

FIGURES

| WORK ITEM | 1988/89 | | | | 1989/90 | | | | | | | | | | | | 1990/91 | | | | | | | | | | | | | | | | | | | |
|---|-------------|---|---|---|---------------|---|---|---|---|---|----|----|---------------|---|---|---|---------|---|---|---|---|---|----|----|--|--|--|--|--|--|--|--|--|--|--|--|
| | 12 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | | | | | | | | | | | | |
| (Study Stage) | 1st Stage → | | | | ← 2nd Stage → | | | | | | | | ← 3rd Stage → | | | | | | | | | | | | | | | | | | | | | | | |
| 1. Preparatory Work | □ | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2. Field Investigation | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| (1) Data Collection and Review | ██████████ | | | | ██████████ | | | | | | | | ██ | | | | | | | | | | | | | | | | | | | | | | | |
| (2) Hydrogeological Investigation | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ① Geomorphological/Geological Reconnaissance | ██████████ | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ② Electrical Prospecting | ██████████ | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ③ Well Drilling Survey | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ④ Water Quality Test | ██████████ | | | | ██████████ | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| (3) Hydrological Investigation | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ① Inventory of Existing Wells | ██████████ | | | | ██████████ | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ② Groundwater Level Observation | ██████████ | | | | ██████████ | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ③ Surface Water and Rainfall Observation | ██████████ | | | | ██████████ | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| (4) Water Source Investigation | ██████████ | | | | ██████████ | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| (5) Water Treatment System Investigation | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ① Existing Facility Survey | ██████████ | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ② Water Treatment and Supply System | ██████████ | | | | ██████████ | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ③ Supply Water Quality | ██████████ | | | | ██████████ | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| (6) Socioeconomic Investigation | ██████████ | | | | ██████████ | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| (7) Topographic Survey | ██████████ | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| (8) Tender Call/Contract for Field Investigation Work | ██████████ | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

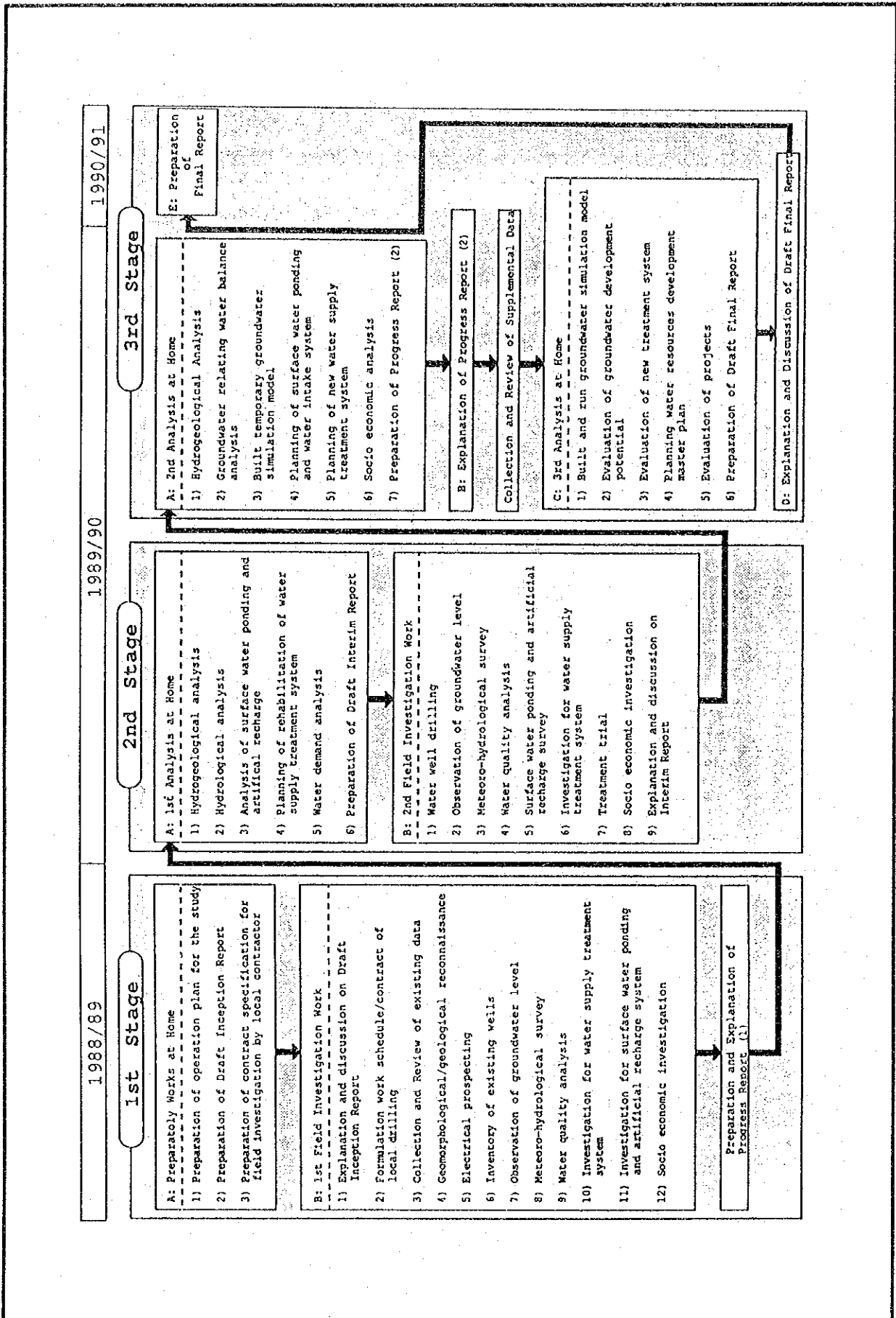
| WORK ITEM | 1988/89 | | | | 1989/90 | | | | | | | | | | | | 1990/91 | | | | | | | | | | | | | |
|--|------------|---|---|---|---------|---|---|---|---|---|----|----|----|---|---|---|---------|---|---|---|---|---|----|----|--|--|--|--|--|--|
| | 12 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | | | | | | |
| 3. Home Work | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| (1) Review of Field Investigation Findings | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| (2) Hydrogeological Analysis | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| (3) Hydrological Analysis | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| (4) Groundwater Simulation | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| (5) Water Quality Analysis | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| (6) Water Source Study | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| (7) Water Treatment and Supply Plan | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| (8) Socioeconomic Analysis | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| (9) Formulation of Water Resources Development Master Plan | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ① Evaluation of Exploitable Water Potential | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ② Groundwater Supply Plan | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ③ Surface Water Supply Plan | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ④ Water Treatment System | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ⑤ Water Management Plan | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| (10) Project Evaluation | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 4. Report | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| (1) Inception Report | □ | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| (2) Progress Report (1) | ██████████ | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| (3) Progress Report (2) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| (4) Interim Report | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| (5) Draft Final Report | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| (6) Final Report | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

Note : ██████████ Field Work □ Home Work ██████████ Field Work by MWSC △ — △ Report

HIS MAJESTY'S GOVERNMENT OF NEPAL
GROUND WATER MANAGEMENT PROJECT
IN THE KATHMANDU VALLEY
JAPAN INTERNATIONAL COOPERATION AGENCY

Fig.
1.3.1

WORK SCHEDULE

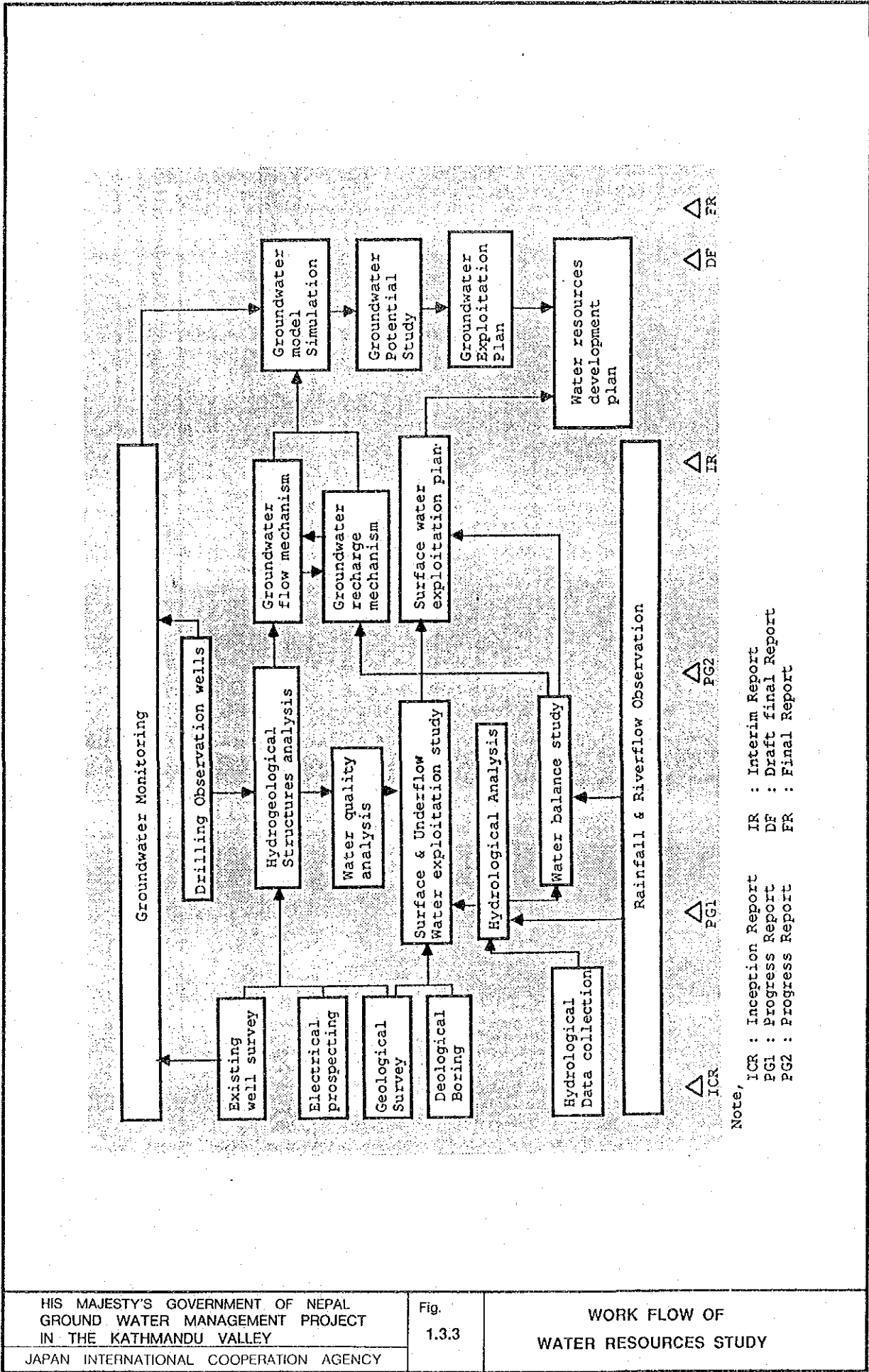


HIS MAJESTY'S GOVERNMENT OF NEPAL
GROUND WATER MANAGEMENT PROJECT
IN THE KATHMANDU VALLEY

JAPAN INTERNATIONAL COOPERATION AGENCY

Fig.
1.3.2

GENERAL WORK FLOW

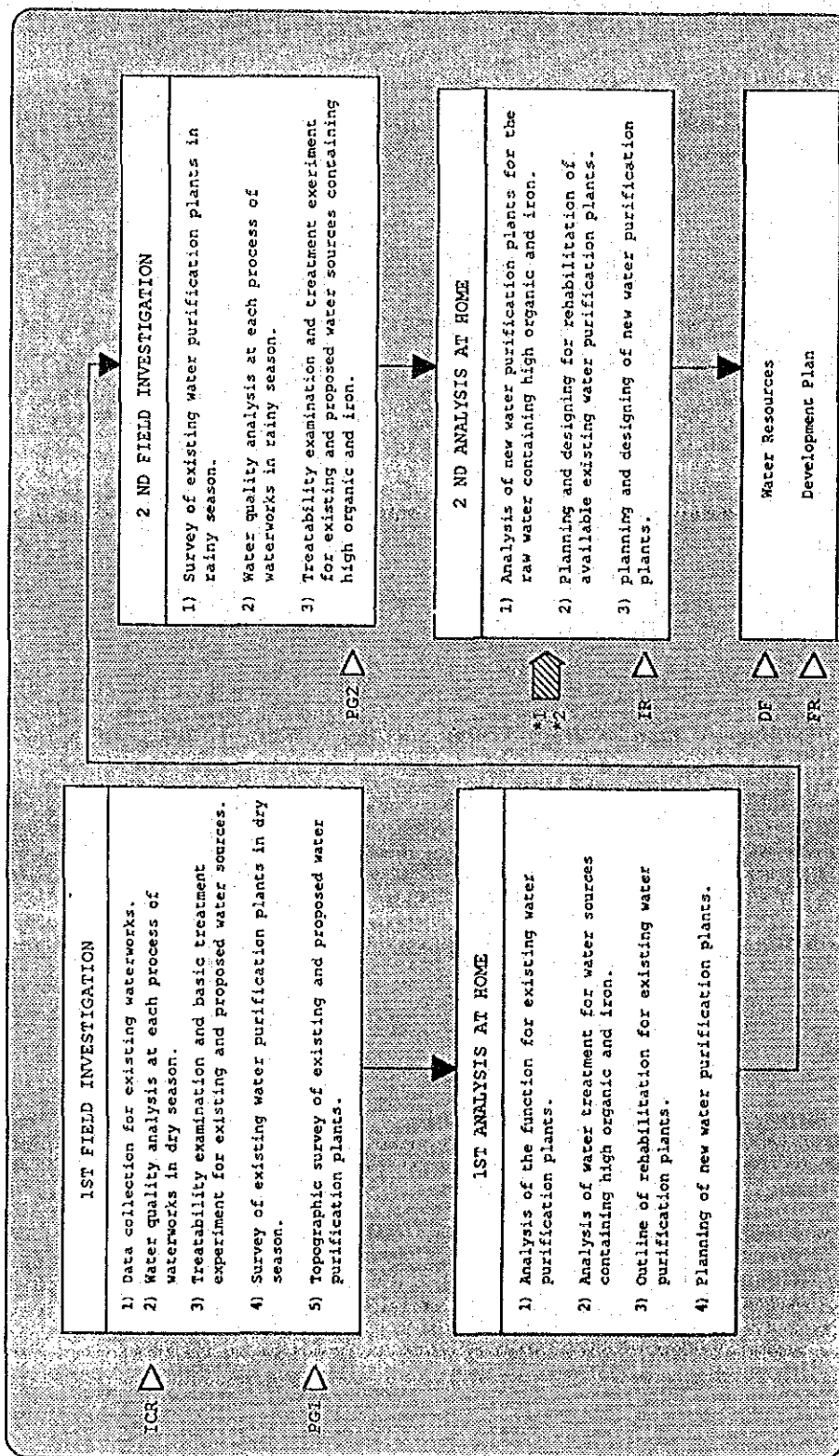


HIS MAJESTY'S GOVERNMENT OF NEPAL
 GROUND WATER MANAGEMENT PROJECT
 IN THE KATHMANDU VALLEY

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Fig.
1.3.3

WORK FLOW OF
WATER RESOURCES STUDY



Notes :

- ICR : Inception Report
- PG1 : Progress Report 1
- PG2 : Progress Report 2
- IR : Interim Report
- DF : Draft Final Report
- FR : Final Report
- *1 : Surface Water Exploitation plan
- *2 : Groundwater Potential

| Experts | Name | 1988/89 | | | | | | | | | | | | 1989/90 | | | | | | | | | | | | 1990/91 | | | | | | | | | | | | | | | | | | | | | | | | | | |
|-----------------------|----------------------|---------|---|---|---|---|---|---|---|---|---|----|----|---------|---|---|---|---|---|---|---|---|---|----|----|---------|---|---|---|---|---|---|---|---|----|----|--|--|--|---|---|---|--|--|--|--|--|--|--|--|--|--|
| | | 12 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | | | | | | | | | | | | | | | | |
| Team Leader | Takao Ichimiya | █ | | | | | | | | | | █ | | | | | | | | | | | | █ | | | | | | | | | | | | | | | | █ | | | | | | | | | | | | |
| Hydrogeologist | Masato Fujinami | █ | | | | █ | | | | | | | | | | | | | | | | | | █ | █ | | | | | | | | | | | | | | | | █ | █ | | | | | | | | | | |
| Geologist | Mituharu Yako | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Geophysist | Harunobu Sumida | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Drilling Expert | Hiroyasu Nishinosono | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Hydrologist | Kunita Okuwa | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Simulation Expert | Mamoru Kuwabara | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Dam Engineer | Koji Kawamura | █ | | | | | | | | | | | | | | | | | | | | | | █ | | | | | | | | | | | | | | | | | █ | | | | | | | | | | | |
| Water Quality Expert | Osamu Sakoda | █ | | | | | | | | | | | | | | | | | | | | | | █ | | | | | | | | | | | | | | | | | █ | | | | | | | | | | | |
| Water Supply Planner | Munetaka Morio | █ | | | | | | | | | | | | | | | | | | | | | | █ | | | | | | | | | | | | | | | | | █ | | | | | | | | | | | |
| Water Supply Engineer | Kazumi Matuda | █ | | | | | | | | | | | | | | | | | | | | | | █ | | | | | | | | | | | | | | | | | █ | | | | | | | | | | | |
| Project Economist | Kinichi Ono | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Survey Expert | Masayuki Ikeda | █ | | | | | | | | | | | | | | | | | | | | | | █ | | | | | | | | | | | | | | | | | █ | | | | | | | | | | | |

Note : Field Works Home Works

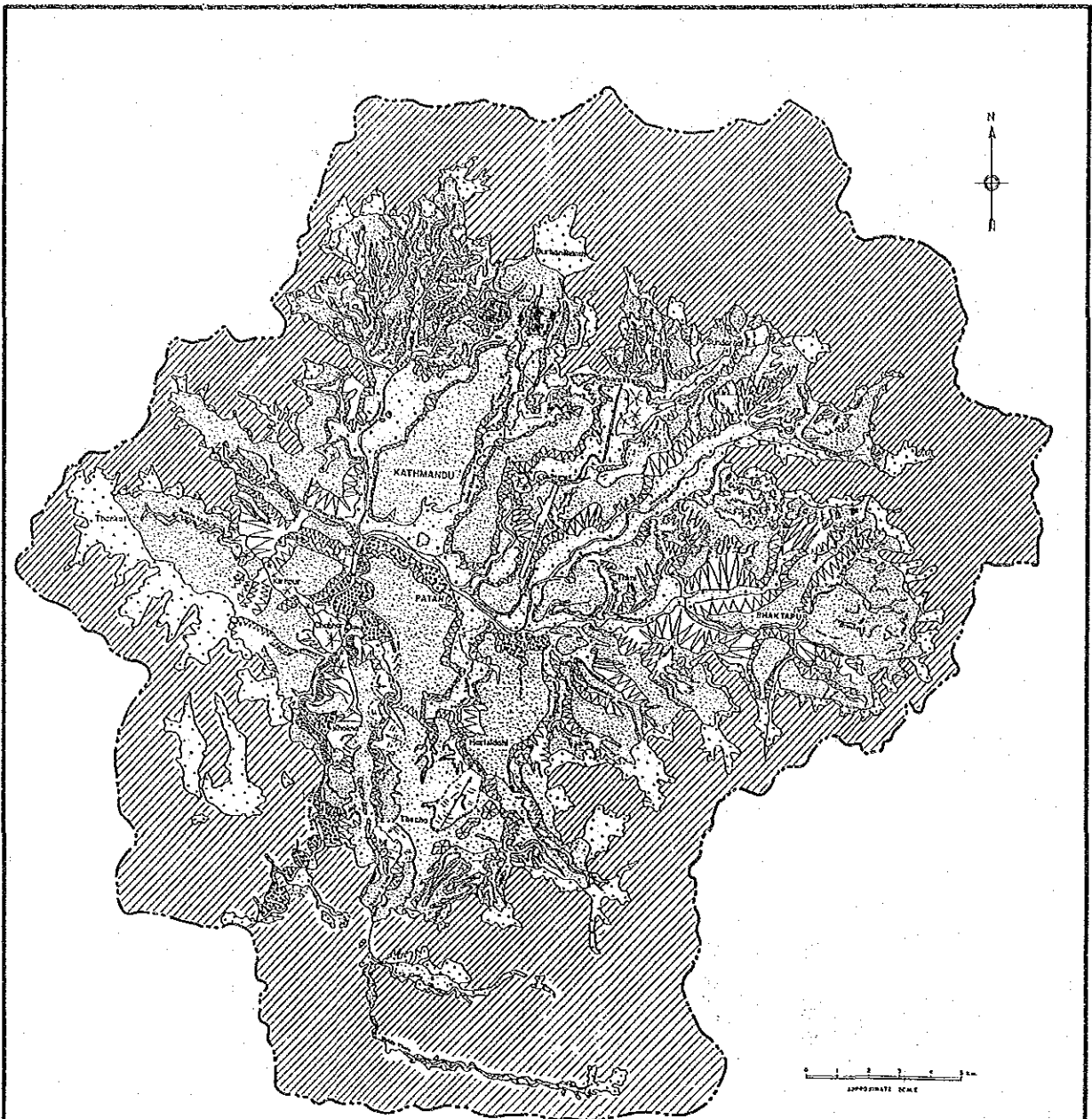
ICR: Inception Report, PR(1): Progress Report(1), PR(2): Progress Report(2)
 IR: Interim Report, DFR: Draft Final Report, FR: Final Report

HIS MAJESTY'S GOVERNMENT OF NEPAL
 GROUND WATER MANAGEMENT PROJECT
 IN THE KATHMANDU VALLEY

JAPAN INTERNATIONAL COOPERATION AGENCY

Fig.
1.4.1

ASSIGMENT SCHEDULE



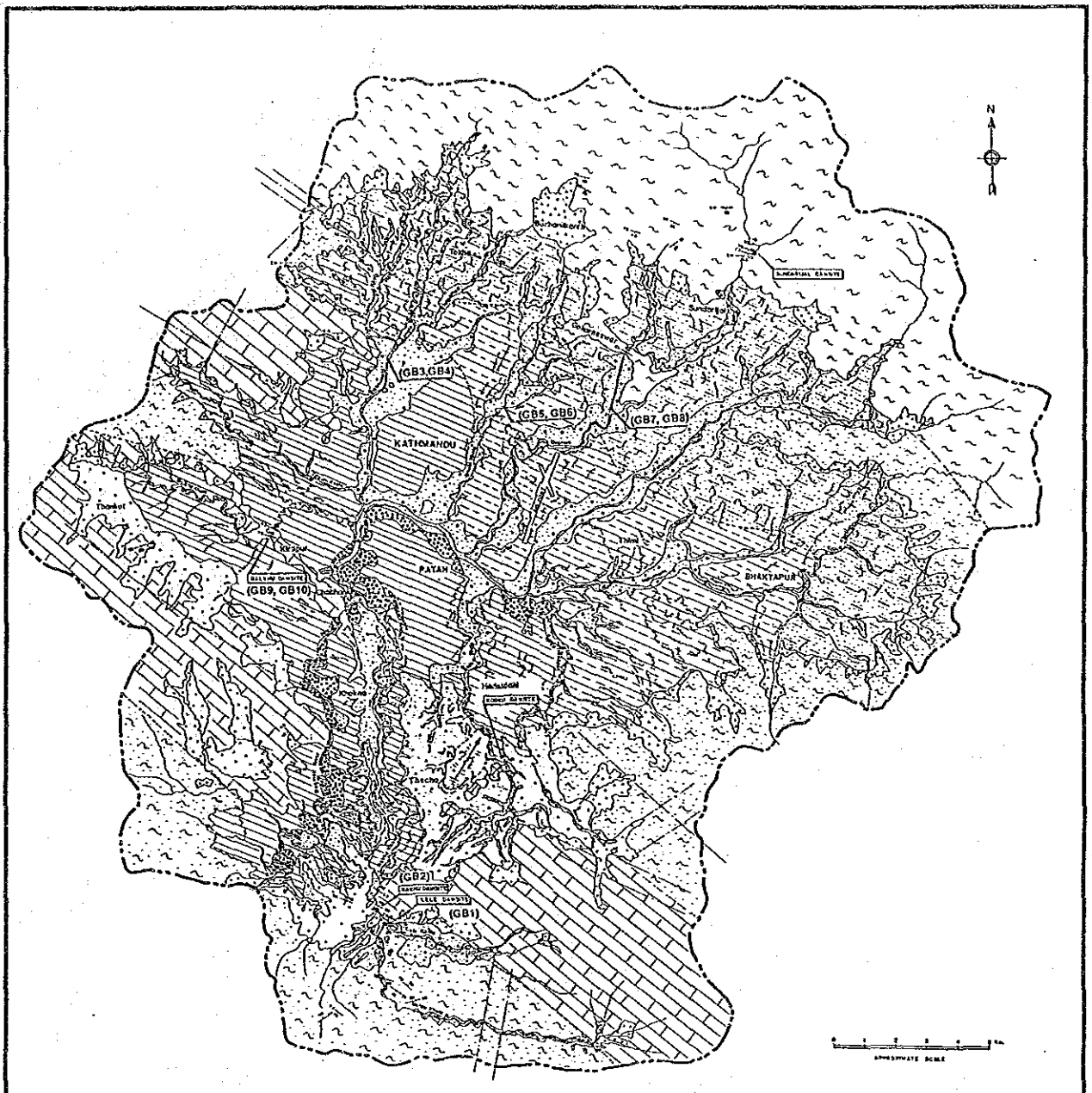
LEGEND

- | | | | |
|--|--------------------------------|--|--|
| | Alluvial Low Plains | | Landslides |
| | Terraces | | Steep Cliffs and Slopes Surrounding Flat and Gentle Plains |
| | Higher Gentle Plain I | | Gentle Slopes Below High Flat Plains |
| | Higher Gentle Plain II | | Low Hills |
| | High Flat Plains | | Watershed Line |
| | Talus and Alluvial Fan | | |
| | High Relief Area and Mountains | | |
| | Intensively Eroded Bad Lands | | |

HIS MAJESTY'S GOVERNMENT OF NEPAL
 GROUND WATER MANAGEMENT PROJECT
 IN THE KATHMANDU VALLEY
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Fig. 2.2.1

