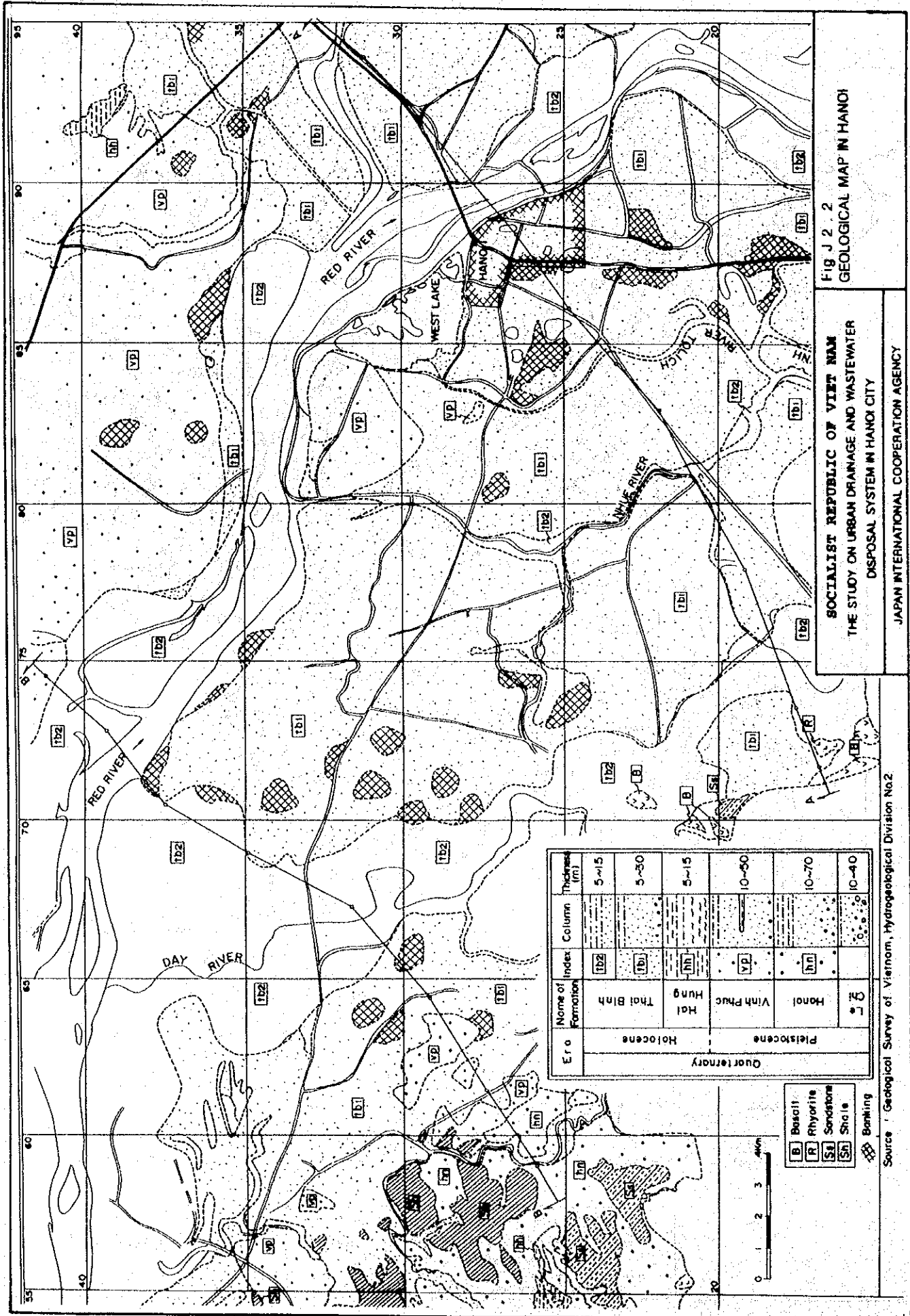


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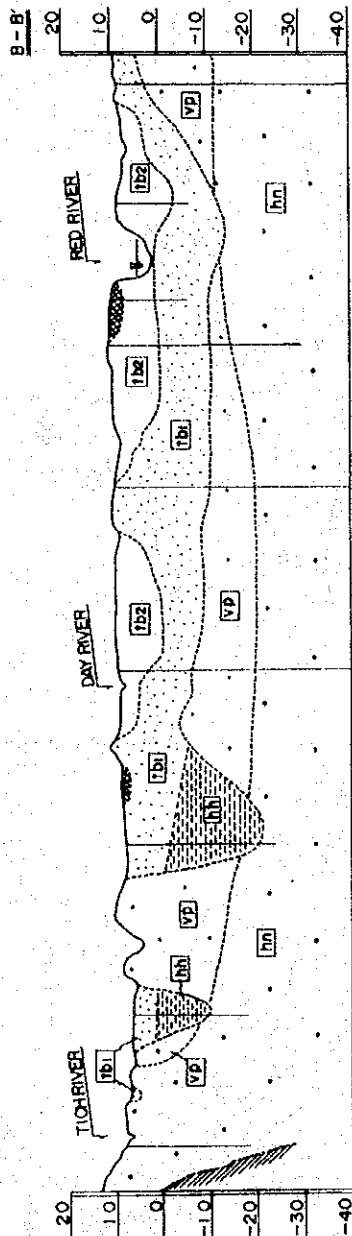
Fig J 2.1
 GEOGRAPHY AROUND HANOI



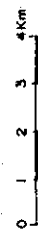
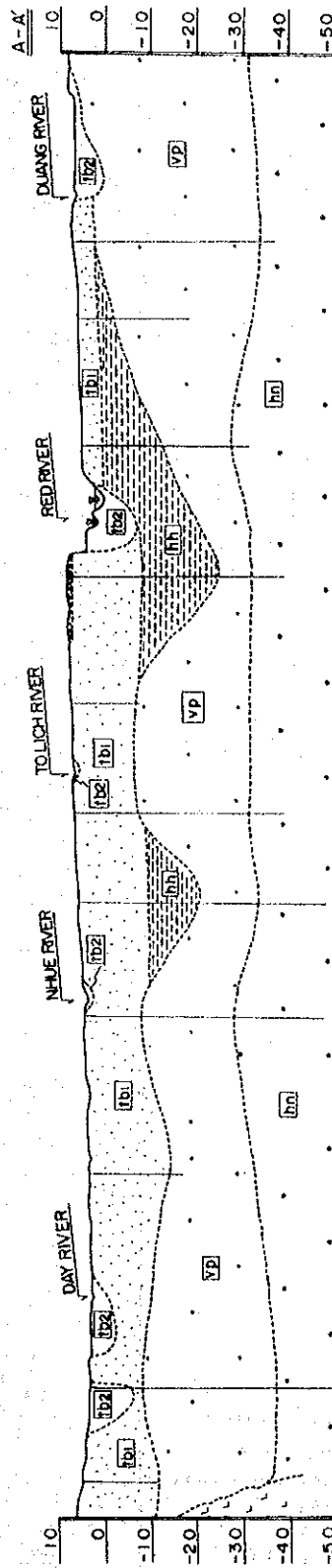
| Ero | Name of Formation | Index | Column | Thickness (m) |
|-------------|-------------------|-------|----------|---------------|
| Quaternary | Hanoi | HN | [Symbol] | 10-70 |
| | Hai Hung | HH | [Symbol] | 5-15 |
| Pleistocene | Vinh Phuc | VP | [Symbol] | 10-50 |
| | Thoi Binh | TB | [Symbol] | 5-30 |
| | Thoi Binh | TB | [Symbol] | 5-15 |

- [B] Basalt
- [R] Rhyolite
- [SL] Sandstone
- [SH] Shale
- [Banking]





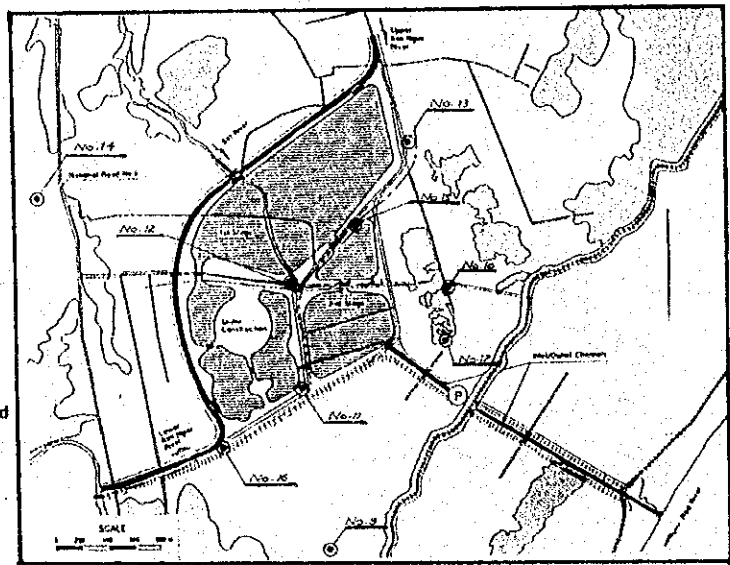
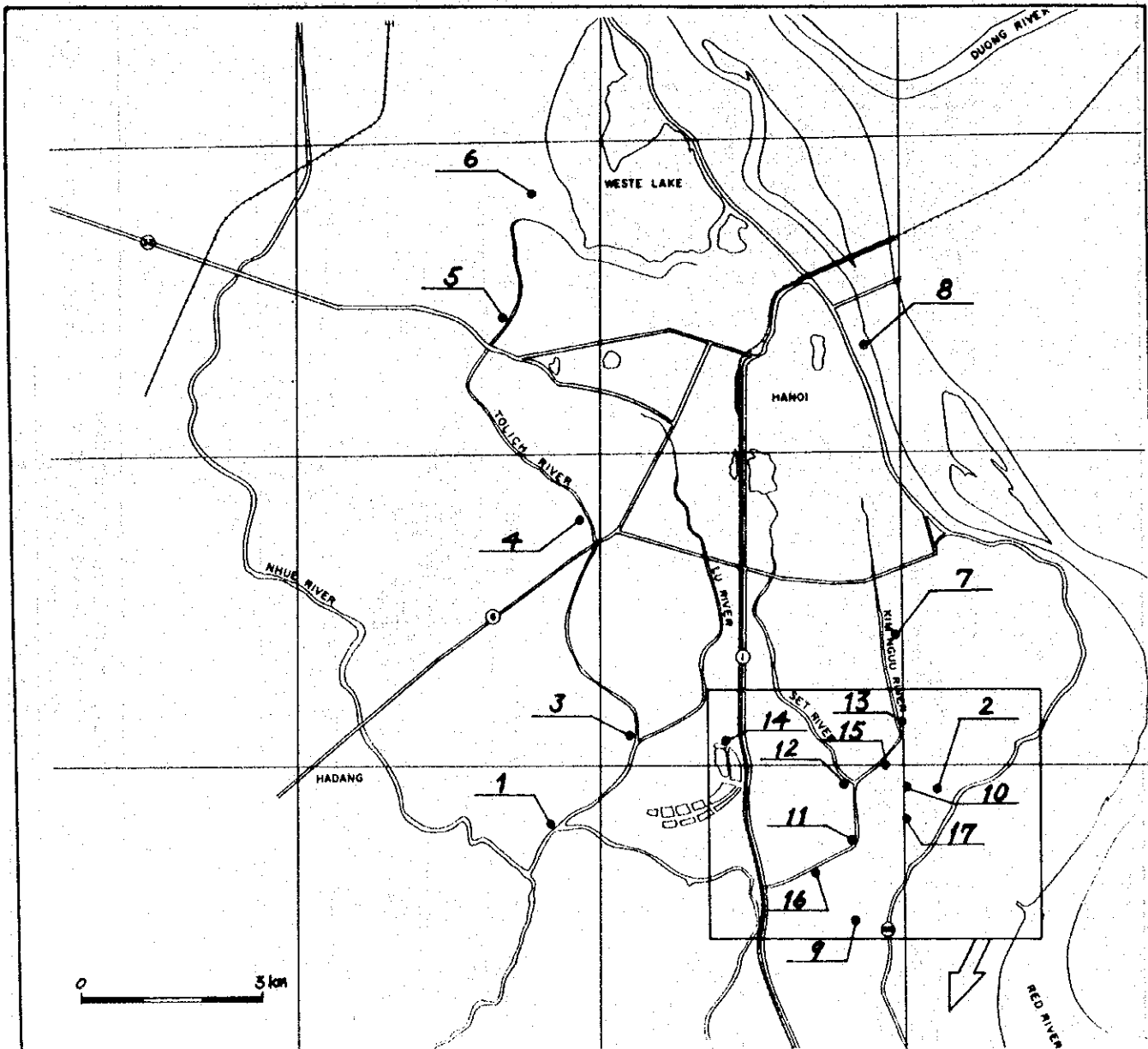
| Era | Name of Formation | Index | Column | Thickness (m) |
|-------------|-------------------|-------|-----------|---------------|
| Quaternary | Holocene | tb2 | [Pattern] | 5-15 |
| | | tb1 | [Pattern] | 5-30 |
| | | hb | [Pattern] | 5-15 |
| Pleistocene | Vinh Phuc | vp | [Pattern] | 10-50 |
| | Hanoi | hn | [Pattern] | 10-70 |
| | Le Chi | | [Pattern] | 10-40 |









