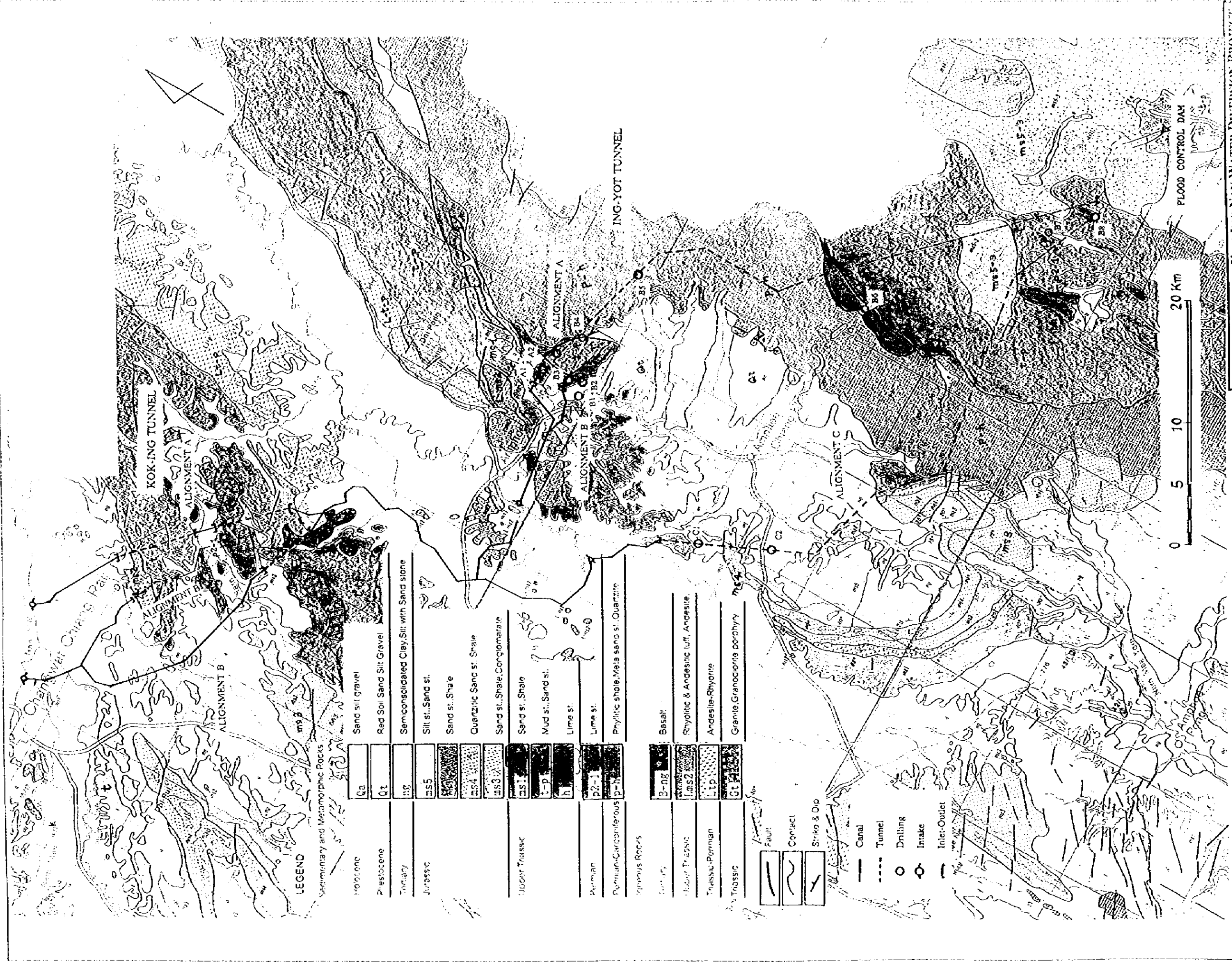


THE STUDY ON THE KOK-ING-NAN WATER DIVERSION PROJECT
 Geological Map of Alternative Water Diversion Plan
 Map & Drawing No.
 JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
 SANYU CONSULTANTS INC. & NIPPON KOEI CO., LTD. Figure 11.1.4-1



LEGEND

Secondary and Metamorphic Rocks	
Quaternary	Qa Sand silt gravel
Pleistocene	Qt Red Soil Sand Silt Gravel
Tertiary	Tg Semiconsolidated Clay Silt with Sand stone
Jurassic	JSS Silt st., Sand st.
	JSSh Sand st., Shale
Upper Triassic	JSS4 Quartzitic Sand st. Shale
	JSS3 Sand st., Shale, Conglomerate
Permian	JSS1 Sand st., Shale
	JSD Mud st., Sand st.
Permian-Carboniferous	h Lime st.
	P2-1 Lime st.
Various Rocks	Psh Phyllitic shale, Meta sand st., Quartzite
	B-Dg Basalt
Lower Triassic	LTS2 Rhyolitic & Andesitic tuff, Andesite.
Triassic-Permian	LTP Andesite-Rhyolite
Triassic	Gt Granite, Granodiorite porphyry