LANDFORM CLASSIFICATION MAP OF
 THE KATHMANDU VALLEY



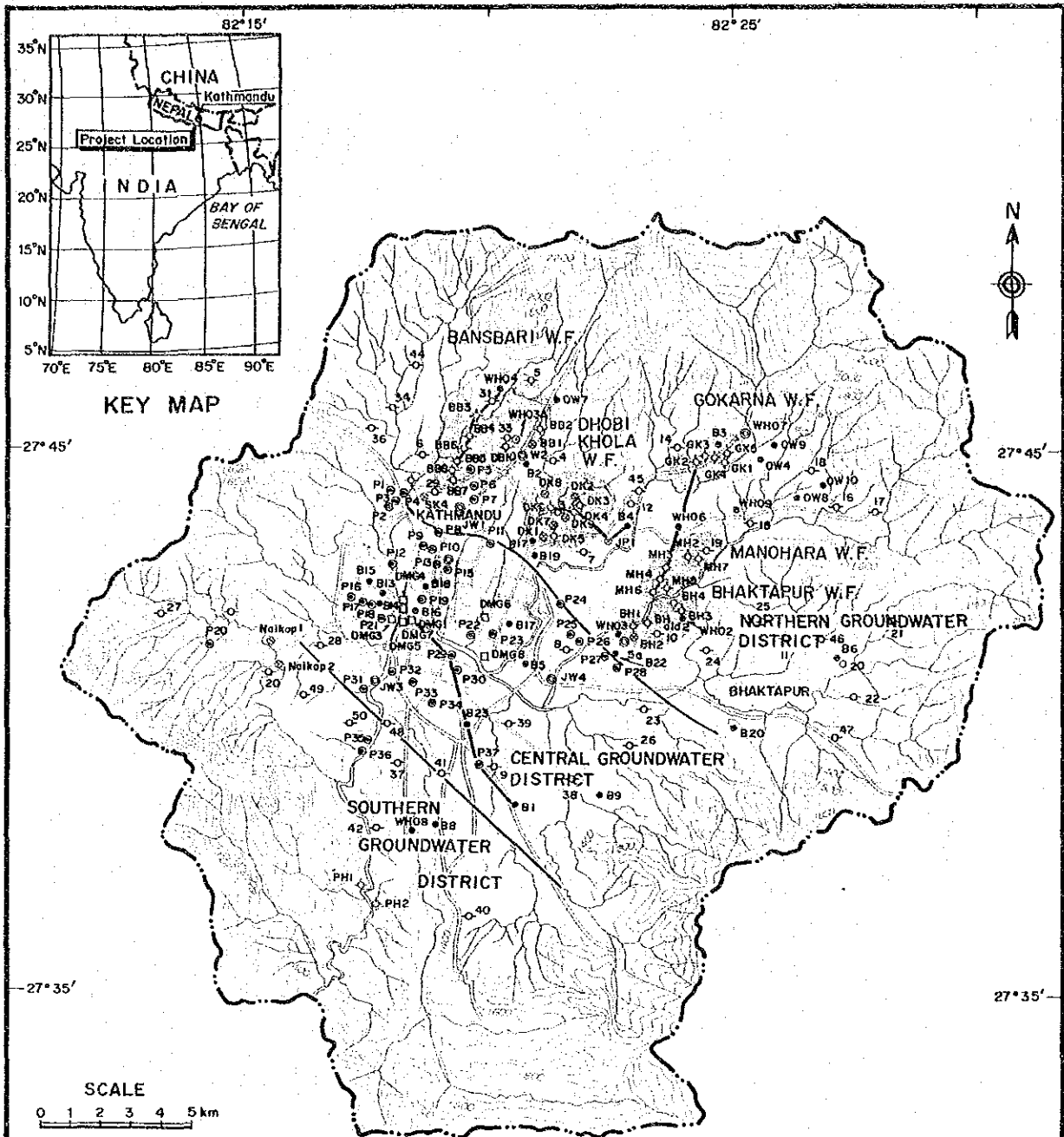
| LEGEND | |
|--------|---|
| | River Deposits |
| | Talus Deposits and Fan Deposits |
| | Terrace Deposits |
| | Predominant Gravel Deposits |
| | Gravel and Clay Deposits |
| | Arenaceous Deposits (Lacustrine Deposits) |
| | Intermediate Type of Arenaceous and Argillaceous Deposits (Lacustrine Deposits) |
| | Argillaceous Deposits (Lacustrine Deposits) |
| | Chandragiri Formation |
| | Crystalline Limestone, Quartzites |
| | Tising Formation |
| | Phyllites, Sandstone, Sandy Limestones |
| | Augen Gneisses, Banded Gneisses |
| | Landslides |
| | Steep Cliffs |
| | Gentle Cliffs |
| | Watershed Line |
| | Dip and strike of Bedding Planes and Schistosity |
| | Water Spring |
| | Lineaments |
| | Boreholes in this Study |

HIS MAJESTY'S GOVERNMENT OF NEPAL
 GROUND WATER MANAGEMENT PROJECT
 IN THE KATHMANDU VALLEY

Fig. 2.2.2

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GEOLOGICAL MAP OF
 THE KATHMANDU VALLEY



LEGEND

- BB6 Production Well of NWSC
- ⊗ DK3 Abandoned Well of NWSC
- WHO7 Observation Well of NWSC
- ⊙ P4 Private Well
- DMG1 Gas Well of DMG
- ⊙ JW1 Observation Well of JICA
- B1 Boring Data & WHO Project Observation Well
- 12 Point of Electrical Prospection
- Location of Schematic Geologic Section
- Groundwater District Boundary
- Boundary of the Kathmandu Valley Basin
- Contour Line at 100m Interval
- River
- Road

HIS MAJESTY'S GOVERNMENT OF NEPAL
GROUND WATER MANAGEMENT PROJECT
IN THE KATHMANDU VALLEY

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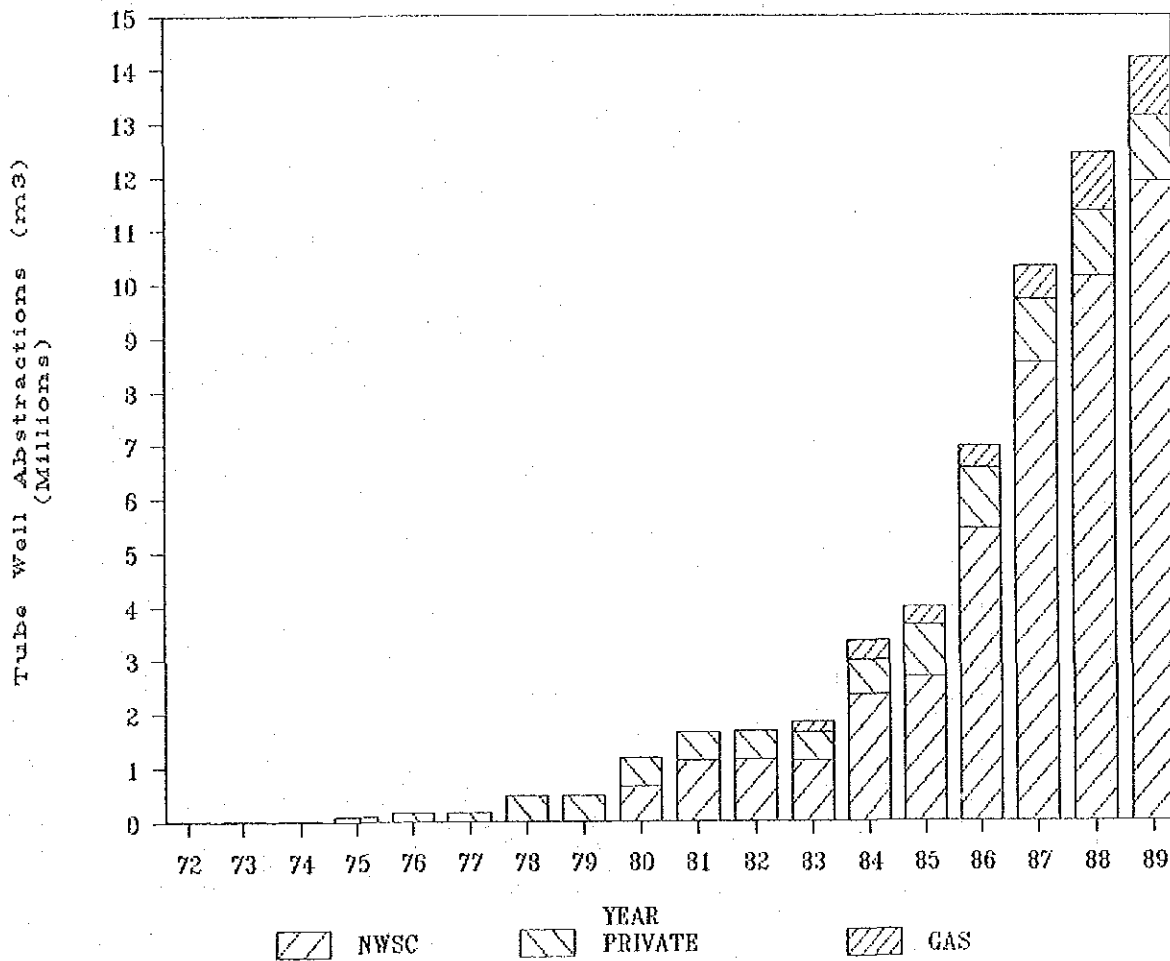
Fig.

2.4.1

GENERAL GROUNDWATER LOCATION MAP

ESTIMATED TUBEWELL ABSTRACTION

1972-1989

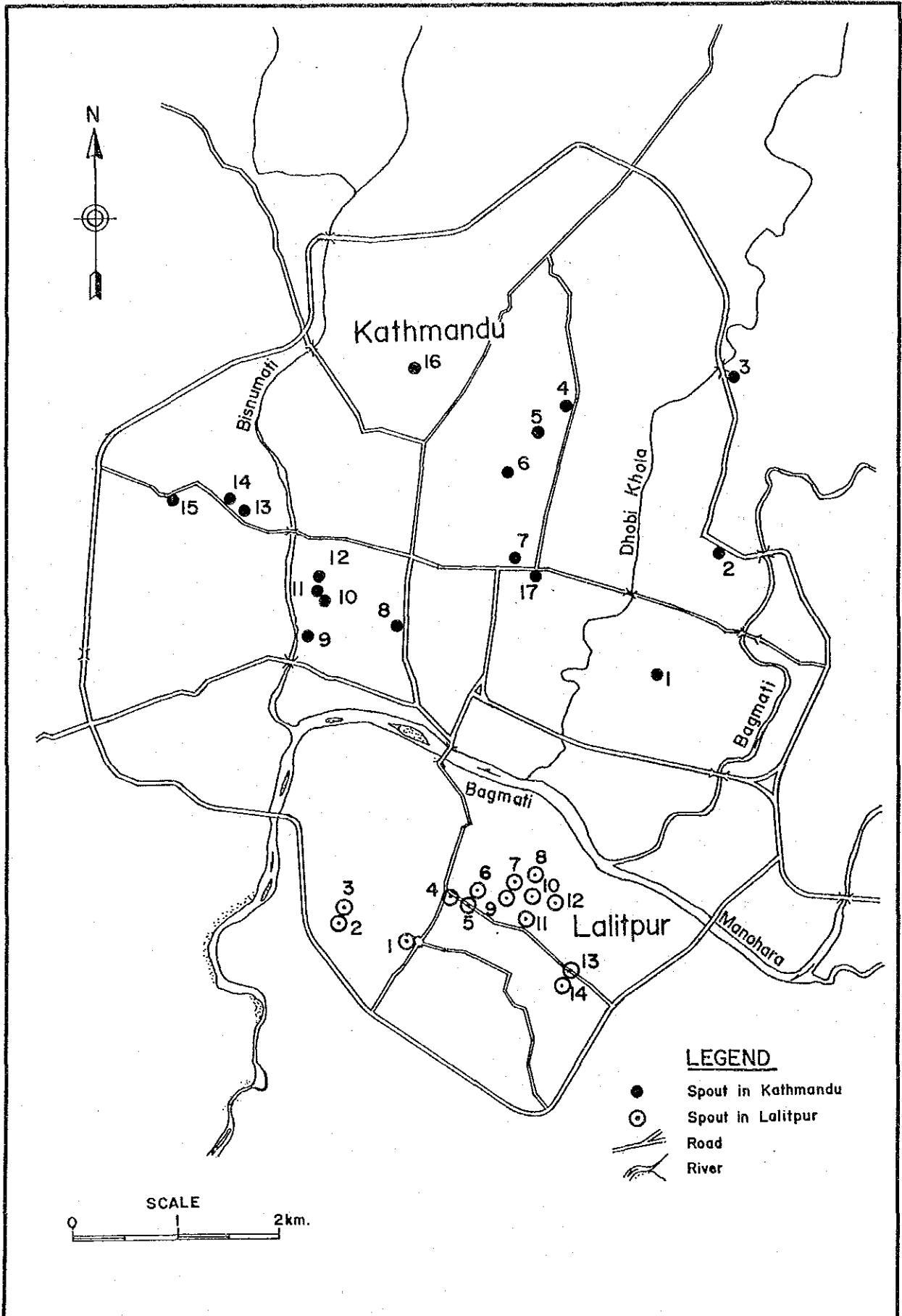


HIS MAJESTY'S GOVERNMENT OF NEPAL
GROUND WATER MANAGEMENT PROJECT
IN THE KATHMANDU VALLEY

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Fig.
2.4.2

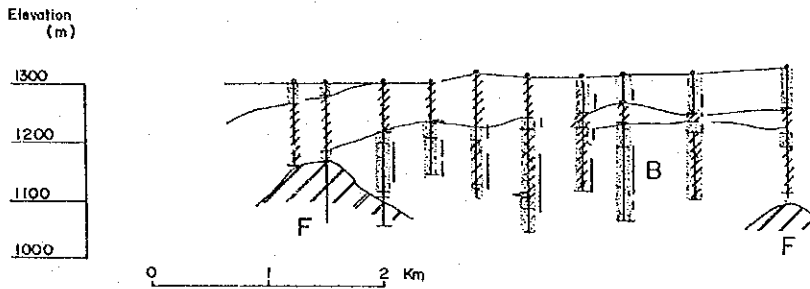
ESTIMATED GROUNDWATER ABSTRSCTION
FROM TUBE WELL IN THE KATHMANDU
VALLEY (1972 - 1989)



| | | |
|--|----------------------|-------------------------------|
| <p>HIS MAJESTY'S GOVERNMENT OF NEPAL GROUND WATER MANAGEMENT PROJECT IN THE KATHMANDU VALLEY</p> <p>JAPAN INTERNATIONAL COOPERATION AGENCY</p> | <p>Fig. 2.43</p> | <p>LOCATION MAP OF SPOUTS</p> |
|--|----------------------|-------------------------------|

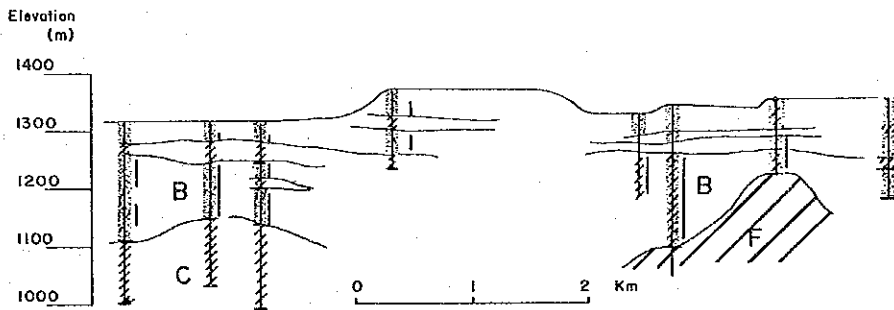
NORTHERN GROUNDWATER DISTRICT (BANSBARI)

SKI 29 BB7 P5 6B8 BB5 BB6 BB4 BB3 31



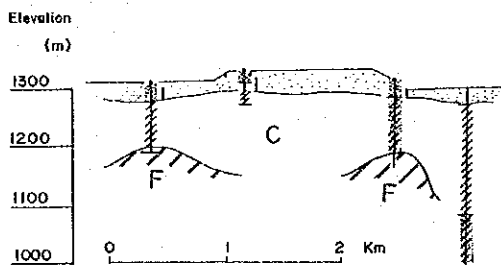
NORTHERN GROUNDWATER DISTRICT (MANOHARA)

MH 6 MH4 MH3 WHO 6 GK2 GK3 GK5 WHO 7

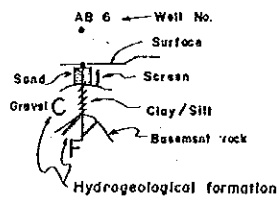


NORTHERN GROUNDWATER DISTRICT (DHOBI KHOLA)

DK 6 DK 4 JP 1 B4



LEGEND



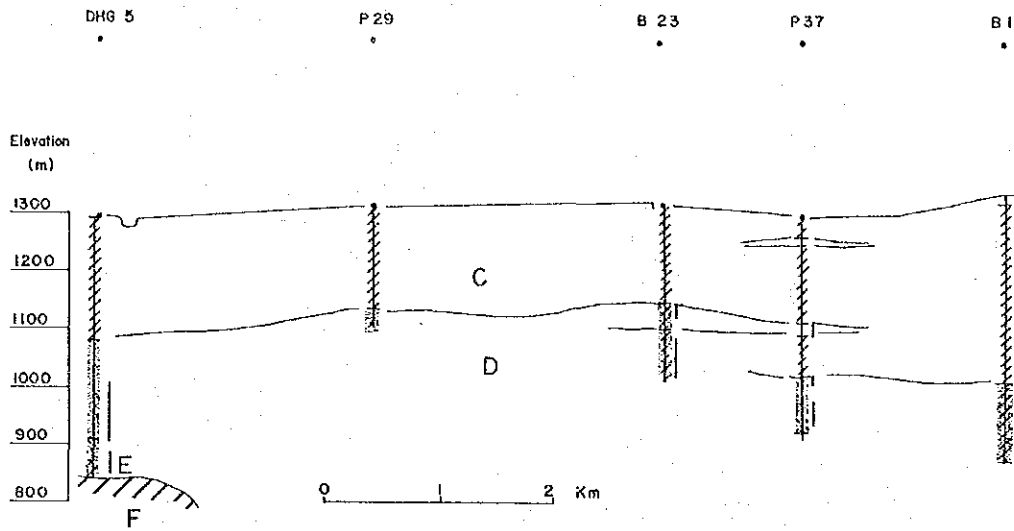
HIS MAJESTY'S GOVERNMENT OF NEPAL
GROUND WATER MANAGEMENT PROJECT
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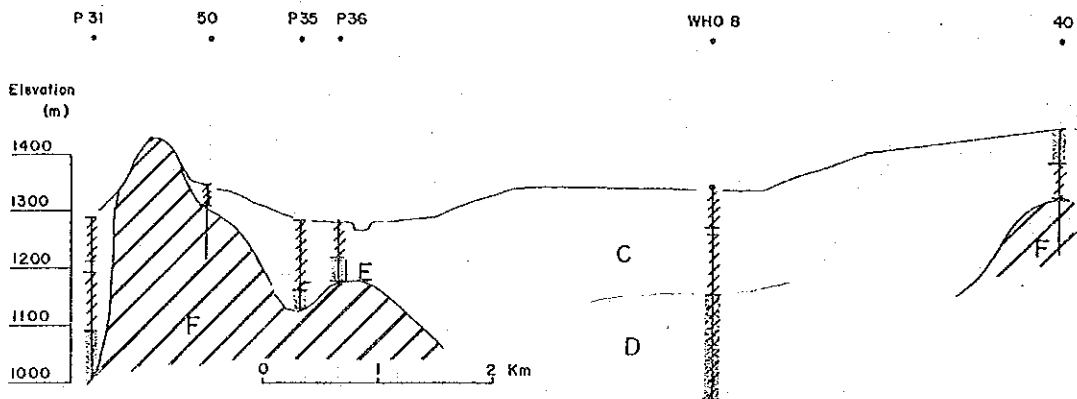
Fig.
2.4.4

SCHEMATIC GEOLOGIC CROSS SECTION (1/2)

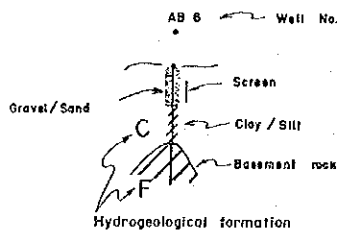
CENTRAL GROUNDWATER DISTRICT



SOUTHERN GROUNDWATER DISTRICT



LEGEND

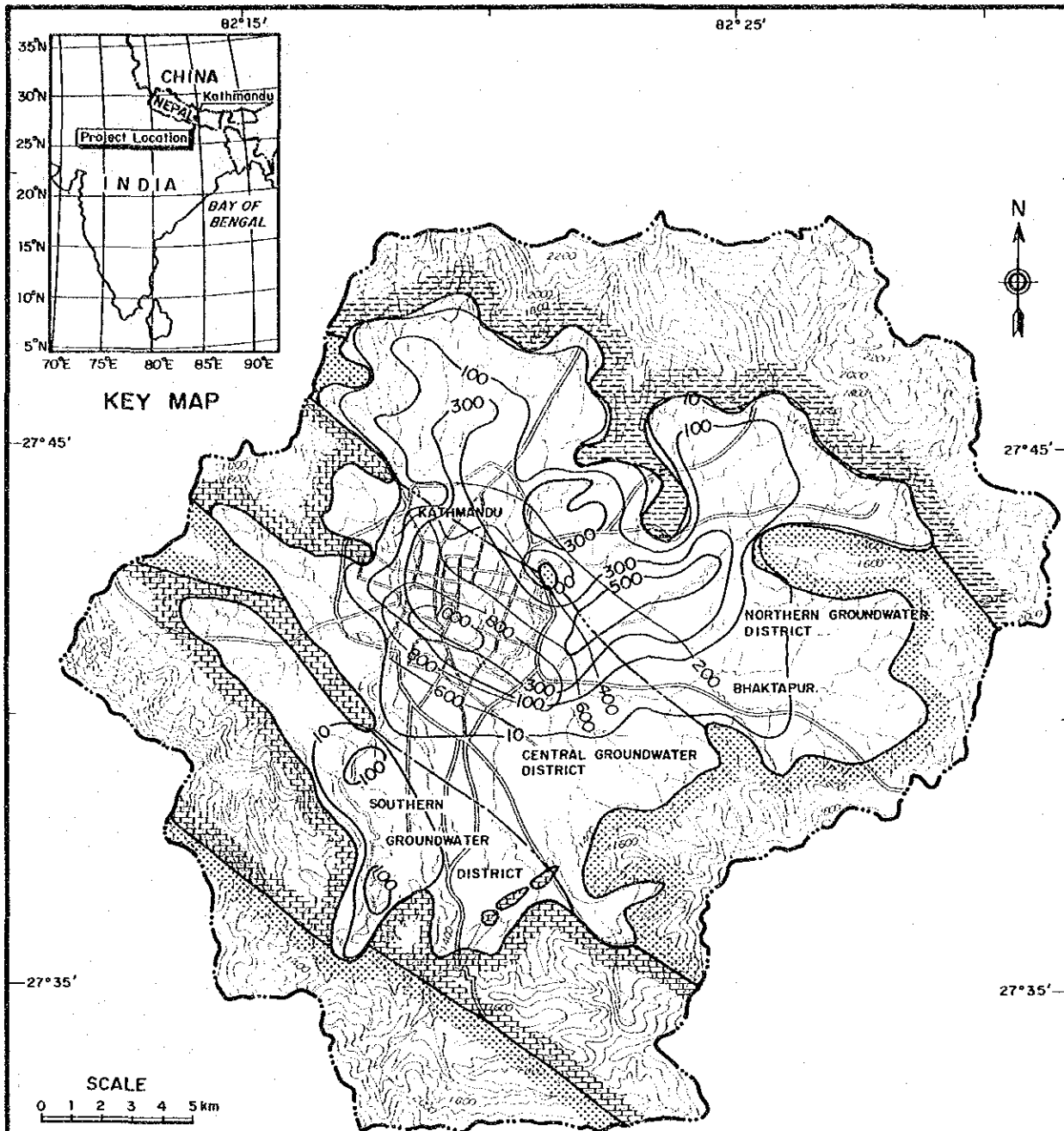


HIS MAJESTY'S GOVERNMENT OF NEPAL
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Fig. 2.4.4

SCHEMATIC GEOLOGIC CROSS SECTION (2/2)

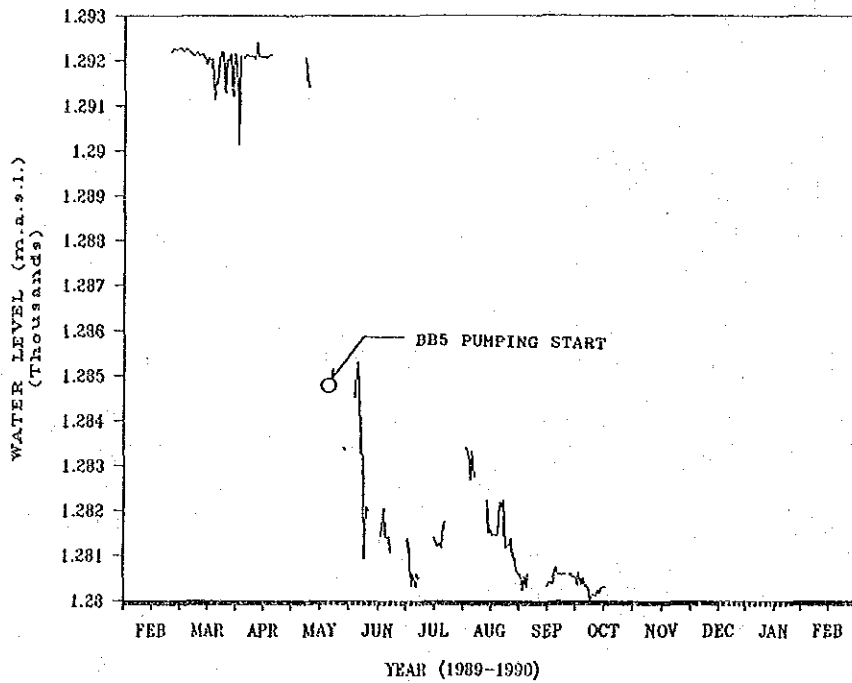


LEGEND

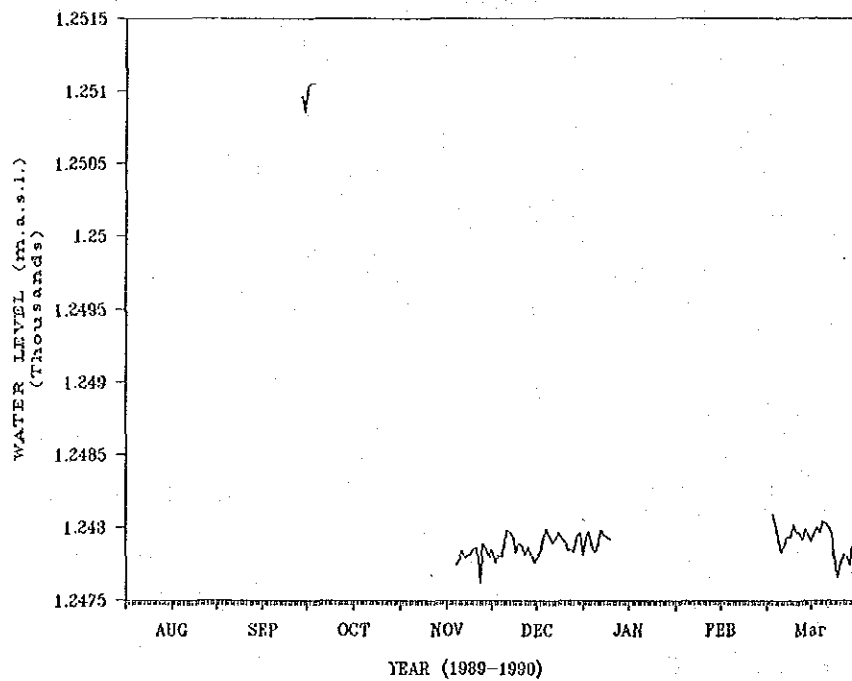
| | | | |
|---|--|--------------|---|
| Hydrogeological Basement Rock (Devonian - Precambrian) | | River | |
| | Chandrarai Formation Crystalline Limestone, Quartzites | | Contour Line at 100m Interval |
| | Tistung Formation Phyllites, Sandstone, Sandy Limestones | | Boundary of the Kathmandu Valley Basin |
| | Augen Gneisses, Banded Gneisses | | Groundwater District Boundary |
| | 200 EC Contur (MS/cm) | | Road |
| | 500 Iso Transmissivity Contour (m²/day) | | |

| | | |
|---|----------------------|----------------------------|
| HIS MAJESTY'S GOVERNMENT OF NEPAL GROUND WATER MANAGEMENT PROJECT IN THE KATHMANDU VALLEY | Fig. 2.4.5 | HYDROGEOLOGICAL MAP |
| JAPAN INTERNATIONAL COOPERATION AGENCY | | |