Source : Geological Survey of Vietnam, Hydrogeological Division No.2

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Fig J 2.3
 GEOLOGICAL PROFILES IN HANOI



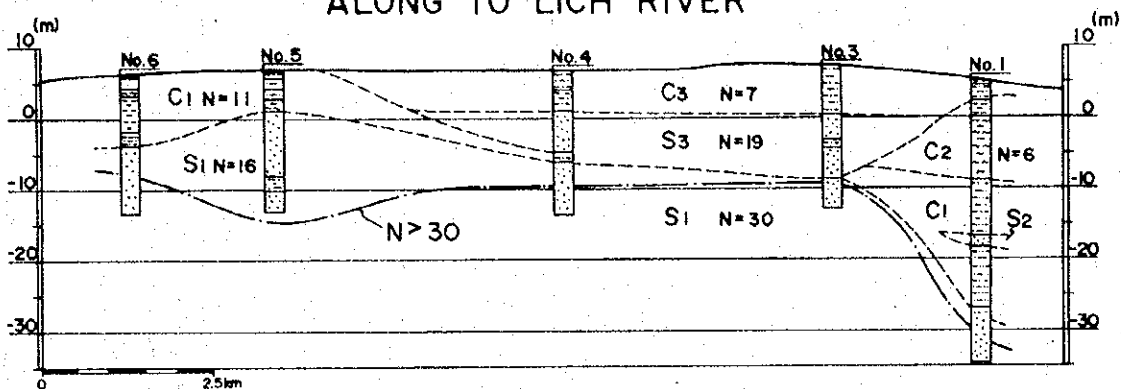
LEGEND (YEN SO SITE)

-  : Residential Area
-  : Existing/Proposed Road
-  : Bridge
-  : Culvert
-  : Control Gate
-  : Pumping Station

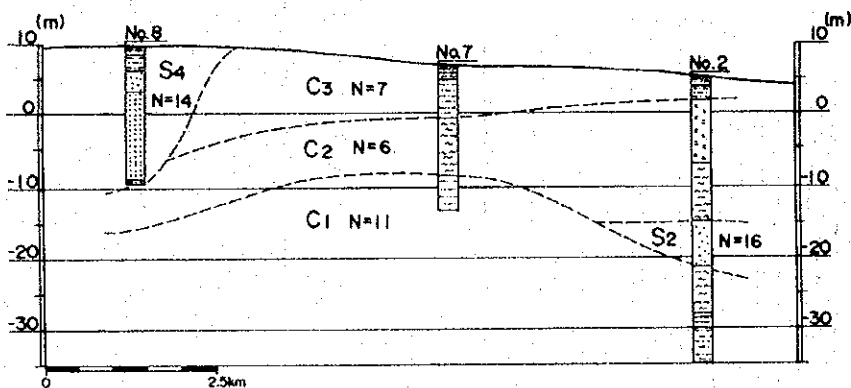
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Fig J 3 . 1
 LOCATION MAP OF BOREHOLES

ALONG TO LICH RIVER



ALONG UPPER KIM NGUU RIVER

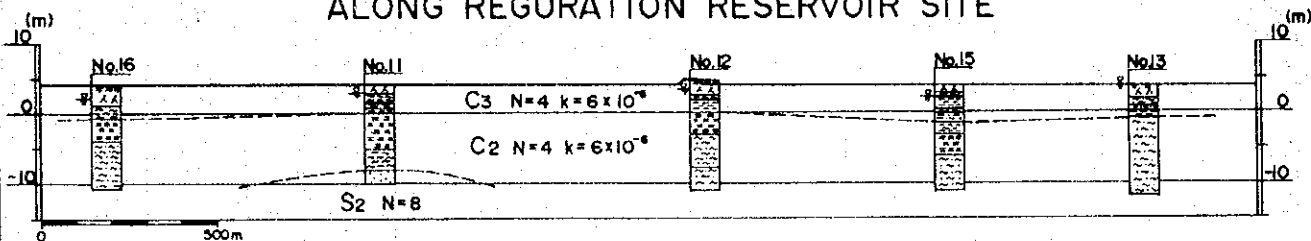


LEGEND

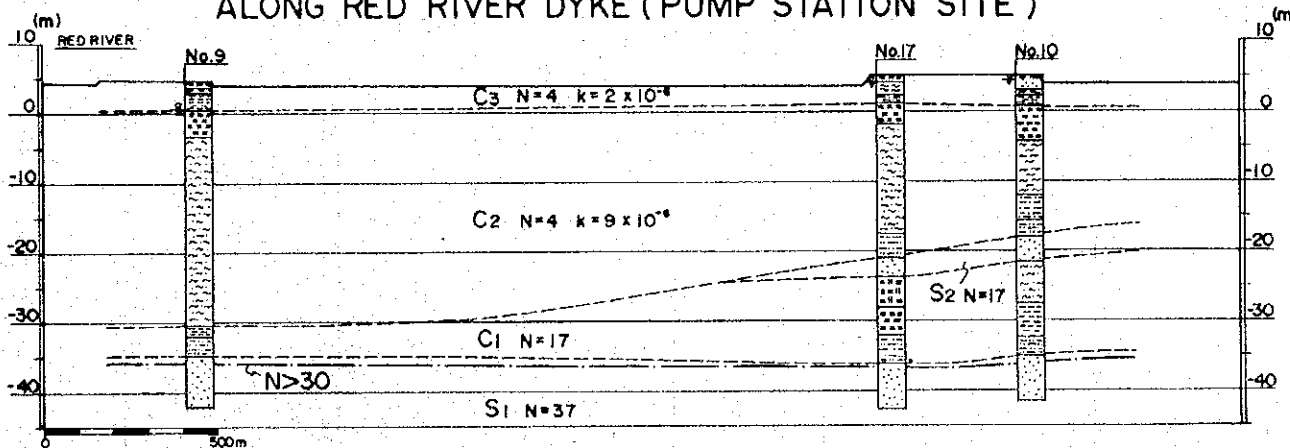
- C3 } Clayey Layer
- C2 } Clayey Layer
- C1 } Clayey Layer
- S4 } Sandy Layer
- S3 } Sandy Layer
- S2 } Sandy Layer
- S1 } Sandy Layer

N: N-value (counts/30cm)
 K: coefficient of Permeability In-situ Test (cm/s)

ALONG REGURATION RESERVOIR SITE



ALONG RED RIVER DYKE (PUMP STATION SITE)



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Fig J 3 . 2
 GEOTECHNICAL PROFILES

COMPOSITE DIAGRAM OF WELL NO. 1

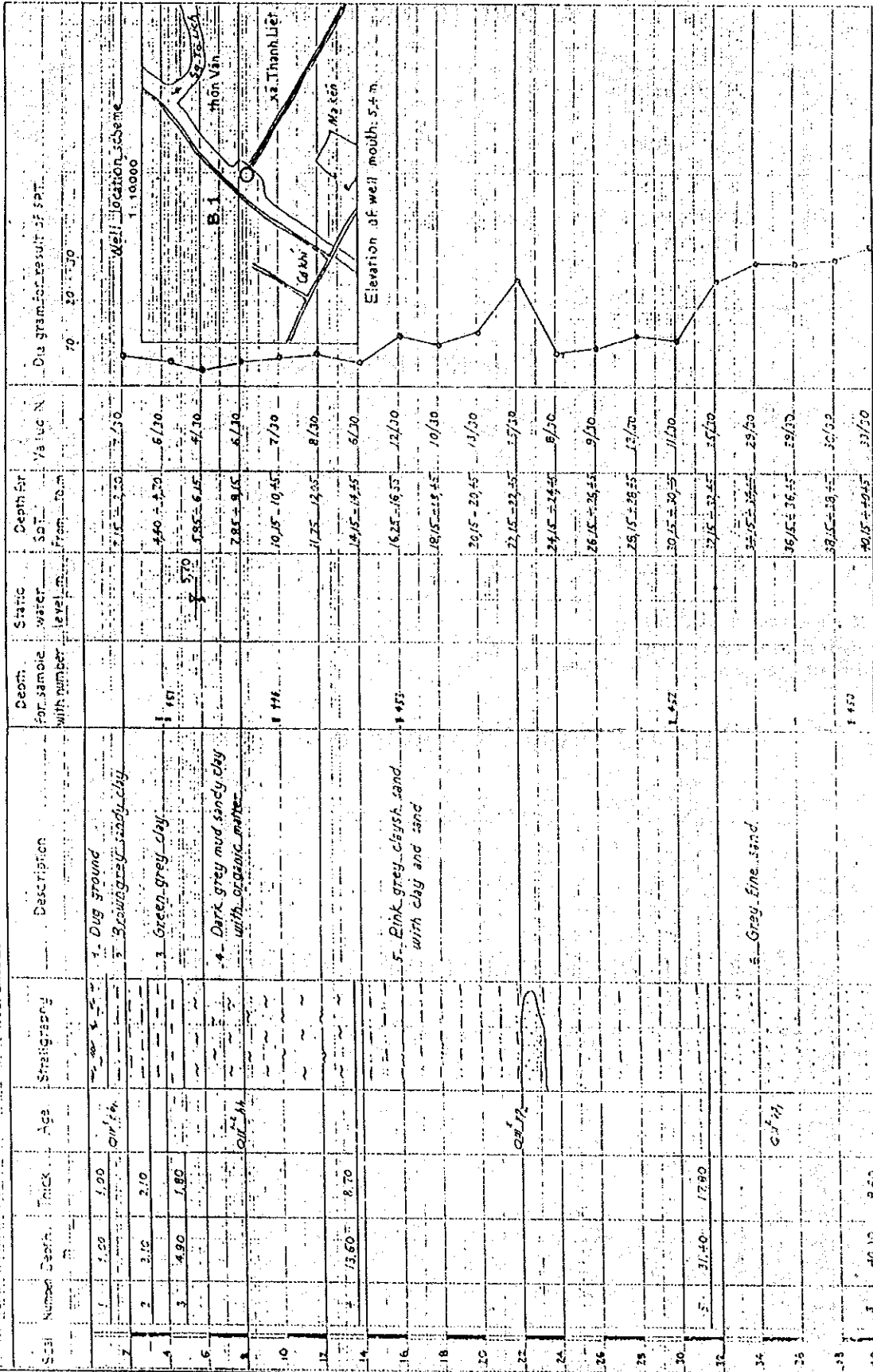


Fig J 3 . 3 (1)
COMPOSITE DIAGRAM OF BORING LOG
(1/17)

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COMPOSITE DIAGRAM OF WELL N° 2