	Fault
	Contact
	Strike & Dip
	Canal
	Tunnel
	Drilling
	Intake
	Inlet-Outlet



THE STUDY ON THE KOK-ING-NAN WATER DIVERSION PROJECT
 Geological Map of Alternative Water Diversion Plan
 Map & Drawing No.
 JAPAN INTERNATIONAL COOPERATION AGENCY (JICA) FIGURE
 SANYU CONSULTANTS INC. & NIPPON KOEI CO. LTD. 11.1-1-1

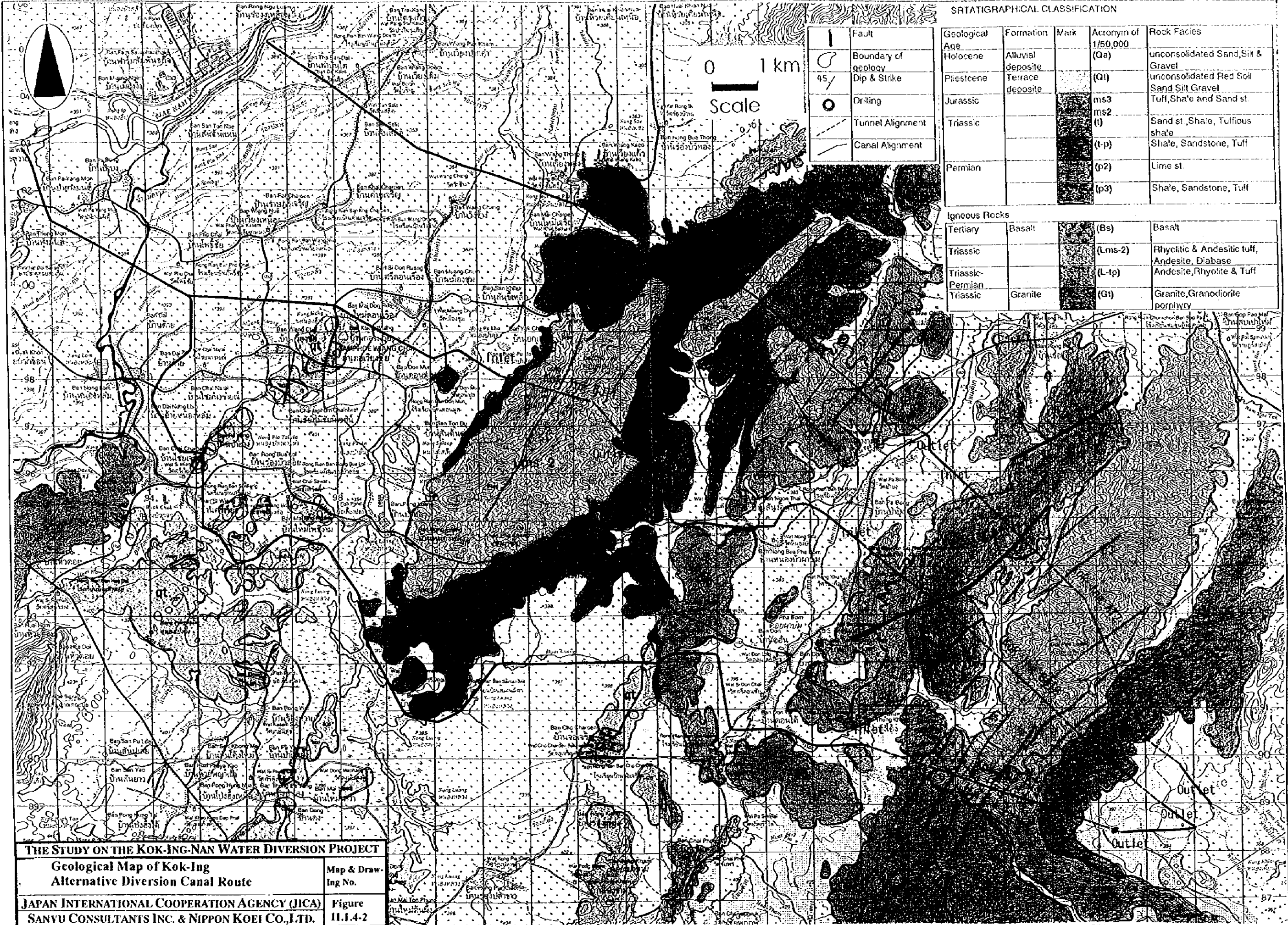
SRTATIGRAPHICAL CLASSIFICATION

Geological Age	Formation	Mark	Acronym of 1/50,000	Rock Facies
Holocene	Alluvial deposit		(Qa)	unconsolidated Sand, Silt & Gravel
Pleistocene	Terrace deposit		(Ql)	unconsolidated Red Soil Sand Silt Gravel
Jurassic			ms3	Tuff, Shale and Sand st.
Triassic			ms2 (l)	Sand st., Shale, Tuffeous shale
			(l-p)	Shale, Sandstone, Tuff
Permian			(p2)	Lime st.
			(p3)	Shale, Sandstone, Tuff