WELL HYDROGRAPH OF BB5



WELL HYDROGRAPH OF DK1

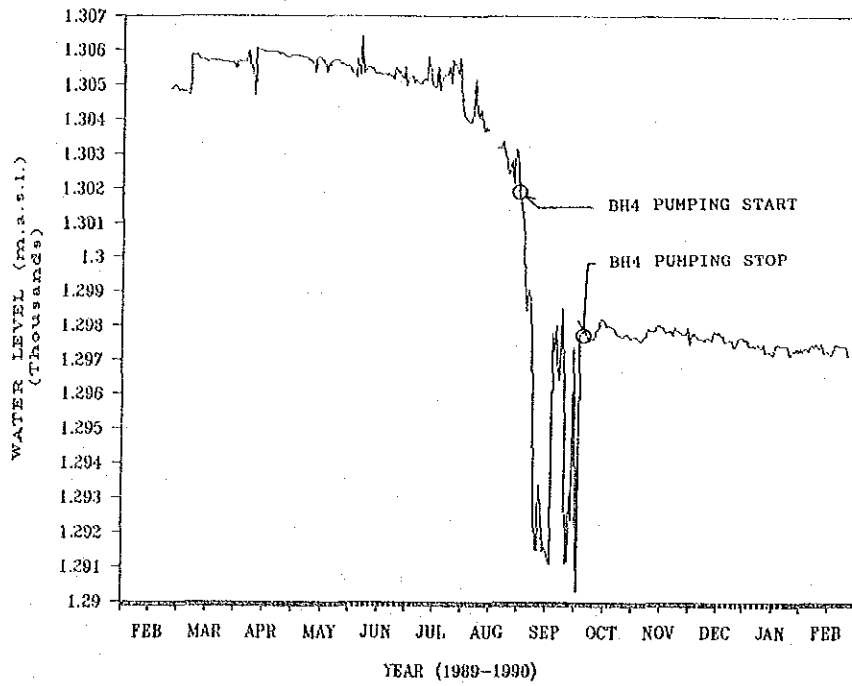


HIS MAJESTY'S GOVERNMENT OF NEPAL
GROUND WATER MANAGEMENT PROJECT
IN THE KATHMANDU VALLEY
JAPAN INTERNATIONAL COOPERATION AGENCY

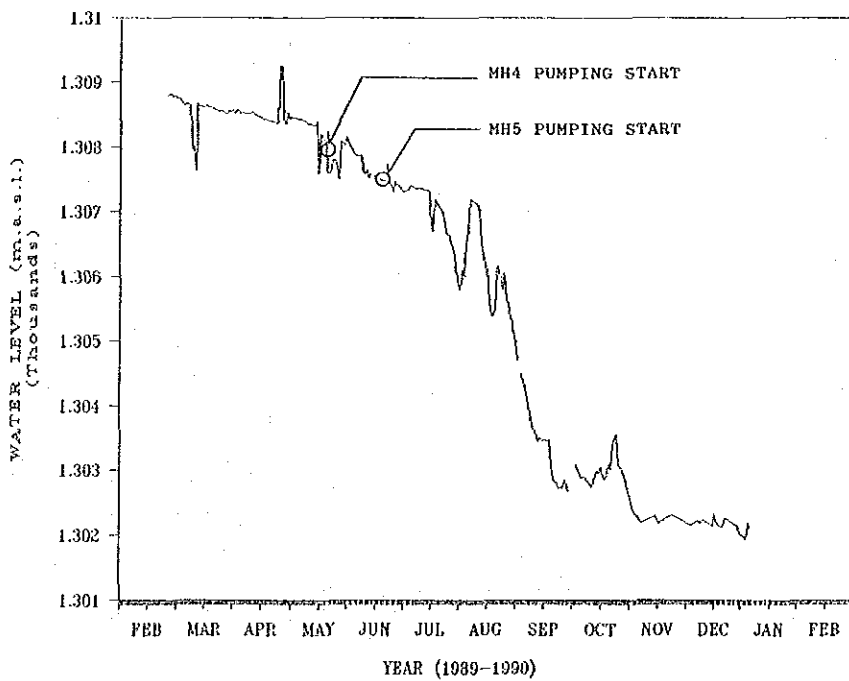
Fig.
2.4.6

WELL HYDROGRAPH (1/4)

WELL HYDROGRAPH OF BH4



WELL HYDROGRAPH OF MH6



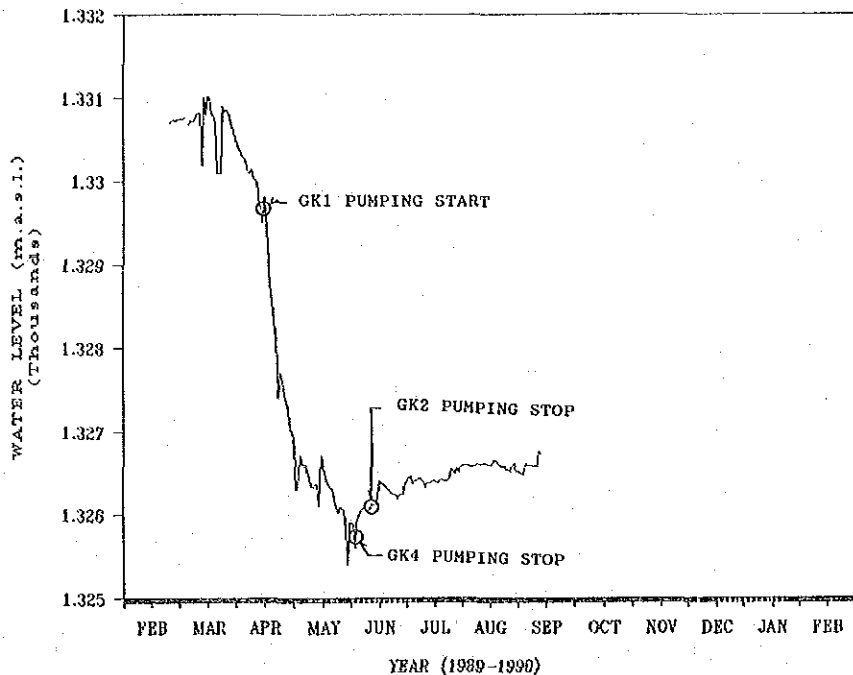
HIS MAJESTY'S GOVERNMENT OF NEPAL
GROUND WATER MANAGEMENT PROJECT
IN THE KATHMANDU VALLEY

JAPAN INTERNATIONAL COOPERATION AGENCY

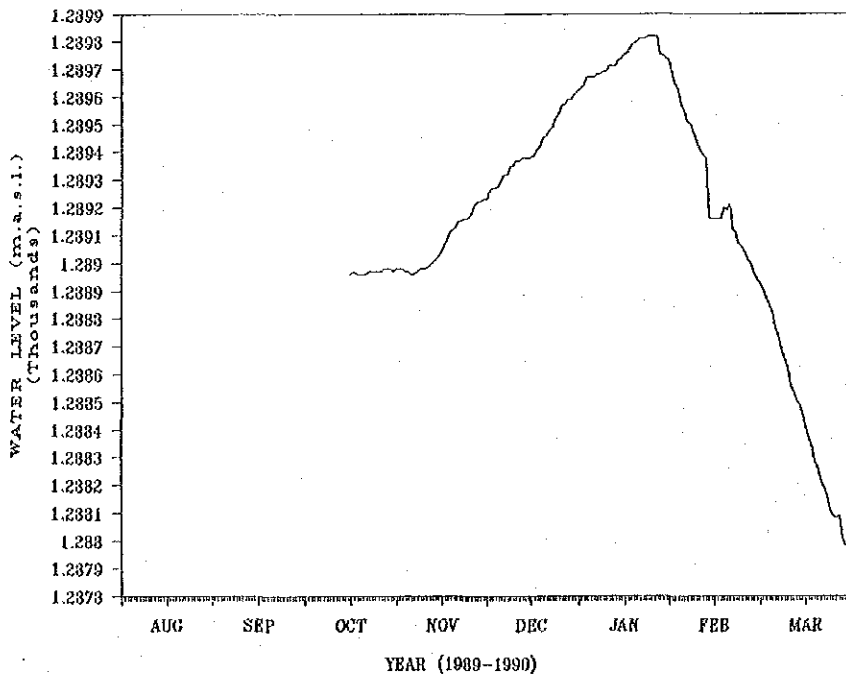
Fig.
2.4.6

WELL HYDROGRAPH (2/4)

WELL HYDROGRAPH OF GK5



WELL HYDROGRAPH OF JW1



HIS MAJESTY'S GOVERNMENT OF NEPAL
GROUND WATER MANAGEMENT PROJECT
IN THE KATHMANDU VALLEY

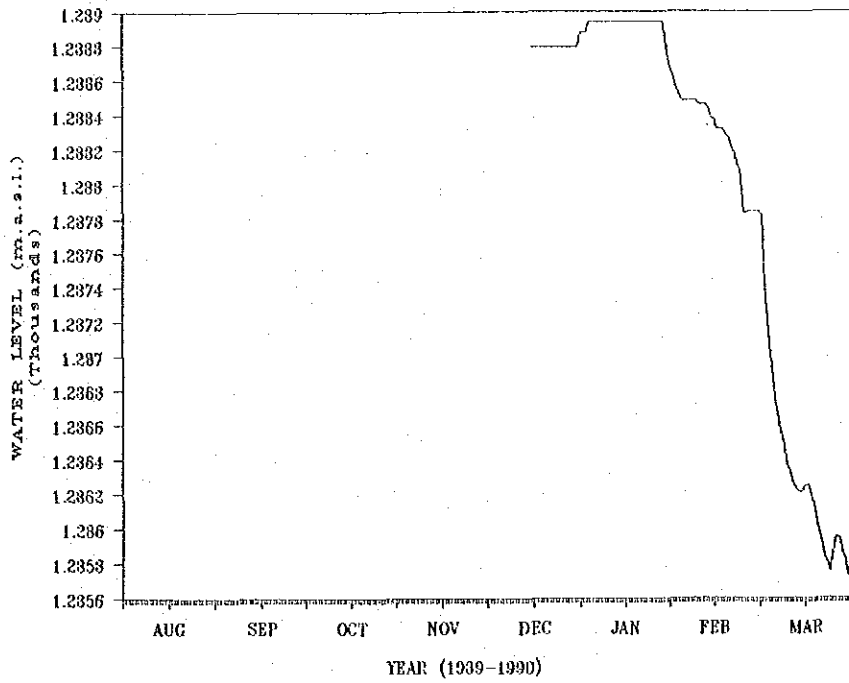
JAPAN INTERNATIONAL COOPERATION AGENCY

Fig.

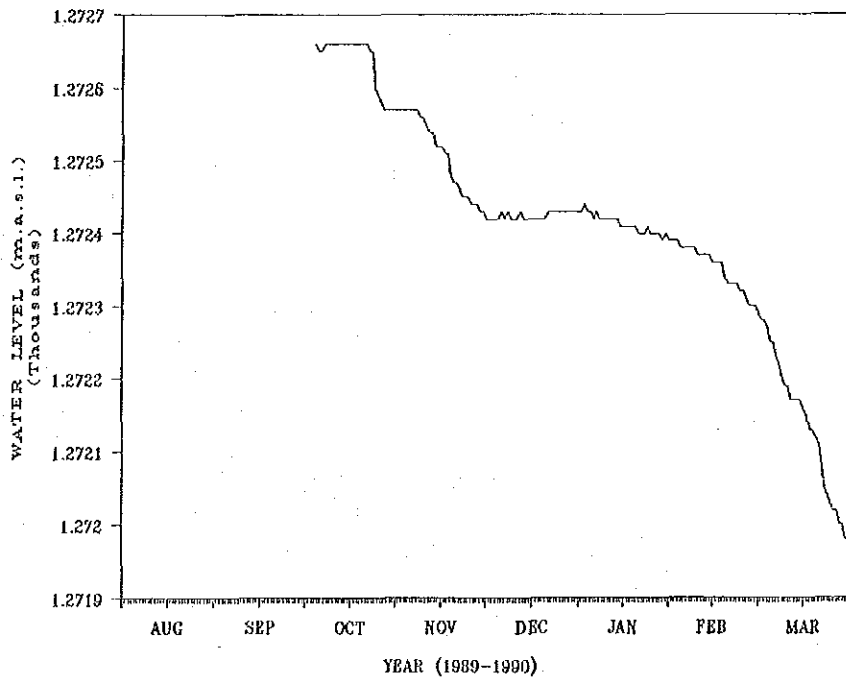
2.4.6

WELL HYDROGRAPH (3/4)

WELL HYDROGRAPH OF JW2



WELL HYDROGRAPH OF JW4



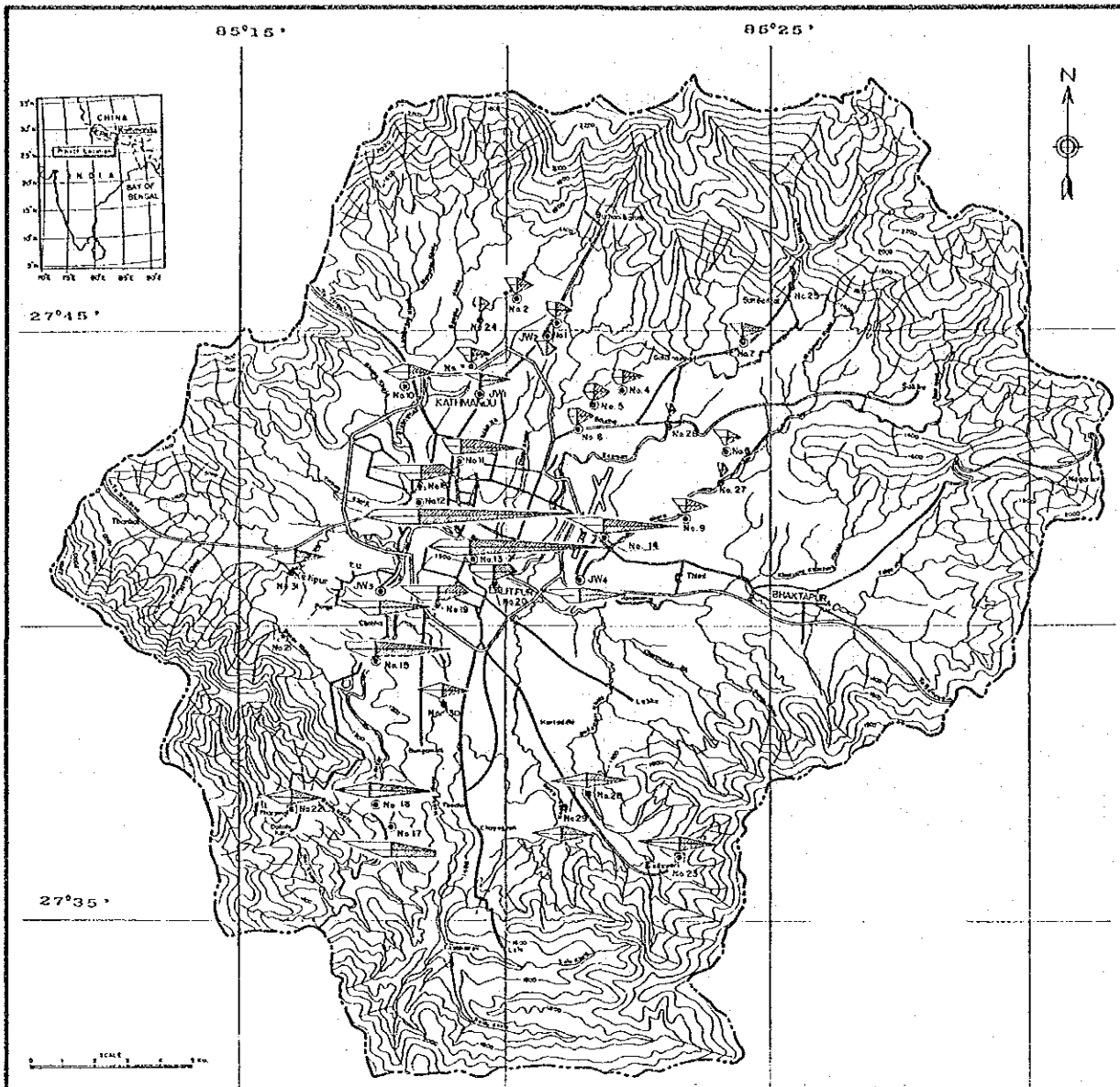
HIS MAJESTY'S GOVERNMENT OF NEPAL
GROUND WATER MANAGEMENT PROJECT
IN THE KATHMANDU VALLEY

JAPAN INTERNATIONAL COOPERATION AGENCY

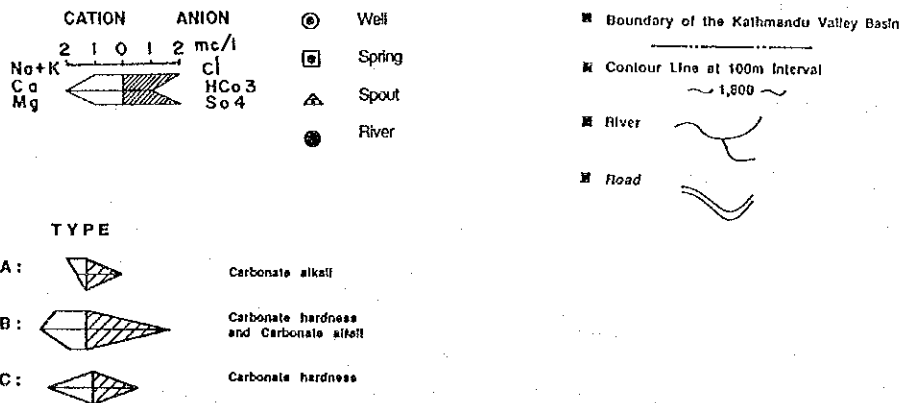
Fig.

2.4.6

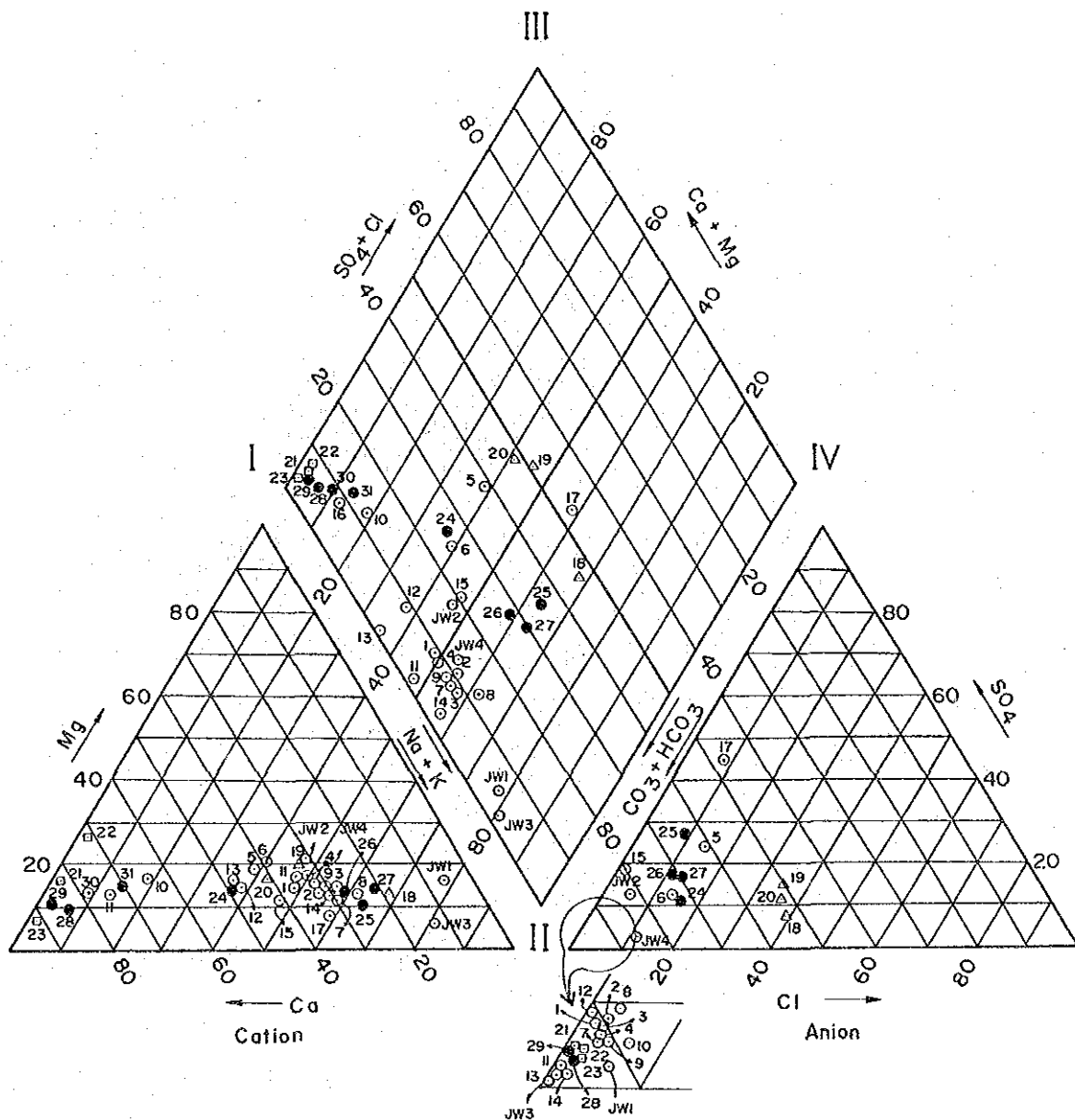
WELL HYDROGRAPH (4/4)



LEGEND



| | | |
|---|---------------|----------------------|
| HIS MAJESTY'S GOVERNMENT OF NEPAL GROUND WATER MANAGEMENT PROJECT IN THE KATHMANDU VALLEY JAPAN INTERNATIONAL COOPERATION AGENCY | Fig. 2.4.7 | STIFF'S HEXA-DIAGRAM |
|---|---------------|----------------------|



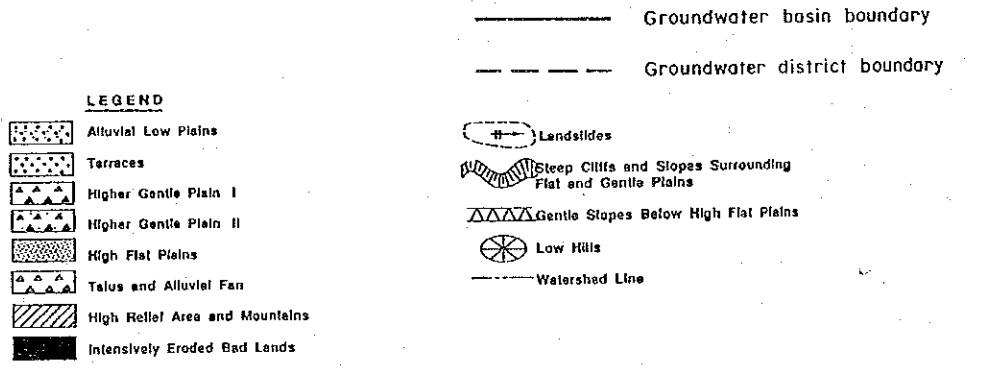
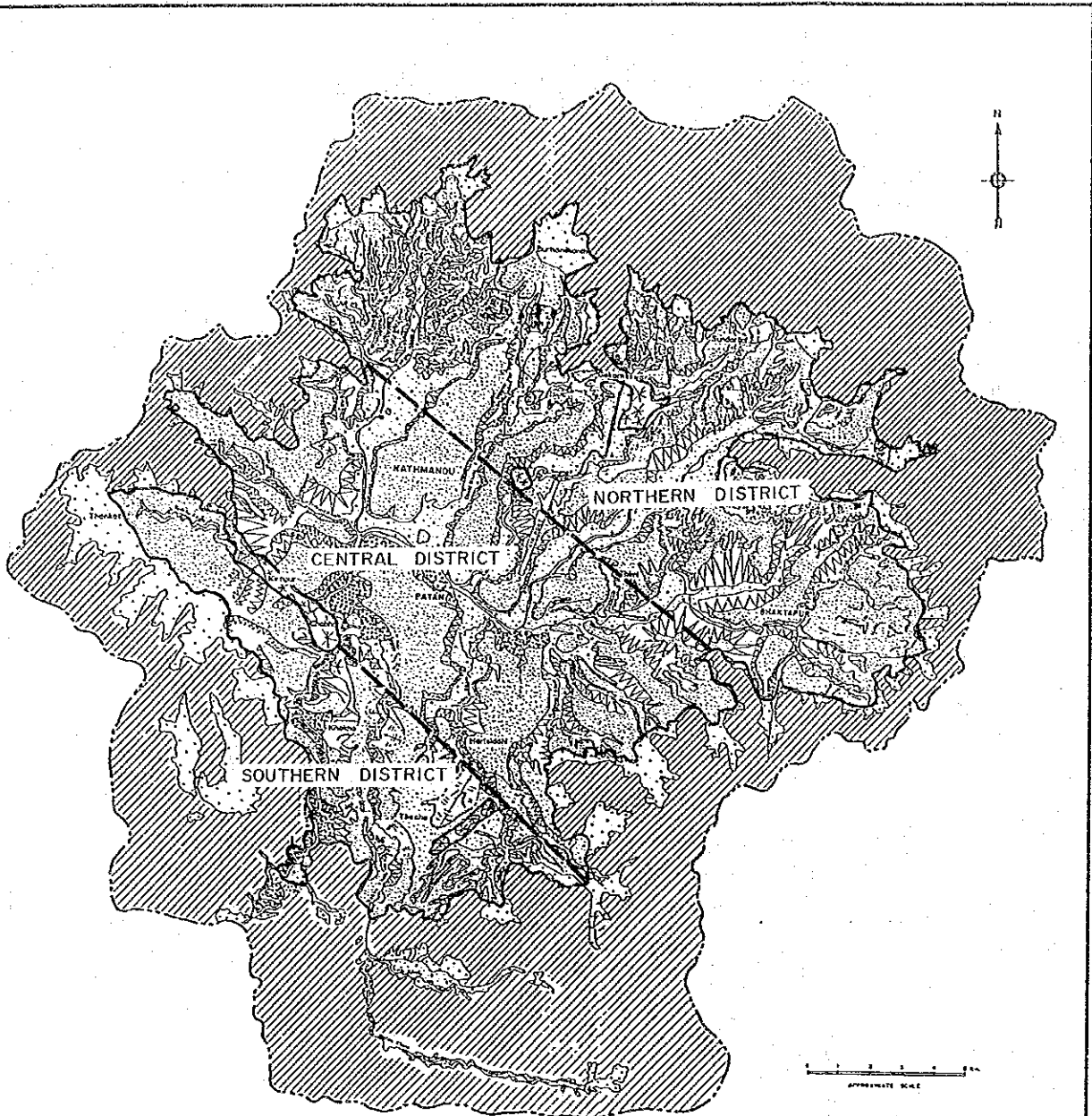
TYPE

- I $\text{Ca}(\text{HCO}_3)_2$
- II NaHCO_3
- III $\text{CaSO}_4, \text{CaCl}_2$
- IV $\text{Na}_2\text{SO}_4, \text{NaCl}$

