------------------------|--------------------|-----------|
| O P E N C H A N N E L | S-21 | 3.90 | 2.60 | 9 | No | |
| | S-22 | 2.90 | 1.60 | 7 | No | |
| | S-23 | 1.20 | 0.25 | 3 | No | |
| | S-24 | 0.80 | 0.30 | 3 | No | |
| | S-25 | 3.10 | 2.00 | 7 | No | |
| | S-26 | 3.15 | 1.60 | 7 | No | |
| | S-27 | 3.15 | 1.20 | 7 | No | |
| | S-28 | 2.70 | 1.20 | 6 | No | |
| | S-29 | 3.60 | 2.50 | 8 | No | |
| | S-30 | 4.30 | 2.80 | 10 | No | |
| | S-31 | 2.10 | 1.60 | 5 | No | |
| | S-32 | 1.60 | 1.50 | 4 | 1.00 | |
| | S-33 | 3.00 | 2.50 | 7 | No | |
| | S-34 | 2.80 | 1.70 | 7 | No | |
| | S-35 | 1.50 | 0.70 | 4 | No | |
| | S-36 | 2.70 | 1.20 | 6 | No | |
| | S-37 | 3.15 | 1.20 | 7 | No | |
| | S-38 | 3.15 | 1.20 | 7 | No | |
| | S-39 | 1.00 | 0.90 | 3 | No | |
| | S-40 | 2.70 | 1.40 | 6 | No | |

Table 1.3.2 Summary of Sounding (3/3)

| Location | Sounding No. | Depth of Test Hole (m) | Depth of Rock Surface (m) | Quantity of S.P.T. (times) | Water Table (GL-m) | Soil Type |
|---|--------------|------------------------|---------------------------|----------------------------|--------------------|-----------|
| O P E N C H A N N E L | S-41 | 1.10 | 1.00 | 3 | No | |
| | S-42 | 0.95 | 0.90 | 3 | No | |
| | S-43 | 3.15 | 1.80 | 7 | No | |
| | S-44 | 4.95 | 3.90 | 11 | No | |
| | S-45 | 4.20 | 3.40 | 10 | No | |
| | S-46 | 4.50 | 3.80 | 10 | No | |
| | S-47 | 4.95 | 3.40 | 11 | No | |
| | S-48 | 2.25 | 0.90 | 5 | No | |
| | S-49 | 2.25 | 1.00 | 5 | No | |
| | S-50 | 1.20 | 1.10 | 3 | No | |
| | S-51 | 2.70 | 1.20 | 6 | No | |
| | S-52 | 4.05 | 3.00 | 9 | No | |
| | S-53 | 3.20 | 2.90 | 7 | No | |
| | S-54 | 4.05 | 3.00 | 9 | No | |
| * T/L | S-55 | 2.25 | 1.50 | 5 | No | |
| | S-56 | 2.25 | 1.45 | 5 | No | |
| | S-57 | 0.40 | 0.30 | 1 | No | |
| | S-57 | 3.10 | 2.90 | 3 | No | |
| ** P/H | S-58 | 7.20 | 4.70 | 16 | 1.20 | |
| | S-59 | 4.00 | 3.00 | 8 | 2.70 | |
| | S-60 | 2.25 | 0.60 | 5 | No | |

NOTE: TOTAL DEPTH: 187.9

* T/L : Transmission Line

** P/H : Poza Honda

Table 1.3.3 Summary of Test Pitting

| Sample No. | Depth (m) | Sample-1 | Sample-2 | Depth of Rock Contact (m) | Water Table (m) | Remarks |
|--------------------------|-----------|--------------|-------------|---------------------------|-----------------|-----------------------------------|
| | | Depth (m) | Depth (m) | | | |
| OPEN CHANNEL | | | | | | |
| C-10 | 3.00 | 0.50 - 1.40 | 2.00 - 3.00 | 1.40 | - | |
| C-11 | 2.00 | 0.55 - 2.00 | - | - | 1.60 | |
| C-12 | 4.00 | 0.60 - 1.60 | 2.00 - 3.60 | 3.60 | - | |
| C-13 | 4.00 | 0.80 - 2.00 | 2.00 - 3.50 | 2.60 | - | |
| C-14 | 4.00 | 0.90 - 1.90 | 1.90 - 3.50 | 4.20 | - | |
| C-15 | 3.00 | 0.40 - 1.00 | 1.20 - 1.60 | 1.60 | - | |
| C-16 | 4.00 | 0.85 - 1.80 | 2.00 - 3.50 | 3.20 | - | |
| C-17 | 3.00 | 0.40 - 1.60 | 2.00 - 3.00 | 1.60 | - | |
| C-18 | 3.00 | 0.30 - 1.60 | 2.00 - 3.50 | 1.60 | - | |
| C-19 | 4.00 | 1.00 - 1.70 | 1.70 - 3.60 | 3.60 | - | |
| TRANSMISSION LINE | | | | | | |
| C-20 | 1.50 | 0.35 - 1.10 | - | 1.10 | - | Unable to take undisturbed sample |
| C-21 | 3.00 | 0.40 - 1.00 | 1.00 - 2.15 | 2.15 | - | |
| C-22 | 3.50 | *0.60 - 0.70 | 1.00 - 2.35 | 2.35 | - | |
| C-23 | 3.50 | *1.10 - 1.50 | 2.00 - 2.80 | 2.80 | - | |
| C-24 | 4.00 | *1.50 - 1.80 | 2.50 - 4.00 | - | - | |

NOTE: Total Depth: 49.50 m

* Undisturbed sample

Table 1.5.1 Rock Mass Rating System (after Bieniawski, 1979)

| A. CLASSIFICATION PARAMETERS AND THEIR RATINGS | | Ranges of Values | | | | | |
|--|-------------------------------------|---|---|---|---|---|----------------------|
| 1 | Point load strength index (MPa) | 10 | 4 - 10 | 2 - 4 | 1 - 2 | For this low range, Uniaxial compressive test is preferred | |
| | Uniaxial compressive strength (MPa) | 250 | 100 - 250 | 50 - 100 | 25 - 50 | | 5 - 25 1 - 5 1 |
| 2 | Rating | 15 | 12 | 7 | 4 | 2 | |
| | Drill core quality ROD () | 90 - 100 | 75 - 90 | 50 - 75 | 25 - 50 | < 25 | |
| | Rating | 20 | 17 | 13 | 8 | 3 | |
| 3 | Spacing of discontinuities | 2 m | 0.6 - 2 m | 200 - 600 mm | 60 - 200 mm | < 60 mm | |
| | Rating | 20 | 15 | 10 | 8 | 5 | |
| 4 | Condition of discontinuities | Very rough surfaces Not continuous No separation Unweathered wall rock. | Slightly rough surfaces Separation < 1 mm Slightly weathered wall | Slightly rough surfaces Separation < 1 mm Slightly weathered wall | Slickensided surfaces or Gouge < 5 mm thick or Separation 1 - 5 mm Continuous | Soft gouge > 5 mm thick or Separation > 5 mm Continuous | |
| | | Rating | 30 | 25 | 20 | 10 | 0 |
| 5 | Groundwater | Inflow per 10 m tunnel length (L/min) | None | 10 - 25 | 25 - 125 | > 125 | |
| | | Joint water pressure | 0 | < 0.1 | 0.2 - 0.5 | > 0.5 | |
| | | Ratio Major principal stress | 0 | < 0.1 | 0.1 - 0.2 | 0.2 - 0.5 | > 0.5 |
| | | General conditions | Completely dry | Damp | Wet | Dripping | Flowing |
| Rating | 15 | 10 | 7 | 4 | 0 | | |

| B. RATING ADJUSTMENT FOR DISCONTINUITY ORIENTATIONS | | Strike and Dip Orientations of Discontinuities | |
|---|-------------------|--|------------------|
| Ratings | Tunnels and mines | 0 | -2 |
| | Foundations | 0 | -2 |
| | Slopes | 0 | -5 |
| | | Very favorable | Favorable |
| | | Fair | Unfavorable |
| | | -5 | -10 |
| | | -7 | -15 |
| | | -25 | -50 |
| | | | Very unfavorable |

| C. ROCK MASS CLASSES DETERMINED FROM TOTAL RATINGS | |
|--|----------------|
| Rating | 100 - 81 |
| Class No. | I |
| Description | Very good rock |
| Rating | 80 - 61 |
| Class No. | II |
| Description | Good rock |
| Rating | 60 - 41 |
| Class No. | III |
| Description | Fair rock |
| Rating | 40 - 21 |
| Class No. | IV |
| Description | Poor rock |
| Rating | < 20 |
| Class No. | V |
| Description | Very poor rock |

| D. MEANING OF ROCK MASS CLASSES | |
|---------------------------------------|---------------------|
| Class No. | I |
| Average stand-up time | 20 yr for 15-m span |
| Cohesion of the rock mass (kPa) | > 400 |
| Friction angle of the rock mass (deg) | > 45 |
| Class No. | II |
| Average stand-up time | 1 yr poor 10-m span |
| Cohesion of the rock mass (kPa) | 300 - 400 |
| Friction angle of the rock mass (deg) | 35 - 45 |
| Class No. | III |
| Average stand-up time | 1 yr for 5-m span |
| Cohesion of the rock mass (kPa) | 200 - 300 |
| Friction angle of the rock mass (deg) | 25 - 35 |
| Class No. | IV |
| Average stand-up time | 10 h for 2.5-m span |
| Cohesion of the rock mass (kPa) | 100 - 200 |
| Friction angle of the rock mass (deg) | 15 - 25 |
| Class No. | V |
| Average stand-up time | 30 min for 1 m span |
| Cohesion of the rock mass (kPa) | > 100 |
| Friction angle of the rock mass (deg) | > 15 |

* After Bieniawski (1979)

Table 1.5.2 Summary of Rock Test (Detailed Design 1994 and Feasibility Study 1991)

| SITE | Hole No. | Sample No. | Depth (m) | | Rock Type | Specific Gravity | Water Absorption (%) | Natural Density (gr/cm ³) | Unconfined Compressive Strength (kg/cm ²) | Static Elastic Modulus (kg/cm ²) | Tensile Strength (kg/cm ²) | Poisson Ratio | Swelling Pressure (kg/cm ²) | Slaking Durability (%) | Content of Clay Mineral |
|---|----------|------------|-----------|------|-----------|------------------|----------------------|---------------------------------------|---|--|--|---------------|---|------------------------|-------------------------|
| | | | From | To | | | | | | | | | | | |
| Daule Peripa-La Esperanza Diversion Tunnel | DP93-1 | -1 | 21.3 | 21.8 | Fine SS. | 2.758 | 46.2 | 1.79 | 49 | 12,300 | 13.0 | 0.11 | 0.00 | 87.0 | **SnvI |
| | -2 | -1 | 23.3 | 23.7 | Md. | 2.704 | 41.5 | 1.82 | 103 | 12,600 | 6.5 | 0.20 | 6.50 | 0.1 | SnvI |
| | -3 | -1 | 22.0 | 22.5 | Sandy Md. | 2.695 | 46.9 | 1.86 | 60 | 21,100 | 14.0 | 0.25 | 1.20 | 73.0 | SnvI |
| La Esperanza-Poza Honda Transbasin (Diversion Tunnel) | SR93-3 | -1 | 20.3 | 20.7 | Sandy Md. | 2.736 | 36.5 | 2.07 | 63 | 22,600 | 16.0 | 0.21 | 1.70 | 79.0 | SnvI |
| | -4 | -1 | 33.0 | 33.5 | " | 2.768 | 39.2 | 2.04 | 64 | 12,800 | 15.0 | 0.18 | 0.50 | 86.0 | SnvI |
| | *B -3 | -1 | 39.5 | 40.0 | " | - | 24.0 | 2.00 | 45 | - | - | - | - | - | - |
| | * -4 | -1 | 39.5 | 40.0 | " | - | 22.0 | 2.10 | 73 | - | - | - | - | - | - |
| Poza Honda-Mancha Grande Diversion Tunnel | MG93-1 | -1 | 24.1 | 24.5 | Muddy SS. | 2.608 | 32.8 | 2.06 | 38 | 7,700 | 11.0 | 0.22 | 0.40 | 68.0 | SnvI |
| | 93-3 | -1 | 24.2 | 24.5 | " | 2.735 | 39.7 | 2.00 | 6 | 1,900 | 2.0 | 0.20 | 0.20 | 0.4 | SnvI |
| | 93-2 | -1 | 36.5 | 37.0 | Sandy Md. | 2.661 | 34.9 | 2.07 | 80 | 6,100 | 12.0 | 0.21 | 0.20 | 12.0 | SnvI |
| | *B -5 | -1 | 21.0 | 21.5 | " | - | 21.0 | 1.90 | 47 | - | - | - | - | - | - |
| | * -2 | -2 | 29.5 | 30.0 | " | - | - | - | 46 | - | - | - | - | - | - |
| | *B -6 | -1 | 28.0 | 28.5 | " | - | 30.0 | 2.00 | 33 | - | - | - | - | - | - |
| La Esperanza-Poza Honda Transbasin (Pumping Station Head Tank Substation) | SR93-1 | -1 | 48.3 | 48.9 | Muddy SS. | 2.726 | 4.4 | 2.00 | 92 | 37,500 | 18.0 | 0.24 | 0.26 | 77.0 | SnvI |
| | 2 | -1 | 18.3 | 18.8 | Fine SS. | 2.657 | 34.8 | 2.10 | 129 | 56,000 | 29.0 | 0.19 | 0.08 | 95.0 | SnvI |
| | *B -1 | -1 | 29.5 | 29.9 | " | - | 22.0 | 1.90 | 71 | - | - | - | - | - | - |
| | SR93-5 | -1 | 8.7 | 9.7 | Sandy Md. | 2.733 | 39.0 | 2.00 | 134 | 16,500 | 21.0 | 0.16 | 0.10 | 68.4 | SnvI |

Note: * Examination in the Feasibility Study, 1991.