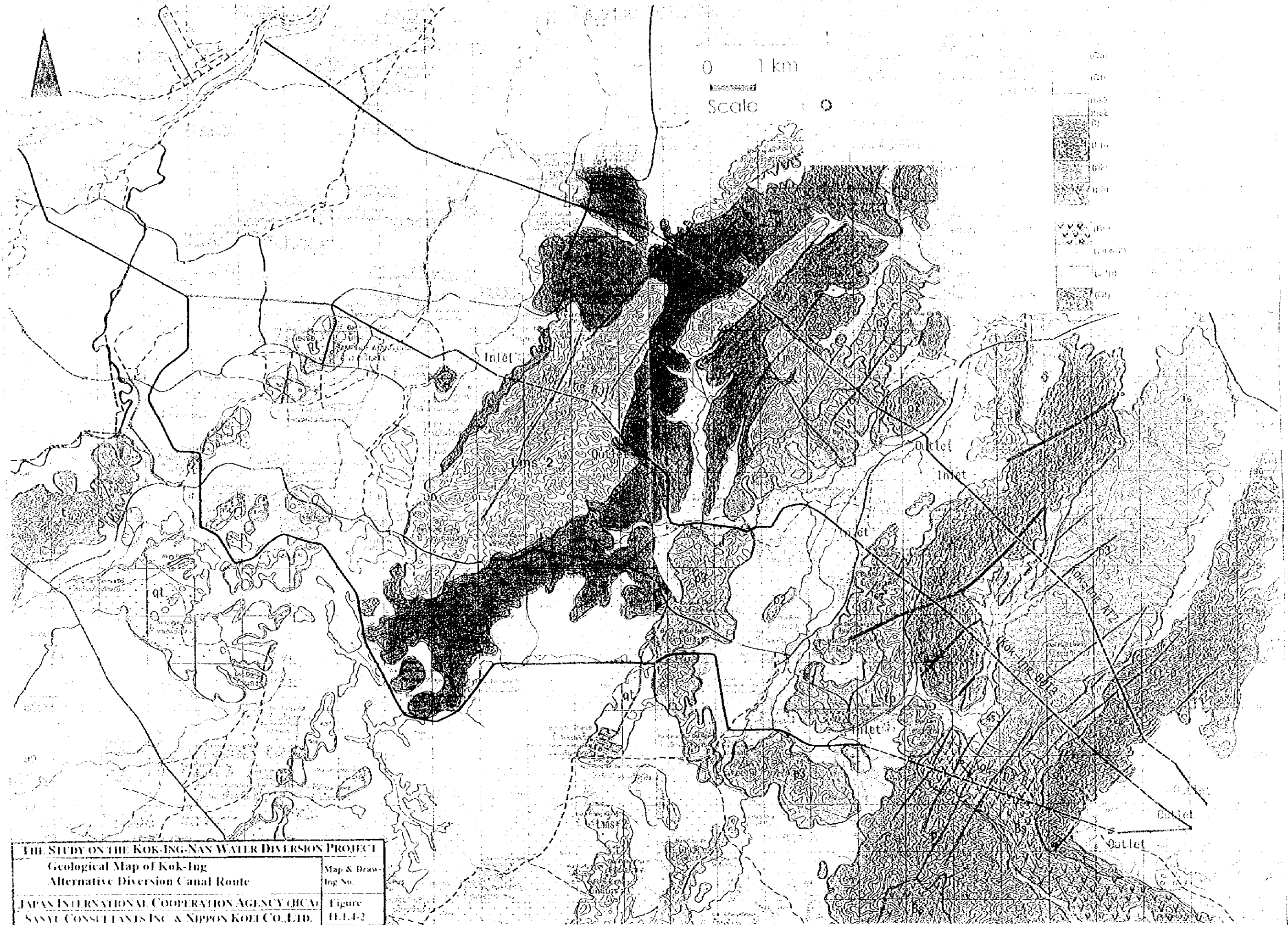
Igneous Rocks			
Tertiary	Basalt		(Bs) Basalt
Triassic			(Lms-2) Rhyolitic & Andesitic tuff, Andesite, Diabase
			(L-p) Andesite, Rhyolite & Tuff
Triassic-Permian	Granite		(Gt) Granite, Granodiorite porphyry
Triassic			

- Fault
- Boundary of geology
- Dip & Strike
- Drilling
- Tunnel Alignment
- Canal Alignment