LEGEND

- Well
- Spring
- △ Spout
- River

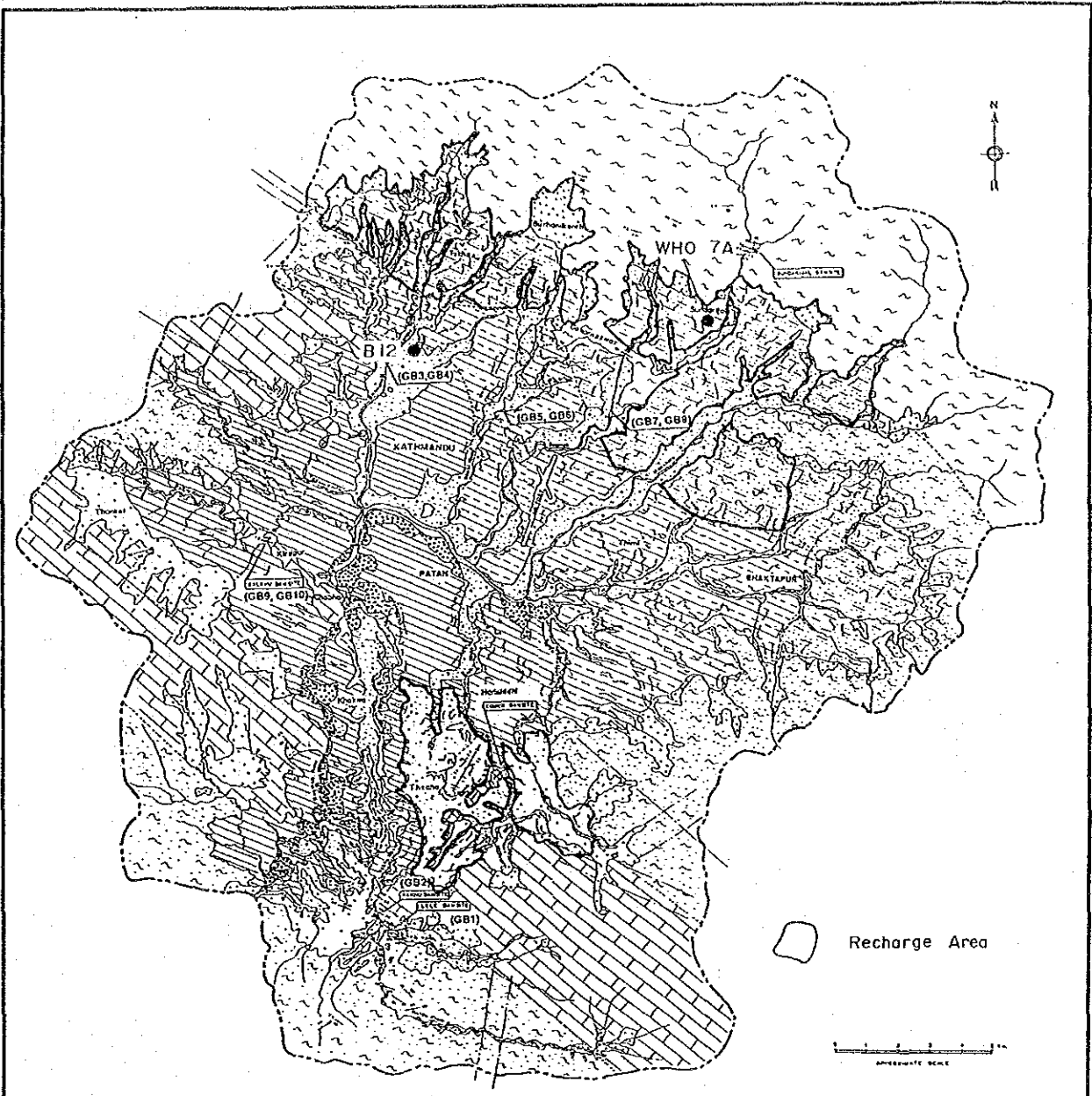
| | | |
|---|---------------|-------------------|
| HIS MAJESTY'S GOVERNMENT OF NEPAL GROUND WATER MANAGEMENT PROJECT IN THE KATHMANDU VALLEY JAPAN INTERNATIONAL COOPERATION AGENCY | Fig. 2.4.8 | TRILINEAR DIAGRAM |
|---|---------------|-------------------|



HIS MAJESTY'S GOVERNMENT OF NEPAL
 GROUND WATER MANAGEMENT PROJECT
 IN THE KATHMANDU VALLEY
 JAPAN INTERNATIONAL COOPERATION AGENCY

Fig.
 3.1.1

**GROUNDWATER BASIN OF
 THE KATHMANDU VALLEY**



Recharge Area

APPROXIMATE SCALE

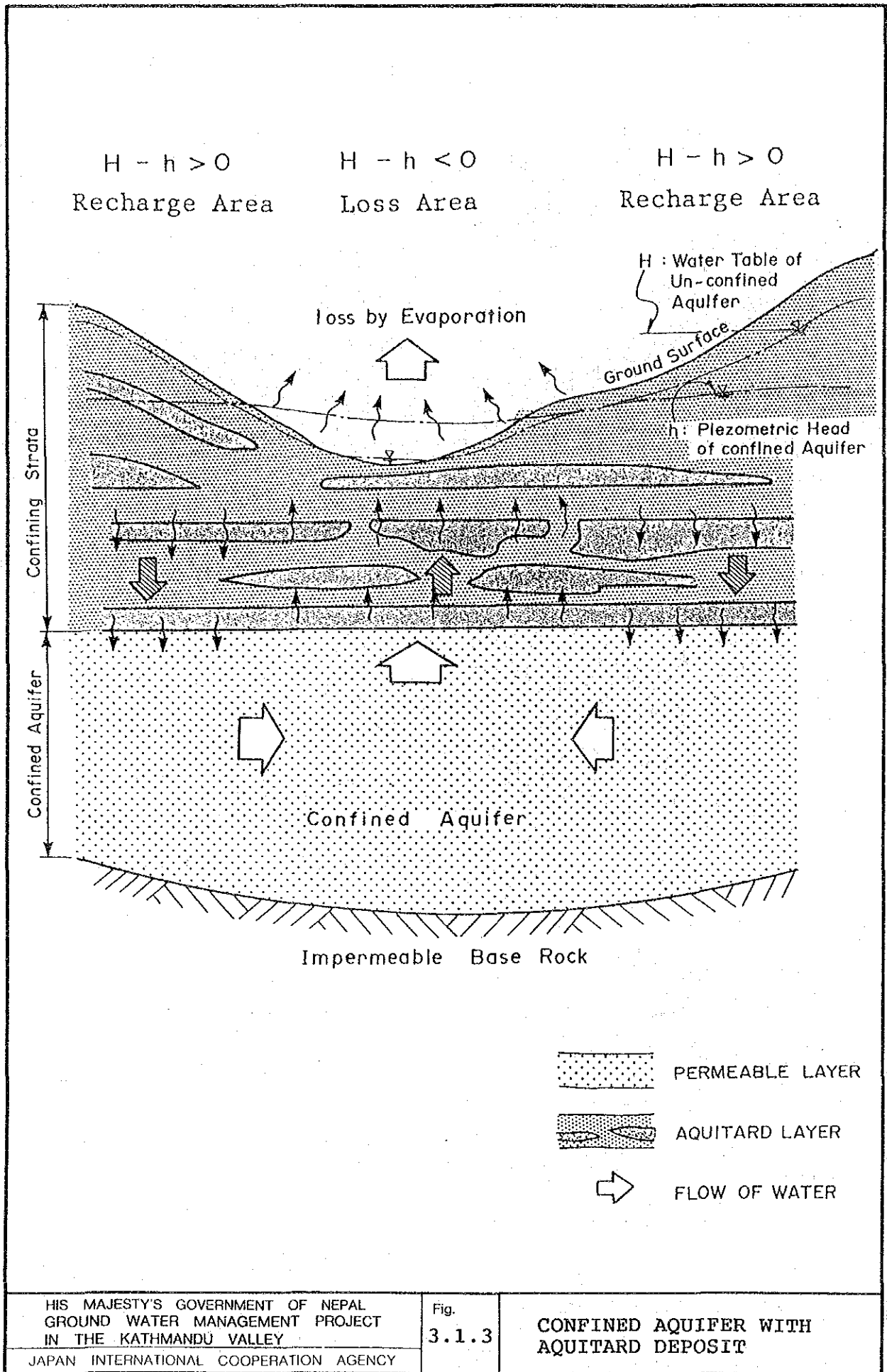
| LEGEND | |
|--|---|
| Quaternary | River Deposits |
| | Talus Deposits and Fan Deposits |
| | Terrace Deposits |
| | Predominant Gravel Deposits |
| | Gravel and Clay Deposits |
| | Arenaceous Deposits (Lacustrine Deposits) |
| | Intermediate Type of Arenaceous and Argillaceous Deposits (Lacustrine Deposits) |
| | Argillaceous Deposits (Lacustrine Deposits) |
| Kathmandu Group (Precambrian-Devonian) | Chandragiri Formation |
| | Crystalline Limestone, Quartzites |
| | Tistung Formation |
| | Phyllites, Sandstone, Sandy Limestones |
| | Augen Gneisses, Banded Gneisses |
| | Landslides |
| | Steep Cliffs |
| | Gentle Cliffs |
| | Watershed Line |
| | Dip and strike of Bedding Planes and Schistosity |
| | Water Spring |
| | Lineaments |
| | Boreholes in this Study |

HIS MAJESTY'S GOVERNMENT OF NEPAL
GROUND WATER MANAGEMENT PROJECT
IN THE KATHMANDU VALLEY

JAPAN INTERNATIONAL COOPERATION AGENCY

Fig. 3.1.2

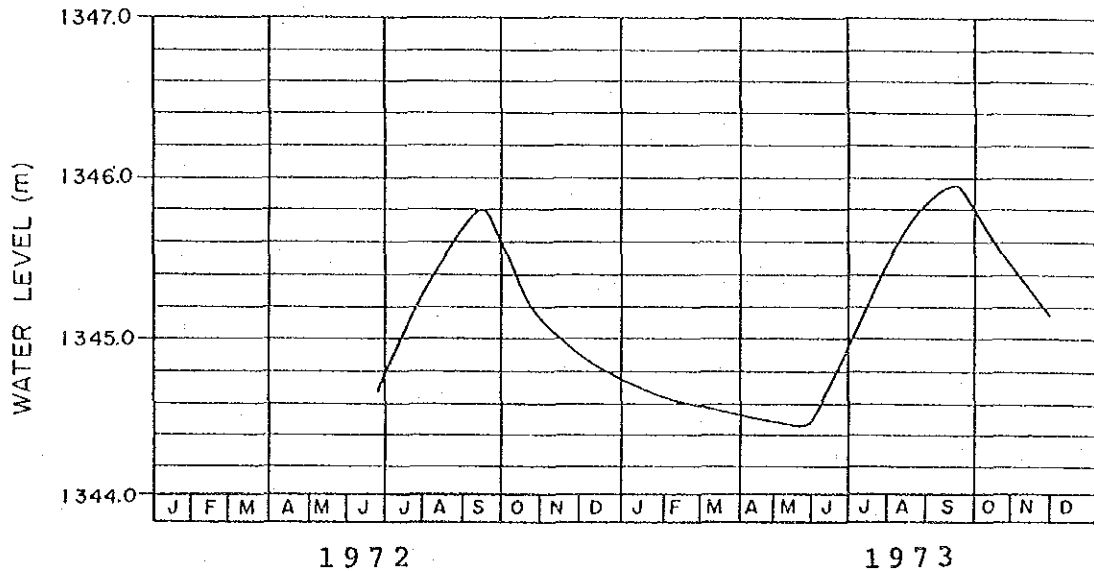
PERMEABLE AREA IN THE KATHMANDU VALLEY



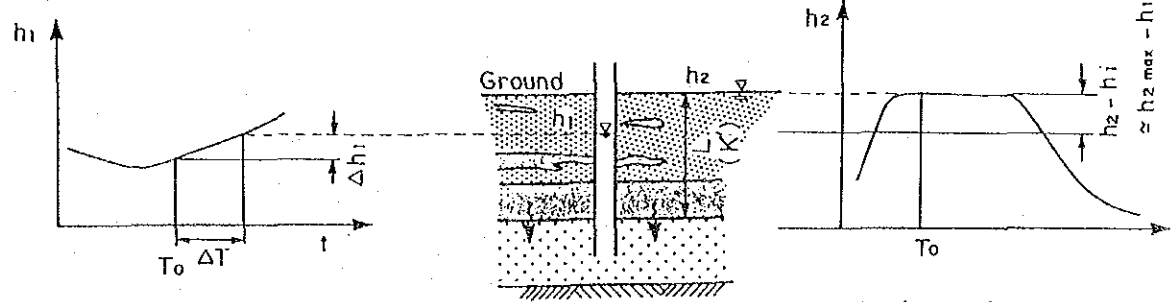
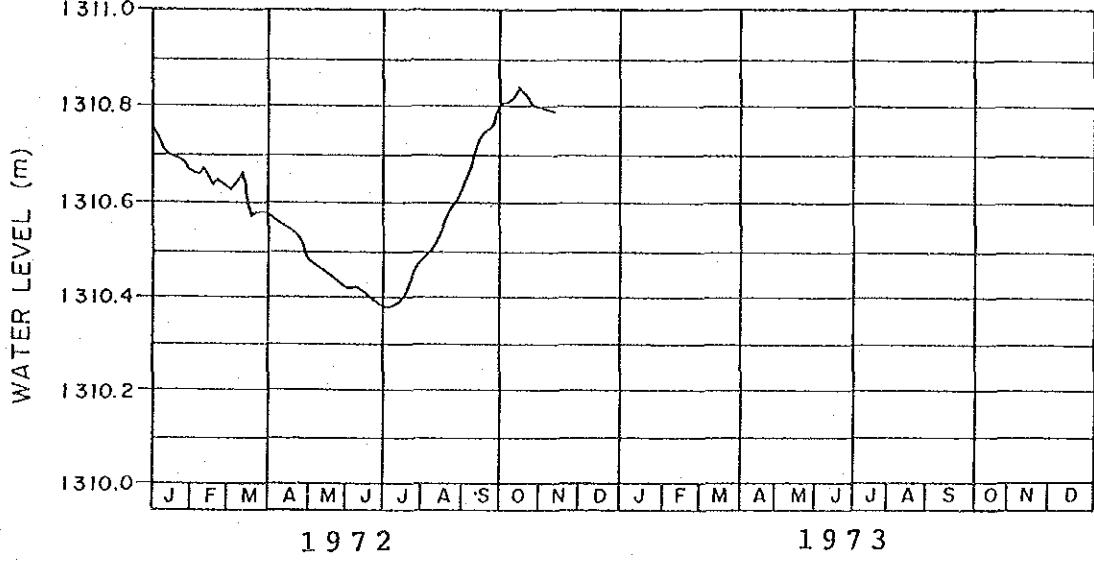
HIS MAJESTY'S GOVERNMENT OF NEPAL
 GROUND WATER MANAGEMENT PROJECT
 IN THE KATHMANDU VALLEY
 JAPAN INTERNATIONAL COOPERATION AGENCY

Fig. 3.1.3
CONFINED AQUIFER WITH AQUITARD DEPOSIT

STATION WHO7A



STATION B12



$$n \frac{\Delta h_1}{\Delta T} = K' \frac{(h_2 - h_1)}{L} \approx K' \frac{h_{2 \max} - h_{1 \text{ average}}}{L}$$

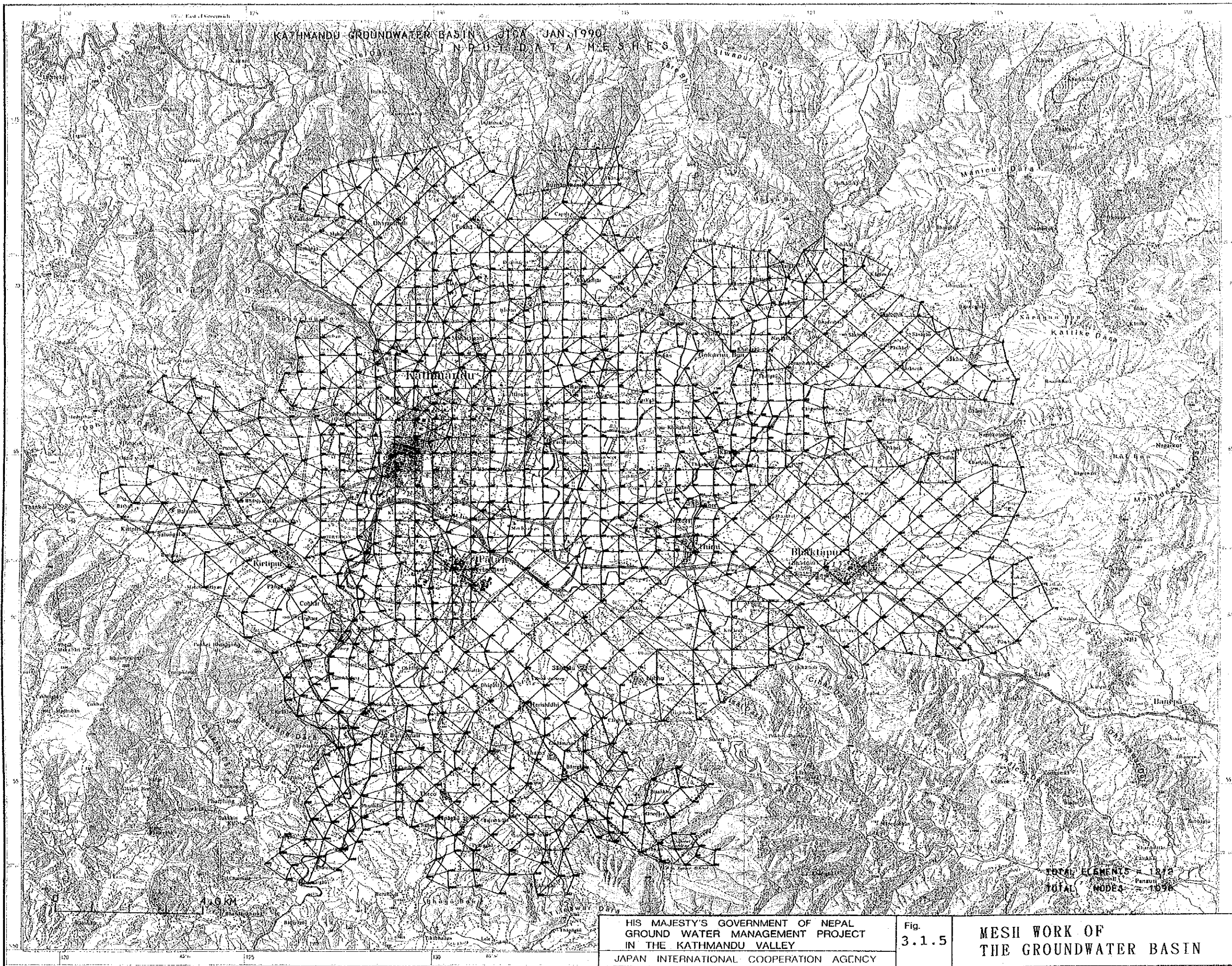
$$K' = \frac{L}{h_{2 \max} - h_{1 \text{ average}}} \cdot n \frac{\Delta h_1}{\Delta T}$$

- n : Porosity (=0.15)
- L : Thickness of Aquitard
- K : Permeability
- h₁ : Piezometric head of confined Aquifer
- h₂ : Water Table of un-confined Aquifer

HIS MAJESTY'S GOVERNMENT OF NEPAL
GROUND WATER MANAGEMENT PROJECT
IN THE KATHMANDU VALLEY
JAPAN INTERNATIONAL COOPERATION AGENCY

Fig.
3.1.4

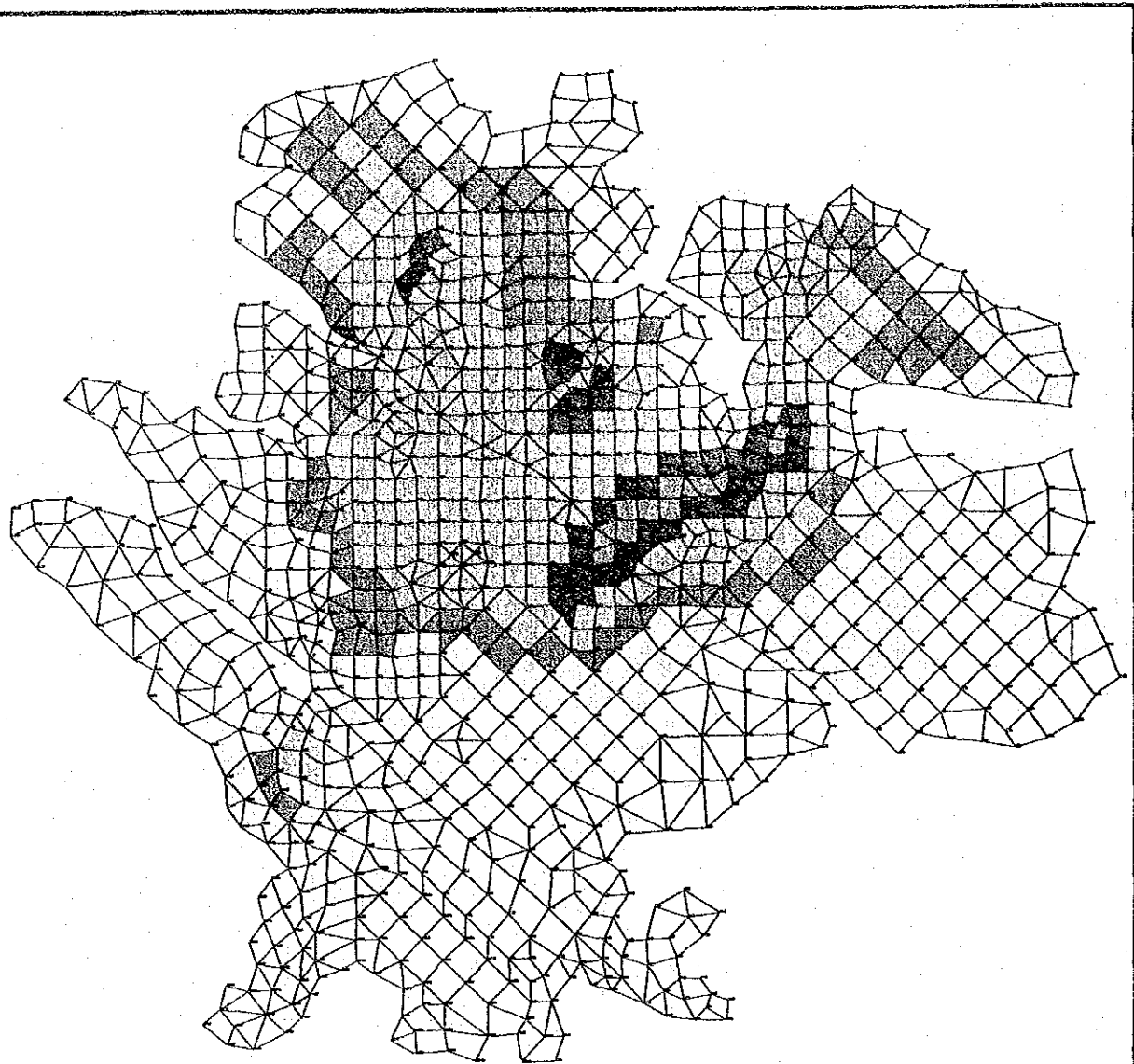
WELL HYDROGRAPH AND
GROUNDWATER RECHARGE



HIS MAJESTY'S GOVERNMENT OF NEPAL
 GROUND WATER MANAGEMENT PROJECT
 IN THE KATHMANDU VALLEY
 JAPAN INTERNATIONAL COOPERATION AGENCY








Fig. 3.1.5

MESH WORK OF THE GROUNDWATER BASIN



0 4.0 KM

TOTAL ELEMENTS = 1212
TOTAL NODES = 1098

| Classification | Transmissivity (m ² /day) |
|---|---|
|  1 | 10.0 |
|  2 | 25.0 |
|  3 | 75.0 |
|  4 | 150.0 |
|  5 | 300.0 |
|  6 | 500.0 |
|  7 | 700.0 |

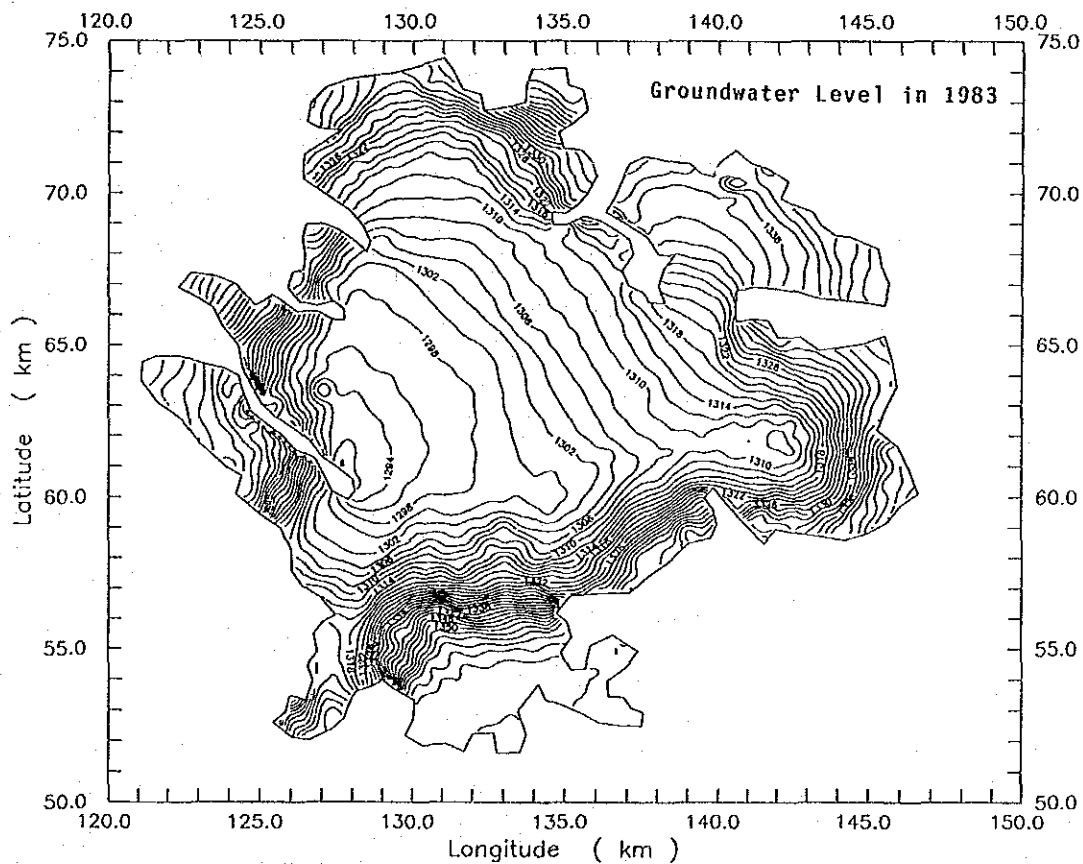
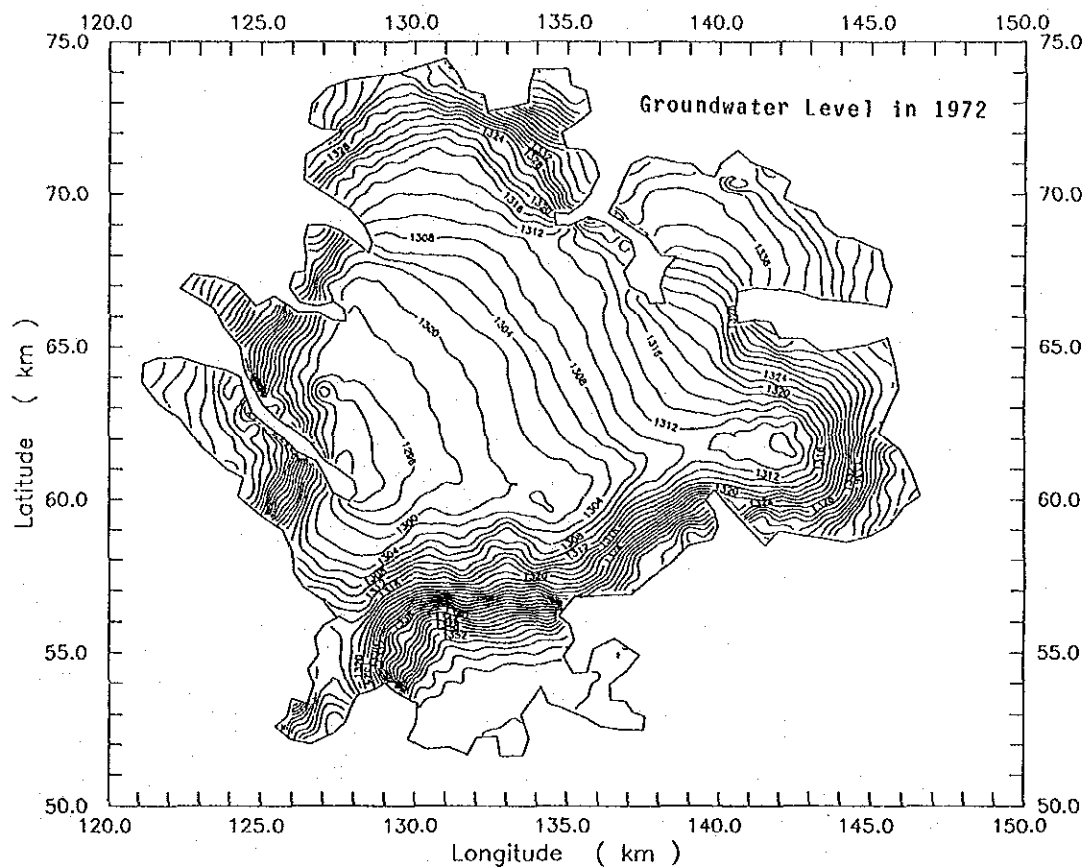
HIS MAJESTY'S GOVERNMENT OF NEPAL
GROUND WATER MANAGEMENT PROJECT
IN THE KATHMANDU VALLEY