** SnvI: Smectite (Montmorillonite)/Illite complex

Table 1.5.3 Geotechnical Design Criteria

| Engineering Properties | | Daulc-Peripa-La Esperanza Diversion Tunnel | | La Esperanza-Poza Honda Diversion Tunnel | | Poza Honda-Mancha Grande Diversion Tunnel | |
|----------------------------------|------------------------|--|-----------|--|-----------|---|-----------|
| Bedrock Condition | | Muddy fine sandstone | | Sandy mudstone | | Mudstone, minor sandstone | |
| | | Intact | Weathered | Intact | Weathered | Intact | Weathered |
| Rock quality Class | Bieniawski | II-III | III-IV | III | IV | III-IV | IV-V |
| | JPN Standard | Cm | C1-D | Cm-C1 | C1-D | C1 | C1-D |
| Unit Weight | (g/cm ³) | 1.80 | 1.70 | 2.00 | 1.80 | 2.00 | 1.80 |
| Uniaxial compressive strength qu | (kgf/cm ²) | 50 | 30 | 50 | 30 | 40 | 30 |
| Elasticity Modulus Es | (kgf/cm ²) | 20,000 | 10,000 | 20,000 | 10,000 | 12,000 | 10,000 |
| Deformation Modulus Ds | (kgf/cm ²) | 10,000 | 5,000 | 10,000 | 5,000 | 7,000 | 5,000 |
| Poisson's ratio | | 0.20 | 0.25 | 0.20 | 0.25 | 0.25 | 0.30 |
| Cohesion C | (kgf/cm ²) | 5.00 | 2.50 | 5.00 | 2.50 | 3.00 | 2.00 |
| Internal Angle of Friction | (degree) | 40 | 35 | 40 | 35 | 40 | 30 |
| Permeability in drill holes | | Medium to low | . | High | . | High to medium | . |

Table 1.5.4 Rock Classification for Engineering Geology in Japanese Standard

| Rock Class | Characteristics |
|------------|---|
| A | Hard and fresh rocks. Rock-forming minerals are fresh and not weathered or altered. Joints and cracks are closed tightly, no weathering on their planes. Clear sound is emitted when hammered. |
| B | Hard and fresh rocks. Rock forming minerals are weathered slightly or partially altered. Joints and cracks are closed tightly, without weathering. Clear sound is emitted when hammered. |
| CII | Fairly hard and slightly weathered rocks. Rock-forming minerals, except quartz, are weathered or altered. Tightness of joints and cracks is slightly reduced and each block is apt to be exfoliated along joints and cracks which sometimes contain clay and other materials, stained by limonites. Slightly dull sound is emitted when hammered. |
| CL | Slightly soft and moderately weathered rock. Rock-forming minerals, except quartz, are weathered or altered. Exfoliation occurs along joint and cracks by hammering. Joints and cracks sometimes contain clay and other materials. Slightly dull sound is emitted when hammered. |
| CM | Soft and weathered rocks. Rock minerals are weathered. Exfoliation occurs easily along joints and cracks by hammering. Joints and cracks contain clay and other materials. Dull sound is emitted when hammered. |
| D | Very soft, highly weathered, fractured and/or altered rocks. Rock-forming minerals are highly weathered. Joints and cracks are very loose, easily collapse by weak hammering, which contain clay and other materials. Very dull sound is emitted when hammered. |

| Rock Class | Compressive strength (qu kg/cm ²) | Modulus of elasticity (Es kg/cm ²) | Modulus of deformation (Ed kg/cm ²) | Seismic velocity (km/sec) | Poisson's ratio |
|------------|--|--|---|---------------------------|-----------------|
| A&B | more than 800 | more than 80,000 | more than 50,000 | more than 3.7 | less than 0.2 |
| CII | more than 800 or 800 to 200 or (less than 200) | 80,000 to 40,000 | 50,000 to 20,000 | 3.7 to 3 | 0.2 to 0.3 |
| CM | 800 to 200 or (less than 200) | 40,000 to 15,000 | 20,000 to 5,000 | 3 to 1.5 | 0.2 to 0.3 |
| CL | 400 to 200 or (less than 200) | less than 15,000 | less than 5,000 | less than 1.5 | more than 0.3 |
| D | less than 200 | less than 15,000 | less than 5,000 | less than 1.5 | more than 0.3 |

| Rock Class | Cohesion (kg/cm ²) | Internal friction angle (degree) | Borehole test | |
|------------|--------------------------------|----------------------------------|--|---|
| | | | Modulus of deformation (kg/cm ²) | Modulus of elasticity Es(kg/cm ²) |
| A&B | more than 40 | 55 to 65 | more than 50,000 | more than 100,000 |
| CII | 40 to 20 | 40 to 55 | 60,000 to 15,000 | 150,000 to 60,000 |
| CM | 20 to 10 | 30 to 45 | 20,000 to 3,000 | 60,000 to 10,000 |
| CL&D | less than 10 | 15 to 38 | less than 6,000 | less than 15,000 |

Notes :

- (1) Compressive strength shows the result of rock piece test.
- (2) Figures in bracket show the compressive strength for soft rocks.
- (3) Modulus of elasticity and deformation show the results of in situ plate loading tests.
- (4) Es means secantial elasticity.

Source ; Standard of Central Research Institute of Electric Power Industry

Table 1.5.5 Summary of Field Permeability Test

| SITE | Hole No. | Depth (m) | K (cm/sec) | Lugeon Value (lit/min.m) | Rock Type | Rock Class | Test Results |
|--|-----------------------------|----------------------|----------------------|--------------------------|------------------------|---------------|---------------|
| Daule Peripa-La Esperanza Diversion Tunnel | DP 93-1 (Mulas Tributary) | 20 - 25 | 5.8×10^{-5} | 4.7 | Sandstone | CM III | |
| | | 25 - 30 | 3.1×10^{-4} | 26 | Sandstone | CL-CM IV-III | |
| | DP 93-2 (Cañales Tributary) | 10 - 15 | 4.6×10^{-4} | 37 | Sandstone | CL IV | |
| | | 15 - 20 | 8.1×10^{-6} | 0.7 | Muddy - Sandstone | CL-CM IV-III | |
| | | 20 - 25 | 5.8×10^{-5} | 4.8 | Mudstone | CL-CM IV-III | |
| | DP 93-3 (Conguillo Inlet) | 15 - 20 | 7.5×10^{-4} | 61 | Fine S.S. - Muddy S.S | CM III-II | |
| | | 20 - 25 | 1.7×10^{-4} | 14 | Sandstone - Mudstone | CM III-II | |
| | | 25 - 30 | 7.0×10^{-6} | 0.6 | Sandstone | CM III-II | |
| | SR 93-3 (Caña Dulce Inlet) | 15 - 20 | 4.9×10^{-4} | 40 | Sandy - Mudstone | CL-CM III | |
| | | 20 - 25 | 2.6×10^{-4} | 21 | Sandy - Mudstone | CL-CM III | |
| 25 - 30 | | 3.7×10^{-4} | 30 | Sandy - Mudstone | CL-CM III | | |
| 25 - 30 | | 4.9×10^{-4} | 40 | Sandy - Mudstone | CL IV III | | |
| SR 93-4 (Los Cuyuyes Outlet) | 30 - 35 | 1.5×10^{-3} | 122 | Sandy - Mudstone | CL IV III | | |
| | 35 - 40 | 6.0×10^{-4} | 49 | Sandstone | CL CM III | | |
| | 5 - 10 | 1.2×10^{-3} | 100 | Sandy - Mudstone | CL IV | | |
| La Esperanza-Poza Honda Transbasin | SR 93-2 (Substation) | 2 - 5 | 3.3×10^{-3} | - | Colluvial | Soil | Open end test |
| | | 5 - 7.8 | 1.7×10^{-5} | - | Weathered - Mudstone | D | Open end test |
| | SR 93-5 (Head Tank) | 10 - 15 | 5.1×10^{-4} | 41 | Fine - sandstone | CL | |
| | | 15 - 20 | 4.2×10^{-4} | 34 | Fine S.S. - Sandy M.S. | CL | |
| | | 20 - 25 | 3.4×10^{-4} | 28 | Fine - sandstone | CL | |
| | | 17.5 - 22.5 | 5.1×10^{-4} | 41 | Sandy - Mudstone | D-CL IV-III | |
| | MG 93-1 (Poza Honda Inlet) | 22.5 - 27.5 | 8.7×10^{-4} | 71 | Sandy M.S. - Fine S.S. | CL | |
| | | 27.5 - 32.5 | 6.5×10^{-4} | 52 | Fine S.S. - Muddy S.S. | CL | |
| | | 30 - 35 | 5.4×10^{-4} | 44 | Sandy - Mudstone | D-CL IV-III | |
| | MG 93-2 (M. Grande Outlet) | 35 - 40 | 2.1×10^{-4} | 17 | Sandy - Mudstone | D-CL IV-III | |
| | | 40 - 45 | 2.2×10^{-4} | 17 | Sandy - Mudstone | D-CL IV-III | |
| | MG 93-3 (M. Grande Outlet) | 0 - 3 | 1.0×10^{-3} | - | Alluvial | Soil | Open end test |
| 3 - 5 | | 1.0×10^{-4} | - | Alluvial | Soil | Open end test | |
| 5 - 8 | | 6.1×10^{-5} | - | Colluvial | Soil | Open end test | |
| 9 - 12 | | 6.2×10^{-5} | - | Colluvial | Soil | Open end test | |
| 12 - 15 | | 6.2×10^{-5} | - | Colluvial | Soil | Open end test | |