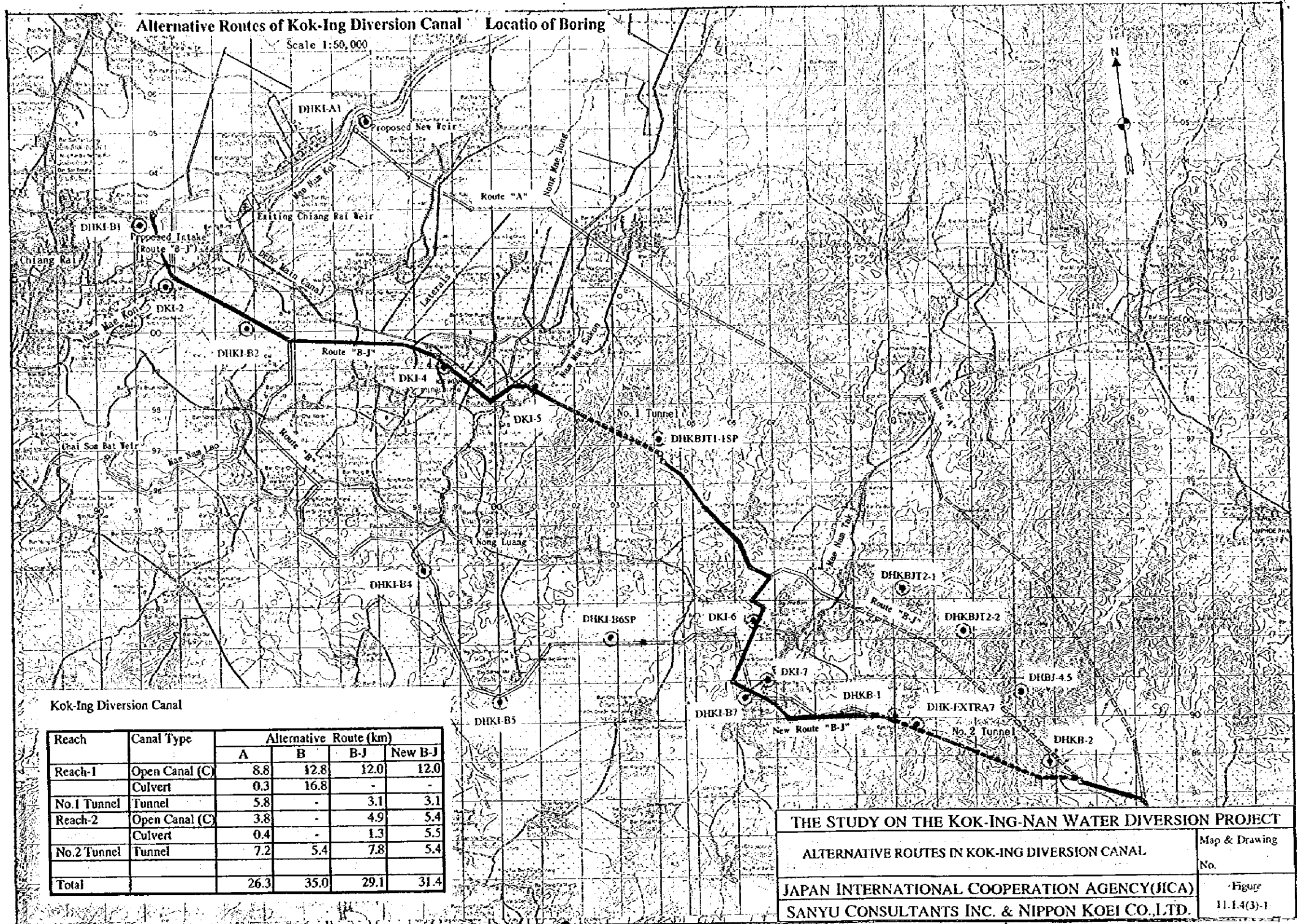
0 1 km
Scale



THE STUDY ON THE KOK-ING-NAN WATER DIVERSION PROJECT
Geological Map of Kok-Ing Alternative Diversion Canal Route
 Map & Draw- Ing No.
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA) Figure
SANYU CONSULTANTS INC. & NIPPON KOEI CO., LTD. II.1.4-2



THE STUDY ON THE KOK-ING-NAN WATER DIVERSION PROJECT	
Geological Map of Kok-Ing Alternative Diversion Canal Route	
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	Map & Draw- ing No.
SANYI CONSULTANTS INC. & NIPPON KOGI CO., LTD.	Figure H.1.1-2