JAPAN INTERNATIONAL COOPERATION AGENCY

Fig.
3.1.6

CLASSIFICATION OF PERMEABILITY

GROUNDWATER BASIN OF THE KATHMANDU VALLEY



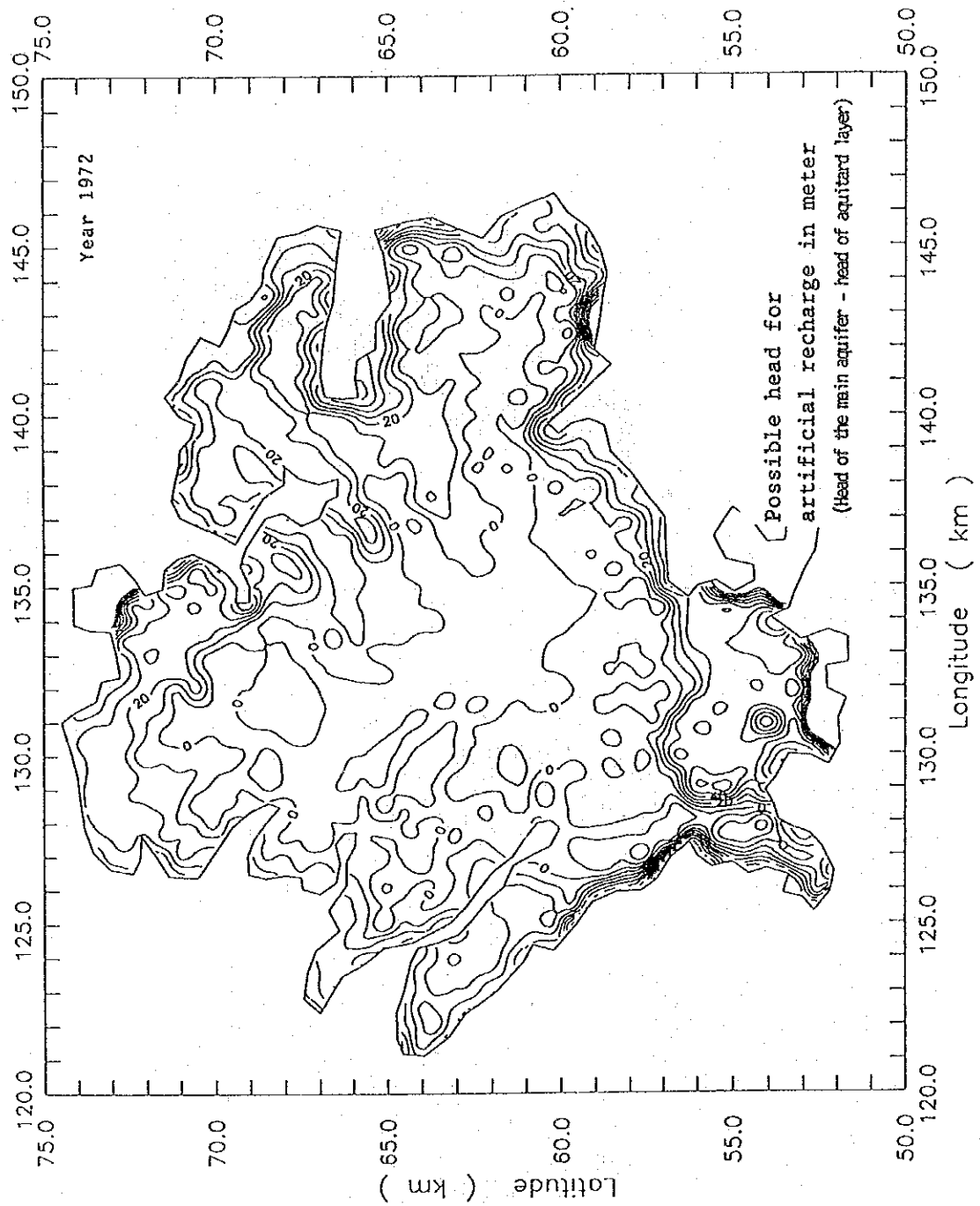
HIS MAJESTY'S GOVERNMENT OF NEPAL
GROUND WATER MANAGEMENT PROJECT
IN THE KATHMANDU VALLEY

JAPAN INTERNATIONAL COOPERATION AGENCY

Fig.
3.1.7

GROUNDWATER IN 1972/1983
(STEADY CONDITION)

GROUNDWATER BASIN OF THE KATHMANDU VALLEY



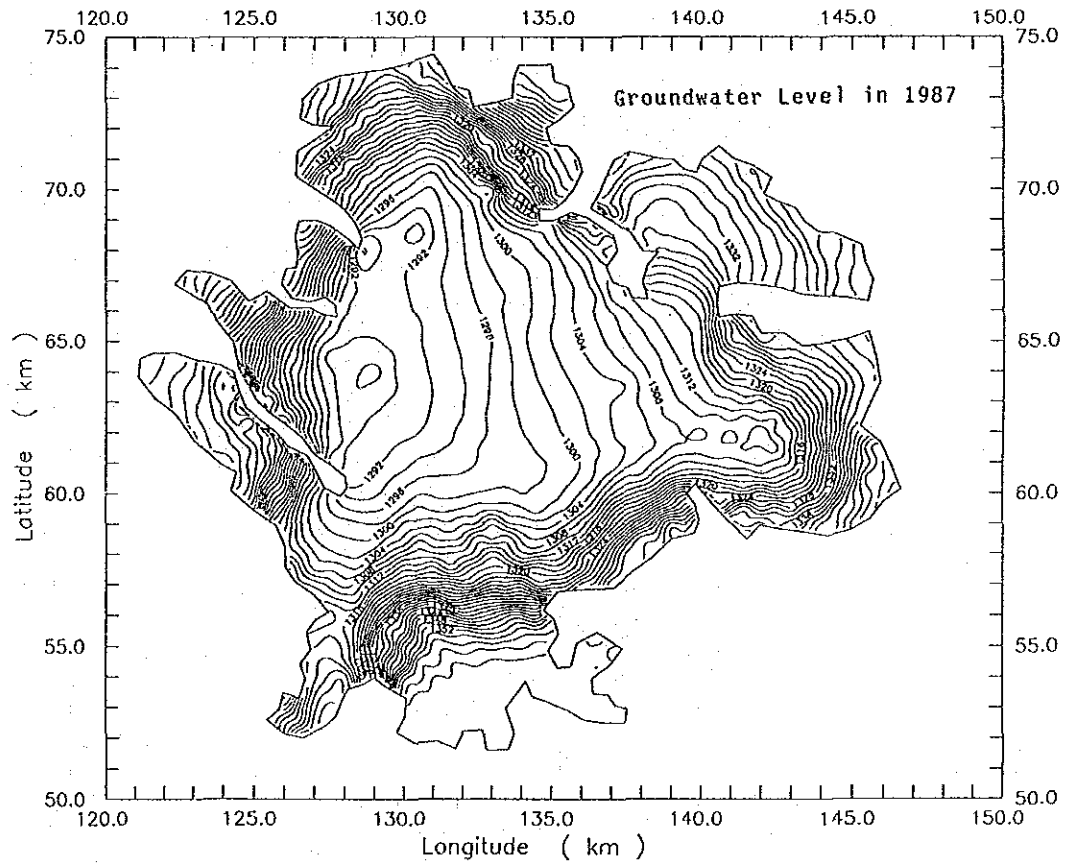
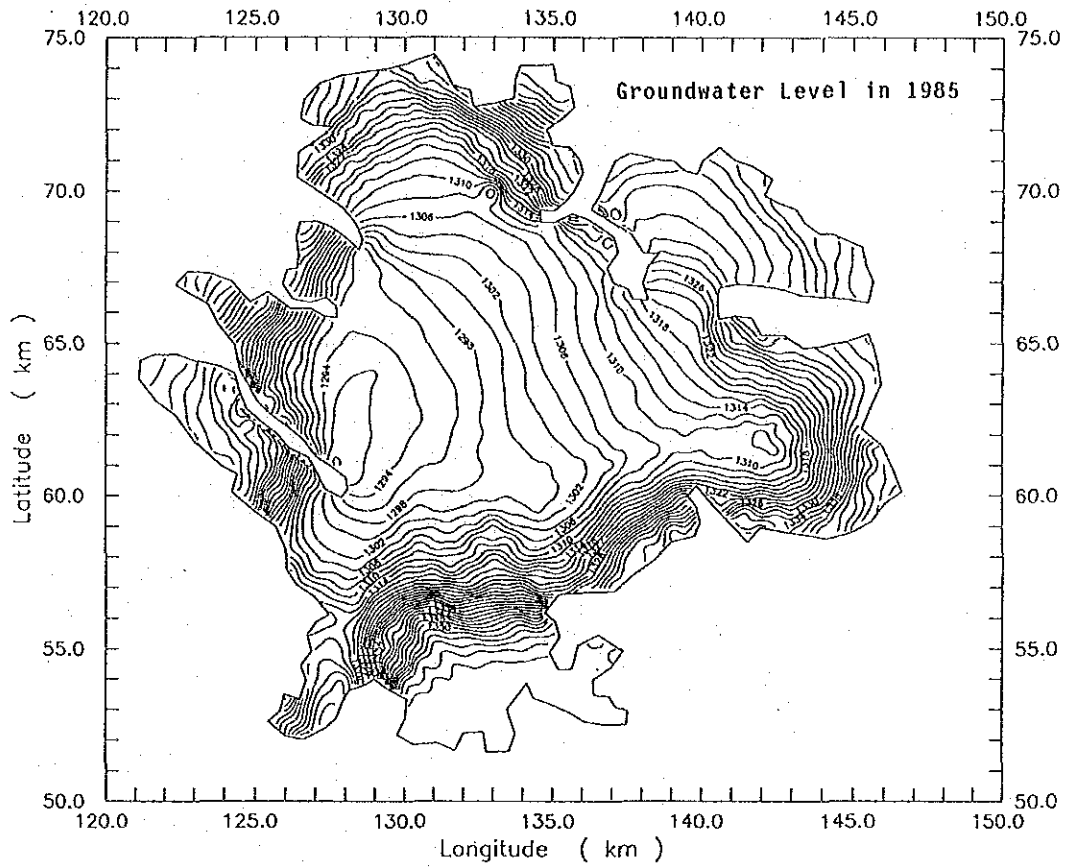
HIS MAJESTY'S GOVERNMENT OF NEPAL
GROUND WATER MANAGEMENT PROJECT
IN THE KATHMANDU VALLEY

JAPAN INTERNATIONAL COOPERATION AGENCY

Fig.
3.1.8

POSSIBLE ARTIFICIAL
RECHARGE AREA

GROUNDWATER BASIN OF THE KATHMANDU VALLEY



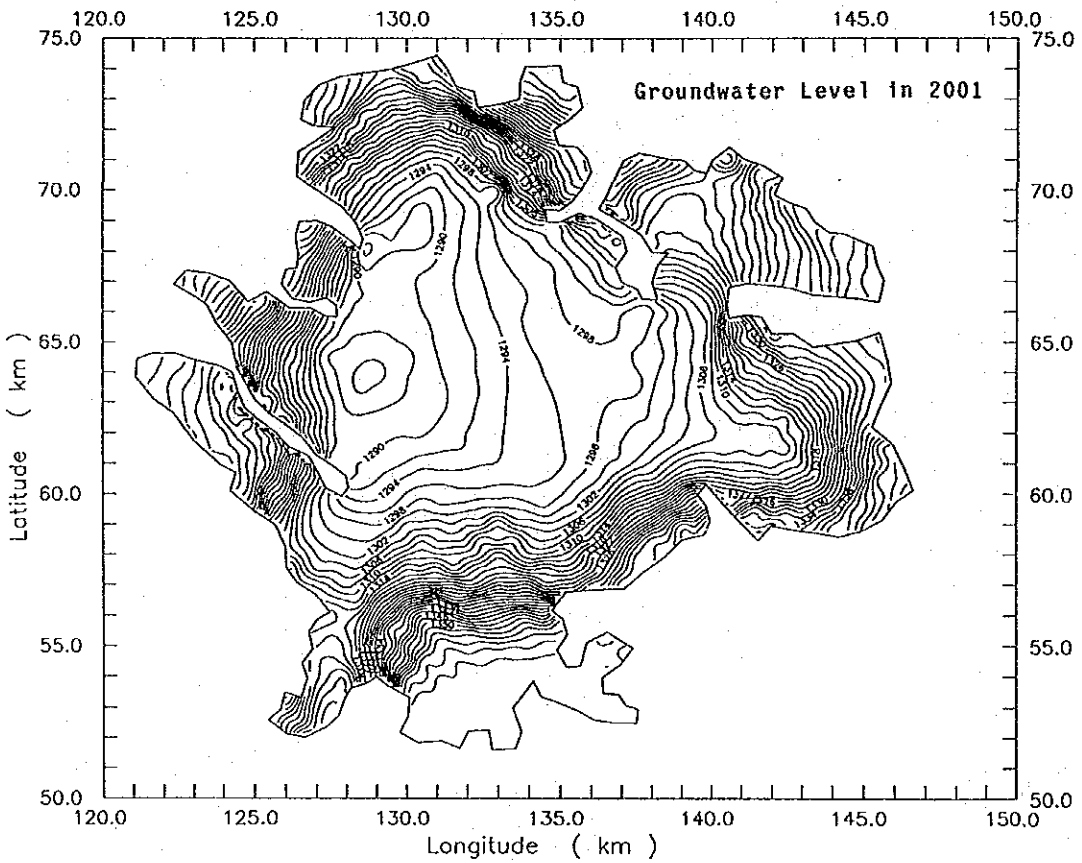
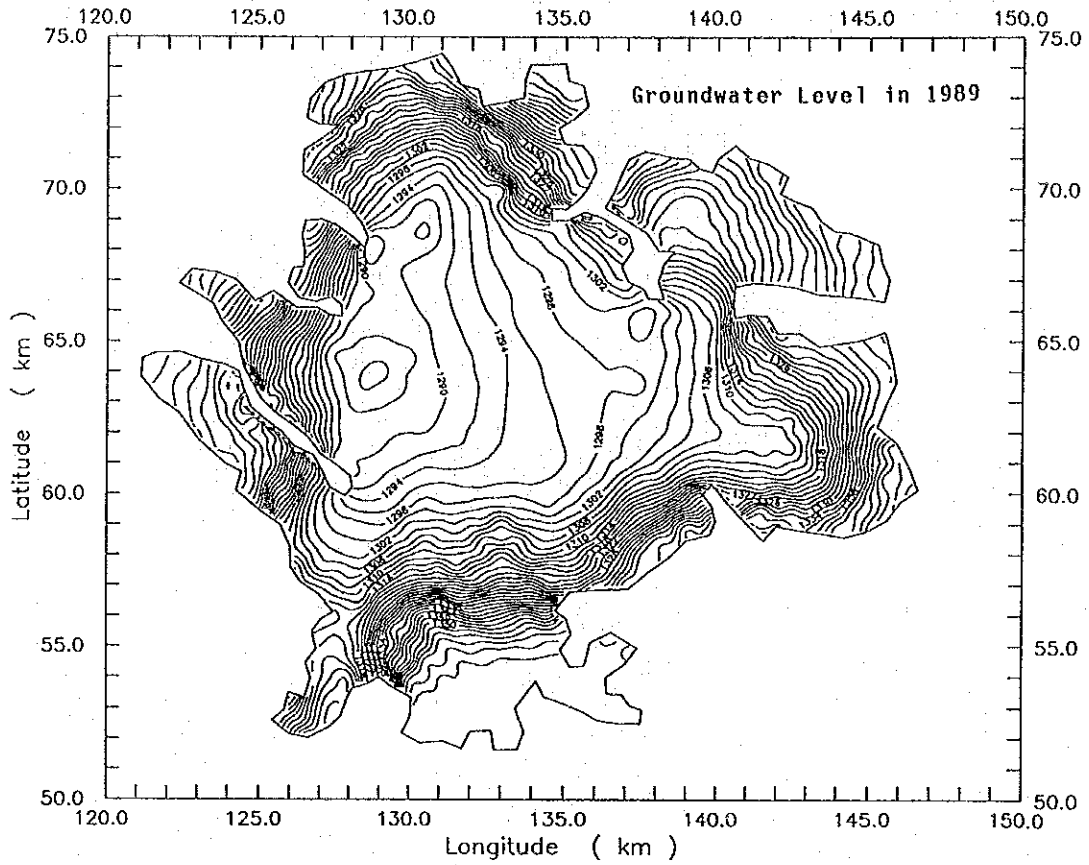
HIS MAJESTY'S GOVERNMENT OF NEPAL
GROUND WATER MANAGEMENT PROJECT
IN THE KATHMANDU VALLEY

JAPAN INTERNATIONAL COOPERATION AGENCY

Fig.
3.1.9

GROUNDWATER IN 1985/1987
(NON-STEADY CONDITION)

GROUNDWATER BASIN OF THE KATHMANDU VALLEY



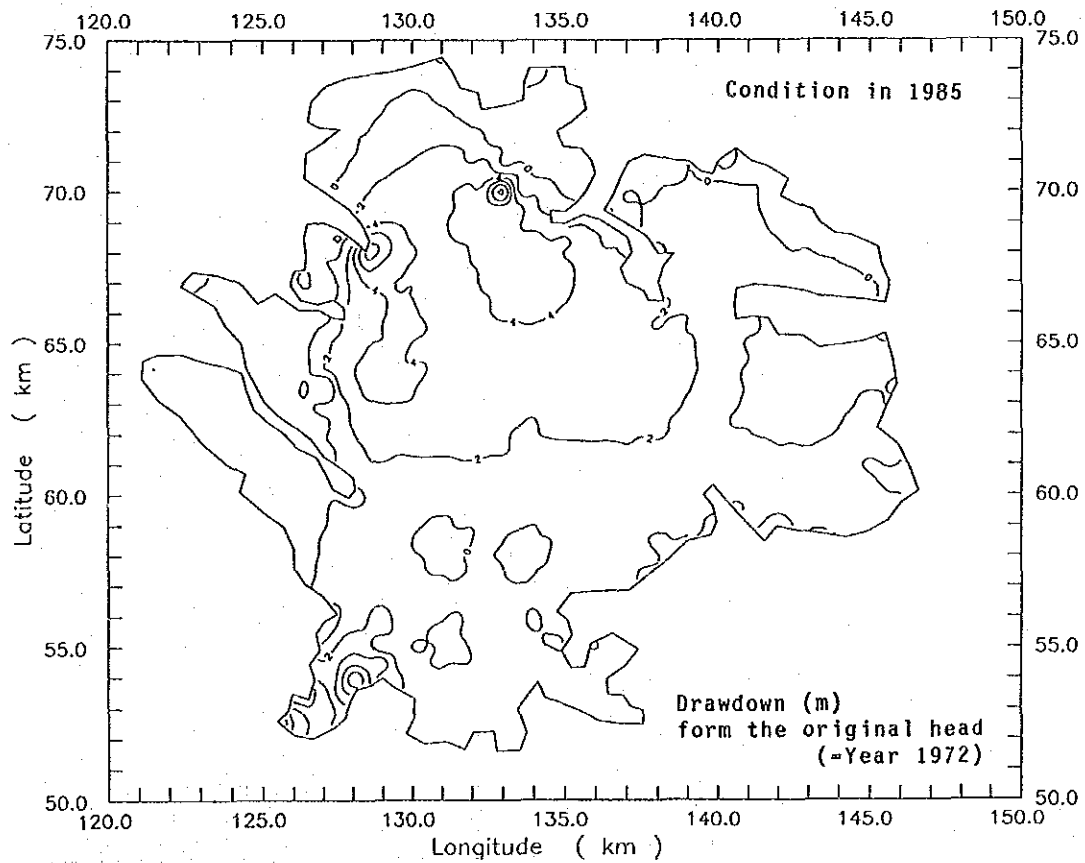
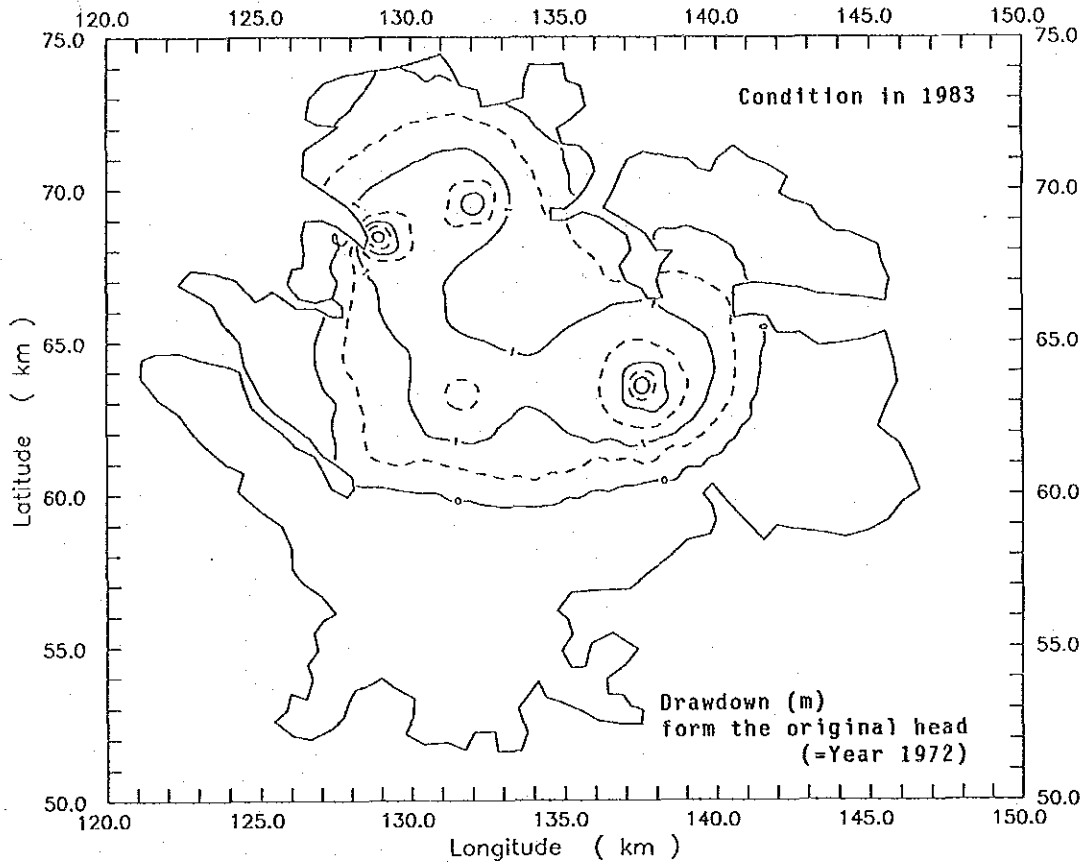
HIS MAJESTY'S GOVERNMENT OF NEPAL
GROUND WATER MANAGEMENT PROJECT
IN THE KATHMANDU VALLEY

JAPAN INTERNATIONAL COOPERATION AGENCY

Fig.
3.1.10

GROUNDWATER IN 1989/2001
(NON-STEADY CONDITION)

GROUNDWATER BASIN OF THE KATHMANDU VALLEY



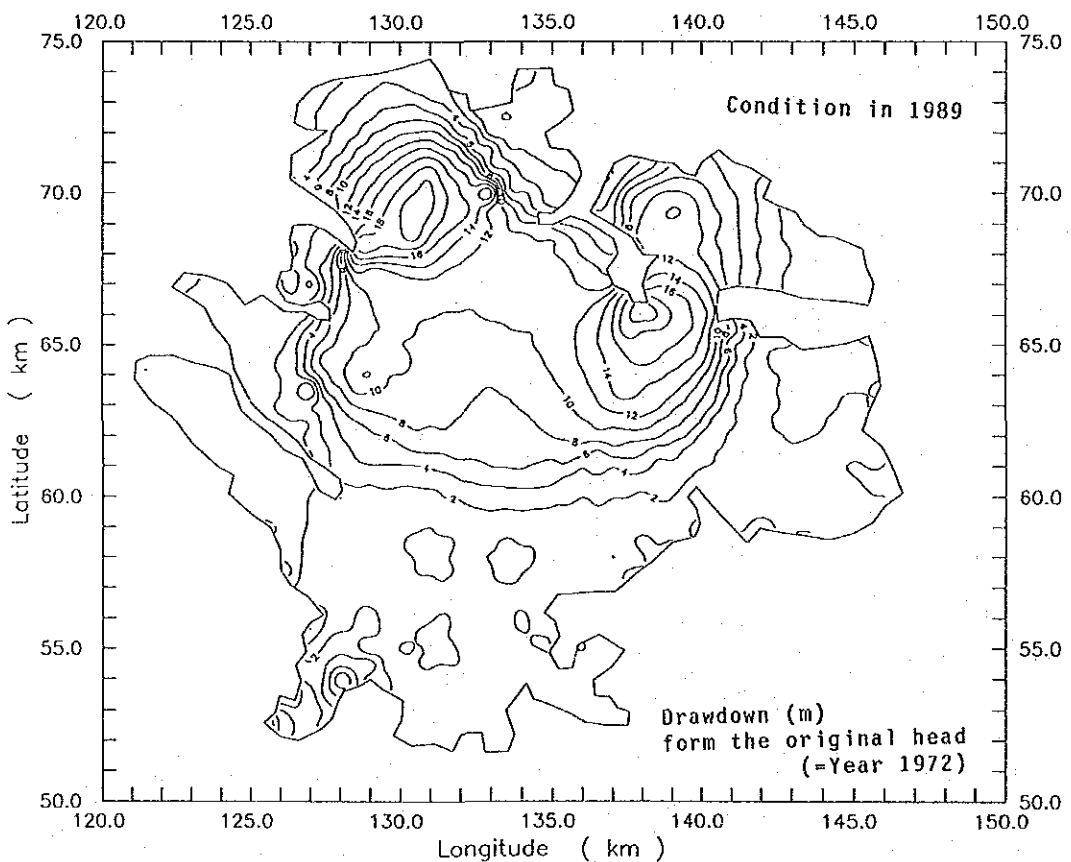
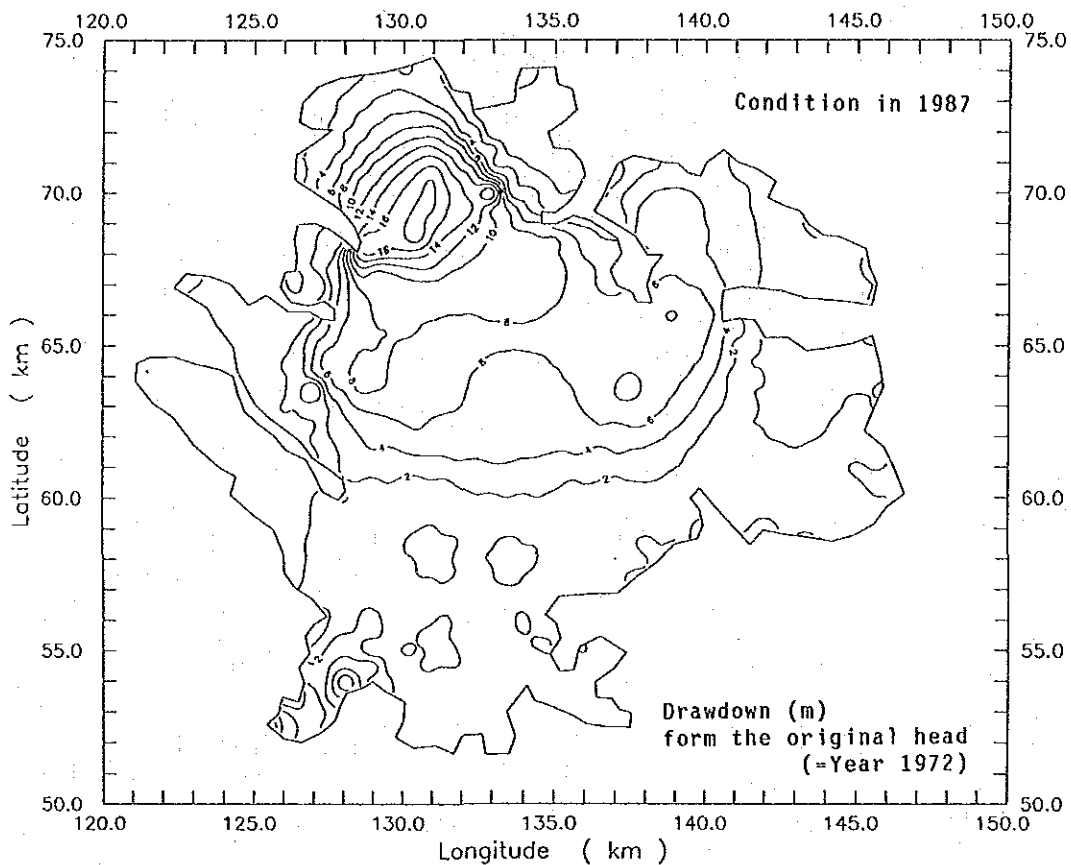
HIS MAJESTY'S GOVERNMENT OF NEPAL
GROUND WATER MANAGEMENT PROJECT
IN THE KATHMANDU VALLEY