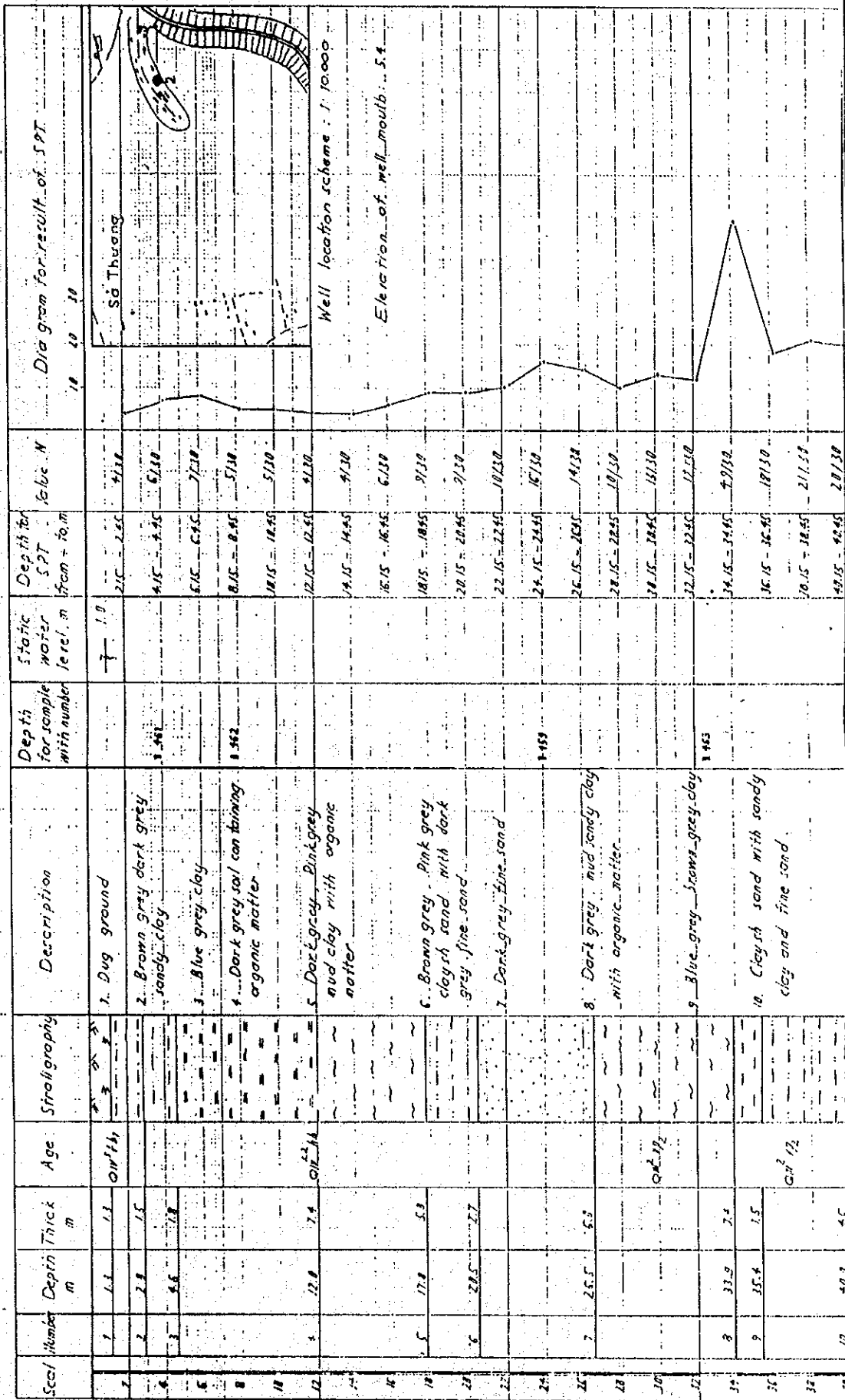
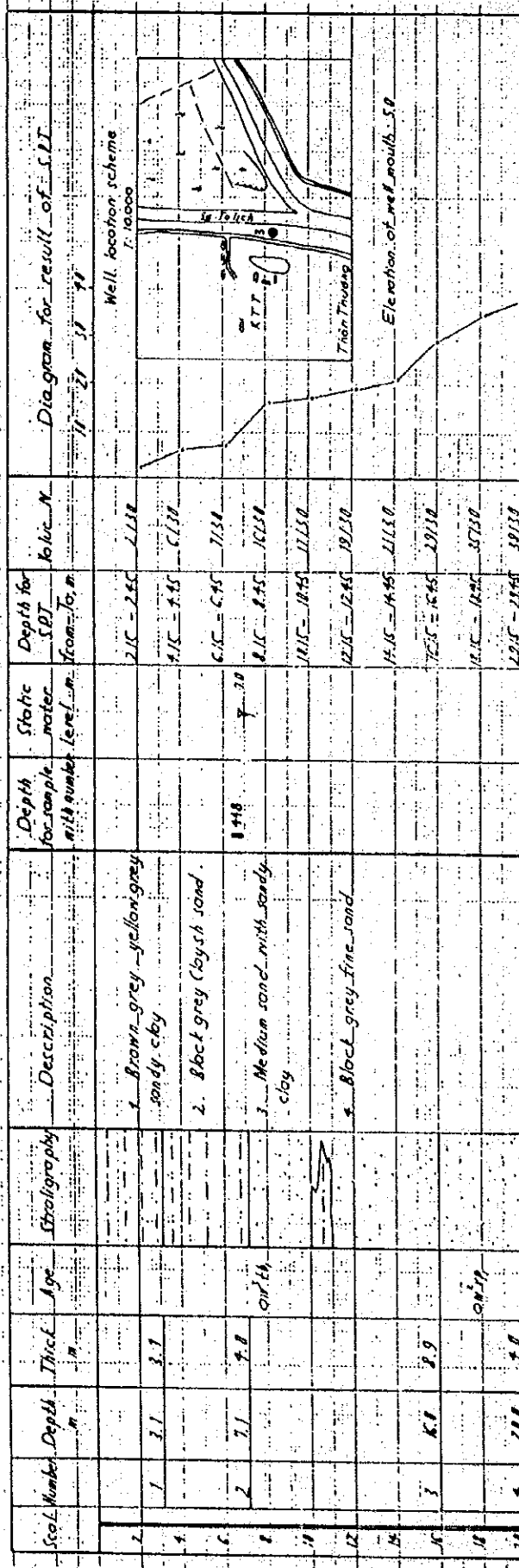


Fig J 3. 3 (2)
COMPOSITE DIAGRAM OF BORING LOG
(2/17)

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COMPOSITE DIAGRAM OF WELL NO. 3



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Fig J 3. 3 (3)
COMPOSITE DIAGRAM OF BORING LOG
 (3/17)

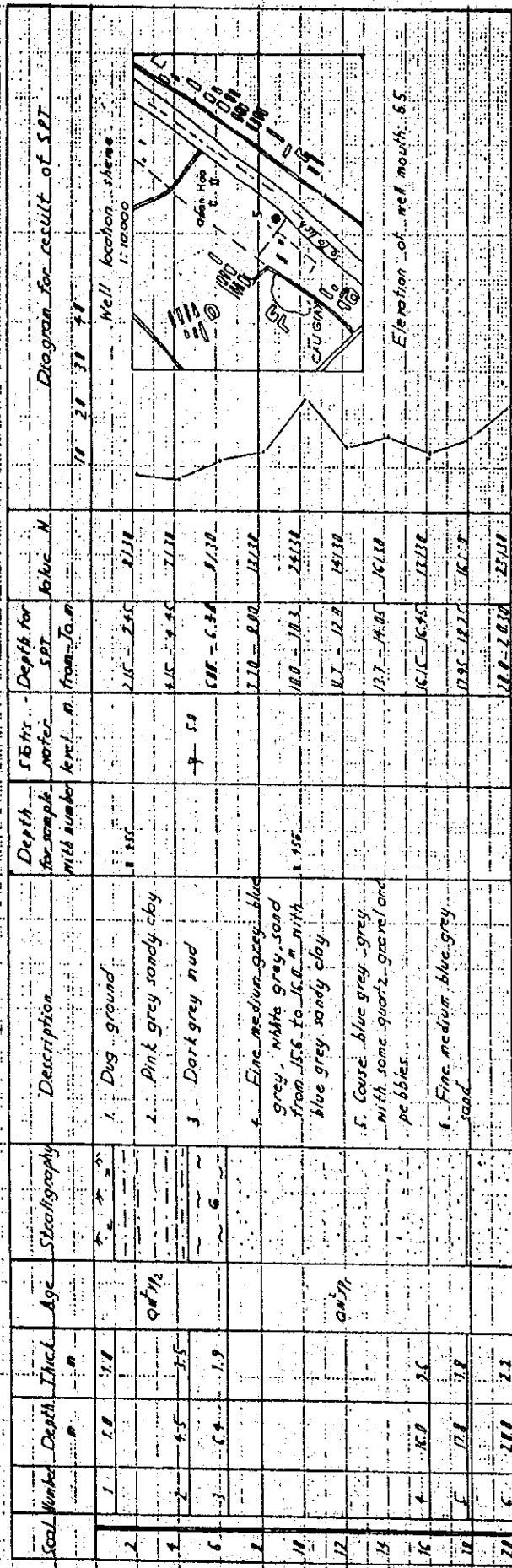
COMPOSITE DIAGRAM OF WELL N^o 4

| Seal Number | Depth m | Thick. m | Age | Stratigraphy | Description | Depth for sample with number level, m | Static water level, m | Depth SPT from 10m | Jobc. N | Dia gram for result of SPT if 21 21 21 | Well location scheme 1:10,000 |
|-------------|------------|-------------|-------|--|---|---|-----------------------------|--------------------------|---------|---|----------------------------------|
| 2 | 2.9 | 2.9 | | | 1. Brown grey-yellow-grey sandy clay | 1.43 | | 21C-270 | 7158 | | |
| 4 | 5.2 | 3.3 | Q11th | 2. Dark grey in the lower part, pink grey clay sand | | 2-62 | 415-545 | 9119 | | | |
| 7 | 1.1 | 1.8 | | 3. Black grey fine sand | | | 615-645 | 18130 | | | |
| 11 | 1.8 | 2.9 | | 4. Grey blue-grey, light grey medium sand with some gravel and pebbles | | | 815-835 | 20110 | | | |
| 12 | 1.8 | 1.0 | Q12th | | | | 1015-1045 | 18130 | | | |
| 14 | | | | | | | 1215-1245 | 24130 | | | |
| 15 | | | | | | | 1415-1445 | 28130 | | | |
| 16 | | | | | 5. Black grey, pink grey sandy clay | 1.457 | 1615-1645 | 31130 | | | |
| 18 | | | | | 6. Black grey blue grey fine sand | | 1815-1845 | 37130 | | | |
| 20 | 2.8 | 5.2 | | | | | 2015-2045 | 38130 | | | |

Elevation of well mouth 6.4

Fig J 3 . 3 (4)
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COMPOSITE DIAGRAM OF WELL N°5



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Fig J 3 . 3 (5)
COMPOSITE DIAGRAM OF BORING LOG
 (5/17)

COMPOSITE DIAGRAM OF WELL N°6

| Soil Mark | Depth | Thick | Age | Stratigraphy | Description | Depth for sample with number | Status water level, m | Depth for SPT from top | Soil No. | Diagram for result of SPT |
|-----------|-------|-------|-------------------------------|--------------|---|------------------------------|-----------------------|------------------------|----------|---------------------------|
| 1 | 2.4 | 2.4 | | | 1. Dug-ground | | | 2.0 - 2.3 | 9130 | |
| 2 | 3.5 | 3.5 | | | 2. Dark grey mud | | | 4.15 - 4.35 | 11130 | |
| 3 | 8.4 | 8.4 | Q ₀ M ₂ | | 3. Yellow grey-blue grey brown grey clay | | | 5.7 - 6.0 | 9130 | |
| 4 | 11.7 | 11.7 | | | 4. Brown grey pink grey sandy clay | | | 8.15 - 8.45 | 12130 | |
| 5 | 19.70 | 19.70 | Q ₀ M ₁ | | 5. Coarse sand with some pebbles and gravel | | | 10.15 - 10.45 | 10130 | |
| 6 | | | | | | | 9 | | | |
| 7 | | | | | | | | | | |
| 8 | | | | | | | | | | |
| 9 | | | | | | | | | | |
| 10 | | | | | | | | | | |
| 11 | | | | | | | | | | |
| 12 | | | | | | | | | | |
| 13 | | | | | | | | | | |
| 14 | | | | | | | | | | |
| 15 | | | | | | | | | | |
| 16 | | | | | | | | | | |
| 17 | | | | | | | | | | |
| 18 | | | | | | | | | | |
| 19 | | | | | | | | | | |
| 20 | | | | | | | | | | |

COMPOSITE DIAGRAM OF WELL No. 7

| Soil Number | Depth | Thick | Age | Stratigraphy | Description | Depth for sample with water level, m | Static water level, m | Depth SPT from 16.0 m | Value N | Diagram for result of SPT |
|-------------|------------|-------|-----|--------------|--|--------------------------------------|-----------------------|-----------------------|---------|---------------------------|
| 1 | 1.8 | 1.8 | | | 1. Dig ground | 1.8 | 1.8 | 2.15 - 2.45 | 19.130 | |
| 2 | 1.8 - 2.2 | 0.4 | | | 2. Red grey mud | 2.2 | 2.2 | 2.45 - 2.50 | 21.170 | |
| 3 | 2.2 - 3.1 | 0.9 | | | 3. Brown grey, black grey, pink grey sandy clay | 3.1 | 3.1 | 2.50 - 2.55 | 19.130 | |
| 4 | 3.1 - 4.2 | 1.1 | | | 4. Black grey, pink grey mud, sandy clay with organic matter | 4.2 | 4.2 | 2.55 - 2.60 | 21.170 | |
| 5 | 4.2 - 5.1 | 0.9 | | | 5. Grey, black grey, clay with pink grey sandy clay and gravel | 5.1 | 5.1 | 2.60 - 2.65 | 19.130 | |
| 6 | 5.1 - 5.8 | 0.7 | | | | 5.8 | 5.8 | 2.65 - 2.70 | 19.130 | |
| 7 | 5.8 - 6.5 | 0.7 | | | | 6.5 | 6.5 | 2.70 - 2.75 | 19.130 | |
| 8 | 6.5 - 7.2 | 0.7 | | | | 7.2 | 7.2 | 2.75 - 2.80 | 19.130 | |
| 9 | 7.2 - 7.9 | 0.7 | | | | 7.9 | 7.9 | 2.80 - 2.85 | 19.130 | |
| 10 | 7.9 - 8.6 | 0.7 | | | | 8.6 | 8.6 | 2.85 - 2.90 | 19.130 | |
| 11 | 8.6 - 9.3 | 0.7 | | | | 9.3 | 9.3 | 2.90 - 2.95 | 19.130 | |
| 12 | 9.3 - 10.0 | 0.7 | | | | 10.0 | 10.0 | 2.95 - 3.00 | 19.130 | |