Table 1.5.6 Summary of Rock Test (Daule-Peripa-La Esperanza Diversion Tunnel, in the year 1986)

| Hole No. | Sample No. | Depth (m) | | Rock Type | Unconfined Compressive Strength (kgf/cm ²) | Static Elastic Modulus (kgf/cm ²) | Poisson Ratio | Triaxial Compressive Strength | | Swelling Expansion (kgf/cm ²) | CaCO ₃ Content (%) |
|----------|------------|-----------|-------|-----------|--|---|---------------|-------------------------------|----|---|-------------------------------|
| | | From | To | | | | | C (kgf/cm ²) | φ | | |
| Co-1 | -1 | 16.55 | 16.85 | Mudstone | | | | | | | |
| | -2 | 24.65 | 25.15 | " | 23 | 4,500 | 0.29 | | | 0.54 | |
| | -3 | 26.70 | 26.90 | " | 45 | 5,960 | 0.40 | 6 | 48 | | 0.45 |
| Co-2 | -1 | 16.30 | 16.65 | " | 14 | 3,500 | | | | | |
| | -4 | 35.85 | 36.05 | " | 57 | 12,500 | 0.38 | 15 | 21 | | |
| LE-2 | -3 | 29.70 | 30.00 | " | 28 | 5,000 | 0.33 | | | | |
| | -5 | 40.50 | 40.75 | " | 65 | 9,583 | 0.17 | | | | |
| CO-2 | 2 | 25.00 | 25.20 | Sandstone | 100 | 30,000 | 0.30 | | | 0.63 | |
| | 3 | 30.00 | 30.45 | " | 53 | 17,454 | 0.29 | | | 0.39 | |
| LE-2 | 1 | 20.50 | 20.80 | " | 40 | 6,666 | 0.20 | | | | |
| | 2 | 26.70 | 27.00 | " | 55 | 5,750 | 0.22 | | | | 6.45 |
| | 4 | 36.70 | 37.00 | " | | | | 18 | 27 | | |
| | 6 | 43.20 | 43.50 | " | 76 | 20,000 | 0.28 | | | | |
| LE-3 | 1 | 8.10 | 8.40 | " | | | | 18 | 37 | | |
| | 2 | 15.45 | 15.75 | " | 17 | 2,000 | 0.13 | | | | 0.45 |
| | 3 | 17.95 | 18.25 | " | 63 | 17,100 | 0.38 | | | | |
| | 4 | 38.37 | 38.50 | " | 144 | 26,000 | 0.17 | | | | |
| LE-4 | 1 | 60.00 | 60.30 | " | 31 | 5,647 | 0.05 | | | | |
| | 2 | 68.00 | 68.30 | " | 80 | 22,857 | 0.50 | | | 0.26 | 0.45 |
| | 3 | 73.60 | 73.90 | " | 31 | 6,300 | 0.27 | | | 0.17 | |
| | 4 | 83.00 | 85.50 | " | 18 | 2,352 | 0.21 | | | | |
| ME-1 | 1 | 20.95 | 21.25 | " | 28 | 4,516 | 0.03 | | | | |
| | 2 | 25.30 | 25.60 | " | 42 | 2,816 | 0.03 | | | | |
| | 3 | 17.80 | 18.10 | " | 136 | 10,000 | 0.06 | | | | |
| | 4 | 18.65 | 18.95 | " | 58 | 4,838 | 0.15 | | | | |
| | 5 | 23.00 | 23.30 | " | 45 | 1,461 | 0.46 | | | | |
| ME-2 | 1 | 11.80 | 12.25 | " | 60 | 4,109 | 0.32 | | | | |
| | 2 | 16.30 | 16.60 | " | 76 | 7,207 | 0.29 | | | | |
| | 3 | 24.15 | 24.47 | " | 63 | 5,084 | 0.10 | | | | |
| ME-3 | 1 | 10.20 | 10.50 | " | 61 | 4,071 | 0.15 | | | | |
| | 2 | 11.20 | 11.50 | " | 90 | 106,681 | 0.50 | | | | |
| | 3 | 19.00 | 19.25 | " | 53 | 16,580 | 0.30 | | | | 4.05 |
| ME-4 | 1 | 12.60 | 13.00 | " | 44 | 4,891 | 0.04 | | | | |

Table 1.5.7 Record of Water Pressure Test(1/5)

RECORD OF WATER PRESSURE TEST HOLE NO. DP93-1
DEPTH(m): 20-25

| GAUGE PRESS. | INJECTION | | TEST LENGTH | HOLE DIA. | GAUGE HEIGHT | WATER LEVEL | FRICTION LOSS | TEST PRESS. | LUGEON VALUE | k-VALUE |
|--------------|-----------|---------|-------------|-----------|--------------|-------------|---------------|-------------|--------------|----------|
| | kg/cm2 | lit/min | | | | | | | | |
| 1.0 | 1.7 | 0.34 | 5.0 | 99.0 | 0.55 | 18.55 | 0.00 | 2.9 | 1.2 | 1.43E-05 |
| 4.0 | 14.5 | 2.90 | 5.0 | 99.0 | 0.55 | 18.55 | 0.00 | 5.9 | 4.9 | 6.01E-05 |
| 8.0 | 23.5 | 4.70 | 5.0 | 99.0 | 0.55 | 18.55 | 0.00 | 9.9 | 4.7 | 5.81E-05 |
| 4.0 | 15.0 | 3.00 | 5.0 | 99.0 | 0.55 | 18.55 | 0.00 | 5.9 | 5.1 | 6.21E-05 |
| 1.0 | 3.0 | 0.60 | 5.0 | 99.0 | 0.55 | 18.55 | 0.00 | 2.9 | 2.1 | 2.52E-05 |

RECORD OF WATER PRESSURE TEST HOLE NO. DP93-1
DEPTH(m): 25-30

| GAUGE PRESS. | INJECTION | | TEST LENGTH | HOLE DIA. | GAUGE HEIGHT | WATER LEVEL | FRICTION LOSS | TEST PRESS. | LUGEON VALUE | k-VALUE |
|--------------|-----------|---------|-------------|-----------|--------------|-------------|---------------|-------------|--------------|----------|
| | kg/cm2 | lit/min | | | | | | | | |
| 1.0 | 34.4 | 6.88 | 5.0 | 99.0 | 0.58 | 23.15 | 0.06 | 3.3 | 20.8 | 2.54E-04 |
| 4.0 | 56.8 | 11.36 | 5.0 | 99.0 | 0.58 | 23.15 | 0.37 | 6.0 | 18.9 | 2.32E-04 |
| 5.0 | 85.0 | 17.00 | 5.0 | 99.0 | 0.58 | 23.15 | 0.85 | 6.5 | 26.1 | 3.19E-04 |
| 4.0 | 44.1 | 8.82 | 5.0 | 99.0 | 0.58 | 23.15 | 0.18 | 6.2 | 14.2 | 1.74E-04 |
| 1.0 | 35.0 | 7.00 | 5.0 | 99.0 | 0.58 | 23.15 | 0.06 | 3.3 | 21.1 | 2.59E-04 |

RECORD OF WATER PRESSURE TEST HOLE NO. DP93-2
DEPTH(m): 10-15

| GAUGE PRESS. | INJECTION | | TEST LENGTH | HOLE DIA. | GAUGE HEIGHT | WATER LEVEL | FRICTION LOSS | TEST PRESS. | LUGEON VALUE | k-VALUE |
|--------------|-----------|---------|-------------|-----------|--------------|-------------|---------------|-------------|--------------|----------|
| | kg/cm2 | lit/min | | | | | | | | |
| 1.0 | 15.2 | 3.04 | 5.0 | 99.0 | 0.60 | 0.90 | 0.00 | 1.2 | 26.4 | 3.24E-04 |
| 3.0 | 45.3 | 9.06 | 5.0 | 99.0 | 0.60 | 0.90 | 0.10 | 3.1 | 29.7 | 3.64E-04 |
| 5.0 | 90.5 | 18.10 | 5.0 | 99.0 | 0.60 | 0.90 | 0.38 | 4.8 | 37.9 | 4.65E-04 |
| 3.0 | 55.0 | 11.00 | 5.0 | 99.0 | 0.60 | 0.90 | 0.15 | 3.0 | 36.7 | 4.49E-04 |
| 1.0 | 25.0 | 5.00 | 5.0 | 99.0 | 0.60 | 0.90 | 0.00 | 1.2 | 43.5 | 5.32E-04 |

RECORD OF WATER PRESSURE TEST HOLE NO. DP93-2
DEPTH(m): 15-20

| GAUGE PRESS. | INJECTION | | TEST LENGTH | HOLE DIA. | GAUGE HEIGHT | WATER LEVEL | FRICTION LOSS | TEST PRESS. | LUGEON VALUE | k-VALUE |
|--------------|-----------|---------|-------------|-----------|--------------|-------------|---------------|-------------|--------------|----------|
| | kg/cm2 | lit/min | | | | | | | | |
| 1.0 | 0.50 | 0.10 | 5.0 | 99.0 | 0.75 | 0.90 | 0.00 | 1.2 | 0.9 | 1.05E-05 |
| 3.0 | 0.60 | 0.12 | 5.0 | 99.0 | 0.75 | 0.90 | 0.00 | 3.2 | 0.4 | 4.64E-06 |
| 5.0 | 1.70 | 0.34 | 5.0 | 99.0 | 0.75 | 0.90 | 0.00 | 5.2 | 0.7 | 8.06E-06 |
| 3.0 | 0.50 | 0.10 | 5.0 | 99.0 | 0.75 | 0.90 | 0.00 | 3.2 | 0.3 | 3.87E-06 |
| 1.0 | 0.05 | 0.01 | 5.0 | 99.0 | 0.75 | 0.90 | 0.00 | 1.2 | 0.1 | 1.05E-06 |

RECORD OF WATER PRESSURE TEST HOLE NO. DP93-2
DEPTH(m): 20-25

| GAUGE PRESS. | INJECTION | | TEST LENGTH | HOLE DIA. | GAUGE HEIGHT | WATER LEVEL | FRICTION LOSS | TEST PRESS. | LUGEON VALUE | k-VALUE |
|--------------|-----------|---------|-------------|-----------|--------------|-------------|---------------|-------------|--------------|----------|
| | kg/cm2 | lit/min | | | | | | | | |
| 1.0 | 0.30 | 0.06 | 5.0 | 99.0 | 0.60 | 0.90 | 0.00 | 1.2 | 0.5 | 6.39E-06 |
| 3.0 | 4.90 | 0.98 | 5.0 | 99.0 | 0.60 | 0.90 | 0.00 | 3.2 | 3.1 | 3.81E-05 |
| 6.0 | 14.80 | 2.96 | 5.0 | 99.0 | 0.60 | 0.90 | 0.00 | 6.2 | 4.8 | 5.89E-05 |
| 3.0 | 6.00 | 1.20 | 5.0 | 99.0 | 0.60 | 0.90 | 0.00 | 3.2 | 3.8 | 4.66E-05 |
| 1.0 | 0.05 | 0.01 | 5.0 | 99.0 | 0.60 | 0.90 | 0.00 | 1.2 | 0.1 | 1.06E-06 |

RECORD OF WATER PRESSURE TEST HOLE NO. DP93-3
DEPTH(m): 15-20

| GAUGE PRESS. | INJECTION | | TEST LENGTH | HOLE DIA. | GAUGE HEIGHT | WATER LEVEL | FRICTION LOSS | TEST PRESS. | LUGEON VALUE | k-VALUE |
|--------------|-----------|---------|-------------|-----------|--------------|-------------|---------------|-------------|--------------|----------|
| | kg/cm2 | lit/min | | | | | | | | |
| 1.0 | 66.00 | 13.20 | 5.0 | 99.0 | 0.61 | 8.45 | 0.30 | 1.6 | 82.2 | 1.01E-03 |
| 2.0 | 86.90 | 17.38 | 5.0 | 99.0 | 0.61 | 8.45 | 0.53 | 2.4 | 73.0 | 8.94E-04 |
| 4.0 | 122.10 | 24.42 | 5.0 | 99.0 | 0.61 | 8.45 | 0.93 | 4.0 | 61.4 | 7.52E-04 |
| 2.0 | 87.00 | 17.40 | 5.0 | 99.0 | 0.61 | 8.45 | 0.50 | 2.4 | 72.2 | 8.84E-04 |
| 1.0 | 68.00 | 13.60 | 5.0 | 99.0 | 0.61 | 8.45 | 0.33 | 1.6 | 86.3 | 1.06E-03 |

Table 1.5.7 Record of Water Pressure Test(2/5)

RECORD OF WATER PRESSURE TEST HOLE NO. DP93-3
 DEPTH(m): 20-25

| GAUGE PRESS. | INJECTION Qty | | TEST LENGTH | | HOLE DIA. | GAUGE HEIGHT | WATER LEVEL | FRICTION LOSS | TEST PRESS. | LUGEON VALUE | k-VALUE |
|--------------|---------------|---------|-------------|------|-----------|--------------|-------------|---------------|-------------|--------------|---------|
| | kg/cm2 | lit/min | lit/min/m | m | | | | | | | |
| 1.0 | 21.00 | 4.20 | 5.0 | 99.0 | 0.78 | 9.15 | 0.00 | 2.0 | 21.1 | 2.58E-04 | |
| 3.0 | 29.20 | 5.84 | 5.0 | 99.0 | 0.78 | 9.15 | 0.02 | 4.0 | 14.7 | 1.80E-04 | |
| 6.0 | 47.40 | 9.48 | 5.0 | 99.0 | 0.78 | 9.15 | 0.20 | 6.8 | 14.0 | 1.71E-04 | |
| 3.0 | 13.70 | 2.74 | 5.0 | 99.0 | 0.78 | 9.15 | 0.00 | 4.0 | 6.9 | 8.40E-05 | |
| 1.0 | 2.80 | 0.56 | 5.0 | 99.0 | 0.78 | 9.15 | 0.00 | 2.0 | 2.8 | 3.44E-05 | |