JAPAN INTERNATIONAL COOPERATION AGENCY

Fig.
3.1.11

DRAWDOWN OF GROUNDWATER LEVEL
IN 1983/1985

GROUNDWATER BASIN OF THE KATHMANDU VALLEY

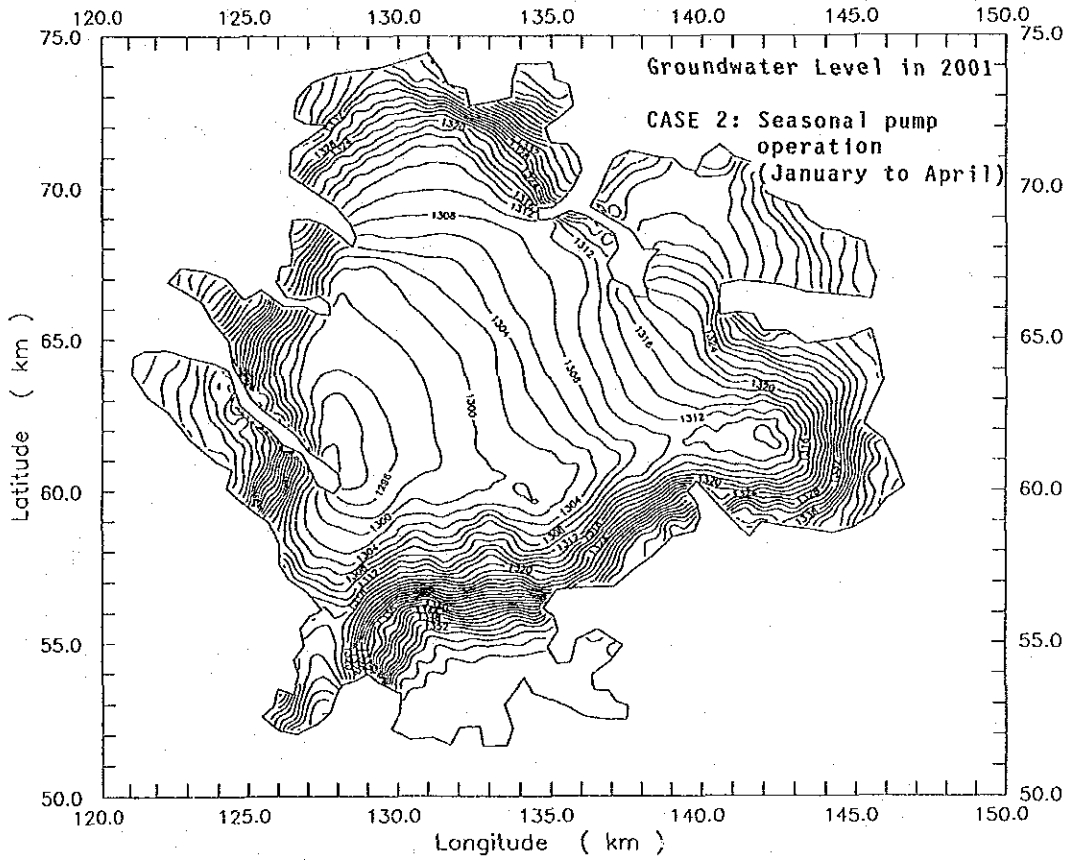
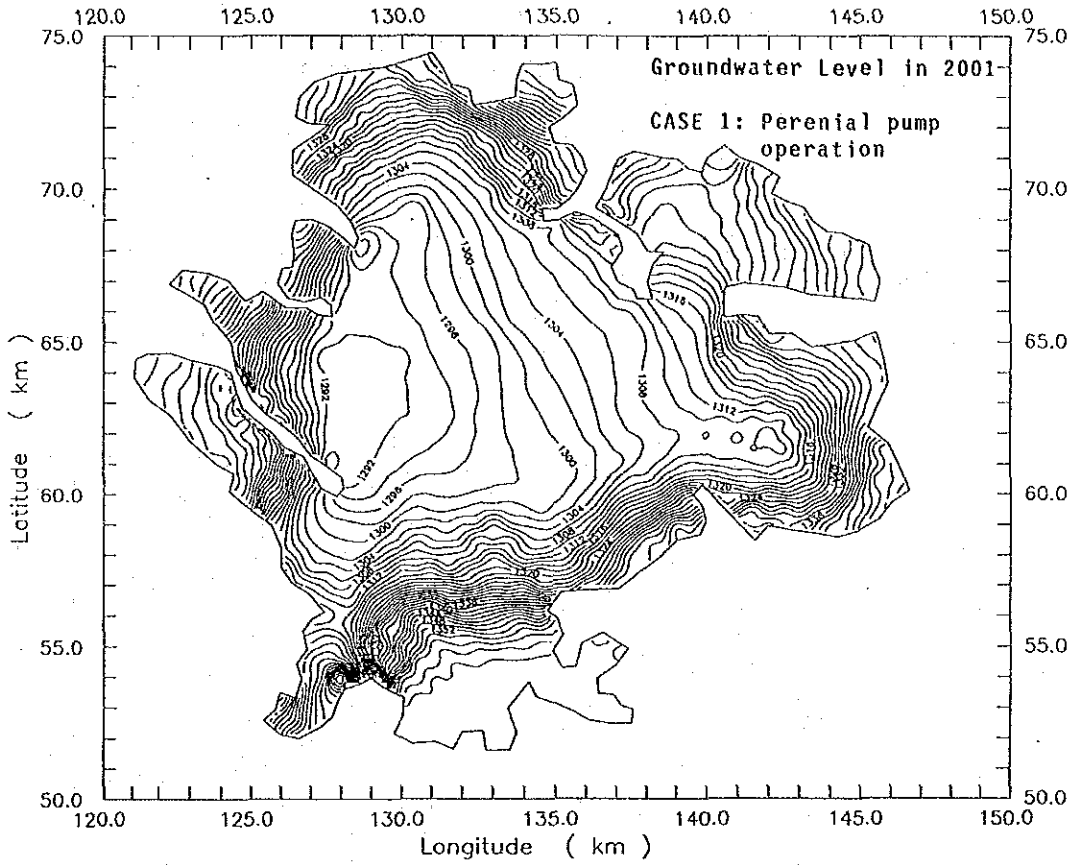


HIS MAJESTY'S GOVERNMENT OF NEPAL
GROUND WATER MANAGEMENT PROJECT
IN THE KATHMANDU VALLEY
JAPAN INTERNATIONAL COOPERATION AGENCY

Fig.
3.1.12

DRAWDOWN OF GROUNDWATER LEVEL
IN 1987/1989

GROUNDWATER BASIN OF THE KATHMANDU VALLEY



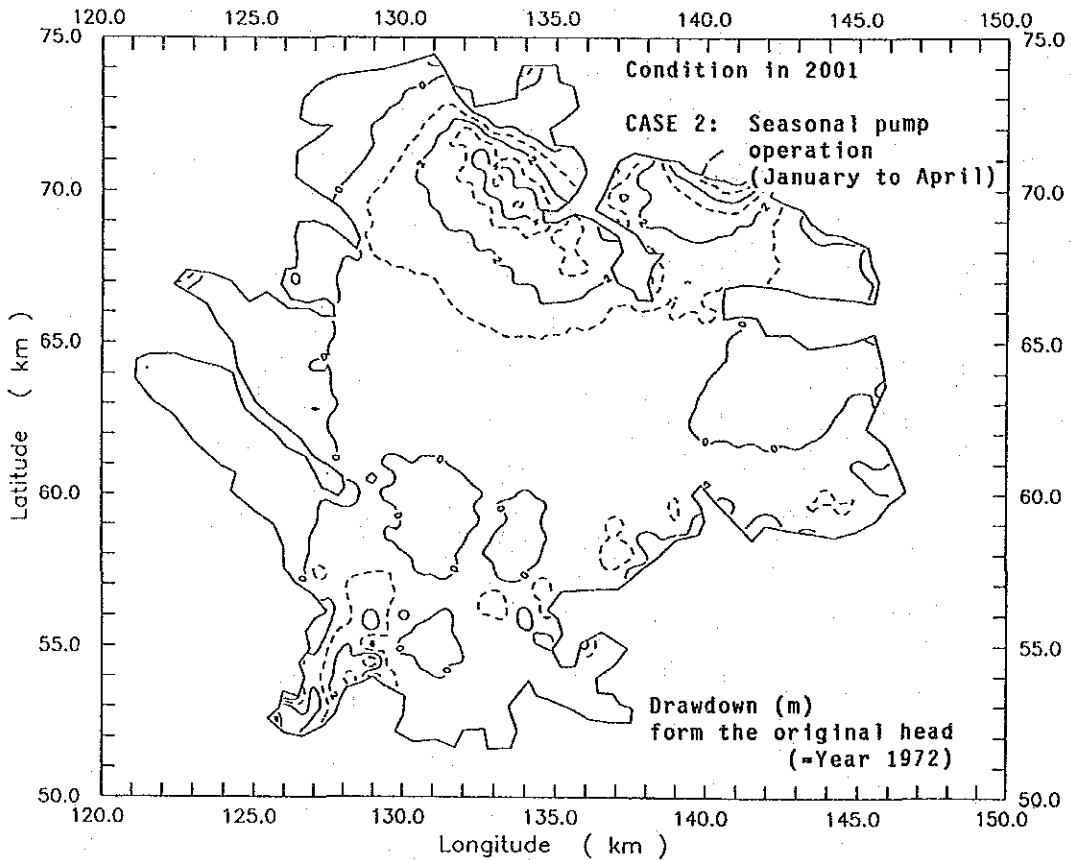
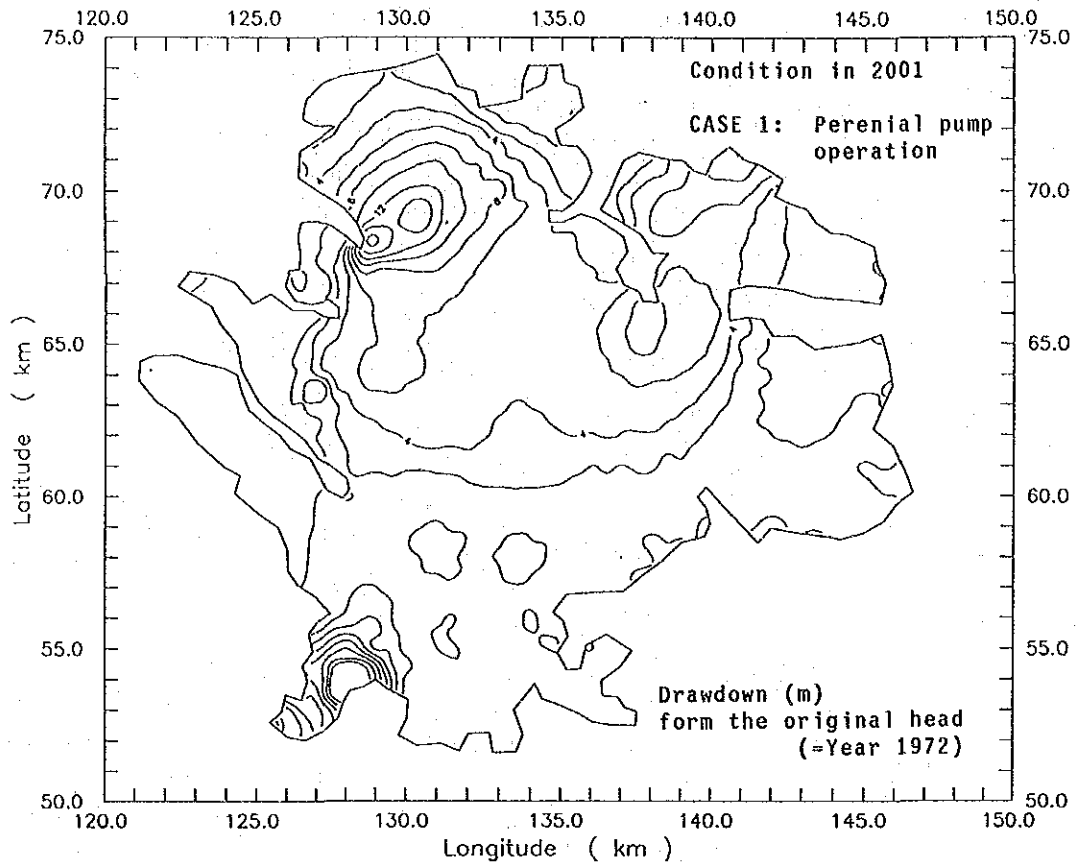
HIS MAJESTY'S GOVERNMENT OF NEPAL
GROUND WATER MANAGEMENT PROJECT
IN THE KATHMANDU VALLEY

JAPAN INTERNATIONAL COOPERATION AGENCY

Fig.
3.1.13

GROUNDWATER IN 2001
(OPTIMUM CASE 1 & 2)

GROUNDWATER BASIN OF THE KATHMANDU VALLEY

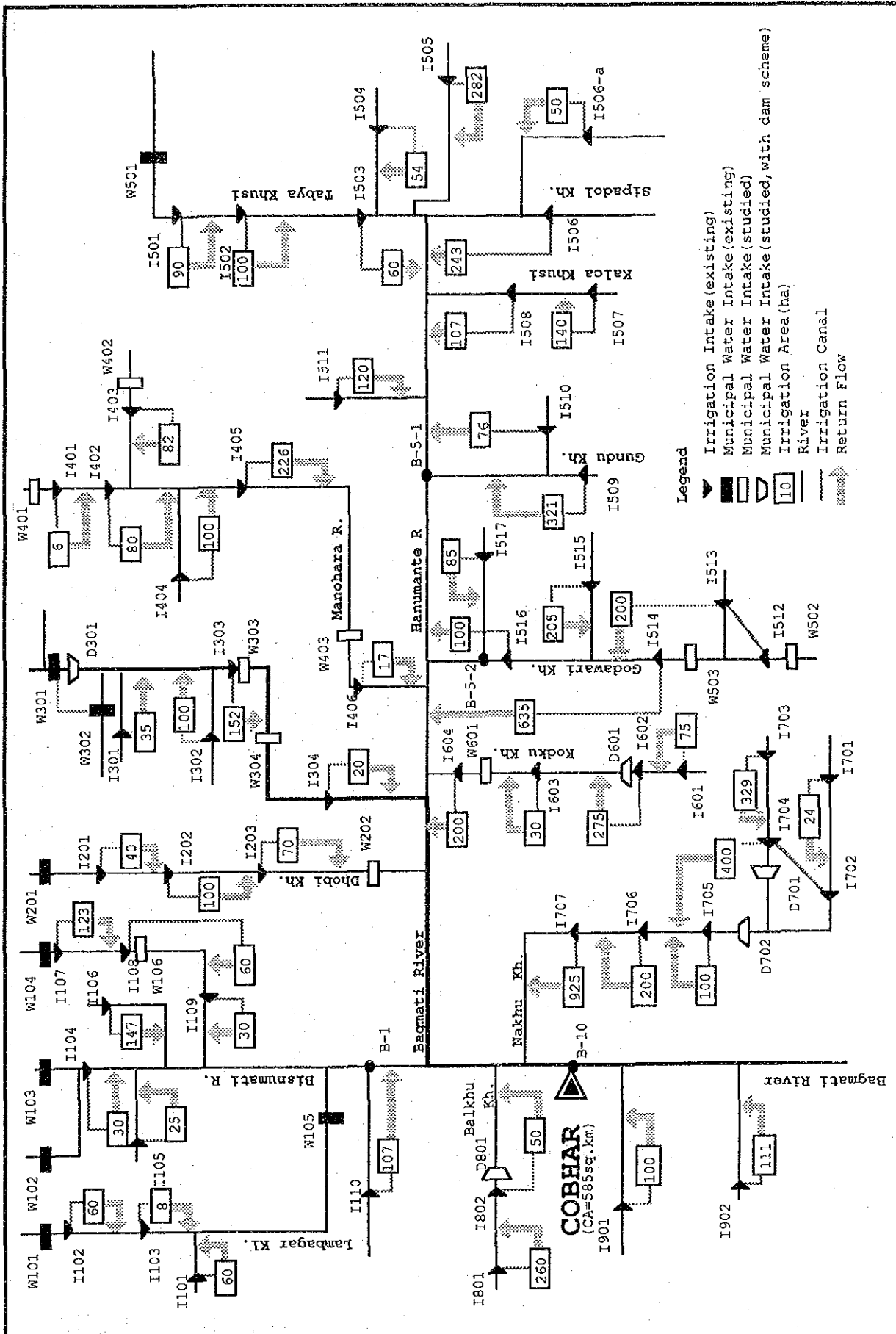


HIS MAJESTY'S GOVERNMENT OF NEPAL
 GROUND WATER MANAGEMENT PROJECT
 IN THE KATHMANDU VALLEY

JAPAN INTERNATIONAL COOPERATION AGENCY

Fig.
 3.1.14

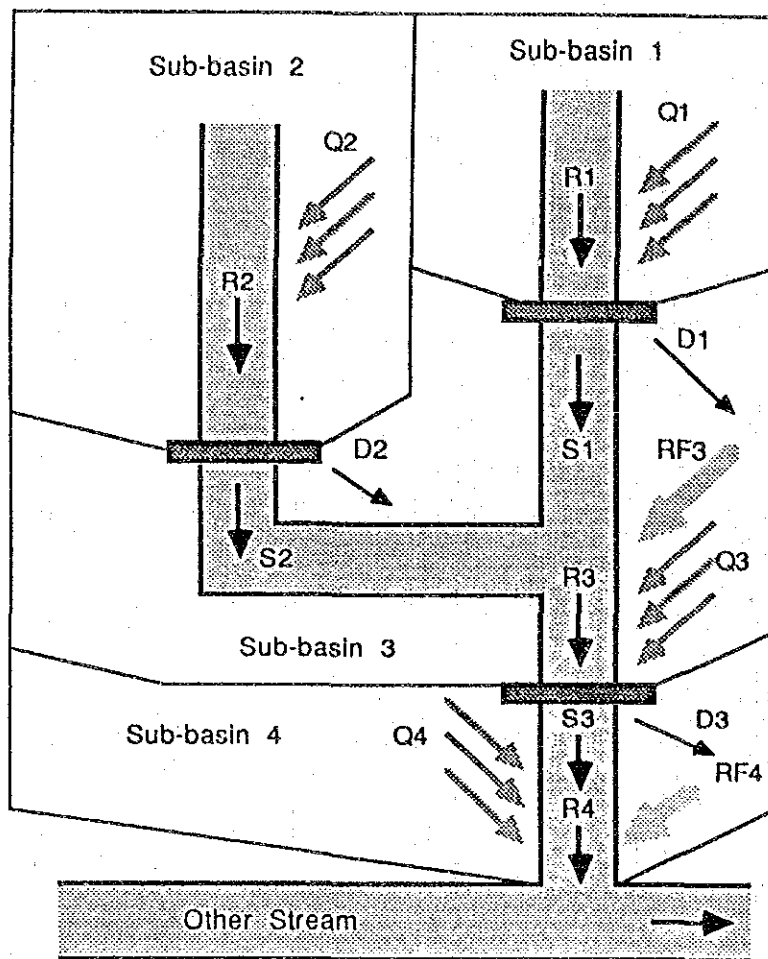
**DRAWDOWN OF GROUNDWATER LEVEL
 IN 2001 (CASE 1 & 2)**



HIS MAJESTY'S GOVERNMENT OF NEPAL
 GROUND WATER MANAGEMENT PROJECT
 IN THE KATHMANDU VALLEY
 JAPAN INTERNATIONAL COOPERATION AGENCY

Fig.
 3.2.1

**WATER DEMAND AND
 SUPPLY BALANCE MODEL
 IN THE KATHMANDU VALLEY**



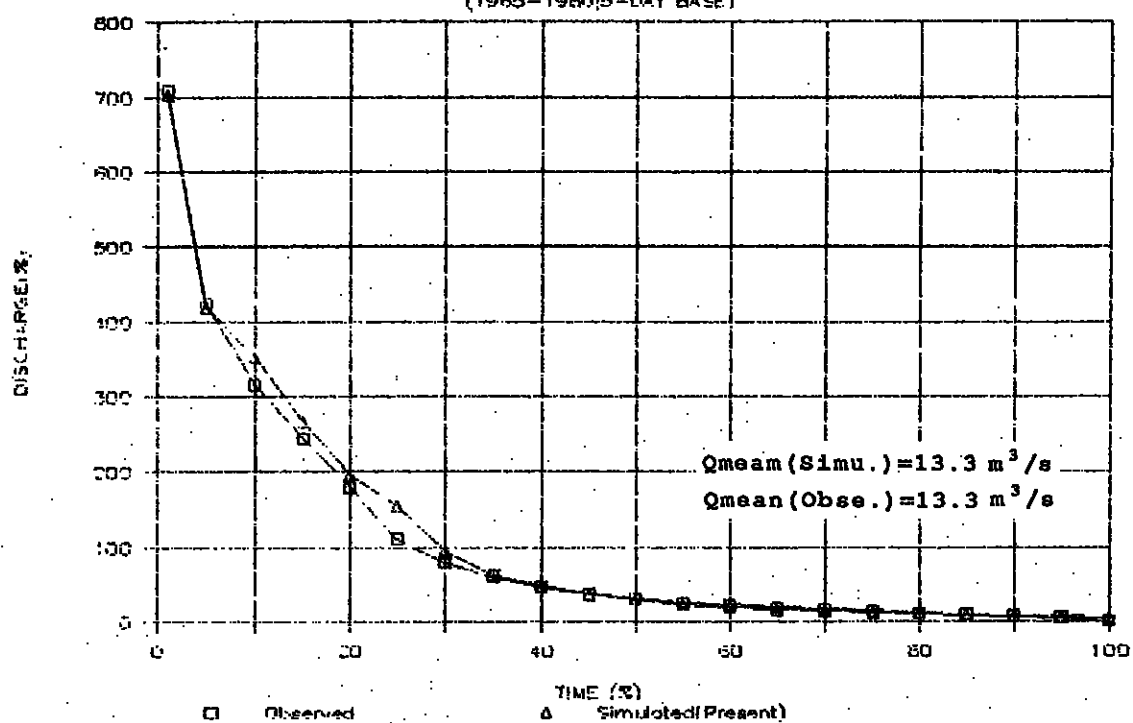
R_i ; Available runoff at intake i ($i=1-3$)
 D_i ; Water demand at intake i ($i=1-3$)
 S_i ; Surplus runoff at intake i ($i=1-3$)
 DF_i ; Water deficit at intake i ($i=1-3$)
 Q_i ; Natural runoff in sub-basin i ($i=1-4$)
 RF_i ; Return flow in sub-basin i ($i=1-4$)
 R_4 ; Runoff into the main stream

$R_1=Q_1$
 $R_2=Q_2$
 $R_3=Q_3+S_1+S_2+RF_3$
 $R_4=Q_4+S_3+RF_4$

$\left[\begin{array}{l} \text{IF ; } R_i > D_i \\ DF_i = 0, S_i = R_i - D_i \\ \text{IF ; } R_i < D_i \\ DF_i = D_i - R_i, S_i = 0 \end{array} \right.$

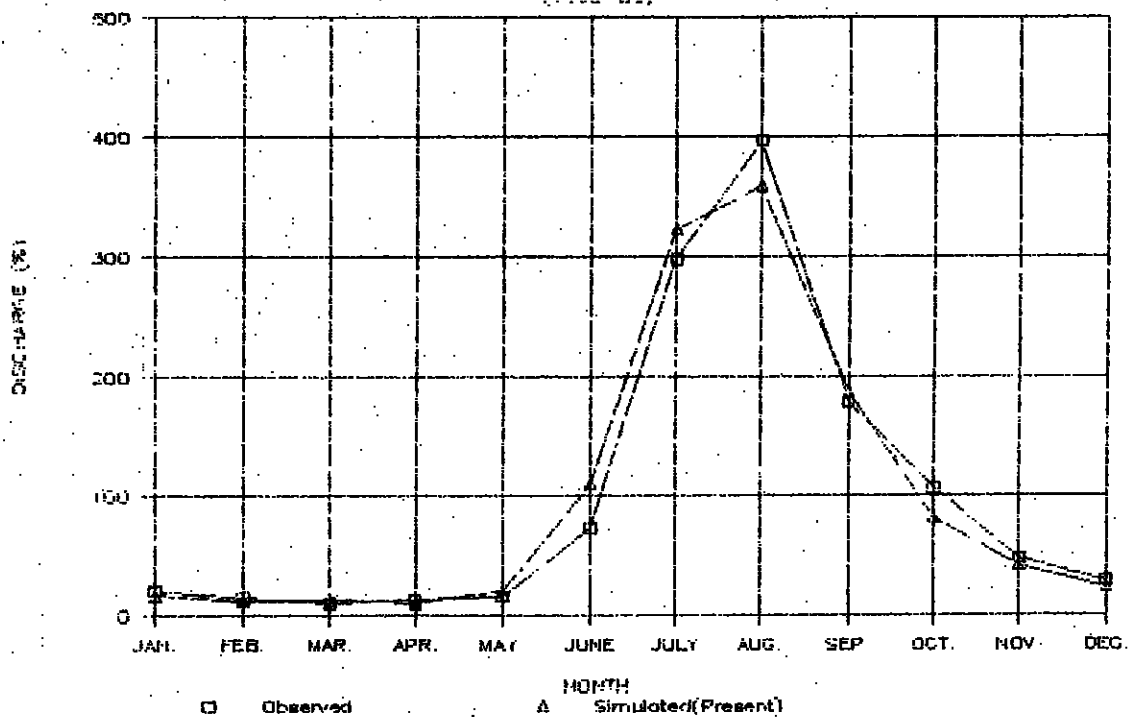
FLOW DURATION CURVE AT COBHAR

(1965-1980; 5-DAY BASE)