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Fig. J. 3. 3 (7)
 COMPOSITE DIAGRAM OF BORING LOG
 (7/17)

COMPOSITE DIAGRAM OF WELL N°8

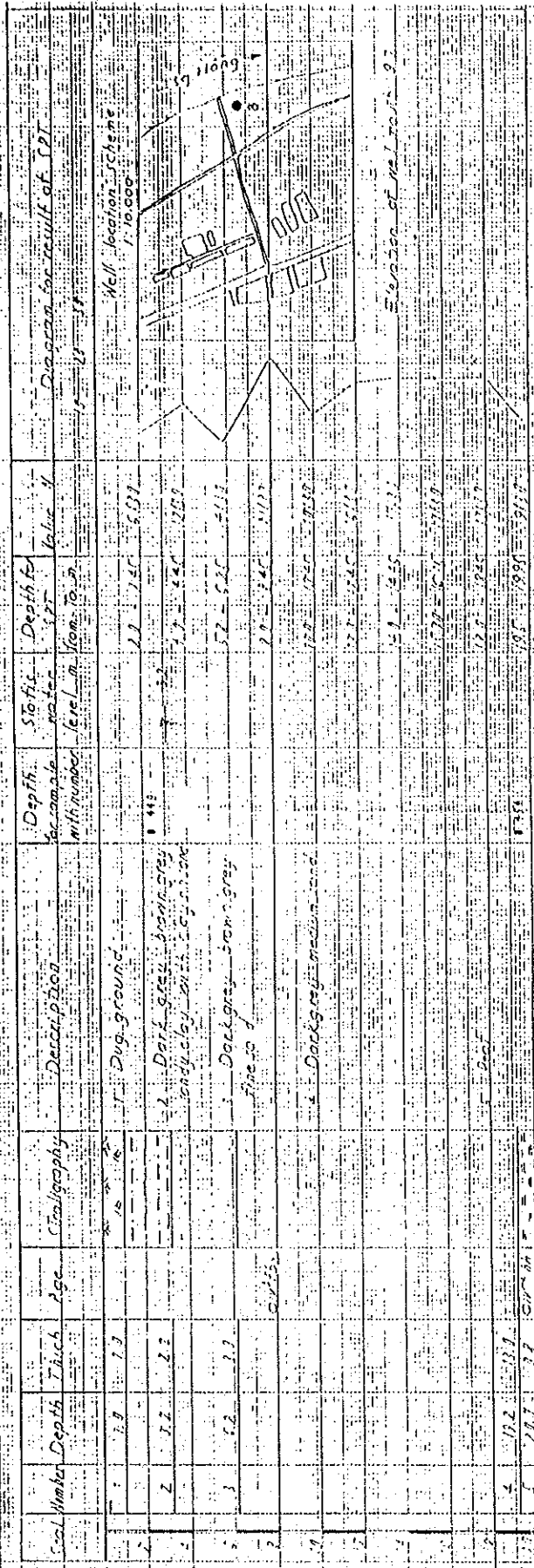


Fig J 3.3 (8)
COMPOSITE DIAGRAM OF BORING LOG
 (8/17)

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COMPOSITE DIAGRAM OF WELL N^o 9

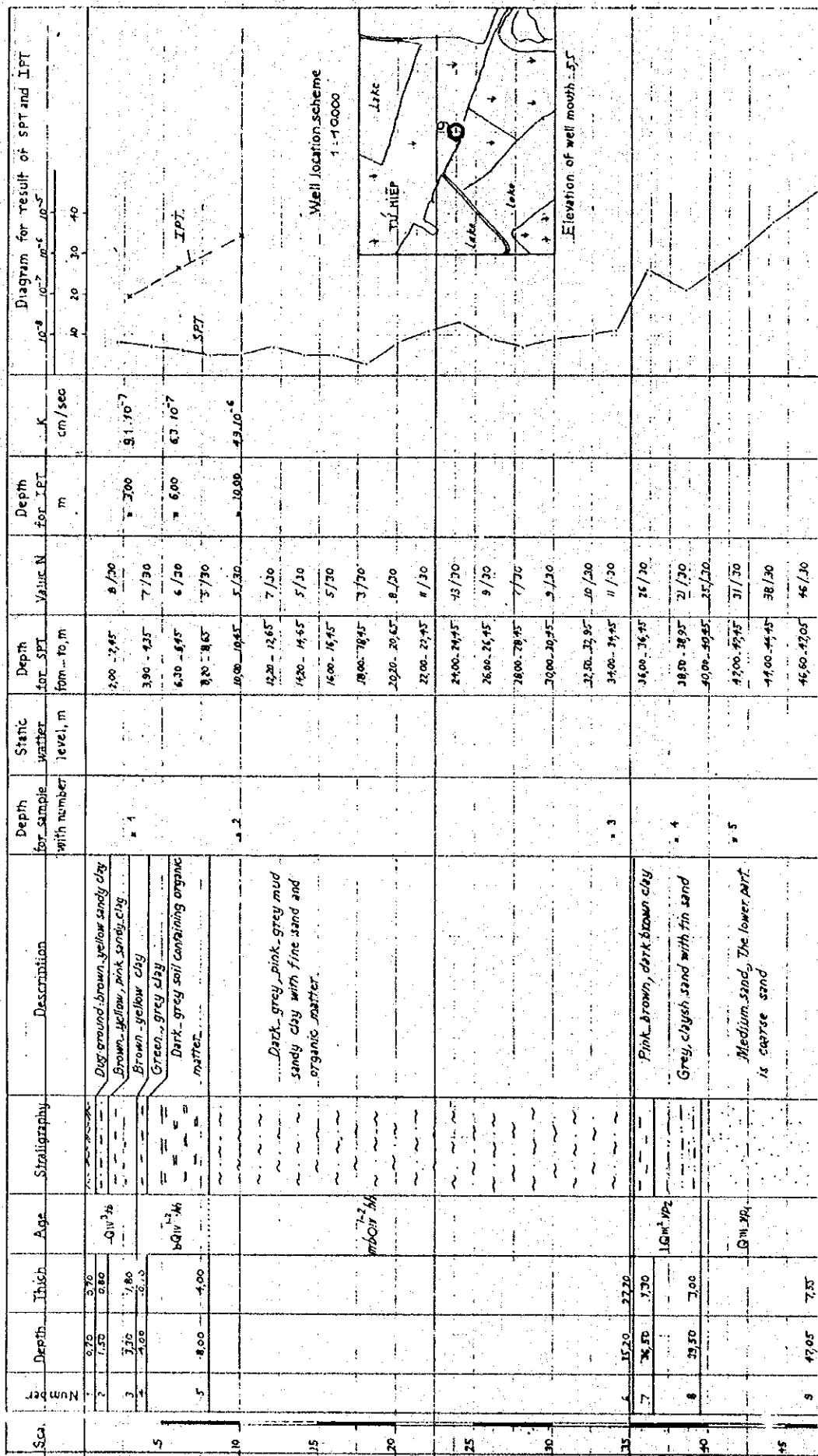


Fig J 3 . 3 (9)
COMPOSITE DIAGRAM OF BORING LOG
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COMPOSITE DIAGRAM OF WELL N^o 10

| Scale | Depth | Thick | Age | Stratigraphy | Description | Depth for sample with number | Static water level, m | Depth for SPT from 10 m | Value N | Depth for IPT, m | K | Diagram for result of SPT and IPT |
|-------|-------|-------|-----------------------|--------------|--|------------------------------|-----------------------|-------------------------|---------|------------------|------------------------|-----------------------------------|
| 1 | 2.25 | 2.25 | Q1W ¹ h | | Dug ground, grey fine sand | | | 180-225 | 3/30 | | | |
| 2 | 3.00 | 0.75 | | | Dark grey mud | | | 380-425 | 2/30 | | | |
| 3 | 4.50 | 1.50 | Q1W ² h | | Grey, pink, grey clay | 6 | | 630-655 | 4/30 | 5.0 | 9.5 · 10 ⁻⁶ | |
| 4 | 5.50 | 5.00 | | | Organic soil | | | 840-885 | 4/30 | 9.8 | 2.2 · 10 ⁻⁵ | |
| 5 | 7.00 | 7.90 | Q1W ³ h | | Grey, dark grey, sandy clay mud with organic matter, the lower part with fine sand | | | 1030-1035 | 1/30 | | | |
| 6 | 8.20 | 1.80 | | | Grey pink grey sandy clay | | | 1200-1245 | 3/30 | | | |
| 7 | 9.50 | 2.30 | | | Grey, dark grey, clayey sand | | | 1400-1445 | 3/30 | 15.0 | 2.1 · 10 ⁻⁵ | |
| 8 | 11.00 | 1.70 | am Q1W ⁴ h | | Grey fine sand | | | 1700-1745 | 5/30 | | | |
| 9 | 12.50 | 6.00 | | | Dark grey, sandy clay mud with vegetal remains | | | 1950-1995 | 5/30 | | | |
| 10 | 14.00 | 5.00 | Q1W ⁵ h | | White grey, yellow grey, clay, the lower part is brown, yellow, brown | | | 2030-2035 | 4/30 | 20.0 | 1.2 · 10 ⁻⁶ | |
| 11 | 15.50 | 2.60 | | | Brown grey, clayey sand with sandy clay and fine sand | | | 2200-2245 | 9/30 | | | |
| 12 | 17.00 | 6.25 | am Q1W ⁶ h | | Medium brown grey sand | | | 2480-2525 | 18/30 | | | |
| 13 | 18.50 | | | | | | | 2540-2585 | 18/30 | | | |
| 14 | 20.00 | | | | | | | 2800-2845 | 7/30 | | | |
| 15 | 21.50 | | | | | | | 3000-3045 | 12/30 | | | |
| 16 | 23.00 | | | | | | | 3100-3145 | 15/30 | | | |
| 17 | 24.50 | | | | | | | 3500-3545 | 26/30 | | | |
| 18 | 26.00 | | | | | | | 3755-3810 | 24/30 | | | |
| 19 | 27.50 | | | | | | | 4030-4075 | 25/30 | | | |
| 20 | 29.00 | | | | | | | 4210-4255 | 42/30 | | | |
| 21 | 30.50 | | | | | | | 4450-4495 | 40/30 | | | |
| 22 | 32.00 | | | | | | | 4600-4705 | 43/30 | | | |

Fig J 3 . 3 (10)
COMPOSITE DIAGRAM OF BORING LOG
(10/17)

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COMPOSITE DIAGRAM OF WELL N-11

| Scale | Number | Depth | Thick. | Age | Stratigraphy | Description | Depth for sample with number | Static water level in | Depth for SPT from -stom | Value N for I.P.T. | Depth for I.P.T. | K cm/sec | Diagram for result of SPT and I.p.t. |
|-------|--------|-------|--------|--------|--------------|--|------------------------------|-----------------------|--------------------------|--------------------|----------------------|----------|--------------------------------------|
| | 1 | 1.20 | 1.20 | | | Dug ground: brown, grey, yellow, gray, sandy clay | | | | | | | |
| 2 | 2 | 2.00 | 0.80 | QV, fb | | D. k grey mud. | 31 | 2.0 - 2.65 | 5/30 | 3.30 | 4.1-10 ⁻⁶ | | |
| 3 | 3 | 2.65 | 0.65 | | | Yellow grey sandy clay | | | | | | | |
| 4 | 4 | 3.50 | 0.85 | | | Green-grey clay | | | | | | | |
| 5 | 5 | 5.40 | | QV, fb | | Black grey organic soil | 12 | 4.0 - 4.65 | 7/30 | 5.50 | 6.1-10 ⁻⁶ | | |
| 6 | 6 | 12.80 | 3.90 | | | Dark grey sandy clay mud with sand and organic matter. | | 6.0 - 6.65 | 2/30 | 9.20 | 3.0-10 ⁻⁶ | | |
| 7 | 7 | 14.85 | 2.05 | QV, fb | | Grey-dark grey fine sand | 43 | 8.0 - 9.65 | 7/30 | 10.30 | | | |

Fig J 3 . 3 (11)
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 COMPOSITE DIAGRAM OF BORING LOG
 (11/17)