RECORD OF WATER PRESSURE TEST HOLE NO. DP93-3
 DEPTH(m): 25-30

| GAUGE PRESS. | INJECTION Qty | | TEST LENGTH | | HOLE DIA. | GAUGE HEIGHT | WATER LEVEL | FRICTION LOSS | TEST PRESS. | LUGEON VALUE | k-VALUE |
|--------------|---------------|---------|-------------|------|-----------|--------------|-------------|---------------|-------------|--------------|---------|
| | kg/cm2 | lit/min | lit/min/m | m | | | | | | | |
| 1.0 | 0.00 | 0.00 | 5.0 | 99.0 | 0.58 | 7.76 | 0.00 | 1.8 | 0.0 | 1.34E-08 | |
| 4.0 | 0.00 | 0.00 | 5.0 | 99.0 | 0.58 | 7.76 | 0.02 | 4.8 | 0.0 | 5.09E-09 | |
| 7.0 | 2.10 | 0.42 | 5.0 | 99.0 | 0.58 | 7.76 | 0.20 | 7.6 | 0.6 | 6.74E-06 | |
| 10.0 | 3.10 | 0.62 | 5.0 | 99.0 | 0.58 | 7.76 | 0.00 | 10.8 | 0.6 | 7.01E-06 | |
| 7.0 | 0.10 | 0.02 | 5.0 | 99.0 | 0.58 | 7.76 | 0.00 | 7.8 | 0.0 | 3.13E-07 | |
| 4.0 | 0.00 | 0.00 | 5.0 | 99.0 | 0.58 | 7.76 | 0.00 | 4.8 | 0.0 | 5.07E-09 | |
| 1.0 | 0.00 | 0.00 | 5.0 | 99.0 | 0.58 | 7.76 | 0.00 | 1.8 | 0.0 | 1.34E-08 | |

RECORD OF WATER PRESSURE TEST HOLE NO. SR93-2
 DEPTH(m): 5-10

| GAUGE PRESS. | INJECTION Qty | | TEST LENGTH | | HOLE DIA. | GAUGE HEIGHT | WATER LEVEL | FRICTION LOSS | TEST PRESS. | LUGEON VALUE | k-VALUE |
|--------------|---------------|---------|-------------|------|-----------|--------------|-------------|---------------|-------------|--------------|---------|
| | kg/cm2 | lit/min | lit/min/m | m | | | | | | | |
| 0.5 | 49.00 | 9.80 | 5.0 | 99.0 | 0.60 | 3.50 | 0.06 | 0.9 | 115.3 | 1.41E-03 | |
| 1.0 | 68.80 | 13.76 | 5.0 | 99.0 | 0.60 | 3.50 | 0.11 | 1.3 | 105.8 | 1.30E-03 | |
| 1.5 | 87.30 | 17.46 | 5.0 | 99.0 | 0.60 | 3.50 | 0.17 | 1.7 | 100.1 | 1.22E-03 | |
| 1.0 | 73.50 | 14.70 | 5.0 | 99.0 | 0.60 | 3.50 | 0.13 | 1.3 | 114.4 | 1.40E-03 | |
| 0.5 | 49.80 | 9.96 | 5.0 | 99.0 | 0.60 | 3.50 | 0.06 | 0.9 | 117.2 | 1.43E-03 | |

RECORD OF WATER PRESSURE TEST HOLE NO. SR93-3
 DEPTH(m): 15-20

| GAUGE PRESS. | INJECTION Qty | | TEST LENGTH | | HOLE DIA. | GAUGE HEIGHT | WATER LEVEL | FRICTION LOSS | TEST PRESS. | LUGEON VALUE | k-VALUE |
|--------------|---------------|---------|-------------|------|-----------|--------------|-------------|---------------|-------------|--------------|---------|
| | kg/cm2 | lit/min | lit/min/m | m | | | | | | | |
| 1.0 | 11.20 | 2.24 | 5.0 | 99.0 | 0.60 | 17.60 | 0.00 | 2.8 | 7.9 | 9.72E-05 | |
| 2.0 | 35.00 | 7.00 | 5.0 | 99.0 | 0.60 | 17.60 | 0.08 | 3.7 | 18.7 | 2.29E-04 | |
| 3.0 | 85.50 | 17.10 | 5.0 | 99.0 | 0.60 | 17.60 | 0.60 | 4.2 | 40.5 | 4.96E-04 | |
| 2.0 | 64.70 | 12.94 | 5.0 | 99.0 | 0.60 | 17.60 | 0.47 | 3.4 | 38.6 | 4.72E-04 | |
| 1.0 | 21.30 | 4.26 | 5.0 | 99.0 | 0.60 | 17.60 | 0.00 | 2.8 | 15.1 | 1.85E-04 | |

RECORD OF WATER PRESSURE TEST HOLE NO. SR93-3
 DEPTH(m): 20-25

| GAUGE PRESS. | INJECTION Qty | | TEST LENGTH | | HOLE DIA. | GAUGE HEIGHT | WATER LEVEL | FRICTION LOSS | TEST PRESS. | LUGEON VALUE | k-VALUE |
|--------------|---------------|---------|-------------|------|-----------|--------------|-------------|---------------|-------------|--------------|---------|
| | kg/cm2 | lit/min | lit/min/m | m | | | | | | | |
| 1.0 | 0.10 | 0.02 | 5.0 | 99.0 | 0.70 | 17.80 | 0.00 | 2.9 | 0.1 | 8.59E-07 | |
| 3.0 | 1.20 | 0.24 | 5.0 | 99.0 | 0.70 | 17.80 | 0.00 | 4.9 | 0.5 | 6.06E-06 | |
| 5.0 | 67.80 | 13.56 | 5.0 | 99.0 | 0.70 | 17.80 | 0.44 | 6.4 | 21.2 | 2.59E-04 | |
| 3.0 | 30.30 | 6.06 | 5.0 | 99.0 | 0.70 | 17.80 | 0.30 | 4.6 | 13.3 | 1.63E-04 | |
| 1.0 | 5.40 | 1.08 | 5.0 | 99.0 | 0.70 | 17.80 | 0.00 | 2.9 | 3.8 | 4.64E-05 | |

Table 1.5.7 Record of Water Pressure Test(3/5)

RECORD OF WATER PRESSURE TEST HOLE NO. SR93-3
 DEPTH(m): 25-30

| GAUGE PRESS. | INJECTION Qty | TEST LENGTH | HOLE DIA. | GAUGE HEIGHT | WATER LEVEL | FRICION LOSS | TEST PRESS. | LUGEON VALUE | k-VALUE | |
|--------------|---------------|-------------|-----------|--------------|-------------|--------------|-------------|--------------|---------|----------|
| kg/cm2 | lit/min | lit/min/m | m | mm | m | m | kg/cm2 | kg/cm2 | cm/sec | |
| 1.0 | 0.70 | 0.14 | 5.0 | 99.0 | 0.80 | 17.80 | 0.00 | 2.9 | 0.5 | 5.99E-06 |
| 2.0 | 0.70 | 0.14 | 5.0 | 99.0 | 0.80 | 17.80 | 0.02 | 3.8 | 0.4 | 4.46E-06 |
| 4.0 | 0.60 | 0.12 | 5.0 | 99.0 | 0.80 | 17.80 | 0.20 | 5.7 | 0.2 | 2.60E-06 |
| 6.0 | 1.00 | 0.20 | 5.0 | 99.0 | 0.80 | 17.80 | 0.00 | 7.9 | 0.3 | 3.12E-06 |
| 7.0 | 135.00 | 27.00 | 5.0 | 99.0 | 0.80 | 17.80 | 0.00 | 8.9 | 30.5 | 3.73E-04 |

RECORD OF WATER PRESSURE TEST HOLE NO. SR93-4
 DEPTH(m): 25-30

| GAUGE PRESS. | INJECTION Qty | TEST LENGTH | HOLE DIA. | GAUGE HEIGHT | WATER LEVEL | FRICION LOSS | TEST PRESS. | LUGEON VALUE | k-VALUE | |
|--------------|---------------|-------------|-----------|--------------|-------------|--------------|-------------|--------------|---------|----------|
| kg/cm2 | lit/min | lit/min/m | m | mm | m | m | kg/cm2 | kg/cm2 | cm/sec | |
| 1.0 | 0.00 | 0.00 | 5.0 | 99.0 | 0.60 | 14.80 | 0.00 | 2.5 | 0.0 | 9.64E-09 |
| 3.0 | 0.01 | 0.00 | 5.0 | 99.0 | 0.60 | 14.80 | 0.00 | 4.5 | 0.0 | 5.39E-08 |
| 6.0 | 0.01 | 0.00 | 5.0 | 99.0 | 0.60 | 14.80 | 0.00 | 7.5 | 0.0 | 3.25E-08 |
| 10.0 | 180.00 | 36.00 | 5.0 | 99.0 | 0.60 | 14.80 | 2.70 | 8.8 | 40.7 | 4.99E-04 |
| 3.0 | 115.00 | 23.00 | 5.0 | 99.0 | 0.60 | 14.80 | 1.38 | 3.2 | 72.7 | 8.90E-04 |
| 1 | 40.20 | 8.04 | 5.0 | 99.0 | 0.60 | 14.80 | 0.20 | 2.3 | 34.4 | 4.21E-04 |

RECORD OF WATER PRESSURE TEST HOLE NO. SR93-4
 DEPTH(m): 30-35

| GAUGE PRESS. | INJECTION Qty | TEST LENGTH | HOLE DIA. | GAUGE HEIGHT | WATER LEVEL | FRICION LOSS | TEST PRESS. | LUGEON VALUE | k-VALUE | |
|--------------|---------------|-------------|-----------|--------------|-------------|--------------|-------------|--------------|---------|----------|
| kg/cm2 | lit/min | lit/min/m | m | mm | m | m | kg/cm2 | kg/cm2 | cm/sec | |
| 1.0 | 91.50 | 18.30 | 5.0 | 99.0 | 0.60 | 14.80 | 1.17 | 1.4 | 133.6 | 1.64E-03 |
| 2.0 | 117.00 | 23.40 | 5.0 | 99.0 | 0.60 | 14.80 | 1.65 | 1.9 | 123.8 | 1.52E-03 |
| 3.0 | 138.00 | 27.60 | 5.0 | 99.0 | 0.60 | 14.80 | 2.28 | 2.3 | 122.1 | 1.50E-03 |
| 2.0 | 121.00 | 24.20 | 5.0 | 99.0 | 0.60 | 14.80 | 1.80 | 1.7 | 139.1 | 1.70E-03 |
| 1.0 | 95.00 | 19.00 | 5.0 | 99.0 | 0.60 | 14.80 | 1.20 | 1.3 | 141.8 | 1.74E-03 |

RECORD OF WATER PRESSURE TEST HOLE NO. SR93-4
 DEPTH(m): 35-40

| GAUGE PRESS. | INJECTION Qty | TEST LENGTH | HOLE DIA. | GAUGE HEIGHT | WATER LEVEL | FRICION LOSS | TEST PRESS. | LUGEON VALUE | k-VALUE | |
|--------------|---------------|-------------|-----------|--------------|-------------|--------------|-------------|--------------|---------|----------|
| kg/cm2 | lit/min | lit/min/m | m | mm | m | m | kg/cm2 | kg/cm2 | cm/sec | |
| 1.0 | 55.50 | 11.10 | 5.0 | 99.0 | 0.60 | 14.80 | 0.53 | 2.0 | 55.1 | 6.74E-04 |
| 3.0 | 91.50 | 18.30 | 5.0 | 99.0 | 0.60 | 14.80 | 1.33 | 3.2 | 57.0 | 6.98E-04 |
| 5.0 | 134.00 | 26.80 | 5.0 | 99.0 | 0.60 | 14.80 | 1.13 | 5.4 | 49.5 | 6.06E-04 |
| 3.0 | 92.00 | 18.40 | 5.0 | 99.0 | 0.60 | 14.80 | 1.40 | 3.1 | 58.6 | 7.17E-04 |
| 1.0 | 48.70 | 9.74 | 5.0 | 99.0 | 0.60 | 14.80 | 0.42 | 2.1 | 45.9 | 5.62E-04 |

RECORD OF WATER PRESSURE TEST HOLE NO. SR93-5
 DEPTH(m): 10-15

| GAUGE PRESS. | INJECTION Qty | TEST LENGTH | HOLE DIA. | GAUGE HEIGHT | WATER LEVEL | FRICION LOSS | TEST PRESS. | LUGEON VALUE | k-VALUE | |
|--------------|---------------|-------------|-----------|--------------|-------------|--------------|-------------|--------------|---------|----------|
| kg/cm2 | lit/min | lit/min/m | m | mm | m | m | kg/cm2 | kg/cm2 | cm/sec | |
| 1.0 | 0.01 | 0.00 | 5.0 | 99.0 | 0.45 | 4.40 | 0.00 | 1.5 | 0.0 | 1.65E-07 |
| 4.0 | 84.30 | 16.86 | 5.0 | 99.0 | 0.45 | 4.40 | 0.33 | 4.2 | 40.6 | 4.97E-04 |
| 6.0 | 122.80 | 24.56 | 5.0 | 99.0 | 0.45 | 4.40 | 0.62 | 5.9 | 41.9 | 5.13E-04 |
| 4.0 | 85.40 | 17.08 | 5.0 | 99.0 | 0.45 | 4.40 | 0.40 | 4.1 | 41.8 | 5.12E-04 |
| 1.0 | 40.70 | 8.14 | 5.0 | 99.0 | 0.45 | 4.40 | 0.10 | 1.4 | 58.8 | 7.20E-04 |