MONTHLY DISCHARGE AT COBHAR

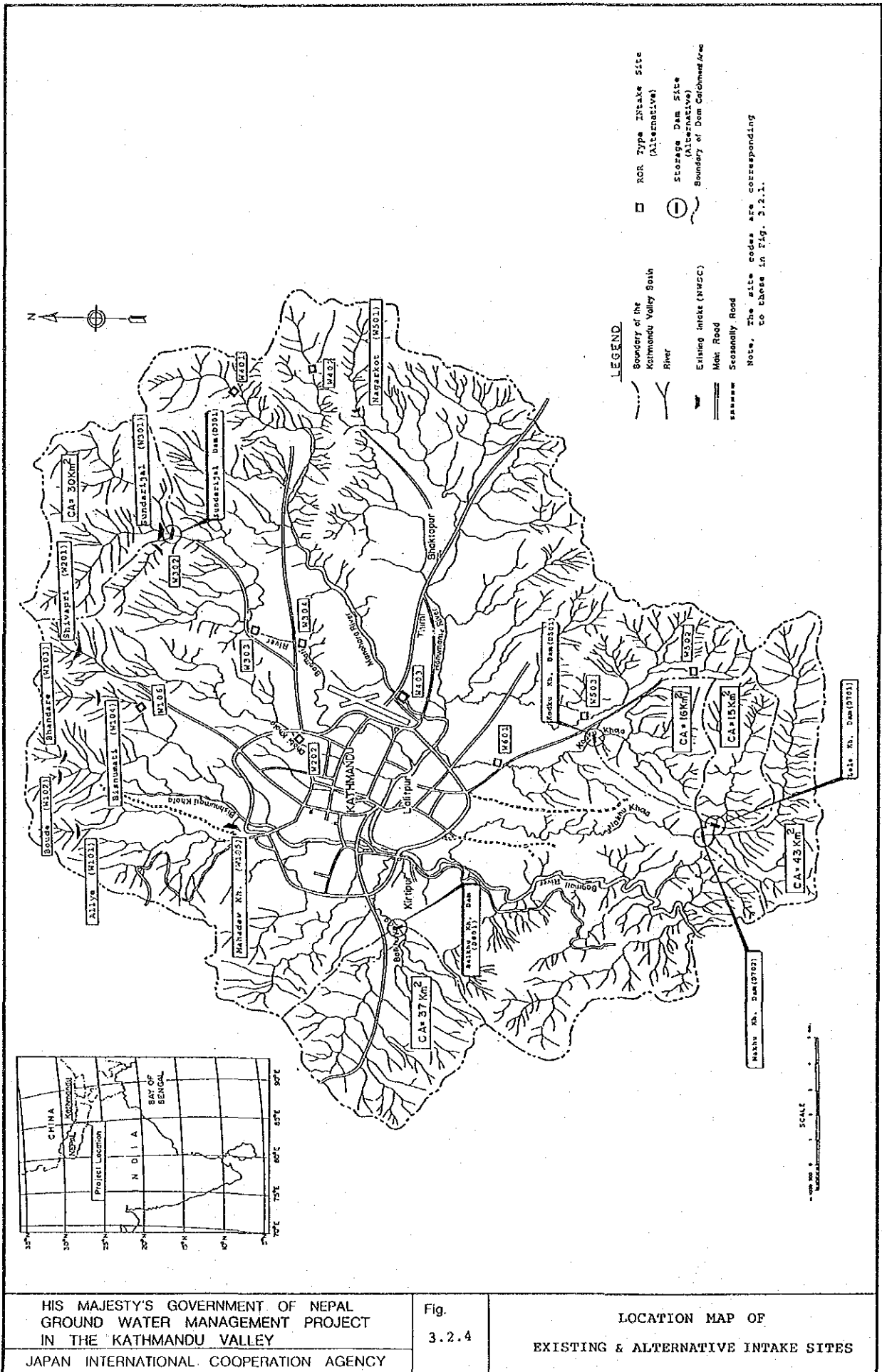
(1965-80)



HIS MAJESTY'S GOVERNMENT OF NEPAL
GROUND WATER MANAGEMENT PROJECT
IN THE KATHMANDU VALLEY
JAPAN INTERNATIONAL COOPERATION AGENCY

Fig.
3.2.3

NET RIVER RUNOFF AT COBHAR
(PRESENT CONDITION)

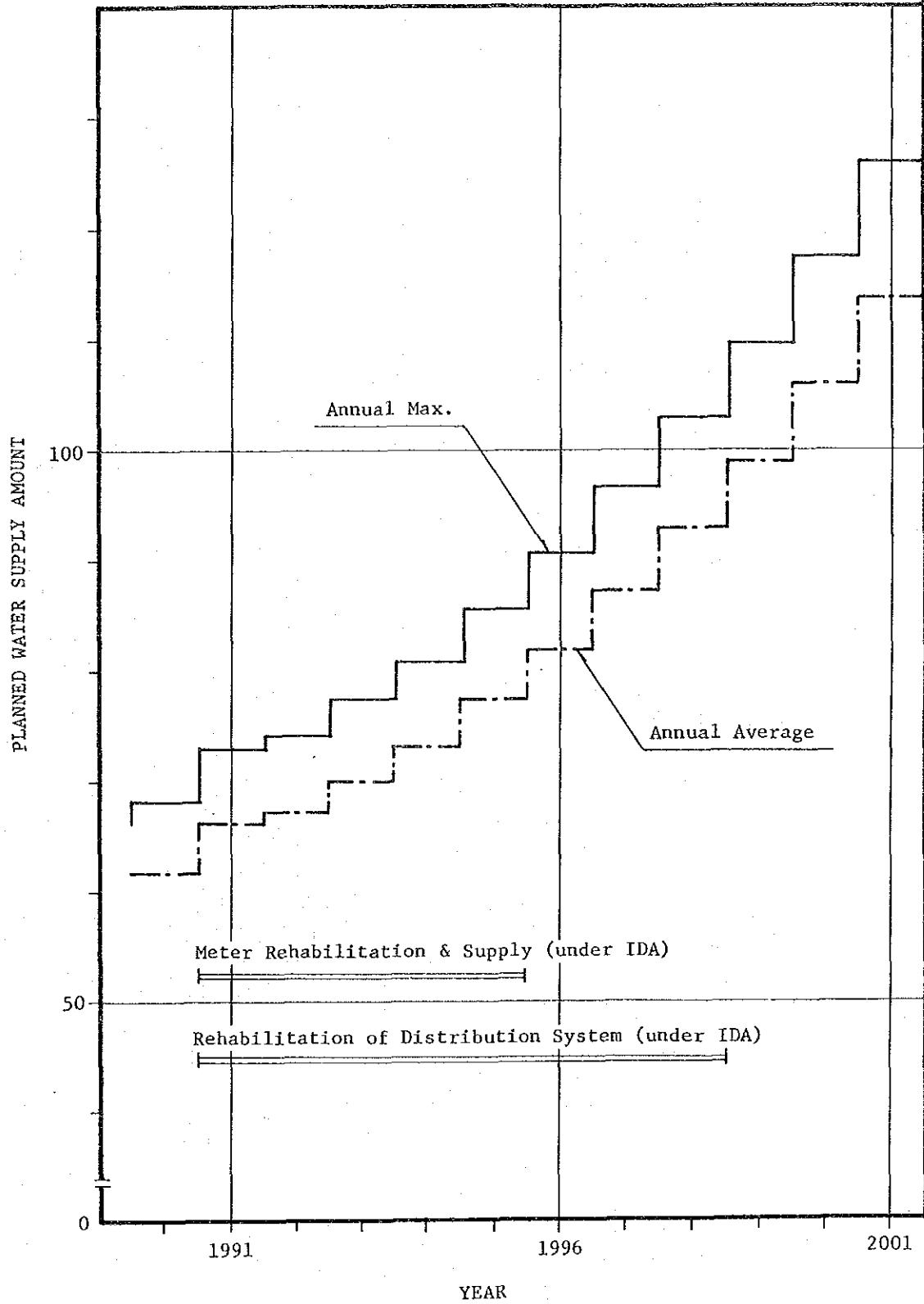


HIS MAJESTY'S GOVERNMENT OF NEPAL
 GROUND WATER MANAGEMENT PROJECT
 IN THE KATHMANDU VALLEY
 JAPAN INTERNATIONAL COOPERATION AGENCY

Fig. 3.2.4

LOCATION MAP OF
 EXISTING & ALTERNATIVE INTAKE SITES

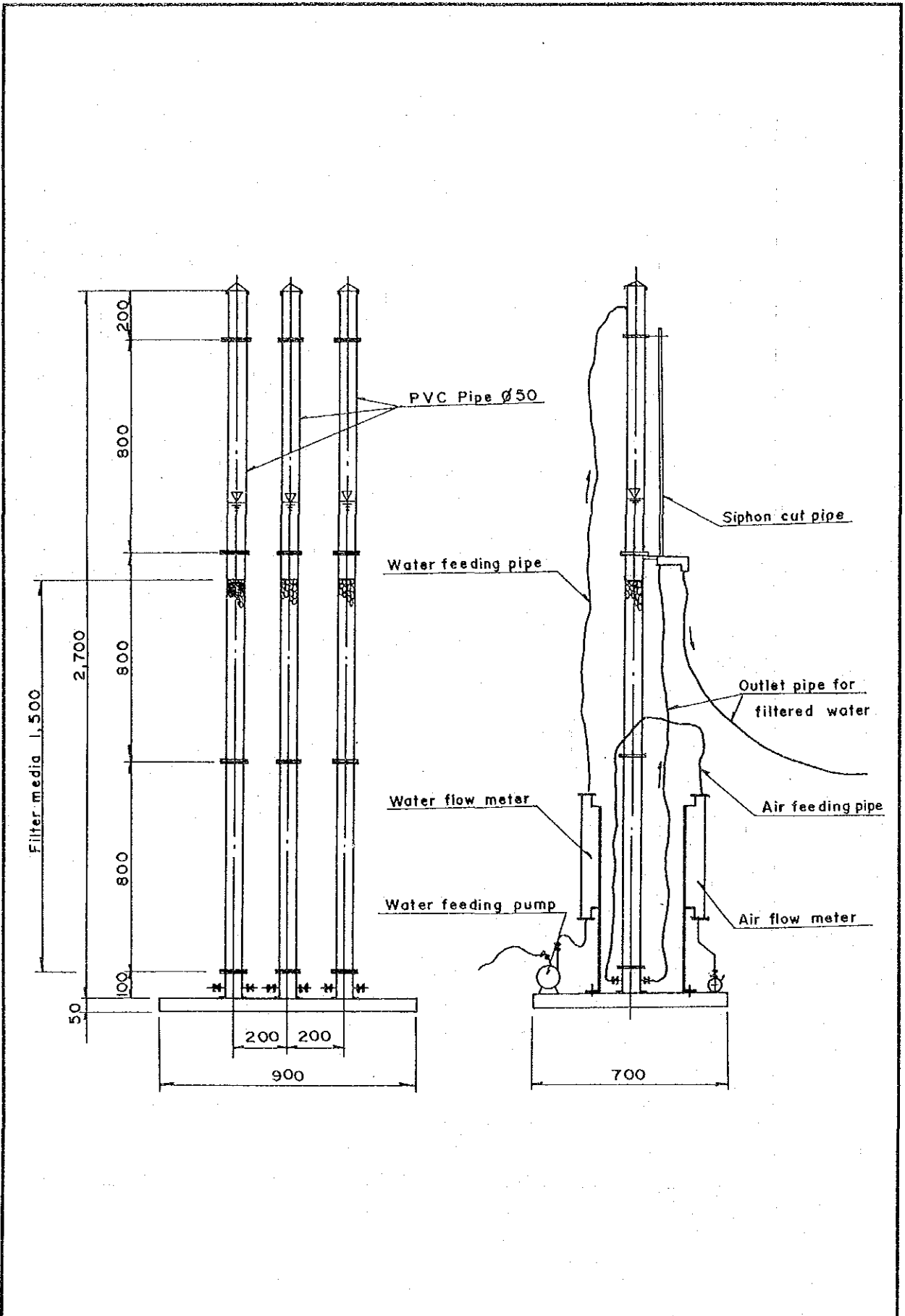
(1000m³/d)



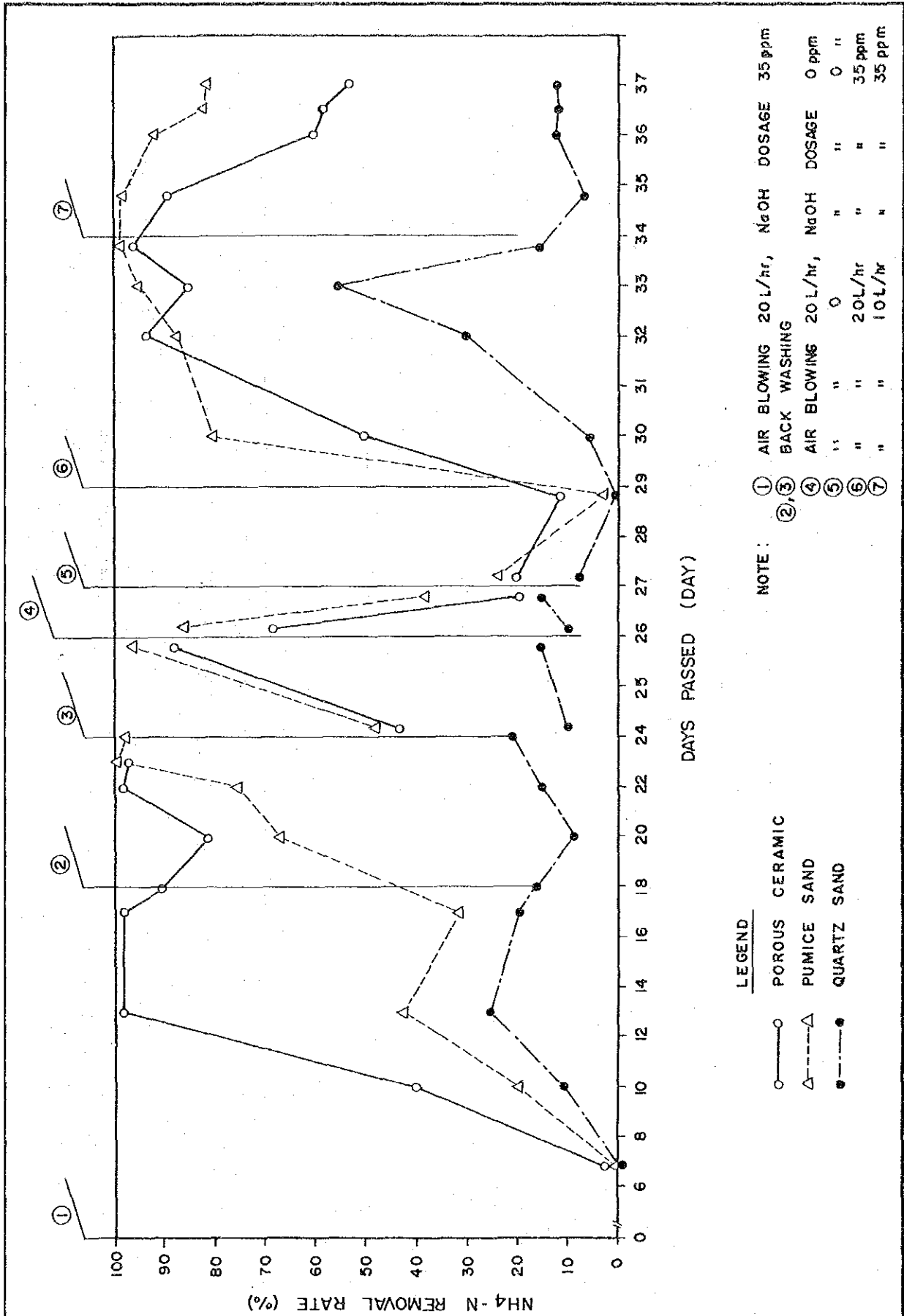
HIS MAJESTY'S GOVERNMENT OF NEPAL
GROUND WATER MANAGEMENT PROJECT
IN THE KATHMANDU VALLEY
JAPAN INTERNATIONAL COOPERATION AGENCY

Fig.
5.2.1

PLANNED WATER SUPPLY AMOUNT



| | | |
|---|-----------------------|--|
| <p>HIS MAJESTY'S GOVERNMENT OF NEPAL GROUND WATER MANAGEMENT PROJECT IN THE KATHMANDU VALLEY JAPAN INTERNATIONAL COOPERATION AGENCY</p> | <p>Fig. 5.3.1</p> | <p>EQUIPMENT OF BIOLOGICAL FILTRATION EXPERIMENT</p> |
|---|-----------------------|--|



NOTE :

| | | | | |
|-----|---------------------|--------|--------|--------|
| ① | AIR BLOWING 20L/hr, | NaOH | DOSAGE | 35 ppm |
| ②,③ | BACK WASHING | | | |
| ④ | AIR BLOWING 20L/hr, | NaOH | DOSAGE | 0 ppm |
| ⑤ | " " | " | " | 0 " |
| ⑥ | " " | 20L/hr | " | 35 ppm |
| ⑦ | " " | 10L/hr | " | 35 ppm |

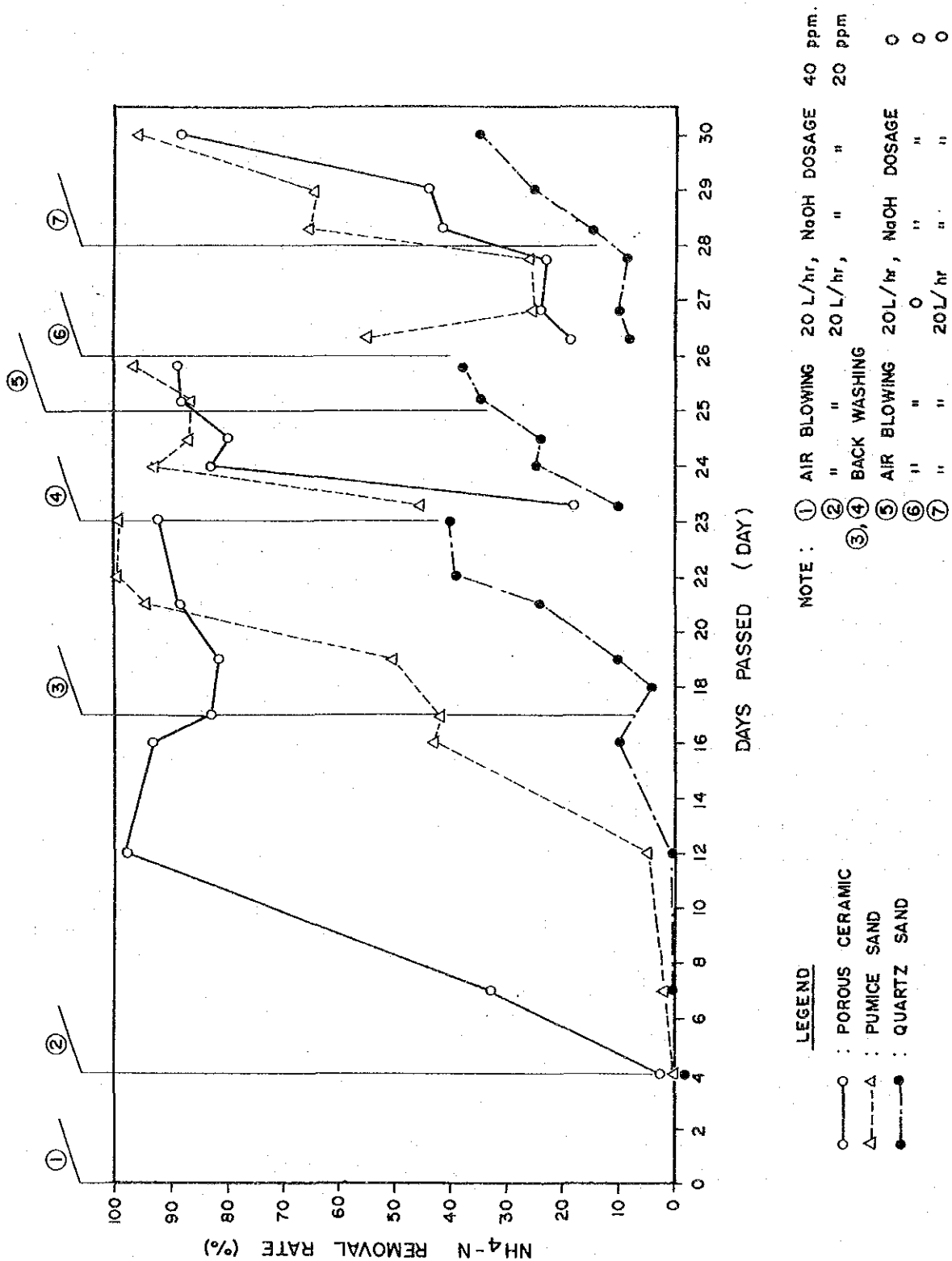
LEGEND

- ——— POROUS CERAMIC
- △ ——— PUMICE SAND
- ——— QUARTZ SAND

HIS MAJESTY'S GOVERNMENT OF NEPAL
 GROUND WATER MANAGEMENT PROJECT
 IN THE KATHMANDU VALLEY
 JAPAN INTERNATIONAL COOPERATION AGENCY

Fig. 5.3.2
 (1/2)

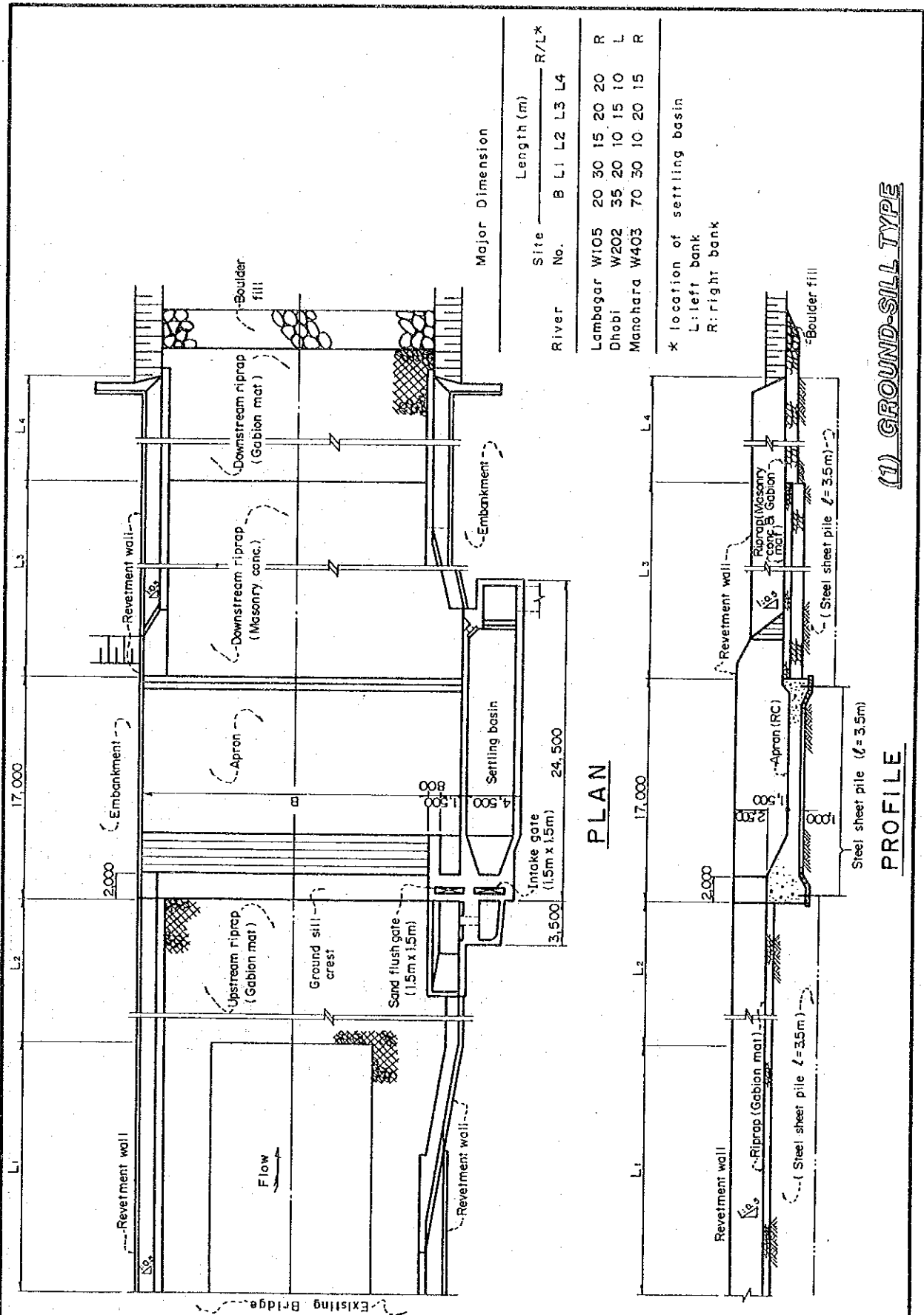
VARIATION IN NH₄-N REMOVAL RATE
 (DK5 WELL)



HIS MAJESTY'S GOVERNMENT OF NEPAL
GROUND WATER MANAGEMENT PROJECT
IN THE KATHMANDU VALLEY
JAPAN INTERNATIONAL COOPERATION AGENCY

Fig. 5.3.2
(2/2)

VARIATION IN NH₄-N REMOVAL RATE
(BANSBARI RESERVOIR)



(1) GROUND-SILL TYPE

PROFILE

HIS MAJESTY'S GOVERNMENT OF NEPAL
GROUND WATER MANAGEMENT PROJECT
IN THE KATHMANDU VALLEY
JAPAN INTERNATIONAL COOPERATION AGENCY

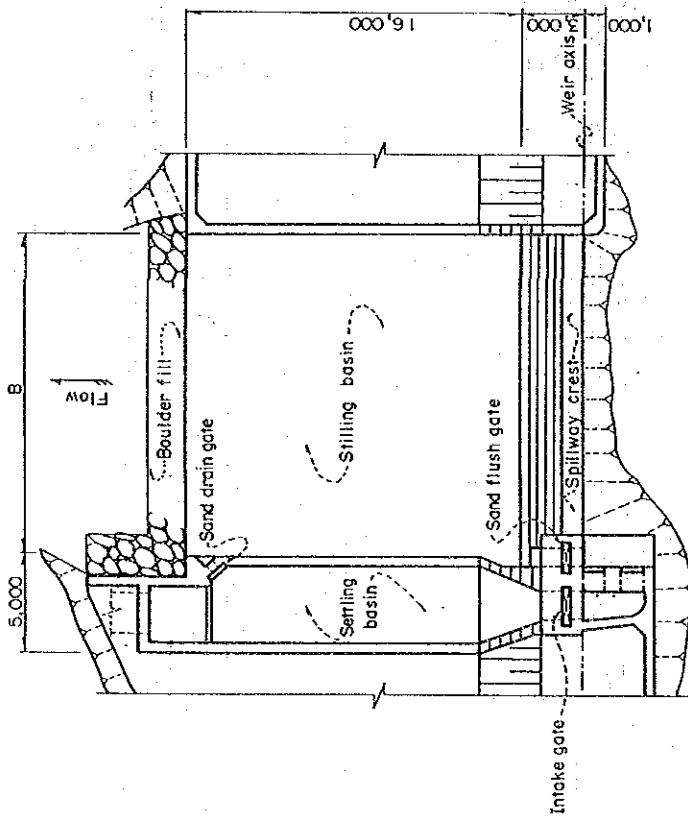
Fig. 5.5.1

GENERAL LAYOUT OF ROR TYPE INTAKE (1)