COMPOSITE DIAGRAM OF WELL No. 12

| Well Number | Depth | Thick | Age | Stratigraphy | Description | Depth for sample with number | State water level | Depth for SET | Value N | Depth from LET | Ki cm/sec | Diagram for result of SET and IPT |
|-------------|-------|-------|-------|--------------|---|------------------------------|-------------------|---------------|---------|----------------|-----------|--|
| | | | | | | | | | | | | |
| 1 | 274 | 250 | | | | | | 255-300 | 4/10 | | | <p style="text-align: center;">Well location scheme 1:10,000</p> |
| 2 | 280 | 250 | QV 3h | | Dug ground; yellow, brown clay; the lower part is grey fine sand | | | | | | | |
| 3 | 450 | 370 | | | Green-grey clay | 14 | | 500-545 | 7/10 | | | |
| 4 | 290 | 290 | | | Black-grey organic soil with vegetal remains | | | 580-725 | 7/10 | | | |
| 5 | 290 | 290 | | | Dark grey sandy clay mud; the lower part with grey fine sand organic matter | 15 | | 830-895 | 1/10 | | | |
| 6 | | | | | | | | 1055-1100 | 7/10 | | | |
| 7 | | | | | | | | 1260-1205 | 9/10 | | | |
| 8 | | | | | | | | 1455-1500 | 7/10 | | | |
| 9 | | | | | | | | | | | | |
| 10 | | | | | | | | | | | | |
| 11 | | | | | | | | | | | | |
| 12 | | | | | | | | | | | | |
| 13 | | | | | | | | | | | | |
| 14 | | | | | | | | | | | | |
| 15 | | | | | | | | | | | | |

Fig J 3 . 3 (12)
COMPOSITE DIAGRAM OF BORING LOG
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COMPOSITE DIAGRAM OF WELL N^o 13

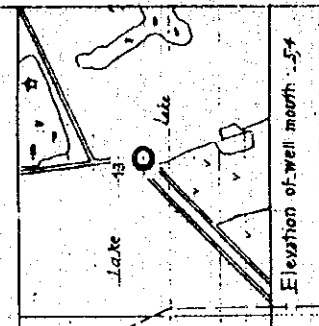
| Stratigraphy | Age | Thick. | Depth | Number | Description | Depth for sample with number | Static water level, m | Depth for SpT. from 70 m | Value N. | Depth for SpT. m | K cm/sec | Diagram for result of SpT and LpT |
|--------------|-------------------|--------|-------|--------|--|------------------------------|-----------------------|--------------------------|----------|------------------|------------------------|---|
| | | | | | | | 0.10 | | | | | Diagram for result of SpT and LpT 10 ⁴ 20 ⁴ 30 ⁴ |
| | | | | | Dud ground: yellow grey fine sand | | | 2.50 - 2.35 | 3/20 | 3.00 | 24 · 10 ⁻⁷ | Well location scheme 1:10,000  |
| | QV ³ h | 1.00 | 2.50 | 2 | Black grey mud with organic matter | 16 | | 4.10 - 4.55 | 1/20 | 5.00 | 1.4 · 10 ⁻⁶ | |
| | | 0.50 | 3.00 | 3 | Pink grey sandy clay | | | 6.00 - 6.45 | 3/20 | | | |
| | | 0.90 | 3.90 | 4 | Green grey clay | | | 8.00 - 8.45 | 2/20 | | | |
| | | | | | Black grey sandy clay mud with vegetal remains | | | 10.0 - 10.45 | 2/20 | 9.00 | 1.6 · 10 ⁻⁵ | Elevation of well mouth 5.4 |
| | QV ³ h | | | | | 17 | | 12.0 - 12.45 | 2/20 | | | |
| | | | | | | | | 14.0 - 14.45 | 3/20 | | | |
| | | | | | | | | 16.0 - 16.45 | 2/20 | | | |
| | | 12.55 | 16.95 | 5 | | | | | | | | |

Fig J 3 . 3 (13)
COMPOSITE DIAGRAM OF BORING LOG
(13/17)

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COMPOSITE DIAGRAM OF WELL N° 14

| Scale | Depth | Thick | Age | Stratigraphy | Description | Depth for sample with number | Static water level | Depth for SPT | Value N | Depth for IPT | Diagram for result of SPT and IPT |
|-------|-------|-------|-----|--------------|---|------------------------------|--------------------|---------------|---------|---------------|--|
| | m | m | | | | from top | m | from top | cm/sec | m | 10 ⁻⁶ 10 ⁻⁵ 10 ⁻⁴ |
| 1 | 1.80 | 780 | GWT | | Dig. ground - pink-grey, brown-grey sand clay | | | | | | |
| 2 | 2.90 | 790 | | | Pink grey, brown sand clay | 2.5 - 2.85 | 7.10 | | | | |
| 3 | 4.40 | 790 | | | Green grey clay | 4.05 - 4.60 | 7.10 | | | | |
| 4 | 6.20 | 270 | | | Grey-dark grey sandy clay mud with vegetal remains | 5.15 - 6.40 | 7.10 | | | | |
| 5 | | | | | Grey fine sand with clayed sand, sandy clay and vegetal remains | 8.15 - 9.60 | 10.70 | | | | |
| 6 | | | | | | | | | | | |
| 7 | | | | | | | | | | | |
| 8 | | | | | | | | | | | |
| 9 | | | | | | | | | | | |
| 10 | 15.00 | 870 | | | | 10.15 - 10.60 | 11.70 | | | | |

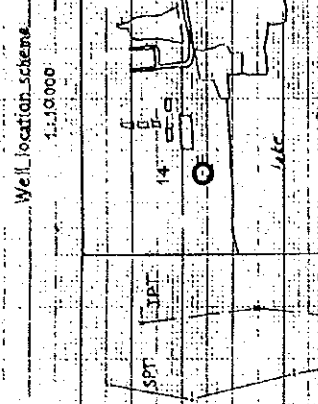


Fig J 3 . 3 (14)
COMPOSITE DIAGRAM OF BORING LOG
(14/17)

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COMPOSITE DIAGRAM OF WELL N-15

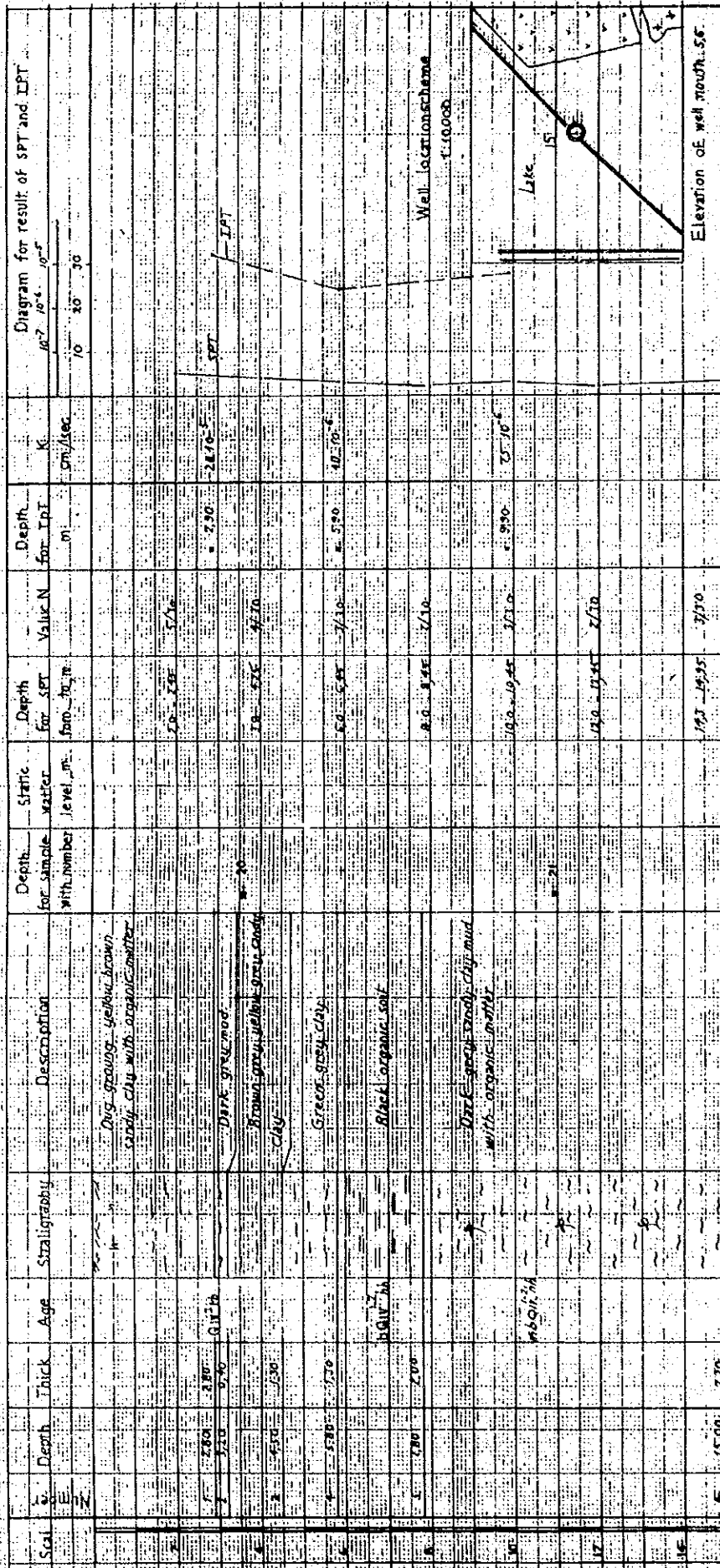


Fig J 3.3 (15)
COMPOSITE DIAGRAM OF BORING LOG
(15/17)

SOCIALIST REPUBLIC OF VIET NAM
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COMPOSITE DIAGRAM OF WELL N^o 16

| Soil | Number | Depth | Thick | Age | Stratigraphy | Description | Depth for sample with number | Static water level, m | Depth for SPT from 10, m | Value N for SPT | Depth for SPT, m | K, cm/sec | Diagram for result of SPT and IPT |
|------|--------|-------|-------|-------------------|--------------|---|------------------------------|-----------------------|--------------------------|-----------------|------------------|------------------------|--|
| 2 | 1 | 3.00 | 3.00 | QIV th | | Dug ground, yellow-brown, pink-brown sandy clay, the lower part with sand | | | 1.70 - 2.15 | 2/30 | 3.00 | 2.9 · 10 ⁻⁶ | <p>Well location scheme 1:10000 Elevation of well mouth: 5.8</p> |
| | 2 | 3.20 | 0.20 | | | Dark grey mud | 22 | | 3.80 - 4.25 | 4/30 | 5.00 | 5.7 · 10 ⁻⁶ | |
| | 3 | 5.00 | 1.80 | | | Green grey clay | | | 5.80 - 6.25 | 4/30 | | | |
| | 4 | | | | | Black organic soil | | | 8.50 - 8.95 | 2/30 | | | |
| | 5 | 15.00 | 6.80 | | | Grey sandy clay mud, the lower part with grey fine sand | 23 | | 11.00 - 11.45 | 3/30 | | | |
| | 12 | | | | | | | | 12.60 - 13.05 | 5/30 | | | |
| | 14 | | | | | | | | 14.60 - 15.05 | 5/30 | | | |

Fig J 3 3 (16)
COMPOSITE DIAGRAM OF BORING LOG
(16/17)