Table 1.5.7 Record of Water Pressure Test(4/5)

RECORD OF WATER PRESSURE TEST HOLE NO. SR93-5
 DEPTH(m): 15-20

| GAUGE PRESS. | INJECTION Q _{ty} | TEST LENGTH | HOLE DIA. | GAUGE HEIGHT | WATER LEVEL | FRICITION LOSS | TEST PRESS. | LUGEON VALUE | k-VALUE | |
|--------------------|---------------------------|-------------|-----------|--------------|-------------|--------------------|--------------------|--------------|---------|----------|
| kg/cm ² | lit/min lit/min/m | m | mm | m | m | kg/cm ² | kg/cm ² | | cm/sec | |
| 1.0 | 0.01 | 0.00 | 5.0 | 99.0 | 0.55 | 6.55 | 0.00 | 1.7 | 0.0 | 1.43E-07 |
| 2.0 | 0.01 | 0.00 | 5.0 | 99.0 | 0.55 | 6.55 | 0.00 | 2.7 | 0.0 | 9.03E-08 |
| 4.0 | 0.01 | 0.00 | 5.0 | 99.0 | 0.55 | 6.55 | 0.00 | 4.7 | 0.0 | 5.20E-08 |
| 6.0 | 103.20 | 20.64 | 5.0 | 99.0 | 0.55 | 6.55 | 0.68 | 6.0 | 34.2 | 4.19E-04 |
| 4.0 | 52.80 | 10.56 | 5.0 | 99.0 | 0.55 | 6.55 | 0.30 | 4.4 | 23.9 | 2.93E-04 |
| 2.0 | 30.60 | 6.12 | 5.0 | 99.0 | 0.55 | 6.55 | 0.03 | 2.7 | 22.8 | 2.80E-04 |
| 1.0 | 0.01 | 0.00 | 5.0 | 99.0 | 0.55 | 6.55 | 0.00 | 1.7 | 0.0 | 1.43E-07 |

RECORD OF WATER PRESSURE TEST HOLE NO. SR93-5
 DEPTH(m): 20-25

| GAUGE PRESS. | INJECTION Q _{ty} | TEST LENGTH | HOLE DIA. | GAUGE HEIGHT | WATER LEVEL | FRICITION LOSS | TEST PRESS. | LUGEON VALUE | k-VALUE | |
|--------------------|---------------------------|-------------|-----------|--------------|-------------|--------------------|--------------------|--------------|---------|----------|
| kg/cm ² | lit/min lit/min/m | m | mm | m | m | kg/cm ² | kg/cm ² | | cm/sec | |
| 1.0 | 0.01 | 0.00 | 5.0 | 99.0 | 0.45 | 6.30 | 0.00 | 1.7 | 0.0 | 1.46E-07 |
| 2.0 | 0.01 | 0.00 | 5.0 | 99.0 | 0.45 | 6.30 | 0.00 | 2.7 | 0.0 | 9.15E-08 |
| 4.0 | 0.01 | 0.00 | 5.0 | 99.0 | 0.45 | 6.30 | 0.00 | 4.7 | 0.0 | 5.24E-08 |
| 7.0 | 96.20 | 19.24 | 5.0 | 99.0 | 0.45 | 6.30 | 0.80 | 6.9 | 28.0 | 3.43E-04 |
| 4.0 | 78.20 | 15.64 | 5.0 | 99.0 | 0.45 | 6.30 | 0.60 | 4.1 | 38.4 | 4.70E-04 |
| 2.0 | 62.00 | 12.40 | 5.0 | 99.0 | 0.45 | 6.30 | 0.40 | 2.3 | 54.5 | 6.67E-04 |
| 1.0 | 54.00 | 10.80 | 5.0 | 99.0 | 0.45 | 6.30 | 0.30 | 1.4 | 78.5 | 9.62E-04 |

RECORD OF WATER PRESSURE TEST HOLE NO. MG93-1
 DEPTH(m): 17.5-22.5

| GAUGE PRESS. | INJECTION Q _{ty} | TEST LENGTH | HOLE DIA. | GAUGE HEIGHT | WATER LEVEL | FRICITION LOSS | TEST PRESS. | LUGEON VALUE | k-VALUE | |
|--------------------|---------------------------|-------------|-----------|--------------|-------------|--------------------|--------------------|--------------|---------|----------|
| kg/cm ² | lit/min lit/min/m | m | mm | m | m | kg/cm ² | kg/cm ² | | cm/sec | |
| 1.0 | 0.10 | 0.02 | 5.0 | 99.0 | 0.60 | 7.65 | 0.00 | 1.8 | 0.1 | 1.34E-06 |
| 4.0 | 7.00 | 1.40 | 5.0 | 99.0 | 0.60 | 7.65 | 0.00 | 4.8 | 2.9 | 3.55E-05 |
| 6.0 | 120.50 | 24.10 | 5.0 | 99.0 | 0.60 | 7.65 | 1.05 | 5.8 | 41.7 | 5.11E-04 |
| 4.0 | 85.00 | 17.00 | 5.0 | 99.0 | 0.60 | 7.65 | 0.67 | 4.2 | 40.9 | 5.01E-04 |
| 1.0 | 12.00 | 2.40 | 5.0 | 99.0 | 0.60 | 7.65 | 0.00 | 1.8 | 13.2 | 1.61E-04 |

RECORD OF WATER PRESSURE TEST HOLE NO. MG93-1
 DEPTH(m): 22.5-27.5

| GAUGE PRESS. | INJECTION Q _{ty} | TEST LENGTH | HOLE DIA. | GAUGE HEIGHT | WATER LEVEL | FRICITION LOSS | TEST PRESS. | LUGEON VALUE | k-VALUE | |
|--------------------|---------------------------|-------------|-----------|--------------|-------------|--------------------|--------------------|--------------|---------|----------|
| kg/cm ² | lit/min lit/min/m | m | mm | m | m | kg/cm ² | kg/cm ² | | cm/sec | |
| 1.0 | | 0.00 | 5.0 | 99.0 | 0.60 | 7.80 | 0.00 | 1.8 | 0.0 | 0.00E+00 |
| 4.0 | 86.80 | 17.36 | 5.0 | 99.0 | 0.60 | 7.80 | 0.79 | 4.1 | 42.9 | 5.25E-04 |
| 5.0 | 142.00 | 28.40 | 5.0 | 99.0 | 0.60 | 7.80 | 1.85 | 4.0 | 71.2 | 8.71E-04 |
| 3.0 | 105.50 | 21.10 | 5.0 | 99.0 | 0.60 | 7.80 | 1.04 | 2.8 | 75.2 | 9.21E-04 |
| 1.0 | 8.90 | 1.78 | 5.0 | 99.0 | 0.60 | 7.80 | 0.00 | 1.8 | 9.7 | 1.18E-04 |

RECORD OF WATER PRESSURE TEST HOLE NO. MG93-1
 DEPTH(m): 27.5-32.5

| GAUGE PRESS. | INJECTION Q _{ty} | TEST LENGTH | HOLE DIA. | GAUGE HEIGHT | WATER LEVEL | FRICITION LOSS | TEST PRESS. | LUGEON VALUE | k-VALUE | |
|--------------------|---------------------------|-------------|-----------|--------------|-------------|--------------------|--------------------|--------------|---------|----------|
| kg/cm ² | lit/min lit/min/m | m | mm | m | m | kg/cm ² | kg/cm ² | | cm/sec | |
| 1.0 | 10.30 | 2.06 | 5.0 | 99.0 | 0.60 | 7.80 | 0.00 | 1.8 | 11.2 | 1.37E-04 |
| 4.0 | 96.00 | 19.20 | 5.0 | 99.0 | 0.60 | 7.80 | 1.10 | 3.7 | 51.3 | 6.28E-04 |
| 6.0 | 129.50 | 25.90 | 5.0 | 99.0 | 0.60 | 7.80 | 1.93 | 4.9 | 52.7 | 6.46E-04 |
| 3.0 | 90.00 | 18.00 | 5.0 | 99.0 | 0.60 | 7.80 | 1.02 | 2.8 | 63.8 | 7.81E-04 |
| 1.0 | 45.00 | 9.00 | 5.0 | 99.0 | 0.60 | 7.80 | 0.28 | 1.6 | 57.7 | 7.06E-04 |

Table 1.5.7 Record of Water Pressure Test(5/5)

RECORD OF WATER PRESSURE TEST HOLE NO. MG93-2
 DEPTH(m): 30-35

| GAUGE PRESS. | INJECTION Q'ty | | TEST LENGTH | HOLE DIA. | GAUGE HEIGHT | WATER LEVEL | FRICITION LOSS | TEST PRESS. | LUGEON VALUE | k-VALUE |
|--------------|----------------|-----------|-------------|-----------|--------------|-------------|----------------|-------------|--------------|----------|
| kg/cm2 | lit/min | lit/min/m | m | mm | m | m | kg/cm2 | kg/cm2 | | cm/sec |
| 1.0 | 81.70 | 16.34 | 5.0 | 99.0 | 0.30 | 28.50 | 0.96 | 2.9 | 56.0 | 6.85E-04 |
| 2.0 | 88.00 | 17.60 | 5.0 | 99.0 | 0.30 | 28.50 | 1.08 | 3.8 | 46.3 | 5.67E-04 |
| 3.0 | 100.00 | 20.00 | 5.0 | 99.0 | 0.30 | 28.50 | 1.35 | 4.5 | 44.2 | 5.40E-04 |
| 2.0 | 89.50 | 17.90 | 5.0 | 99.0 | 0.30 | 28.50 | 1.08 | 3.8 | 47.1 | 5.77E-04 |
| 1.0 | 75.00 | 15.00 | 5.0 | 99.0 | 0.30 | 28.50 | 0.75 | 3.1 | 47.9 | 5.87E-04 |

RECORD OF WATER PRESSURE TEST HOLE NO. MG93-2
 DEPTH(m): 35-40

| GAUGE PRESS. | INJECTION Q'ty | | TEST LENGTH | HOLE DIA. | GAUGE HEIGHT | WATER LEVEL | FRICITION LOSS | TEST PRESS. | LUGEON VALUE | k-VALUE |
|--------------|----------------|-----------|-------------|-----------|--------------|-------------|----------------|-------------|--------------|----------|
| kg/cm2 | lit/min | lit/min/m | m | mm | m | m | kg/cm2 | kg/cm2 | | cm/sec |
| 1.0 | 11.40 | 2.28 | 5.0 | 99.0 | 0.50 | 30.90 | 0.00 | 4.1 | 5.5 | 6.74E-05 |
| 3.0 | 28.60 | 5.72 | 5.0 | 99.0 | 0.50 | 30.90 | 0.00 | 6.1 | 9.3 | 1.14E-04 |
| 5.0 | 64.70 | 12.94 | 5.0 | 99.0 | 0.50 | 30.90 | 0.70 | 7.4 | 17.4 | 2.13E-04 |
| 3.0 | 45.50 | 9.10 | 5.0 | 99.0 | 0.50 | 30.90 | 0.35 | 5.8 | 15.7 | 1.92E-04 |
| 1.0 | 37.30 | 7.46 | 5.0 | 99.0 | 0.50 | 30.90 | 0.18 | 4.0 | 18.8 | 2.31E-04 |

RECORD OF WATER PRESSURE TEST HOLE NO. MG93-2
 DEPTH(m): 40-45

| GAUGE PRESS. | INJECTION Q'ty | | TEST LENGTH | HOLE DIA. | GAUGE HEIGHT | WATER LEVEL | FRICITION LOSS | TEST PRESS. | LUGEON VALUE | k-VALUE |
|--------------|----------------|-----------|-------------|-----------|--------------|-------------|----------------|-------------|--------------|----------|
| kg/cm2 | lit/min | lit/min/m | m | mm | m | m | kg/cm2 | kg/cm2 | | cm/sec |
| 1.0 | 2.50 | 0.50 | 5.0 | 99.0 | 0.80 | 27.00 | 0.00 | 3.8 | 1.3 | 1.62E-05 |
| 4.0 | 11.00 | 2.20 | 5.0 | 99.0 | 0.80 | 27.00 | 0.00 | 6.8 | 3.2 | 3.97E-05 |
| 7.0 | 52.20 | 10.44 | 5.0 | 99.0 | 0.80 | 27.00 | 0.60 | 9.2 | 11.4 | 1.39E-04 |
| 10.0 | 98.30 | 19.66 | 5.0 | 99.0 | 0.80 | 27.00 | 1.80 | 11.0 | 17.9 | 2.19E-04 |
| 7.0 | 62.30 | 12.46 | 5.0 | 99.0 | 0.80 | 27.00 | 0.80 | 9.0 | 13.9 | 1.70E-04 |
| 4.0 | 36.0 | 7.20 | 5.0 | 99.0 | 0.80 | 27.00 | 0.20 | 6.6 | 10.9 | 1.34E-04 |
| 1.0 | 18.0 | 3.60 | 5.0 | 99.0 | 0.80 | 27.00 | 0.00 | 3.8 | 9.5 | 1.17E-04 |