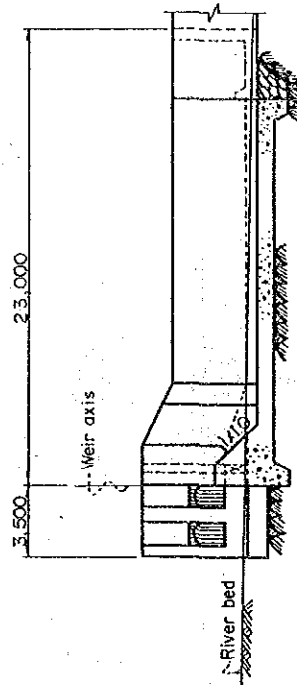
(2) CONCRETE WEIR TYPE

| Major Dimension | | | | | |
|-----------------|----------|------------|----|-----|------|
| River | Site No. | Length (m) | | | R/L* |
| | | B | Hi | H2 | |
| Balkhu | D801 | 16 | 4 | 3.5 | L |
| Bisnumati | W106 | 6.5 | 3 | 2.5 | L |

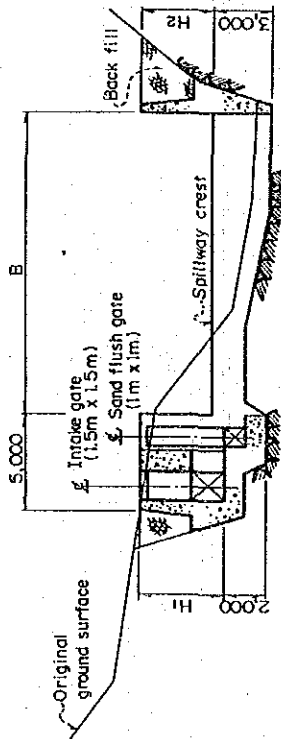
* location of settling basin
 L: left bank
 R: right bank



PLAN



PROFILE



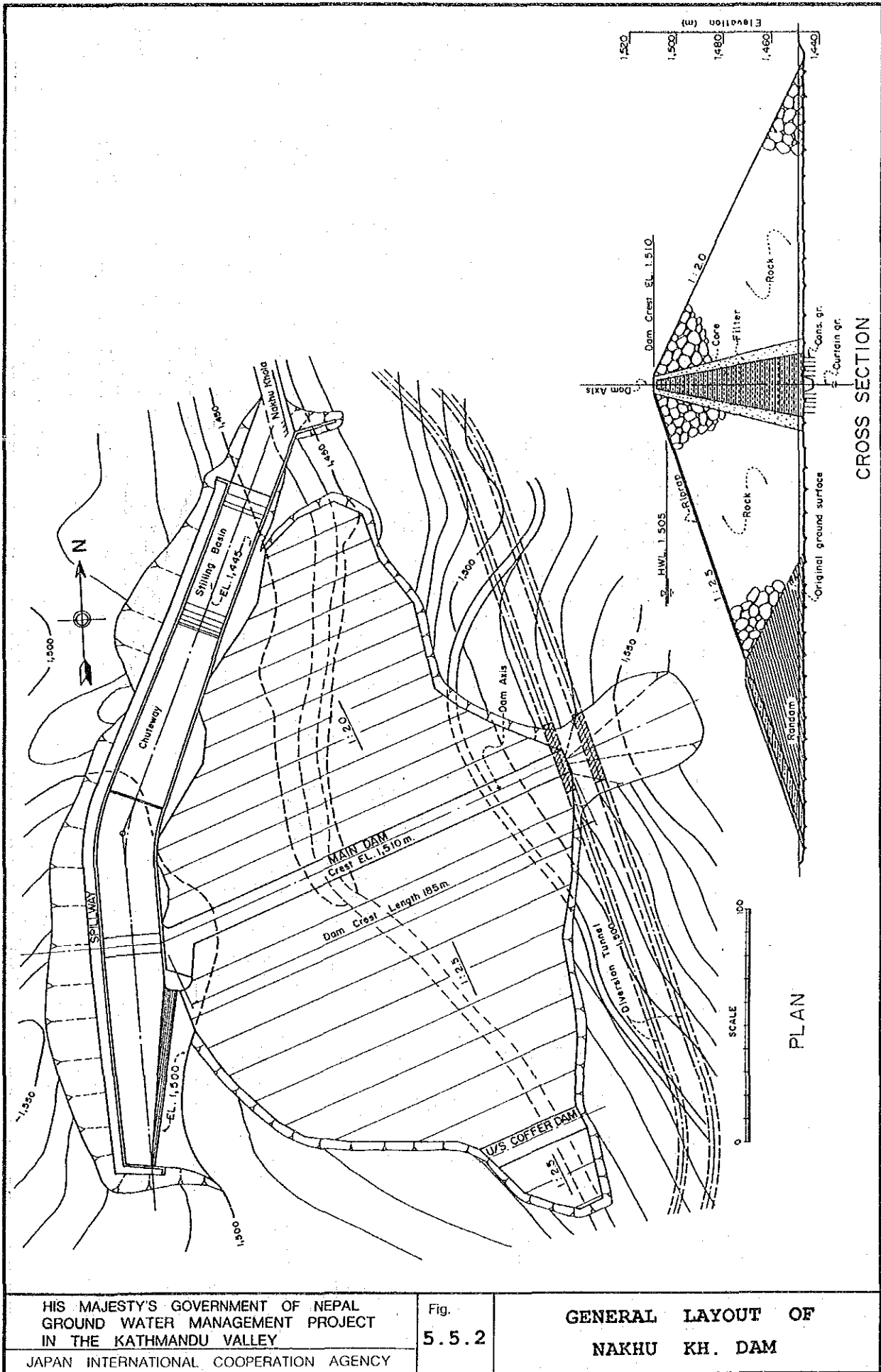
UPSTREAM ELEVATION

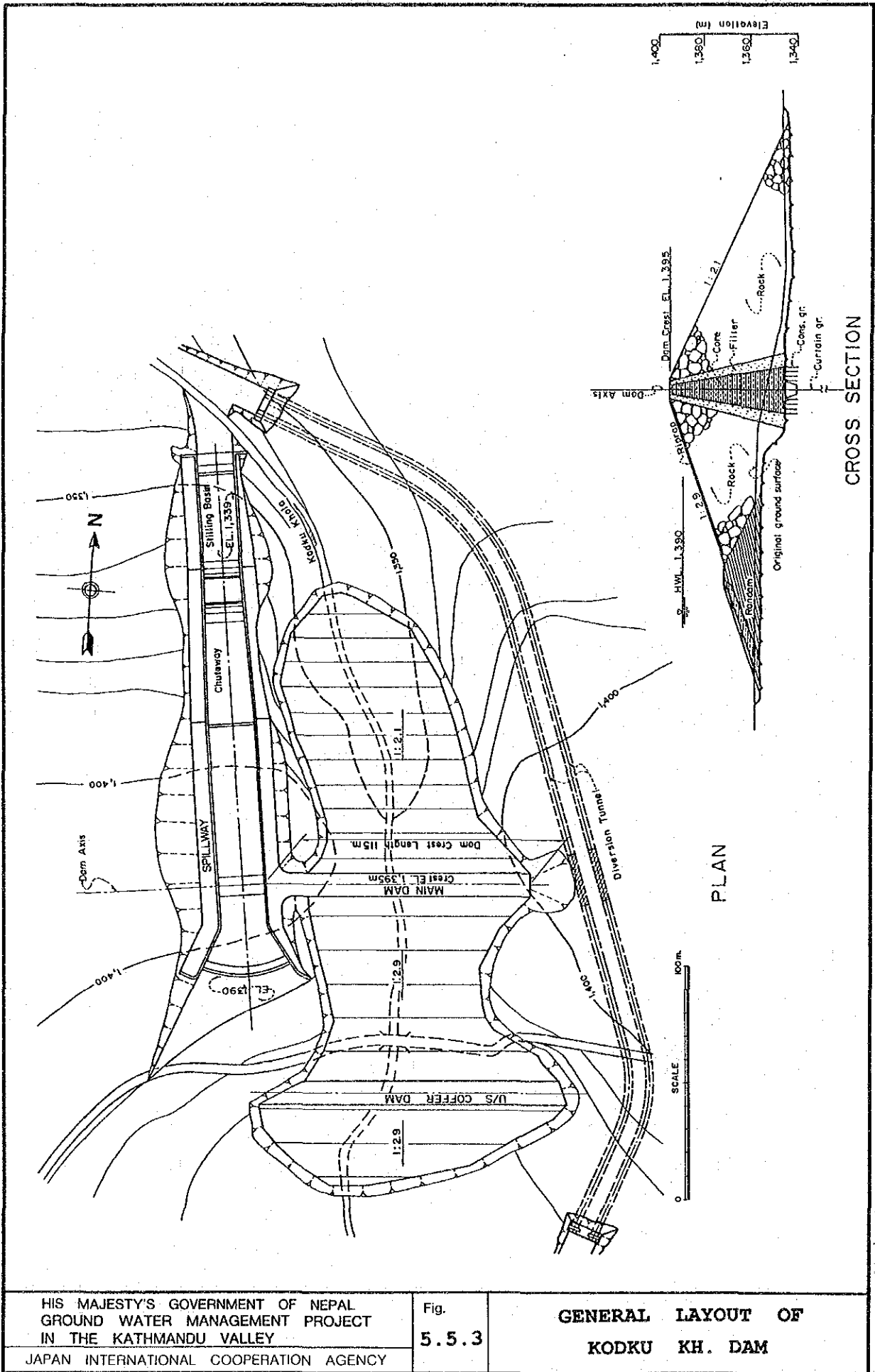
HIS MAJESTY'S GOVERNMENT OF NEPAL
 GROUND WATER MANAGEMENT PROJECT
 IN THE KATHMANDU VALLEY

JAPAN INTERNATIONAL COOPERATION AGENCY

Fig.
 5.5.1

GENERAL LAYOUT OF ROR TYPE INTAKE (2)

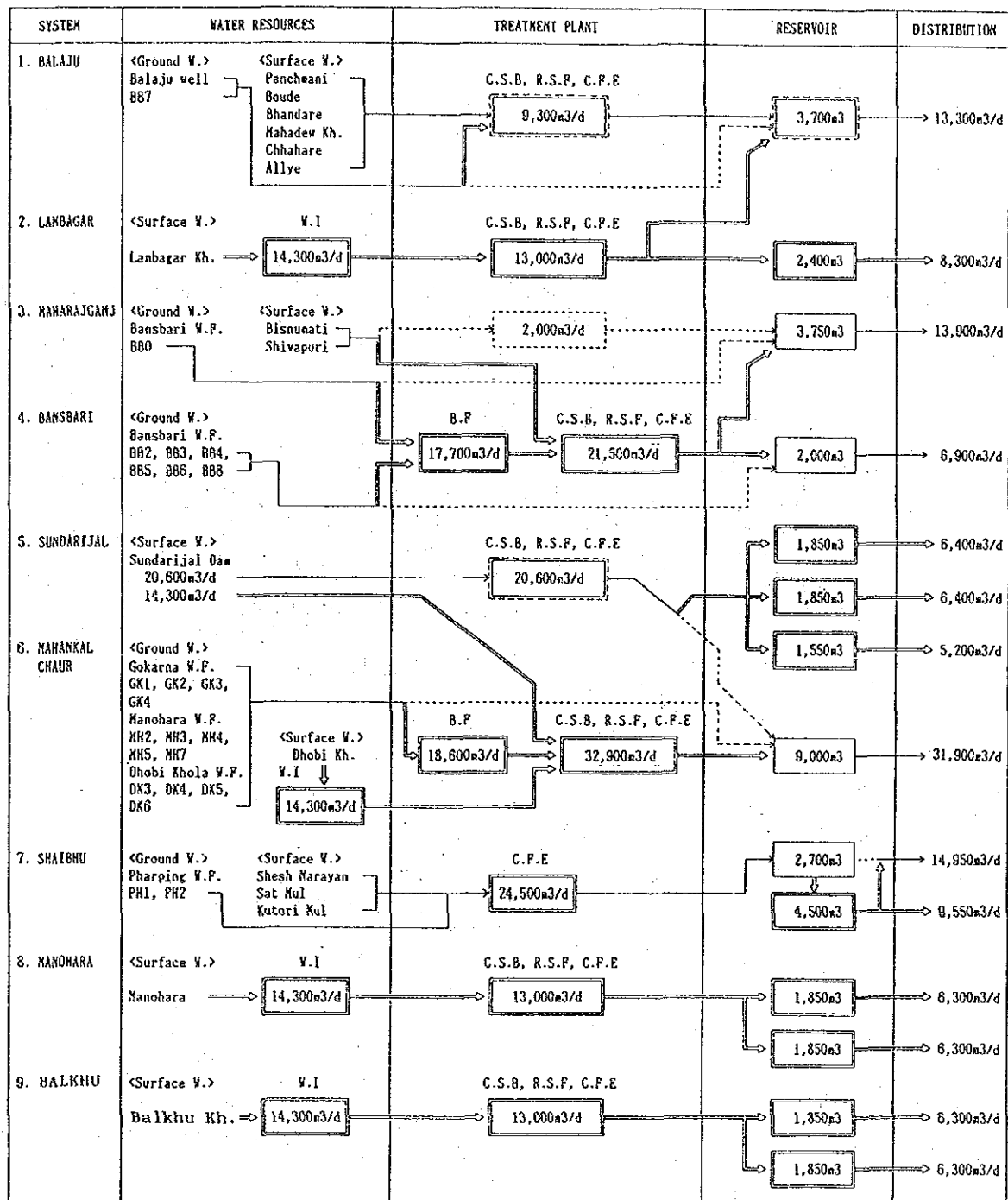




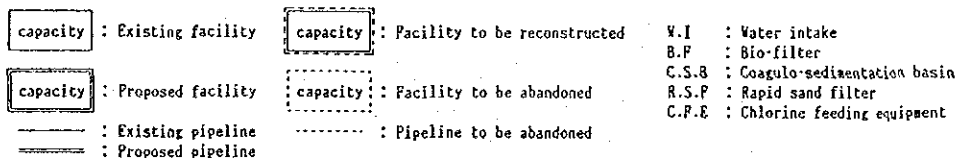
HIS MAJESTY'S GOVERNMENT OF NEPAL
 GROUND WATER MANAGEMENT PROJECT
 IN THE KATHMANDU VALLEY
 JAPAN INTERNATIONAL COOPERATION AGENCY

Fig. 5.5.3

GENERAL LAYOUT OF
 KODKU KH. DAM



LEGEND

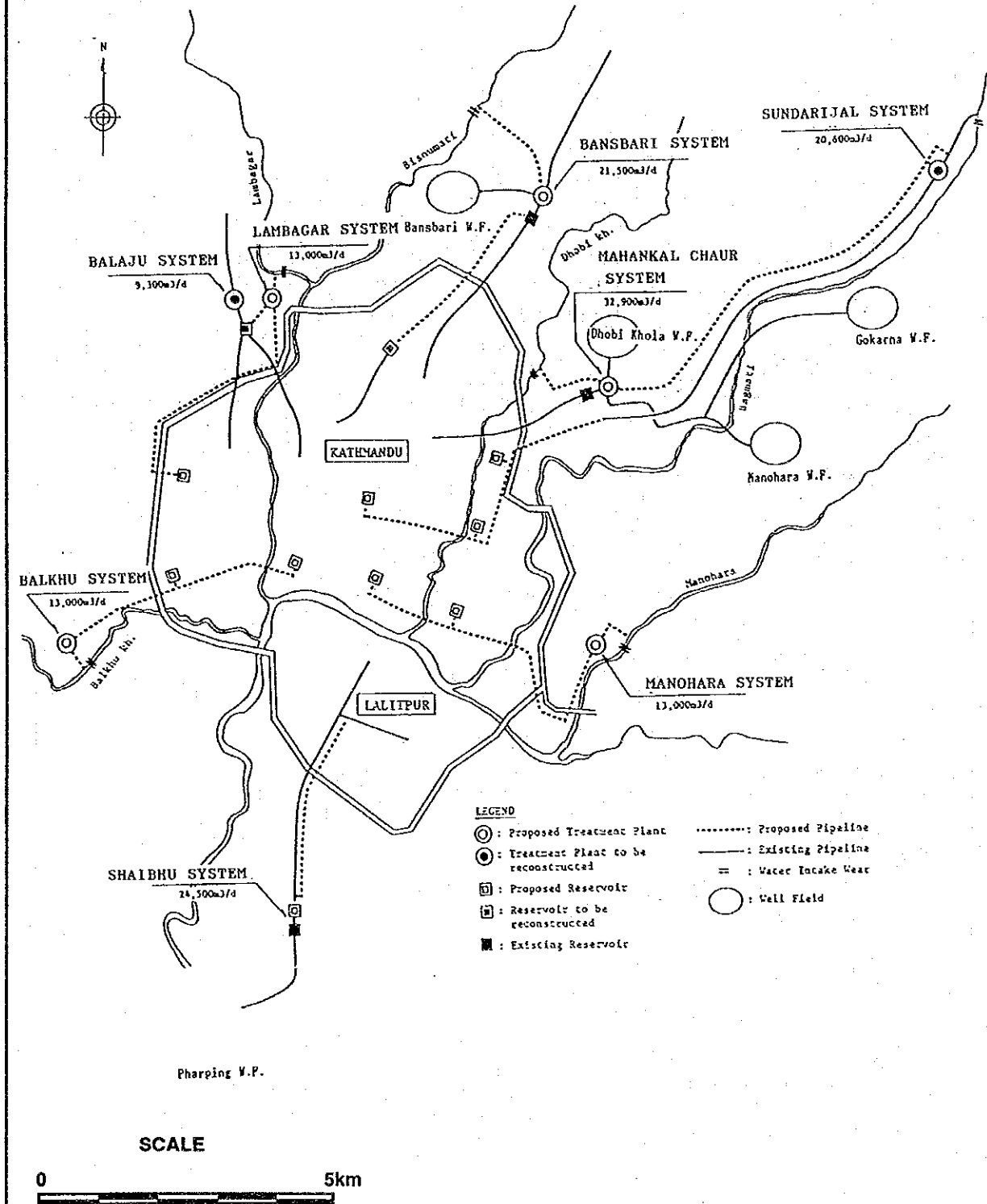


HIS MAJESTY'S GOVERNMENT OF NEPAL
GROUND WATER MANAGEMENT PROJECT
IN THE KATHMANDU VALLEY
JAPAN INTERNATIONAL COOPERATION AGENCY

Fig.
6.2.1

EXISTING AND PROPOSED WATER SUPPLY
SYSTEM

PROPOSED WATER SUPPLY SYSTEM

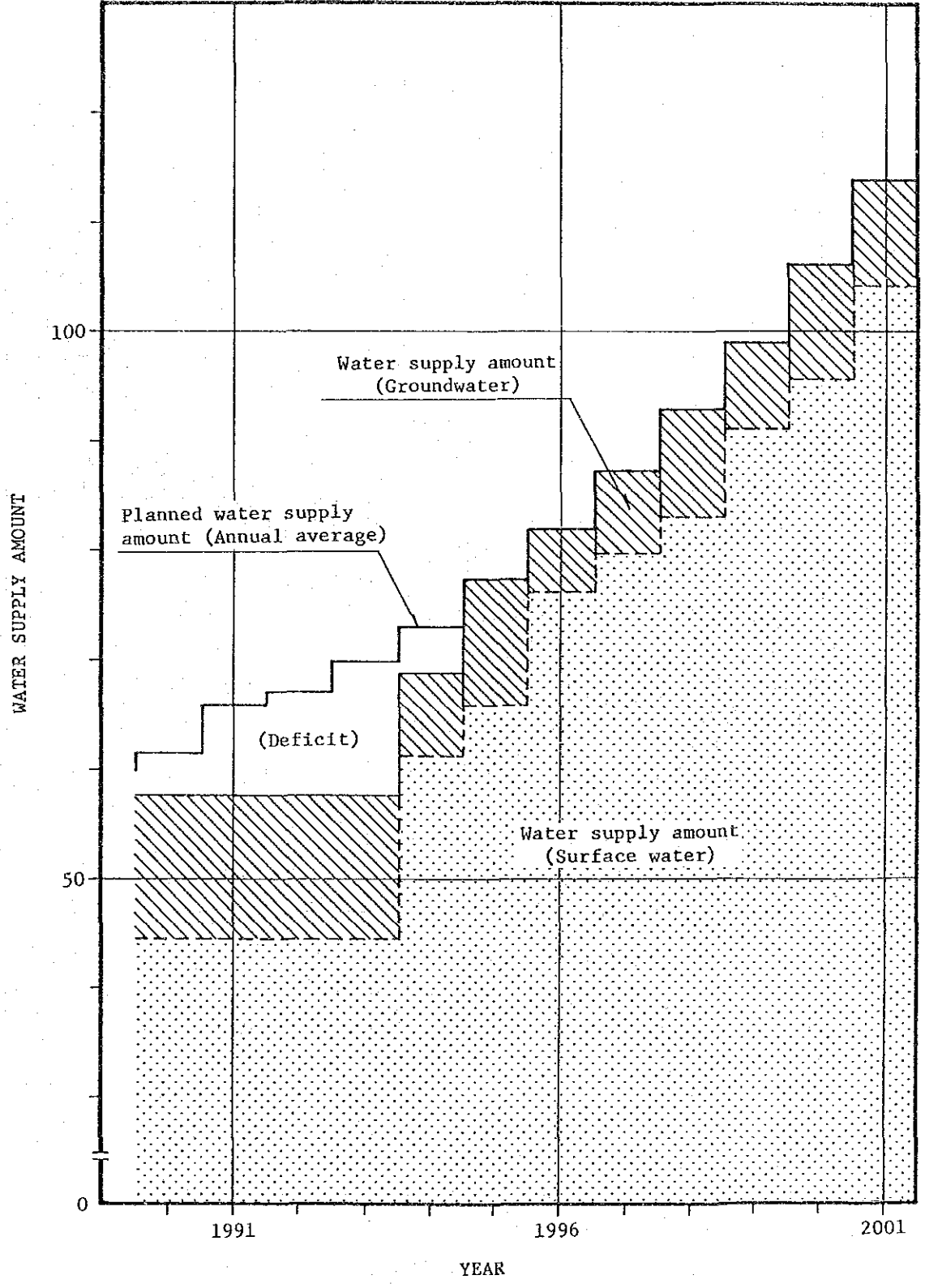


HIS MAJESTY'S GOVERNMENT OF NEPAL
GROUND WATER MANAGEMENT PROJECT
IN THE KATHMANDU VALLEY
JAPAN INTERNATIONAL COOPERATION AGENCY

Fig.
6.2.2

LAYOUT OF PROPOSED WATER SUPPLY
SYSTEM

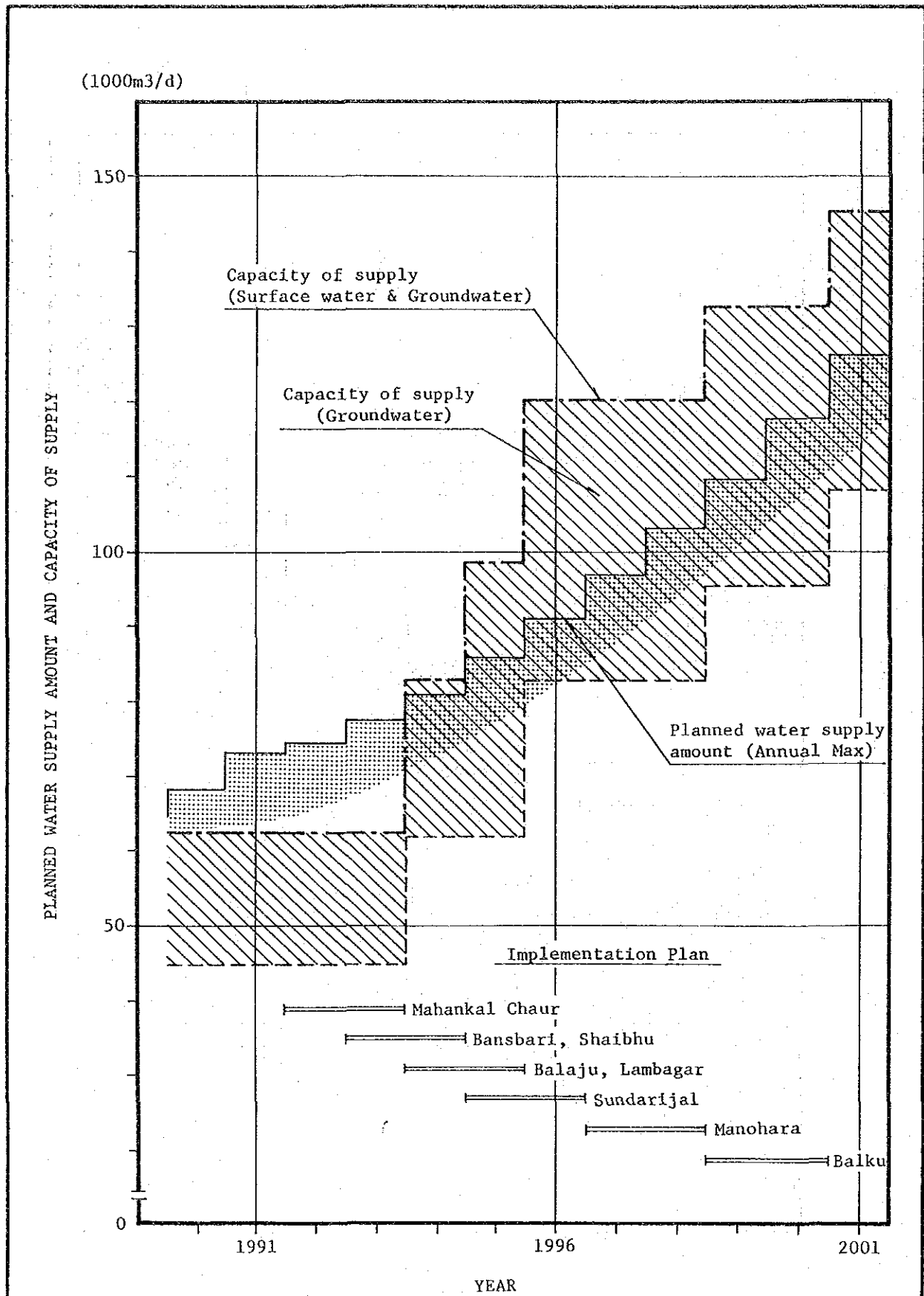
(1000m³/d)



HIS MAJESTY'S GOVERNMENT OF NEPAL
GROUND WATER MANAGEMENT PROJECT
IN THE KATHMANDU VALLEY
JAPAN INTERNATIONAL COOPERATION AGENCY

Fig.
6.3.1

WATER SUPPLY AMOUNT IN EACH YEAR



HIS MAJESTY'S GOVERNMENT OF NEPAL
 GROUND WATER MANAGEMENT PROJECT
 IN THE KATHMANDU VALLEY
 JAPAN INTERNATIONAL COOPERATION AGENCY

Fig. 6.3.2

PLANNED WATER SUPPLY AMOUNT AND
 CAPACITY OF SUPPLY

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