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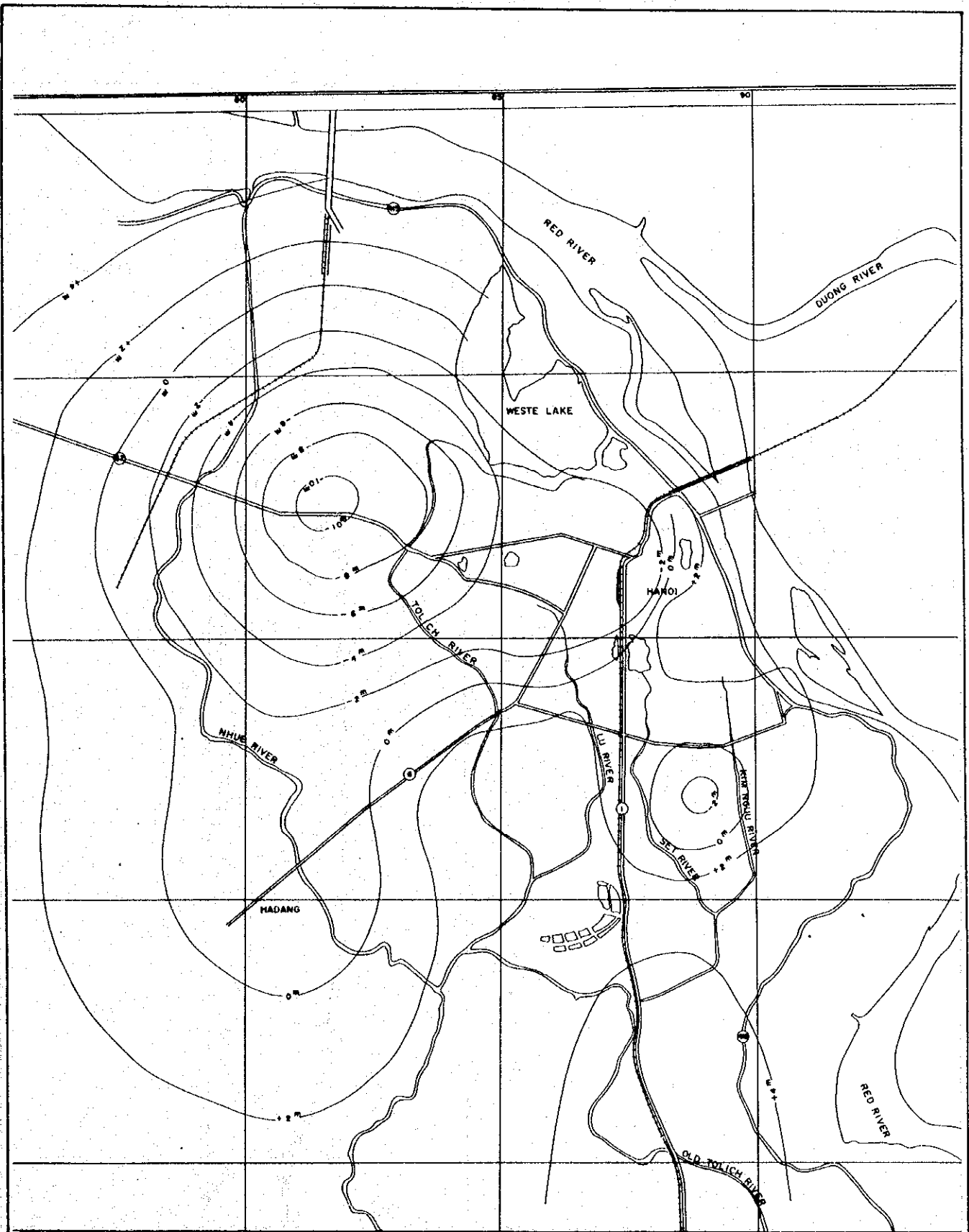
COMPOSITE DIAGRAM OF WELL No 17

| Scal. | Number | Depth | Thick | Age | Stratigraphy | Description | Depth for sample with number | Static water level, m | Depth for SPT from... m | Valuc N for IPT, m | Depth for IPT, m | K, cm/sec | Diagram for result of SPT and IPT |
|-------|--------|-------|-------|----------------------|--------------|--|------------------------------|-----------------------|-------------------------|--------------------|------------------|----------------------|-----------------------------------|
| | 1 | 1.00 | 1.00 | | | Dark grey, brown grey, green grey clay | | | | | | | |
| | 2 | 2.80 | 1.80 | QIV ^{1/4} | | Dark grey, mud | 2* | | 2.80-3.25 | 2/30 | 3.20 | 2.5-10 ⁻⁶ | |
| | 3 | 4.00 | 1.20 | | | Brown grey, dark grey, sandy clay | | | 4.05-4.50 | 1/30 | | | |
| 5 | 4 | 7.10 | 3.10 | 5QIV ^{1/2} | | Dark grey, organic soil | | | 6.65-7.20 | 1/30 | 5.10 | 5.3-10 ⁻⁶ | |
| 10 | | | | | | Grey, dark grey, sandy clay, mud with vegetal remains | 25 | | 9.05-9.50 | 2/30 | 9.80 | 2.5-10 ⁻⁵ | |
| 15 | | | | | | | | | 11.80-12.25 | 7/30 | | | |
| 20 | | | | | | | | | 14.05-14.50 | 2/30 | | | |
| | 5 | 22.80 | 1.570 | IV ^{1/2} M | | Grey, dark grey, clayish sand with clay, sand and organic matter | | | 16.35-16.80 | 2/30 | | | |
| 25 | | | | | | | | | 17.65-18.05 | 2/30 | | | |
| | 6 | 26.60 | 3.80 | III ^{1/2} M | | Grey, fine sand, with clay and organic matter | | | 24.00-24.45 | 6/30 | | | |
| | 7 | 29.30 | 2.70 | III ^{1/2} M | | Light, soft, black, silty, with vegetable matter | | | 26.10-26.55 | 9/30 | | | |
| 30 | | | | | | | | | 27.00-27.35 | 16/30 | | | |
| | 8 | 33.80 | 4.50 | II ^{1/2} M | | White, grey, brown, grey, clay | | | 30.00-30.45 | 6/30 | | | |
| 35 | | | | | | | | | 32.05-32.50 | 5/30 | | | |
| | 9 | 38.40 | 4.20 | IQIV ^{1/2} | | Yellow, grey, brown, grey, dust sand, with sandy clay and sand | | | 34.00-34.45 | 16/30 | | | |
| 40 | | | | | | | | | 36.00-36.45 | 26/30 | | | |
| | 10 | 42.20 | 3.80 | III ^{1/2} M | | Medium, yellow, grey, brown, grey sand | | | 37.50-37.95 | 29/30 | | | |
| 45 | | | | | | | | | 40.00-40.45 | 31/30 | | | |
| | 11 | 48.00 | 5.80 | II ^{1/2} M | | | | | 45.00-45.45 | 34/30 | | | |
| | 12 | | | | | | | | 48.05-48.50 | 37-40 | | | |

Fig J 3. 3 (17)
COMPOSITE DIAGRAM OF BORING LOG
(17/17)

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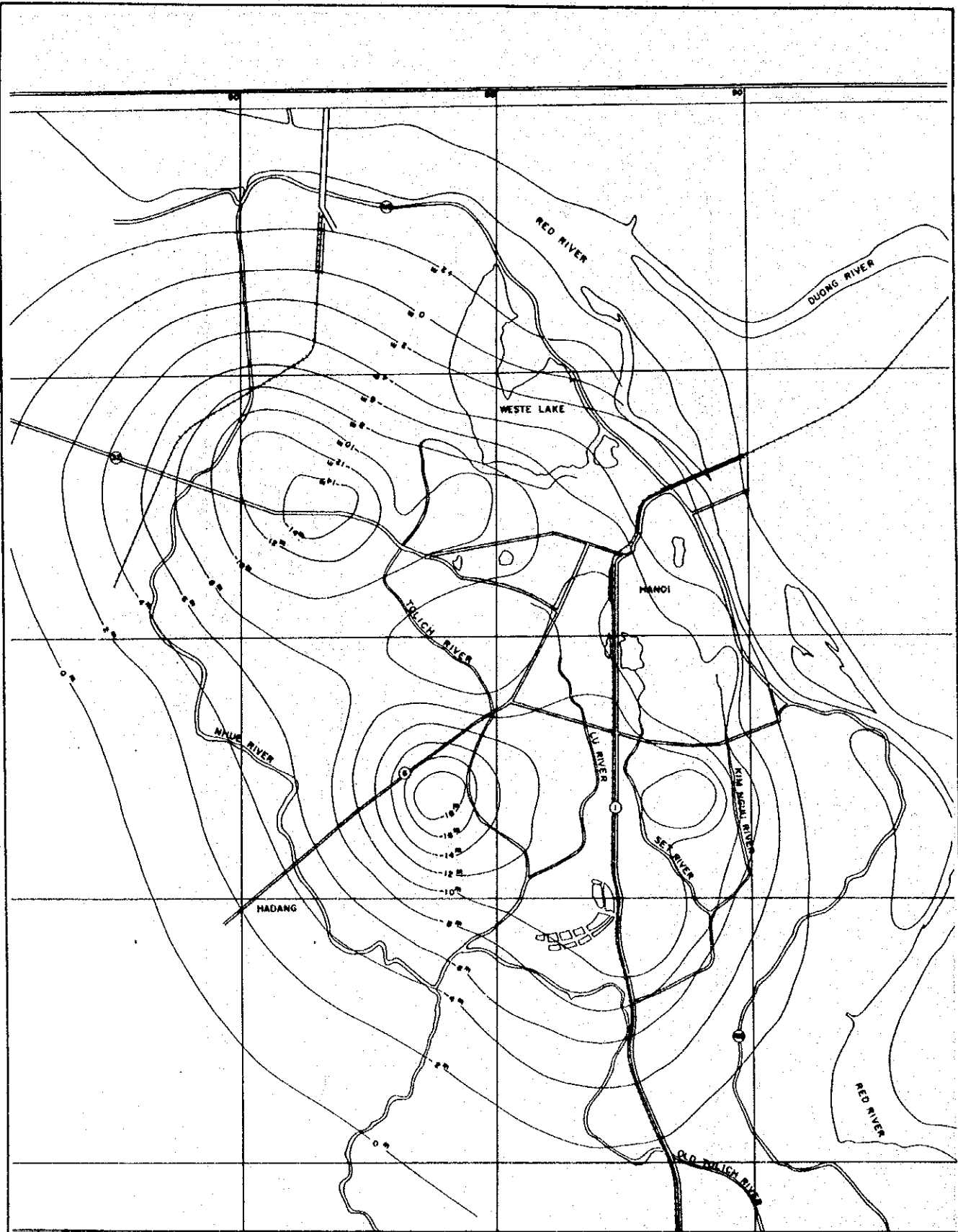
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Source : WATER MASTER PLAN IN HANOI CITY (1993) FINNIDA

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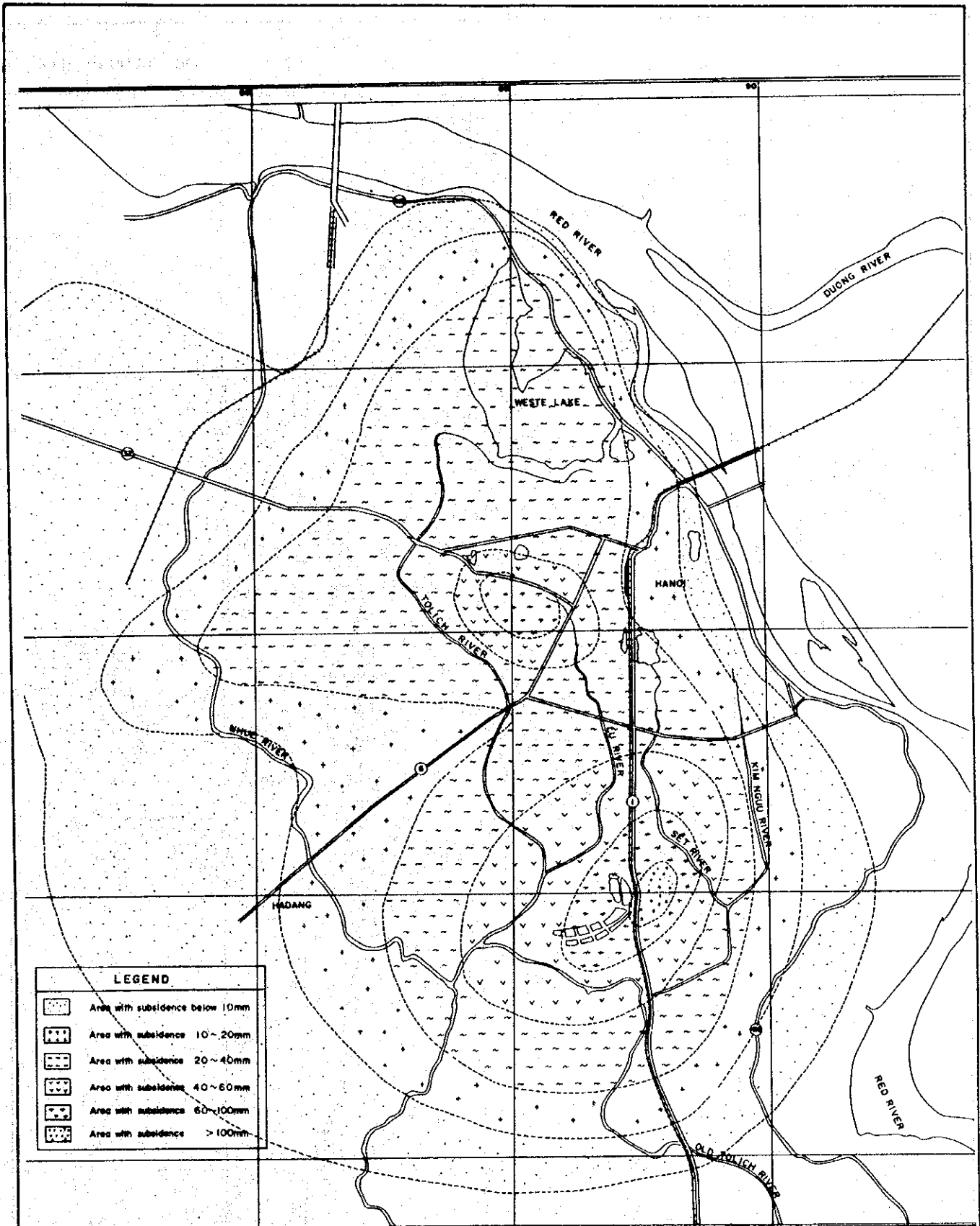
Fig J 3 . 4
 ISOTOPIC ELEVATION LINE OF
 UPPER AQUIFER (Qb) IN 1992