Alternative Routes of Kok-Ing Diversion Canal Location of Boring

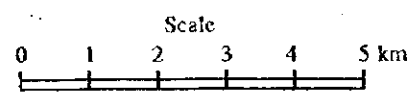
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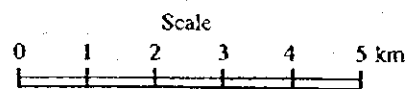
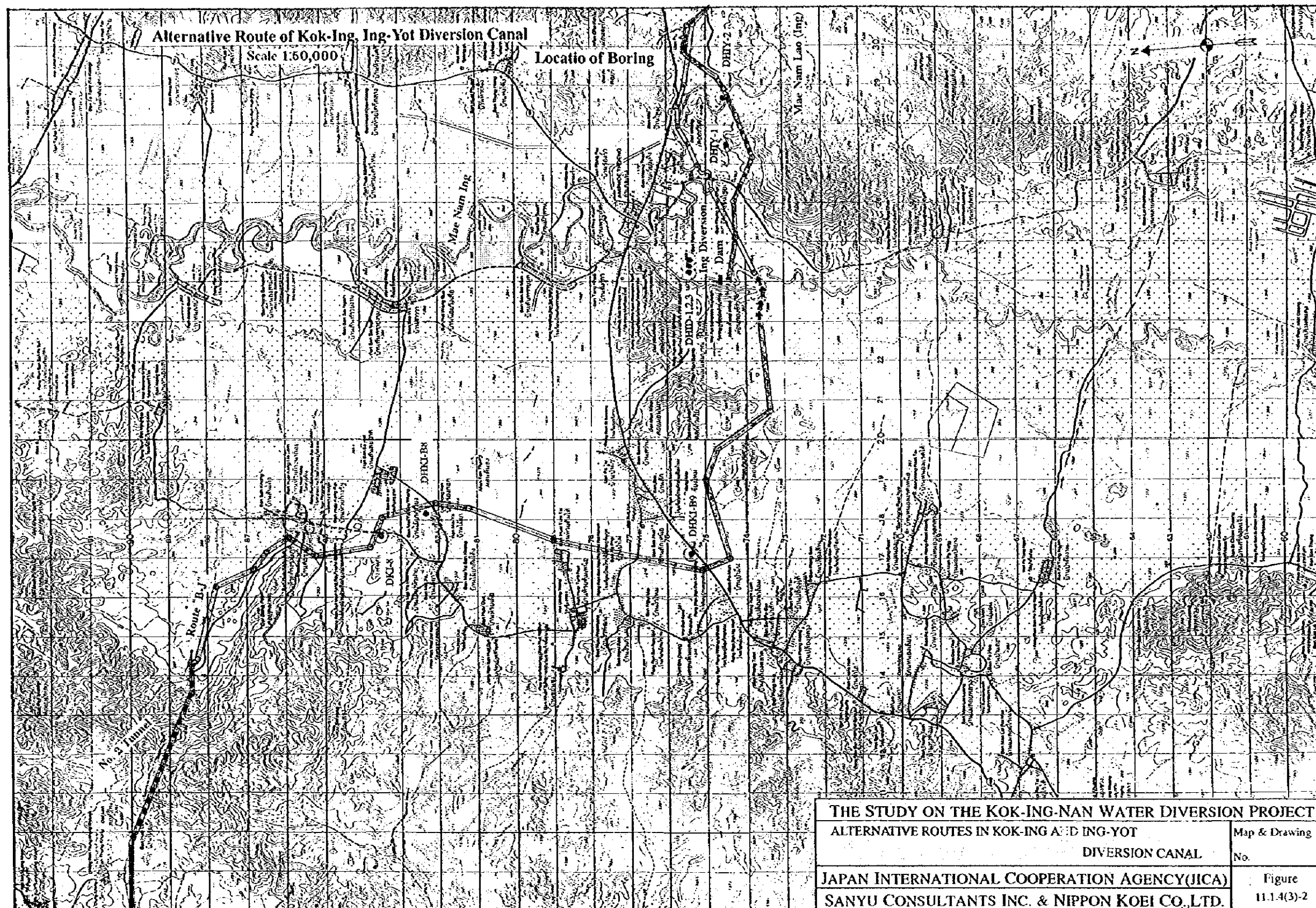
Kok-Ing Diversion Canal

Reach	Canal Type	Alternative Route (km)			
		A	B	B-J	New B-J
Reach-1	Open Canal (C)	8.8	12.8	12.0	12.0
	Culvert	0.3	16.8	-	-
No.1 Tunnel	Tunnel	5.8	-	3.1	3.1
Reach-2	Open Canal (C)	3.8	-	4.9	5.4
	Culvert	0.4	-	1.3	5.5
No.2 Tunnel	Tunnel	7.2	5.4	7.8	5.4
Total		26.3	35.0	29.1	31.4

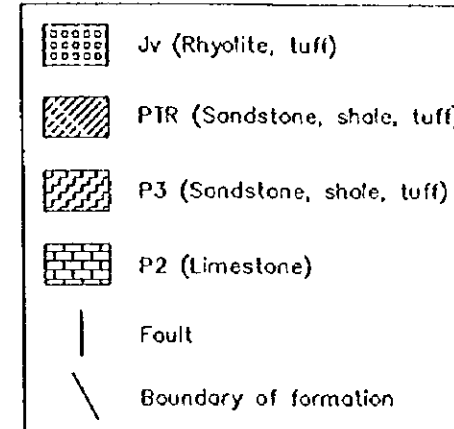
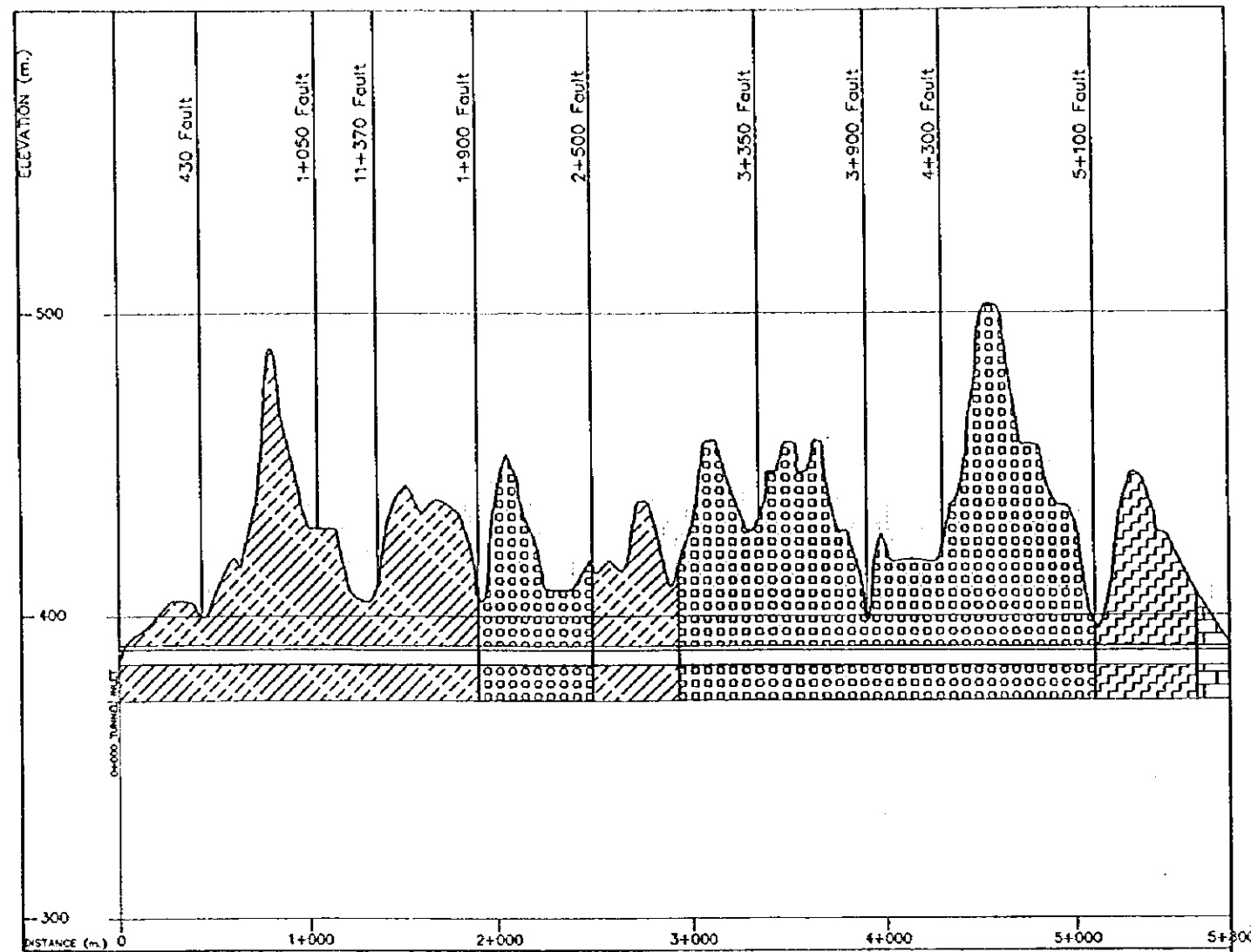
THE STUDY ON THE KOK-ING-NAN WATER DIVERSION PROJECT
 ALTERNATIVE ROUTES IN KOK-ING DIVERSION CANAL
 JAPAN INTERNATIONAL COOPERATION AGENCY(JICA)
 SANYU CONSULTANTS INC. & NIPPON KOEI CO.,LTD.