Table 1.5.8 X-Ray Diffraction Analysis(1/2)

CORPORACION DE DESARROLLO E INVESTIGACION
GEOLOGICO MINERO METALURGICA

ENTREGA DE RESULTADOS DE ANALISIS DIFRACTOMETRICOS

Muestras del área : Prov. Manabi
Fecha ingreso : 94-01-25

Solicitado por : Ing. Fabian Vasconez
Tipo de muestra : Rocas
Nº Lab. : 4673

COMPOSICION MINERALOGICA

| Nº Muestra | DRX Nº | Descripción de la muestra | mayores (> 30%) | menores (< 10-30%) | trazas (< 10%) | vestigios (< 1%) |
|------------|--------|---------------------------|-------------------------------|--------------------|---------------------|------------------------------------|
| DP-93-1 | 2644 | Testigo de Roca | Plagioclasa | | Esmeclita/Illita | Horblenda, Cuarzo, Clorita, Pirita |
| DP-93-2 | 2645 | " | Plagioclasa, Esmeclita/Illita | | Cuarzo | Horblenda, Clorita Pirita |
| DP-93-3 | 2646 | " | Plagioclasa, Esmeclita/Illita | | Cuarzo | Horblenda, Clorita |
| SR-93-1 | 2647 | " | Plagioclasa | Esmeclita/Illita | | Horblenda, Cuarzo, Clorita, Pirita |
| SR-93-2 | 2648 | " | Plagioclasa | Esmeclita/Illita | | Horblenda, Cuarzo, Clorita, Pirita |
| SR-93-3 | 2649 | " | Esmeclita/Illita | | Plagioclasa, Cuarzo | Muscovita, Pirita, Calcita |
| SR-93-4 | 2650 | " | Esmeclita/Illita | | Plagioclasa, Cuarzo | Horblenda, Clorita Pirita, Calcita |

Analista responsable : Alfredo Bacines
Fecha de investigación : 94-02-07

Observaciones :

Table 2.4.1 Summary of Soil Mechanical Test

| SECTOR LOCATION | CALICATA N° TEST PIT N° | MUESTRA N° SAMPLE N° | PROFUNDIDAD DEPTH | HUMEDAD NATURAL NATURAL MOISTURE | | | GRAVEDAD ESPECIFICA SPECIFIC GRAVITY | | | GRANULOMETRIA (TAMIZ E. HIDROMETRO) | | | LIMITES DE ATTERBERG ATTERBERG LIMITS | | | CLASIFICACION CLASIFICATION | PESO UNITARIO UNIT WEIGHT | | COMPRESION UNIAxIAL UNIAxIAL COMPRESSION | | | ENSAYO TRIAXIAL TRIAXIAL TEST | | | CONSOLIDACION CONSOLIDATION | | | COMPACTACION PROCTOR PROCTOR COMPACTION | | HINCHAMIENTO SWELLING | | ENCOGIMIENTO SHRINKAGE | | | PIN - HOLE PIN - HOLE | OBSERVACIONES REMARKS |
|--|----------------------------|-------------------------|----------------------|-------------------------------------|-----------------------|-----|---|-----|---------|--|---------|--------------|--|---------------------------|--------------------------------------|--------------------------------|------------------------------|-----------|---|----------------|--|--|-----------------------|-------------------------|--------------------------------|---------------------|---------------------|--|--|--------------------------|--|---------------------------|--|--|--------------------------|--------------------------|
| | | | | W % | C _s g/g | #4 | #200 | 2/4 | WL % | WP % | IP % | SUCS USCS | HUM g/m ³ | SATUR g/m ³ | q _u kg/cm ² | | C' kg/cm ² | φ' deg | P _p kg/cm ² | C _c | C _v mm ² /min | Y _{max} gr/cm ³ | W _{opt} % | P kg/cm ² | V % | W _s % | L _s % | V _c % | | | | | | | | |
| | | | | | | % | % | % | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| CANAL ABIERTO OPEN CHANNEL | C-10 | M-1 | 0.50-1.40 | 31.2 | 2.788 | 100 | 96.0 | 21 | 59.0 | 37.0 | 22.0 | MH | 1.54 | 1.683 | 1.82 | 0.90 | 20° | 0.55 | 0.125 | 4.046 | 1.07 | 44.4 | 0.20 | 0.00 | | 16.53 | 42.5 | ND1 | DISTURBADA / DISTURBED | | | | | | | |
| | | M-2 | 2.00-3.00 | 34.3 | 2.727 | 100 | 98.7 | 18 | 55.0 | 37.0 | 18.0 | MH | 1.538 | - | - | - | - | - | - | - | - | - | 0.40 | 0.00 | | 12.98 | 47.88 | ND2 | | | | | | | | |
| | C-11 | M-1 | 0.55-2.00 | 37.7 | 2.606 | 100 | 86.9 | 20 | 80 | 54 | 26 | MH | 1.558 | 1.659 | 1.70 | 0.70 | 16° | 0.46 | 0.136 | 2.62 | 1.07 | 45.6 | 1.25 | 0.00 | | 15.80 | 42.09 | ND1 | " " | | | | | | | |
| | | M-2 | 2.00-3.60 | 41.6 | 2.683 | 100 | 89 | 16 | 71 | 48 | 23 | MH | 1.54 | 1.684 | 2.18 | 0.85 | 20° | 1.05 | 0.126 | 4.752 | 1.09 | 42.60 | 1.60 | 0.00 | | 21.53 | 41.19 | ND2 | | | | | | | | |
| | C-12 | M-1 | 0.60-1.60 | 32.2 | 2.679 | 100 | 90 | 14 | 61 | 43 | 18 | MH | 1.58 | 1.708 | - | - | - | - | - | - | 1.13 | 41.60 | 1.60 | 0.00 | | 25.19 | 35.15 | ND2 | " " | | | | | | | |
| | | M-2 | 2.00-3.60 | 41.6 | 2.683 | 100 | 89 | 16 | 71 | 48 | 23 | MH | 1.54 | 1.684 | 2.18 | 0.85 | 20° | 1.05 | 0.126 | 4.752 | 1.09 | 42.60 | 1.60 | 0.00 | | 21.53 | 41.19 | ND2 | | | | | | | | |
| | C-13 | M-1 | 0.80-2.00 | 35.7 | 2.743 | 100 | 97 | 53 | 92 | 47 | 45 | MH | 1.566 | 1.750 | 2.53 | 1.00 | 26° | 0.95 | 0.16 | 1.92 | 1.18 | 36.30 | 1.35 | 0.00 | | 21.12 | 57.33 | ND1 | " " | | | | | | | |
| | | M-2 | 2.00-3.50 | 33.3 | 2.622 | 100 | 99 | 8.0 | 78 | 42 | 36 | MH | - | - | - | - | - | - | - | - | - | - | - | - | | 21.99 | 40.11 | ND1 | | | | | | | | |
| | C-14 | M-1 | 0.90-1.90 | 31.9 | 2.598 | 100 | 76 | 19 | 78 | 43 | 35 | MH | 1.518 | 1.714 | - | - | - | - | - | - | 1.16 | 37.8 | 0.60 | 0.00 | | 32.95 | 28.24 | ND1 | " " | | | | | | | |
| | | M-2 | 1.90-3.50 | 39.7 | 2.565 | 100 | 94 | 18 | 78 | 44 | 34 | MH | 1.523 | 1.708 | 1.01 | 1.60 | 14° | 0.72 | 0.145 | 5.494 | 1.16 | 40.2 | 0.10 | 0.00 | | 31.07 | 31.17 | ND1 | | | | | | | | |
| C-15 | M-1 | 0.40-1.00 | 27.5 | 2.658 | 100 | 76 | 48 | 91 | 39 | 52 | CH | 1.399 | 1.661 | 1.09 | 0.70 | 22° | 0.80 | 0.439 | 1.531 | 1.06 | 34.6 | 1.50 | 0.00 | | 14.75 | 57.08 | ND1 | " " | | | | | | | | |
| | M-2 | 1.20-1.60 | 32.4 | 2.698 | 100 | 98 | 18 | 90 | 44 | 46 | MH | 1.400 | - | - | - | - | - | - | - | - | - | 1.60 | 0.00 | | 12.33 | 57.74 | ND1 | | | | | | | | | |
| C-16 | M-1 | 0.85-1.80 | 30.1 | 2.636 | 100 | 78 | 28 | 62 | 36 | 26 | MH | 1.627 | 1.794 | - | - | - | - | - | - | 1.28 | 32.8 | 0.75 | 0.00 | | 17.39 | 38.72 | ND1 | " " | | | | | | | | |
| | M-2 | 2.00-3.50 | 32.7 | 2.456 | 100 | 95 | 30 | 63 | 34 | 29 | MH | 1.642 | 1.759 | 1.88 | 0.70 | 12° | 0.75 | 0.107 | 13.91 | 1.28 | 31.8 | 1.65 | 0.00 | | 15.40 | 41.82 | ND1 | | | | | | | | | |
| C-17 | M-1 | 0.40-1.60 | 23.3 | 2.623 | 100 | 95 | 30 | 71 | 41 | 30 | MH | 1.498 | 1.718 | 1.66 | 1.50 | 11° | 0.80 | 0.243 | 10.58 | 1.16 | 32.3 | 1.15 | 0.00 | | 16.02 | 44.96 | ND1 | " " | | | | | | | | |
| | M-2 | 2.00-3.00 | 28.6 | 2.680 | 100 | 99 | 43 | 73 | 44 | 29 | MH | 1.496 | - | - | - | - | - | - | - | - | - | 1.10 | 0.00 | | 18.35 | 42.47 | ND2 | | | | | | | | | |
| C-18 | M-1 | 0.30-1.60 | 21.7 | 2.726 | 100 | 95 | 24 | 65 | 35 | 30 | MH | 1.528 | 1.753 | 2.40 | 1.20 | 22° | 0.70 | 0.335 | 6.224 | 1.19 | 34.6 | 1.30 | 0.00 | | 18.28 | 46.14 | ND1 | " " | | | | | | | | |
| | M-2 | 2.00-3.50 | 25.5 | 2.715 | 100 | 95 | 28 | 64 | 36 | 28 | MH | 1.527 | 1.707 | - | - | - | - | - | - | 1.12 | 41.6 | 1.50 | 0.00 | | 11.55 | 53.59 | ND2 | | | | | | | | | |
| C-19 | M-1 | 1.00-1.70 | 24.3 | 2.698 | 100 | 99 | 30 | 45 | 22 | 23 | CL | 1.423 | 1.831 | - | - | - | - | - | - | 1.32 | 29.6 | 0.30 | 0.00 | | 13.83 | 39.02 | ND1 | " " | | | | | | | | |
| | M-2 | 1.70-3.60 | 23.5 | 2.607 | 100 | 58 | 20 | 40 | 21 | 19 | CL | 1.423 | 1.857 | 2.56 | 1.65 | 10° | 0.65 | 0.098 | 2.443 | 1.39 | 30.2 | 0.30 | 0.00 | | 18.28 | 31.00 | ND1 | | | | | | | | | |
| LINEA DE TRANSMISION TRANSMISION LINE | C-20 | M-1 | 0.35-1.10 | 25.7 | 2.649 | 100 | 80 | 39 | 49 | 31 | 18 | ML | 1.541 | 1.728 | 3.00 | 1.80 | 10° | 0.75 | 0.106 | 7.81 | 1.17 | 37.3 | 0.15 | 0.00 | | 19.36 | 40.73 | ND1 | " " | | | | | | | |
| | C-21 | M-1 | 0.40-1.00 | 18.7 | 2.673 | 100 | 50 | 16 | 44 | 28 | 16 | ML | 1.668 | 1.826 | 0.83 | 0.40 | 20° | 0.74 | 0.134 | 6.18 | 1.32 | 31.00 | 1.10 | 0.00 | | 19.99 | 26.61 | ND1 | " " | | | | | | | |
| | | M-2 | 1.00-2.15 | 26.7 | 2.579 | 100 | 88 | 8 | 40 | 22 | 18 | CL | 1.670 | - | - | - | - | - | - | - | - | 0.26 | 0.00 | | 19.17 | 25.00 | ND1 | | | | | | | | | |
| | C-22 | M-1 | 0.60-0.90 | 39.64 | 2.832 | 100 | - | 50 | 106 | 58 | 48 | CH | 1.673 | 1.750 | 13.18 | 1.10 | 26° | 0.40 | 0.18 | 2.597 | 1.16 | 38.00 | 2.49 | 0.00 | | 18.09 | 42.25 | ND1 | INDISTURBADA / UNDISTURBED DISTURBADA / DISTURBED | | | | | | | |
| | | M-2 | 1.00-2.35 | 27.3 | 2.658 | 100 | 49 | 15 | 60 | 29 | 31 | SC | 1.660 | - | - | - | - | - | - | - | - | - | 1.25 | 0.00 | | 19.89 | 39.94 | ND1 | | | | | | | | |
| C-23 | M-1 | 1.20-1.50 | 44.03 | 2.878 | - | - | 65 | 114 | 51 | 63 | CH | 1.719 | 1.757 | 8.38 | 2.60 | 14° | 0.60 | 0.18 | 2.575 | 1.16 | 46.00 | 1.36 | 0.00 | | 27.26 | 44.25 | ND1 | INDISTURBADA / UNDISTURBED DISTURBADA / DISTURBED | | | | | | | | |
| | M-2 | 2.00-2.80 | 37.7 | 2.733 | 100 | 98 | 50 | 74 | 30 | 44 | CH | 1.67 | - | - | - | - | - | - | - | - | - | 0.75 | 0.00 | | 20.27 | 49.19 | ND1 | | | | | | | | | |
| C-24 | M-1 | 1.50-1.80 | 41.57 | 2.803 | - | - | 53 | 87 | 44 | 43 | CH | 1.655 | 1.843 | 1.97 | 0.80 | 14° | 0.5 | 0.15 | 2.404 | 1.31 | 36.00 | 0.51 | 0.00 | | 24.87 | 44.00 | ND1 | INDISTURBADA / UNDISTURBED DISTURBADA / DISTURBED | | | | | | | | |
| | M-2 | 2.50-4.00 | 57.7 | 2.681 | 100 | 90 | 33 | 64 | 32 | 32 | MH | 1.66 | - | - | - | - | - | - | - | - | - | 0.76 | 0.00 | | 16.36 | 44.57 | ND2 | | | | | | | | | |