Source : WATER MASTER PLAN IN HANOI CITY (1993) FINNIDA

SOCIALIST REPUBLIC OF VIET NAM
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Fig J 3.5
 ISOTOPIC ELEVATION LINE OF
 LOWER AQUIFER (Qa) IN 1992



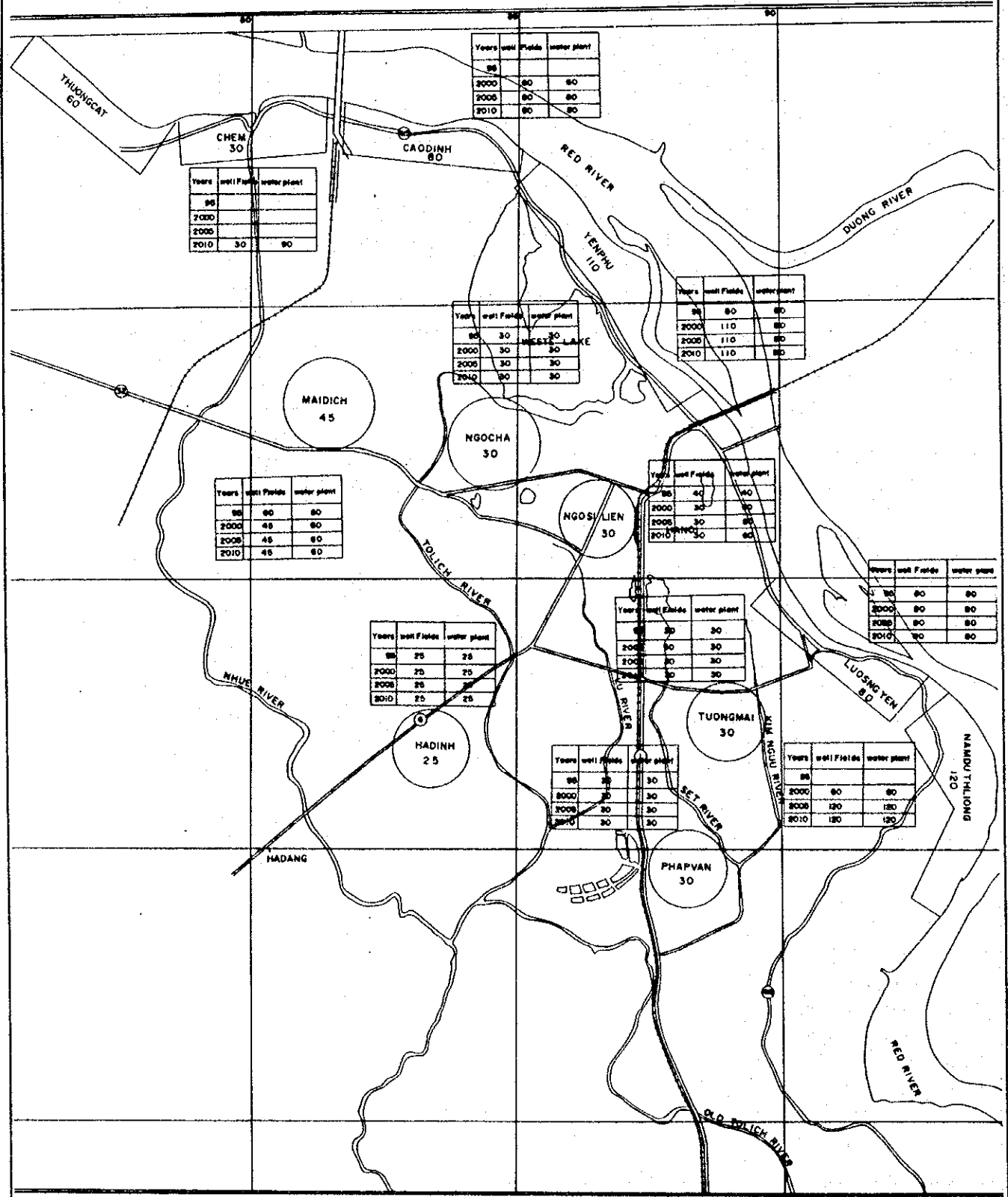
Source : WATER MASTER PLAN IN HANOI CITY (1993) FINNIDA

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Fig J 3.6
GROUND SUBSIDENCE MAP FOR
PERIOD BETWEEN 1988 AND 1992

Unit : 1,000 m³/day



Source : WATER MASTER PLAN IN HANOI CITY (1993) FINNIDA

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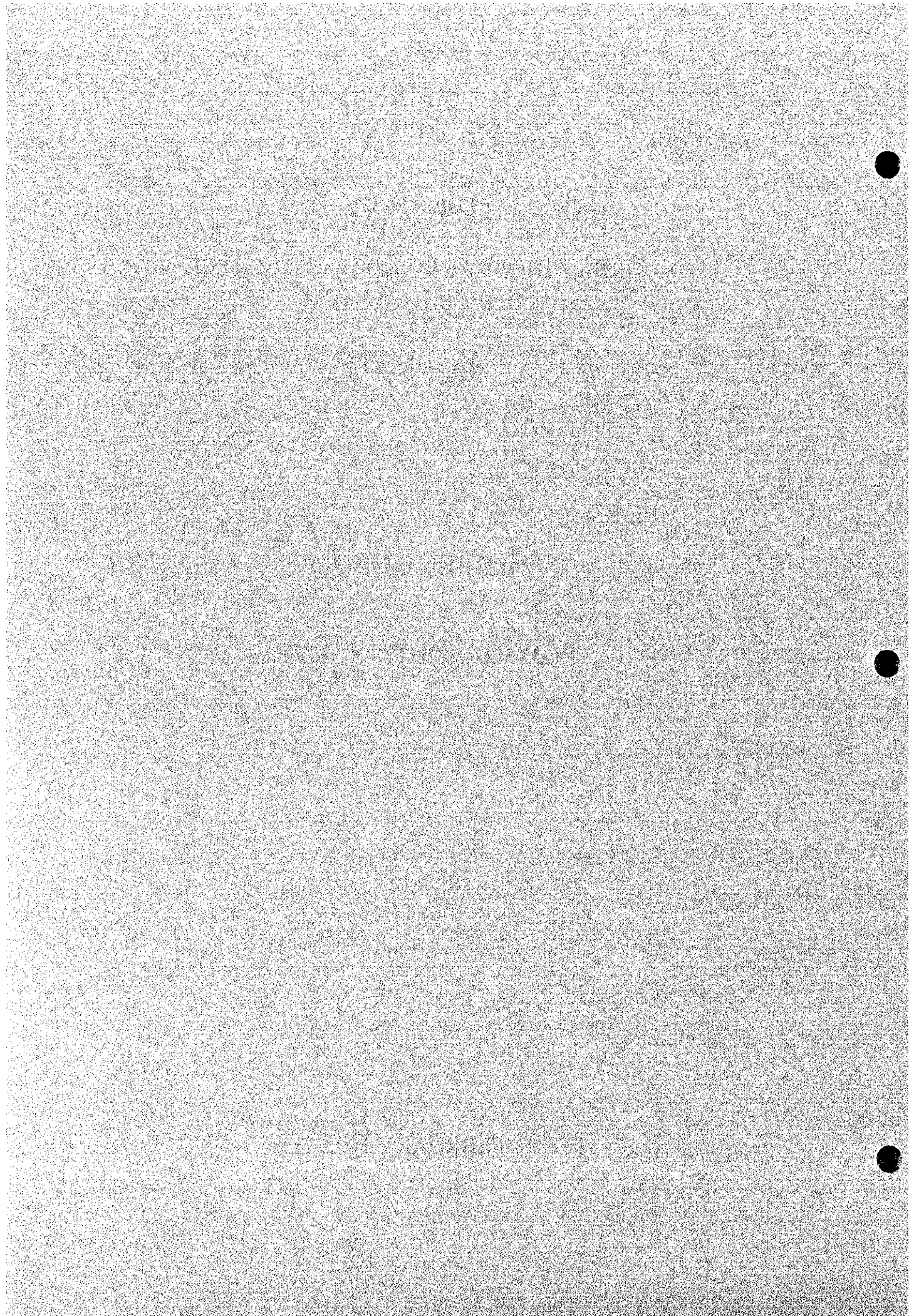
Fig J 3.7
 LOCATION OF FUTURE WELL FIELDS
 (option 3D) IN HANOI CITY

**THE STUDY
ON
URBAN DRAINAGE AND WASTEWATER
DISPOSAL SYSTEM
IN
HANOI CITY**

APPENDIX (K)

TOPOGRAPHIC SURVEY

FEBRUARY 1995



**THE STUDY ON
URBAN DRAINAGE AND WASTEWATER DISPOSAL SYSTEM
IN
HANOI CITY**

**APPENDIX (K)
TOPOGRAPHIC SURVEY**

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K1. INTRODUCTION

This Sectorial Report (K), Topographic Survey, compiles the outlines of survey works executed in the Master Plan and Feasibility Studies. All detailed work outputs, such as drawings and photographs are compiled in the Data Book, Topographic Survey Data.

The contents of the report are as follows:

- (1) Chapter K2 describes the geography of the study area in terms of general understandings of topography in the study area.
- (2) Chapter K3 describes the locations, quantities and scales of the executed survey works in Section 3.1, and general features and results obtained from the field works in Section 3.2.

K2. GENERAL GEOGRAPHY

The study area (Hanoi city and its surrounding areas) is located between the right side levee of the Red River and the left side levee of the Nhue River at about 100 km upstream from both river mouths, and is broadly separated into two areas bounded by the artificial levee of the Red River and the left and right banks of the To Lich River, and the left bank of the Nhue River.

The left side of the To Lich River (east of the river), may also be separated into two areas, a higher area with elevations of 7 to 9 m above the mean sea level, this corresponds to the densely populated old city area situated in the north to northeast, and a low-lying area of 4 to 5 m above mean sea level, which is mainly used for fish ponds, spreads in the south.

On the other hand, at the right side of the To Lich River (west side of the river) an elevation of 7 to 9 m above mean sea level is positioned on the West lake to the east, and the remaining area stays on evaluations of 4 to 6 m above mean sea level with several high portions which may be natural levees created by old river courses.

At present, new city area is spreading from the old city area to the medium range elevation area (4 to 6 m above mean sea level).

Figure K2.1 shows the topography of the Study Area.

K3. EXECUTED WORK

3.1 Work Quantities

Figure K3.1 shows the locations of executed survey works and the utilized reference points of this survey.

3.1.1 Master Plan Stage

The following works were executed during this study stage mainly to clarify the topographic conditions of the To Lich, Lu, Set and Kim Nguu Rivers.