Map & Drawing No. Figure 11.1.4(3)-1





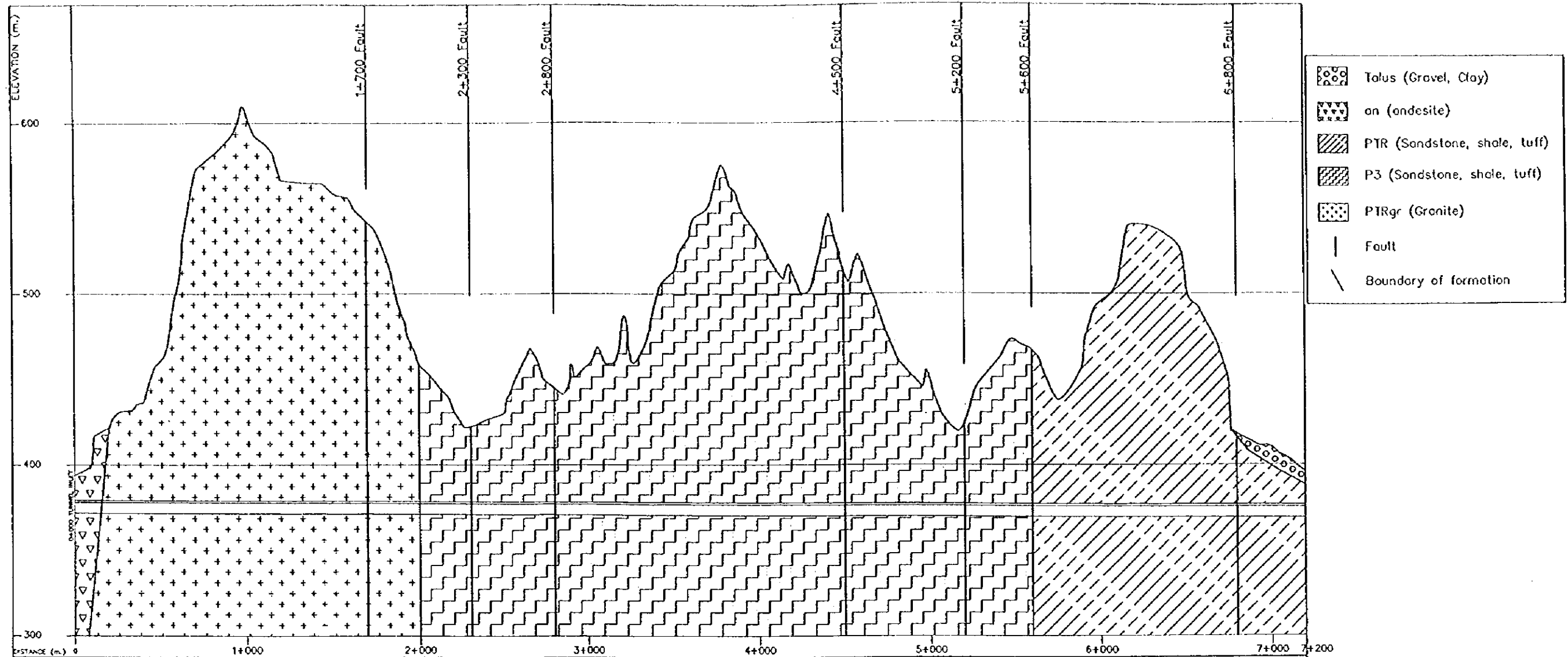
**GEOLOGICAL PROFILE OF ALTERNATIVE TUNNEL ROUTE
KOK-ING NO.1 TUNNEL (A ROUTE)**