GOVERNMENT OF THE REPUBLIC OF ECUADOR
CENTRO DE REHABILITACION DE MANABI (CRM)
THE DETAILED DESIGN STUDY ON THE WATER TRANSBASIN
SCHEMES FOR CHONE-PORTOVIEJO RIVER BASINS
JAPAN INTERNATIONAL COOPERATION AGENCY

TITLE
SUMMARY OF SOIL MECHANICAL TEST

Table 2.4.2 Natural Moisture Content and Specific Gravity

| Sample No. | Depth (m) | Unified Soil Classification | Natural moisture content (%) | Specific gravity |
|------------|-----------|-----------------------------|------------------------------|------------------|
| C10-M1 | 0.50-1.40 | MH | 31.2 | 2.768 |
| M2 | 2.00-3.00 | MH | 34.3 | 2.727 |
| C11-M1 | 0.55-2.00 | MH | 37.7 | 2.606 |
| C12-M1 | 0.60-1.60 | MH | 32.2 | 2.679 |
| M2 | 2.00-3.60 | MH | 41.6 | 2.663 |
| C13-M1 | 0.80-2.00 | MH | 35.7 | 2.743 |
| M2 | 2.00-3.50 | MH | 33.3 | 2.622 |
| C14-M1 | 0.90-1.90 | MH | 31.9 | 2.598 |
| M2 | 1.90-3.50 | MH | 39.7 | 2.568 |
| C15-M1 | 0.40-1.00 | CH | 27.5 | 2.659 |
| M2 | 1.20-1.60 | MH | 32.4 | 2.698 |
| C16-M1 | 0.85-1.80 | MH | 30.1 | 2.636 |
| M2 | 2.00-3.50 | MH | 32.7 | 2.456 |
| C17-M1 | 0.40-1.60 | MH | 23.3 | 2.623 |
| M2 | 2.00-3.00 | MH | 28.6 | 2.680 |
| C18-M1 | 0.30-1.60 | MH | 21.7 | 2.725 |
| M2 | 2.00-3.50 | MH | 25.5 | 2.715 |
| C19-M1 | 1.00-1.70 | CL | 24.3 | 2.668 |
| C19-M2 | 1.70-3.60 | CL | 23.5 | 2.607 |
| C20-M1 | 0.35-1.10 | ML | 25.7 | 2.649 |
| C21-M1 | 0.40-1.00 | ML | 18.7 | 2.673 |
| M2 | 1.00-2.15 | CL | 26.7 | 2.579 |
| C22-M1 | 0.60-0.90 | CH | 39.6 | 2.832 |
| M2 | 1.00-2.35 | SC | 27.3 | 2.658 |
| C23-M1 | 1.20-1.50 | CH | 44.0 | 2.878 |
| M2 | 2.00-2.80 | CH | 37.7 | 2.733 |
| C24-M1 | 1.50-1.80 | CH | 41.6 | 2.803 |
| M2 | 2.50-4.00 | MH | 57.7 | 2.680 |

Note: MH: Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts.
 CH: Inorganic clays of high plasticity, fat clays.
 CL: Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays.
 ML: Inorganic silts and very fine sands, rock flour, silty or clayey fine sands with slight plasticity.
 SC: Clayey sands, poorly graded sand-clay mixtures.

Table 2.4.3 Unit Weight

| Sample No. | Depth (m) | Unified Soil Classification | Density | |
|------------|-----------|-----------------------------|-------------------------------|------------------------------------|
| | | | * γ_t t/m ² | ** γ_{sat} t/m ² |
| C10-M1 | 0.50-1.40 | MH | 1.540 | 1.683 |
| M2 | 2.00-3.00 | MH | 1.538 | - |
| C11-M1 | 0.55-2.00 | MH | 1.559 | 1.659 |
| C12-M1 | 0.60-1.60 | MH | 1.580 | 1.708 |
| M2 | 2.00-3.60 | MH | 1.540 | 1.684 |
| C13-M1 | 0.80-2.00 | MH | 1.566 | 1.750 |
| M2 | 2.00-3.50 | MH | - | - |
| C14-M1 | 0.90-1.90 | MH | 1.518 | 1.714 |
| M2 | 1.90-3.50 | MH | 1.523 | 1.708 |
| C15-M1 | 0.40-1.00 | CH | 1.399 | 1.661 |
| M2 | 1.20-1.60 | MH | 1.400 | - |
| C16-M1 | 0.85-1.80 | MH | 1.627 | 1.794 |
| M2 | 2.00-3.50 | MH | 1.642 | 1.759 |
| C17-M1 | 0.40-1.60 | MH | 1.495 | 1.716 |
| M2 | 2.00-3.00 | MH | 1.496 | - |
| C18-M1 | 0.30-1.60 | MH | 1.528 | 1.753 |
| M2 | 2.00-3.50 | MH | 1.527 | 1.707 |
| C19-M1 | 1.00-1.70 | CL | 1.423 | 1.831 |
| M2 | 1.70-3.60 | CL | 1.423 | 1.857 |
| C20-M1 | 0.35-1.10 | ML | 1.541 | 1.726 |
| C21-M1 | 0.40-1.00 | ML | 1.668 | 1.828 |
| M2 | 1.00-2.15 | CL | 1.670 | - |
| C22-M1 | 0.60-0.90 | CH | 1.673 | 1.750 |
| M2 | 1.00-2.35 | SC | 1.660 | - |
| C23-M1 | 1.20-1.50 | CH | 1.719 | 1.757 |
| M2 | 2.00-2.80 | CH | 1.670 | - |
| C24-M1 | 1.50-1.80 | CH | 1.655 | 1.843 |
| M2 | 2.50-4.00 | MH | 1.660 | - |

Note: * γ_t Density in natural water content
 ** γ_{sat} Density saturated

Table 2.4.4 Atterberg Limits

| Sample No. | Depth (m) | Unified Soil Classification | Atterberg limits | | |
|------------|-----------|-----------------------------|------------------|-------------------|----------------------|
| | | | Liquid limit (%) | Plastic limit (%) | Plasticity index (%) |
| C10-M1 | 0.50-1.40 | MH | 59 | 37 | 22 |
| M2 | 2.00-3.00 | MH | 55 | 37 | 18 |
| C11-M1 | 0.55-2.00 | MH | 80 | 54 | 26 |
| C12-M1 | 0.60-1.60 | MH | 61 | 43 | 18 |
| M2 | 2.00-3.60 | MH | 71 | 48 | 23 |
| C13-M1 | 0.80-2.00 | MH | 92 | 47 | 45 |
| M2 | 2.00-3.50 | MH | 78 | 42 | 36 |
| C14-M1 | 0.90-1.90 | MH | 78 | 43 | 35 |
| M2 | 1.90-3.50 | MH | 78 | 44 | 34 |
| C15-M1 | 0.40-1.00 | CH | 91 | 39 | 52 |
| M2 | 1.20-1.60 | MH | 90 | 44 | 48 |
| C16-M1 | 0.85-1.80 | MH | 62 | 36 | 26 |
| M2 | 2.00-3.50 | MH | 63 | 34 | 29 |
| C17-M1 | 0.40-1.60 | MH | 71 | 41 | 30 |
| M2 | 2.00-3.00 | MH | 73 | 44 | 29 |
| C18-M1 | 0.30-1.60 | MH | 65 | 35 | 30 |
| M2 | 2.00-3.50 | MH | 64 | 36 | 28 |
| C19-M1 | 1.00-1.70 | CL | 45 | 22 | 23 |
| M2 | 1.70-3.60 | CL | 44 | 21 | 19 |
| C20-M1 | 0.35-1.10 | ML | 49 | 31 | 18 |
| C21-M1 | 0.40-1.00 | ML | 44 | 28 | 16 |
| M2 | 1.00-2.15 | CL | 40 | 22 | 16 |
| C22-M1 | 0.60-0.90 | CH | 106 | 58 | 48 |
| M2 | 1.00-2.35 | SC | 60 | 29 | 31 |
| C23-M1 | 1.20-1.50 | CH | 114 | 51 | 63 |
| C23-M2 | 2.00-2.80 | CH | 74 | 30 | 44 |
| C24-1 | 1.50-1.80 | CH | 87 | 44 | 43 |
| M2 | 2.50-4.00 | MH | 64 | 32 | 32 |

Table 2.4.5 Uniaxial and Triaxial Compressive Strength

| Sample No. | Depth (m) | Unified Soil Classification | Uniaxial | Triaxial | |
|------------|-----------|-----------------------------|------------------------|-----------------------|-------------|
| | | | qu t/m ² | C t/m ² | Ø degree |
| C10-M1 | 0.50-1.40 | MH | 1.82 | 0.90 | 20 |
| M2 | 2.00-3.00 | MH | - | - | - |
| C11-M1 | 0.55-2.00 | MH | 1.70 | 0.70 | 18 |
| C12-M1 | 0.60-1.60 | MH | - | - | - |
| M2 | 2.00-3.60 | MH | 2.16 | 0.85 | 20 |
| C13-M1 | 0.80-2.00 | MH | 2.53 | 1.00 | 26 |
| M2 | 2.00-3.50 | MH | - | - | - |
| C14-M1 | 0.90-1.90 | MH | - | - | - |
| M2 | 1.90-3.50 | MH | 1.01 | 1.80 | 14 |
| C15-M1 | 0.40-1.00 | CH | 1.09 | 0.70 | 22 |
| M2 | 1.20-1.60 | MH | - | - | - |
| C16-M1 | 0.85-1.80 | MH | - | - | - |
| M2 | 2.00-3.50 | MH | 1.88 | 0.70 | 12 |
| C17-M1 | 0.40-1.60 | MH | 1.66 | 1.50 | 11 |
| M2 | 2.00-3.00 | MH | - | - | - |
| C18-M1 | 0.30-1.60 | MH | 2.40 | 1.20 | 22 |
| M2 | 2.00-3.50 | MH | - | - | - |
| C19-M1 | 1.00-1.70 | CL | - | - | - |
| M2 | 1.70-3.60 | CL | 2.56 | 1.65 | 10 |
| C20-M1 | 0.35-1.10 | ML | 3.00 | 1.80 | 10 |
| C21-M1 | 0.40-1.00 | ML | 0.83 | 0.40 | 20 |
| M2 | 1.00-2.15 | CL | - | - | - |
| C22-M1 | 0.60-0.90 | CH | 13.18 | 1.10 | 26 |
| M2 | 1.00-2.35 | SC | - | - | - |
| C23-M1 | 1.00-2.15 | CH | 8.58 | 2.60 | 14 |
| M2 | 2.00-2.80 | CH | - | - | - |
| C24-M1 | 2.50-1.80 | CH | 1.97 | 0.80 | 14 |
| M2 | 2.50-4.00 | MH | - | - | - |