(1) **Longitudinal and Cross Sectional Survey of the To Lich River**

Quantity : 14.5 km, 88 sections

Scale of Longitudinal Profiles : H = 1/10,000, V = 1/100

Scale of Cross Sectional Sections : H = 1/200, V=1/100

(2) **Longitudinal and Cross Sectional Survey of Lu River**

Quantity : 5.4 km, 29 sections

Scale of Longitudinal Profiles : H = 1/10,000, V = 1/100

Scale of Cross Sectional Sections : H = 1/200, V=1/100

(3) **Longitudinal and Cross Sectional Survey of Set River**

Quantity : 5.7 km, 33 sections

Scale of Longitudinal Profiles : H = 1/10,000, V = 1/100

Scale of Cross Sectional Sections : H = 1/200, V=1/100

(4) **Longitudinal and Cross Sectional Survey of Kim Nguu River**

Quantity : 11.6 km, 66 sections

Scale of Longitudinal Profiles : H = 1/10,000, V = 1/100

Scale of Cross Sectional Sections : H = 1/200, V=1/100

(5) **Longitudinal and Cross Sectional Survey of Old To Lich River**

Quantity : 0.6 km, 6 sections

Scale of Longitudinal Profiles : H = 1/10,000, V = 1/100

Scale of Cross Sectional Sections : H = 1/200, V=1/100

(6) **Installation of datum points for the execution of above said works by leveling**

Quantity : 15 km

Scale : N/A

3.1.2 Second Stage

The following works were executed during this study stage mainly to clarify the topographic conditions of the Yen So area and the cross-sections of bridges/culverts spanning the existing drainage channels;

(1) Longitudinal and Cross Sectional Survey of the Lu-Set Floodway

Quantity : 1 km, 6 cross sections

Scale of Longitudinal Profiles : H = 1/10,000, V = 1/100

Scale of Cross Sectional Sections : H = 1/200, V=1/100

(2) Topographic Survey for the proposed Thanh Liet Floodgate

Quantity : 3,000 m²

Scale : 1/500

(3) Topographic Survey for the proposed Yen So Pumping Station

Quantity : 6,000 m²

Scale : 1/500

(4) Topographic Survey for the proposed Yen So Regulating Reservoir

Quantity : 600 ha

Scale : 1/500

(5) A dimensions survey, including spot elevation of the bridges/pipe culverts over the drainage channels, and a cross sectional survey upstream, for each bridge/pipe culvert (open channel portion)

Quantity : 160 bridges and 160 cross sections

Scale of Cross Sections : H = 1/200, V=1/100

(6) Topographic survey for the estimation of sludge volume of seven (7) lakes : Thien Quang, Giang Vo, Nam Dong, Van Chuong, Hoang Kiem, Bay Mau, Truc Bach Lakes

Quantity : Spot sounding at 750 points

Scale : 1/2,000

(7) Installation of datum points for the execution of above said works by leveling

Quantity : 23 km

Scale : N/A

(8) Counting of the number of houses along the drainage channels

Quantity : 50 km on both sides of channels

- (9) Three (3) cross sectional surveys crossing the Linh Dam Lake

Quantity : 4 km

Scale of Cross Sectional Sections : H = 1/2,000, V=1/100

3.2 Survey Results

3.2.1 Rivers and Lakes

A longitudinal and cross sectional survey has been carried out for four river channels and one floodway; the To Lich, Lu, Set, Kim Nguu Rivers, a part of the Old To Lich River, and the Lu-Set Floodway. General features of said rivers and floodway are as follows;

(1) To Lich River

The To Lich River, which is the main river course of the study area, originates from West Lake and joins with the Nhue River after receiving water from the Lu and Kim Nguu Rivers. On both sides of the river, natural levees higher than EL. 6 m develop throughout the river stretch. The major stretches of the river have a double cross sectional shape with riverbed elevations of 1 to 2 m, and the levee crown elevations of 6 to 8 m above the mean sea level. At present, twenty (20) major bridges span this river channel.

(2) Lu River

The Lu River, which is one of the tributaries of the To Lich River, originates from Nam Dong lake and joins the To Lich River 2.8 km upstream from its confluence with the Nhue River. The riverbed elevation fluctuates from 1 to 3 m, and the levee crown elevation from 5 to 6 m above the mean sea level. At present, six (6) major bridges span this river channel.

(3) Kim Nguu River

The Kim Nguu River, the upper part of which is an artificial channel, joins the To Lich River 1 km upstream from its confluence with the Nhue River. The riverbed elevation varies from 2 to 3 m and the levee crown elevation stay around EL. 8 m above the mean sea level. At present, six (6) major bridges span over this river channel.

(4) Set River

The Set River, which is a tributary of the Kim Nguu River, originates from Bay Mau lake and joins the Kim Nguu River 6.2 km upstream from its confluence with the To Lich River. The riverbed elevation varies from 2 to 3 m, and the levee crown elevation from 5 to 6 m above the mean sea level. At present, eight (8) major bridges span this river channel.

(5) Lu – Set Floodway

The Lu – Set Floodway, which is an artificial channel, connects the Lu River 3.4 km upstream from the confluence of the Lu and To Lich Rivers, and the Set River 3.4 km upstream from the confluence of the Set and Kim Nguu Rivers. This is to divert flood water from the Lu River to the Set River, and vice versa. The riverbed elevation varies from 2 to 3 m, and the levee crown elevation from 5 to 6 m above the mean sea level. At present, six (6) major bridges span this river channel.

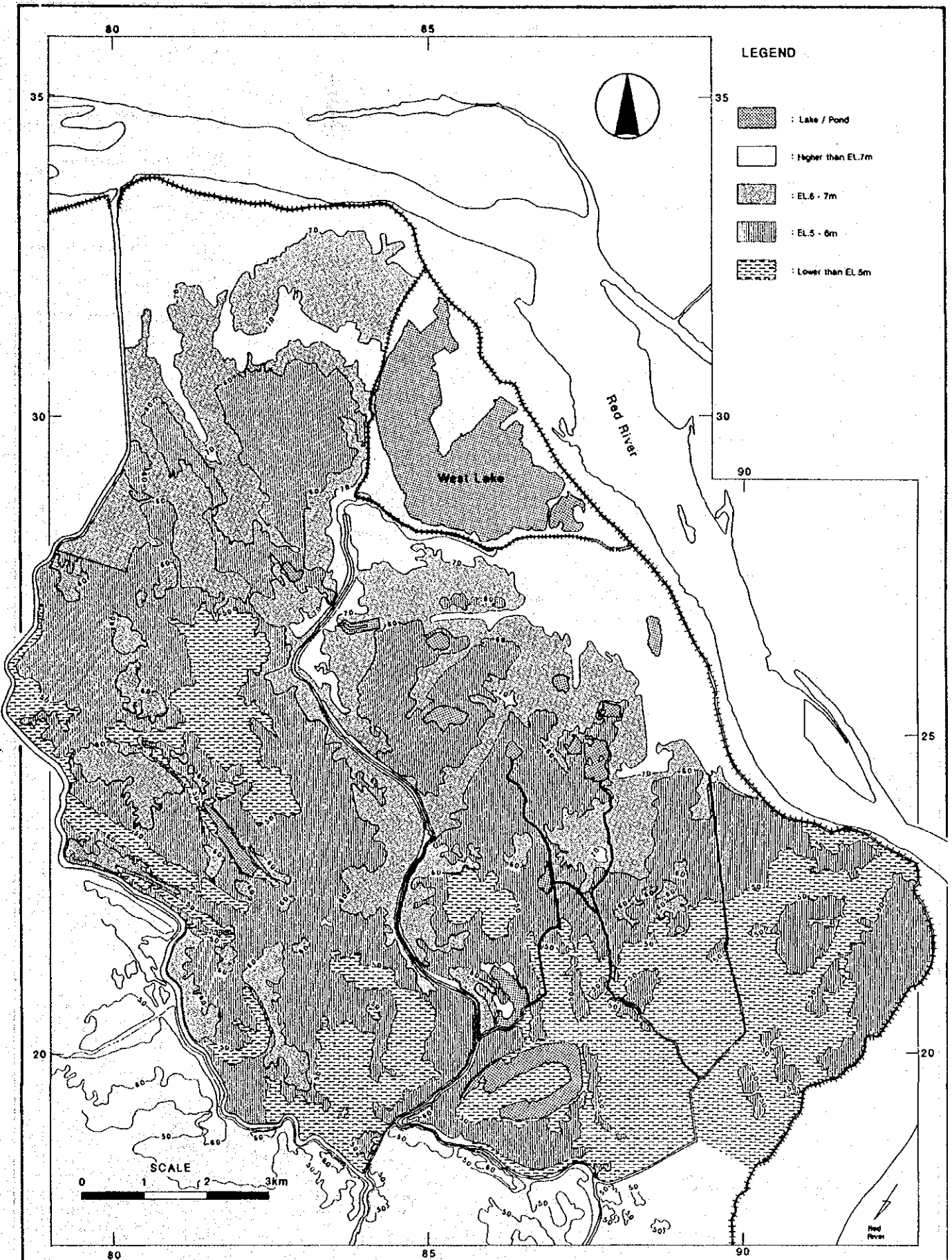
(6) Sludge Volume of 7 Lakes

Sludge volume has been estimated after delineation of the contour lines, based on the field survey data on each lake. The following table shows the estimated sludge volume.

| Name of Lake | Area (m ²) | Average Sediment Thickness (cm) | Sediment Volume (m ³) |
|--------------|------------------------|---------------------------------|-----------------------------------|
| Thien Quang | 53,800 | 18 | 8,600 |
| Giang Vo | 81,200 | 31 | 25,200 |
| Nam Dong | 52,700 | 126 | 66,400 |
| Van Chuong | 44,300 | 143 | 63,300 |
| Hoang Kiem | 117,400 | 16 | 18,800 |
| Bay Mau | 227,100 | 15 | 34,100 |
| Truc Bach | 207,000 | 28 | 47,600 |
| Total | 783,500 | - | 264,000 |

3.2.2 Drainage Channels

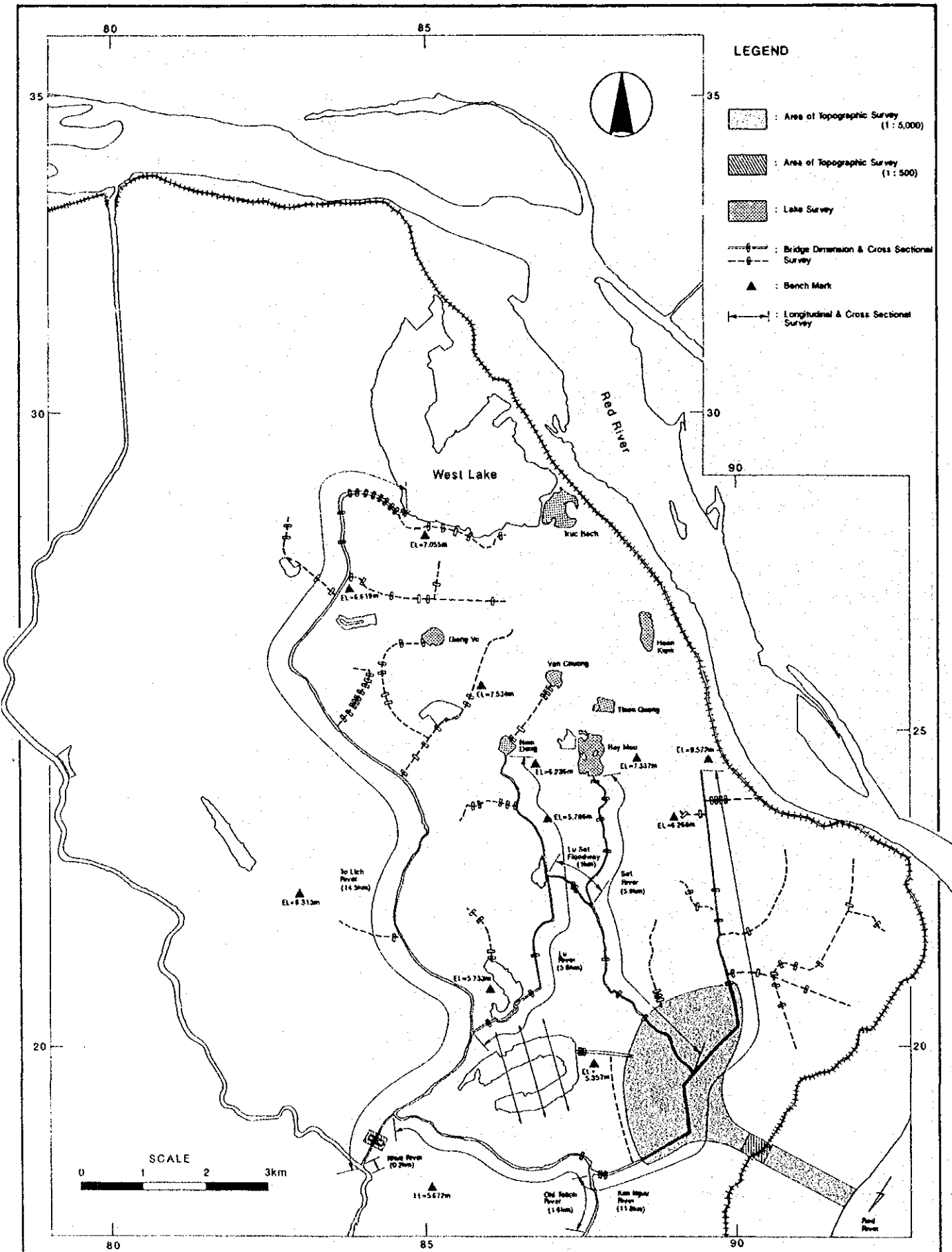
All main drainage channels flow down to the four (4) rivers, and the other drainage channels flow to the main drainage channels. The number of outlet points of drainage channels to the To Lich River are six (6), the Lu River, three (3), the Set River, one (1), and the Kim Nguu River, six(6). Some of the channels flow through densely populated areas, namely, T1, T2, T4, T5 and T6 in the To Lich River basin, L1 and L2 in the Lu River basin, and K2, K3, K4 and K5 in the Kim Nguu River basin. Concrete bridges spanning the drainage channels and pipe culverts crossing the channels number, fifty two (52) in the To Lich, seventeen (17) in the Lu River basin, three (3) in the Set River basin, and twenty seven (27) in the Kim Nguu River basin.



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Fig. K 2 . 1
TOPOGRAPHY OF THE
STUDY AREA



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Fig. K 3 . 1
 LOCATION OF THE EXECUTED
 SURVEY WORK