Geological Condition	Shale, tuff highly weathered condition	Shale, tuff weathered, cracky and clayey along the fault zone	Rhyolitic tuff highly weathered	Shale, tuff highly weathered	Rhyolitic tuff, weathered breakable along bedding plane, cracky and clayey along the fault zone	Sandstone, shale highly weathered
Rock mass classification	D	D-CL, CL, O	D	E-CL	D	D-CL, D, CL, CM, CL, D, D-CL, D
Tunnel type	E2	E1, D2	E1(30%), E2(70%)			D2, D1, D2, E1(30%), E2(70%)

THE STUDY ON KOK-ING-NAN WATER DIVERSION PROJECT	
GEOLOGICAL PROFILE OF ALTERNATIVE TUNNEL ROUTE KOK-ING NO.1 TUNNEL (A ROUTE)	MAP & Drawing No.
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	Figure 11.1.4.
SANYU CONSULTANTS INC. & NIPPON KOEI CO.,LTD.	(3)-3

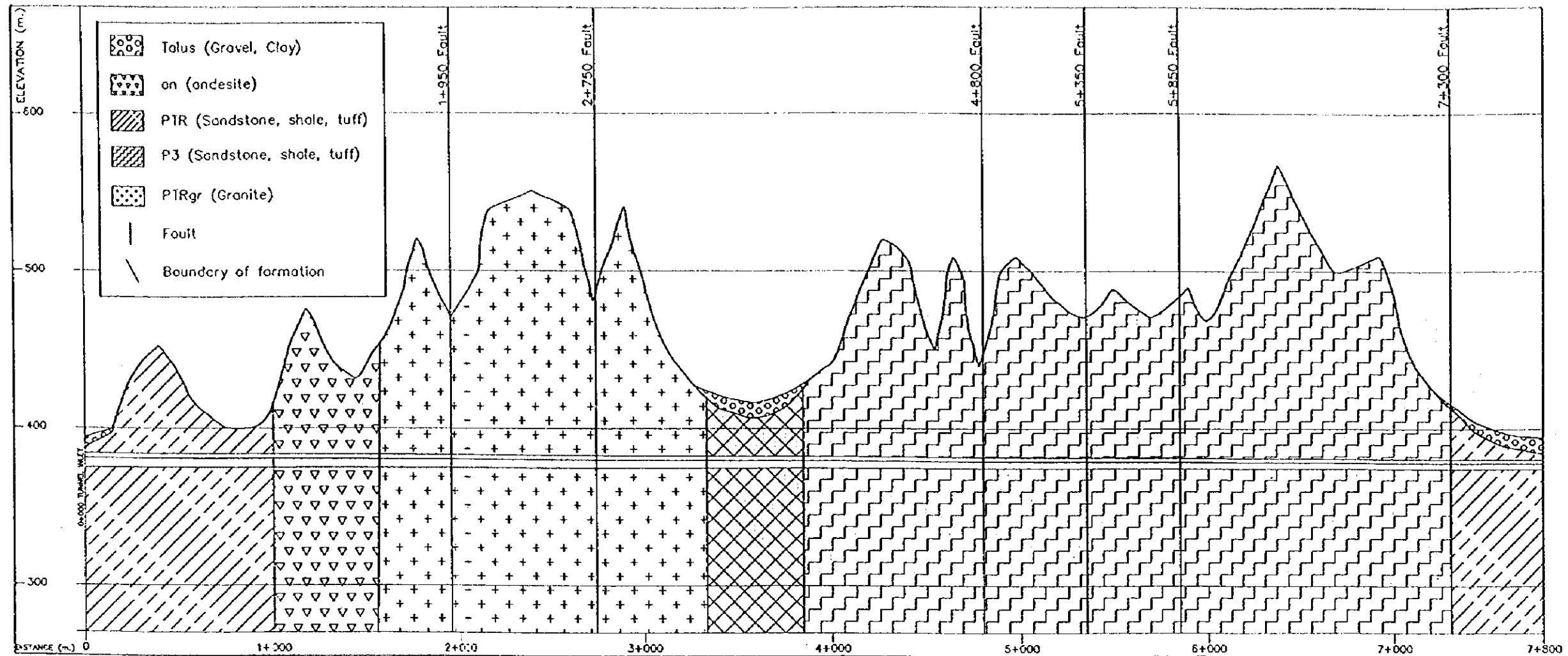
GEOLOGICAL PROFILE OF ALTERNATIVE TUNNEL ROUTE KOK-ING NO.2 TUNNEL (A ROUTE)