Note: * qu Unconfined compressive strength

** C Cohesive strength

*** Ø Internal friction angle

Table 2.4.6 Consolidation

| Sample No. | Depth (m) | Unified Soil Classification | *Pp kg/cm ² | Consolidation Compaction index | Coefficient mm ² /min |
|------------|-----------|-----------------------------|------------------------|--------------------------------|----------------------------------|
| C10-M1 | 0.50-1.40 | MH | 0.55 | 0.125 | 4.05 |
| M2 | 2.00-3.00 | MH | - | - | - |
| C11-M1 | 0.55-2.00 | MH | 0.46 | 0.136 | 2.62 |
| C12-M1 | 0.60-1.60 | MH | - | - | - |
| M2 | 2.00-3.60 | MH | 1.03 | 0.126 | 4.75 |
| C13-M1 | 0.80-2.00 | MH | 0.95 | 0.160 | 1.92 |
| M2 | 2.00-3.50 | MH | - | - | - |
| C14-M1 | 0.90-1.90 | MH | - | - | - |
| M2 | 1.90-3.50 | MH | 0.72 | 0.145 | 5.45 |
| C15-M1 | 0.40-1.00 | CH | 0.80 | 0.493 | 1.63 |
| M2 | 1.20-1.60 | MH | - | - | - |
| C16-M1 | 0.85-1.80 | MH | - | - | - |
| M2 | 2.00-3.50 | MH | 0.75 | 0.107 | 13.91 |
| C17-M1 | 0.40-1.60 | MH | 0.80 | 0.243 | 10.58 |
| M2 | 2.00-3.00 | MH | - | - | - |
| C18-M1 | 0.30-1.60 | MH | 0.70 | 0.336 | 6.22 |
| M2 | 2.00-3.50 | MH | - | - | - |
| C19-M1 | 1.00-1.70 | CL | - | - | - |
| M2 | 1.70-3.60 | CL | 0.65 | 0.098 | 2.44 |
| C20-M1 | 0.35-1.10 | ML | 0.75 | 0.106 | 7.81 |
| C21-M1 | 0.40-1.00 | ML | 0.74 | 0.134 | 6.18 |
| M2 | 1.00-2.15 | CL | - | - | - |
| C22-M1 | 0.60-0.90 | CH | 0.40 | 0.180 | 2.60 |
| M2 | 1.00-2.35 | SC | - | - | - |
| C23-M1 | 1.20-1.50 | CH | 0.60 | 0.180 | 2.58 |
| M2 | 2.00-2.80 | CH | - | - | - |
| C24-M1 | 1.50-1.80 | CH | 0.15 | 2.404 | 1.31 |
| M2 | 2.50-4.00 | MH | - | - | - |

Note: *Pp: Preconsolidation pressure

Table 2.4.7 Proctor Compaction

| Sample No. | Depth (m) | Unified Soil Classification | Proctor compaction | |
|------------|-----------|-----------------------------|---------------------------------|------------------------------|
| | | | Maximum dry density (t/m^3) | Optimum moisture content (%) |
| C10-M1 | 0.50-1.40 | MH | 1.07 | 44.4 |
| M2 | 2.00-3.00 | MH | - | - |
| C11-M1 | 0.55-2.00 | MH | 1.07 | 45.6 |
| C12-M1 | 0.60-1.60 | MH | 1.13 | 41.6 |
| M2 | 2.00-3.60 | MH | 1.09 | 42.6 |
| C13-M1 | 0.80-2.00 | MH | 1.16 | 36.3 |
| M2 | 2.00-3.50 | MH | - | - |
| C14-M1 | 0.90-1.90 | MH | 1.16 | 37.6 |
| M2 | 1.90-3.50 | MH | 1.16 | 40.2 |
| C15-M1 | 0.40-1.00 | CH | 1.06 | 34.6 |
| M2 | 1.20-1.60 | MH | - | - |
| C16-M1 | 0.85-1.80 | MH | 1.26 | 32.8 |
| M2 | 2.00-3.50 | MH | 1.26 | 31.8 |
| C17-M1 | 0.40-1.60 | MH | 1.16 | 32.3 |
| M2 | 2.00-3.00 | MH | - | - |
| C18-M1 | 0.30-1.60 | MH | 1.19 | 34.6 |
| M2 | 2.00-3.50 | MH | 1.12 | 41.6 |
| C19-M1 | 1.00-1.70 | CL | 1.32 | 29.6 |
| M2 | 1.70-3.60 | CL | 1.39 | 30.2 |
| C20-M1 | 0.35-1.10 | ML | 1.17 | 37.6 |
| C21-M1 | 0.40-1.00 | ML | 1.32 | 31.0 |
| M2 | 1.00-2.15 | CL | - | 0.3 |
| C22-M1 | 0.60-0.90 | CH | 1.16 | 38.0 |
| M2 | 1.00-2.35 | SC | - | - |
| C23-M1 | 1.20-1.50 | CH | 1.16 | 46.0 |
| M2 | 2.00-2.80 | CH | - | - |
| C24-M1 | 1.50-1.80 | CH | 1.31 | 36.0 |
| M2 | 2.50-4.00 | MH | - | - |

Table 2.4.8 Swelling

| Sample No. | Depth (m) | Unified Soil Classification | Swelling | |
|------------|-----------|-----------------------------|------------------------------|-----------------|
| | | | Pressure (t/m ²) | Vol. change (%) |
| C10-M1 | 0.50-1.40 | MH | 2.0 | 0.0 |
| M2 | 2.00-3.00 | MH | 4.0 | 0.0 |
| C11-M1 | 0.55-2.00 | MH | 12.5 | 0.0 |
| C12-M1 | 0.60-1.60 | MH | 16.0 | 0.0 |
| M2 | 2.00-3.60 | MH | 16.0 | 0.0 |
| C13-M1 | 0.80-2.00 | MH | 13.5 | 0.0 |
| M2 | 2.00-3.50 | MH | - | - |
| C14-M1 | 0.90-1.90 | MH | 6.0 | 0.0 |
| M2 | 1.90-3.50 | MH | 1.0 | 0.0 |
| C15-M1 | 0.40-1.00 | CH | 15.0 | 0.0 |
| M2 | 1.20-1.60 | MH | 16.0 | 0.0 |
| C16-M1 | 0.85-1.80 | MH | 7.8 | 0.0 |
| M2 | 2.00-3.50 | MH | 16.5 | 0.0 |
| C17-M1 | 0.40-1.60 | MH | 11.5 | 0.0 |
| M2 | 2.00-3.00 | MH | 11.0 | 0.0 |
| C18-M1 | 0.30-1.60 | MH | 13.0 | 0.0 |
| M2 | 2.00-3.50 | MH | 15.0 | 0.0 |
| C19-M1 | 1.00-1.70 | CL | 3.0 | 0.0 |
| M2 | 1.70-3.60 | CL | 3.0 | 0.0 |
| C20-M1 | 0.35-1.10 | ML | 1.5 | 0.0 |
| C21-M1 | 0.40-1.00 | ML | 11.0 | 0.0 |
| M2 | 1.00-2.15 | CL | 2.6 | 0.0 |
| C22-M1 | 0.60-0.90 | CH | 24.9 | 0.0 |
| M2 | 1.00-2.35 | SC | 12.5 | 0.0 |
| C23-M1 | 1.20-1.50 | CH | 13.6 | 0.0 |
| M2 | 2.00-2.80 | CH | 7.5 | 0.0 |
| C24-M1 | 1.50-1.80 | CH | 5.1 | 0.0 |
| M2 | 2.50-4.00 | MH | 7.6 | 0.0 |

Table 2.4.9 Shrinkage

| Sample No. | Depth (m) | Unified Soil Classification | Shrinkage | |
|------------|-----------|-----------------------------|-----------|--------------|
| | | | Limit (%) | V Change (%) |
| C10-M1 | 0.50-1.40 | MH | 16.53 | 42.50 |
| M2 | 2.00-3.00 | MH | 12.98 | 47.88 |
| C11-M1 | 0.55-2.00 | MH | 15.80 | 42.09 |
| C12-M1 | 0.60-1.60 | MH | 25.19 | 35.15 |
| M2 | 2.00-3.60 | MH | 21.53 | 41.19 |
| C13-M1 | 0.80-2.00 | MH | 21.12 | 57.33 |
| M2 | 2.00-3.50 | MH | 21.99 | 40.11 |
| C14-M1 | 0.90-1.90 | MH | 32.95 | 28.24 |
| M2 | 1.90-3.50 | MH | 31.07 | 31.17 |
| C15-M1 | 0.40-1.00 | CH | 14.75 | 57.08 |
| M2 | 1.20-1.60 | MH | 12.33 | 57.74 |
| C16-M1 | 0.85-1.80 | MH | 17.39 | 38.72 |
| M2 | 2.00-3.50 | MH | 15.40 | 41.82 |
| C17-M1 | 0.40-1.60 | MH | 16.02 | 44.96 |
| M2 | 2.00-3.00 | MH | 16.33 | 42.47 |
| C18-M1 | 0.30-1.60 | MH | 18.28 | 46.14 |
| M2 | 2.00-3.50 | MH | 11.35 | 53.59 |
| C19-M1 | 1.00-1.70 | CL | 13.83 | 39.02 |
| M2 | 1.70-3.60 | CL | 18.28 | 31.00 |
| C20-M1 | 0.35-1.10 | ML | 11.36 | 40.73 |
| C21-M1 | 0.40-1.00 | ML | 19.99 | 26.61 |
| M2 | 1.00-2.15 | CL | 19.17 | 25.00 |
| C22-M1 | 0.60-0.90 | CH | 18.05 | 42.25 |
| M2 | 1.00-2.35 | SC | 19.89 | 39.94 |
| C23-M1 | 1.20-1.50 | CH | 27.26 | 44.25 |
| M2 | 2.00-2.80 | CH | 20.27 | 49.19 |
| C24-M1 | 1.50-1.80 | CH | 24.87 | 41.00 |
| M2 | 2.50-4.00 | MH | 26.36 | 44.57 |

Table 2.4.10 Pin-hole

| Sample No. | Depth (m) | Unified Soil Classification | Classification |
|------------|-----------|-----------------------------|----------------|
| C10-M1 | 0.50-1.40 | MH | ND1 |
| M2 | 2.00-3.00 | MH | ND2 |
| C11-M1 | 0.55-2.00 | MH | ND1 |
| C12-M1 | 0.60-1.60 | MH | ND2 |
| M2 | 2.00-3.60 | MH | ND2 |
| C13-M1 | 0.80-2.00 | MH | ND1 |
| M2 | 2.00-3.50 | MH | ND1 |
| C14-M1 | 0.90-1.90 | MH | ND1 |
| M2 | 1.90-3.50 | MH | ND1 |
| C15-M1 | 0.40-1.00 | CH | ND1 |
| M2 | 1.20-1.60 | MH | ND1 |
| C16-M1 | 0.85-1.80 | MH | ND1 |
| M2 | 2.00-3.50 | MH | ND1 |
| C17-M1 | 0.40-1.60 | MH | ND1 |
| M2 | 2.00-3.00 | MH | ND2 |
| C18-M1 | 0.30-1.60 | MH | ND1 |
| M2 | 2.00-3.50 | MH | ND2 |
| C19-M1 | 1.00-1.70 | CL | ND1 |
| M2 | 1.70-3.60 | CL | ND1 |
| C20-M1 | 0.35-1.10 | ML | ND1 |
| C21-M1 | 0.40-1.00 | ML | ND1 |
| M2 | 1.00-2.15 | CL | ND1 |
| C22-M1 | 0.60-0.90 | CH | ND1 |
| M2 | 1.00-2.35 | SC | ND1 |
| C23-M1 | 1.20-1.50 | CH | ND1 |
| M2 | 2.00-2.80 | CH | ND1 |
| C24-M1 | 1.50-1.80 | CH | ND1 |
| M2 | 2.50-4.00 | MH | ND2 |