Geological Condition	Andesite highly weathered (clayey)				Granite, hard, cracky along joint highly weathered around inlet				Sandstone, shale, tuff fractured zone (fault zone) clayey				Sandstone, shale, tuff cracky, easily breakable along bedding plane				Sandstone, shale, tuff, cracky, easily breakable along fault			
Rock mass classification	D	CL	CM	CL	D	CL	D	CL	CM	CL	D	CL	D	CL	D	CL	CM	CL	D	
Tunnel type	E1(30%) E2(70%)	D2	C2(50%) D1(50%)	E1(50%) E2(50%)	E2	D2	C2(50%) D1(50%)	E1(70%) E2(30%)	D2(30%), E1(40%), E2(30%)	C2(50%) D1(50%)	D2	E1(30%) E2(70%)								

THE STUDY ON KOK-ING-NAN WATER DIVERSION PROJECT	
GEOLOGICAL PROFILE OF ALTERNATIVE TUNNEL ROUTE KOK-ING NO.2 TUNNEL (A ROUTE)	MAP & Drawing No.
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	Figure 11.1.4.
SANYU CONSULTANTS INC. & NIPPON KOEI CO.,LTD.	(3)-4

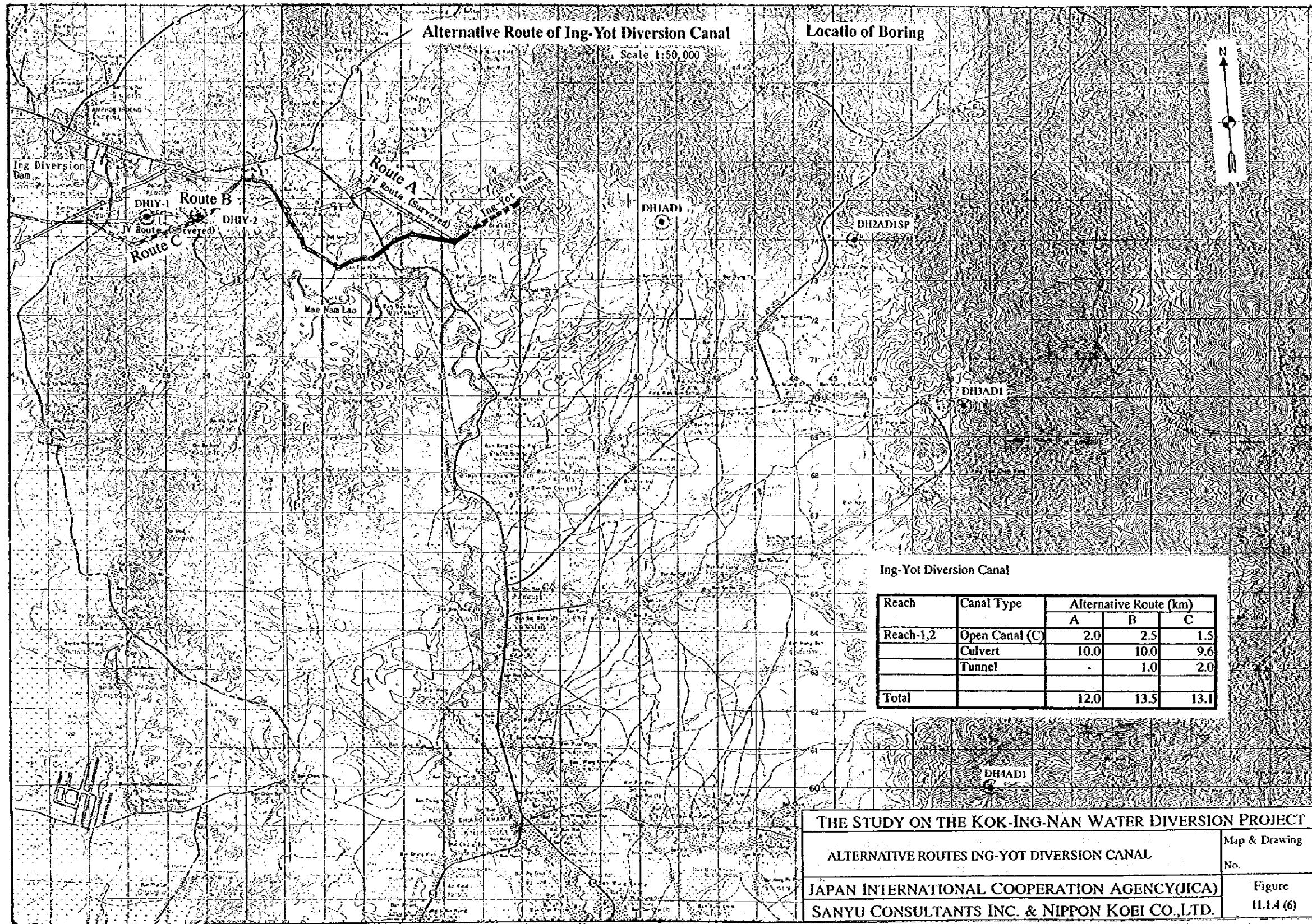
**GEOLOGICAL PROFILE OF ALTERNATIVE TUNNEL ROUTE
KOK-ING NO.2 TUNNEL (B-J ROUTE)**



Geological Condition	Sandstone, shale, tuff highly weathered (clayey)				Andesite highly weathered		Granite, hard, cracky along joint					Fractured zone (fault zone) clayey. Special attention should be paid to the occurrence of water discharge					Sandstone, shale, tuff cracky, easily breakable along bedding plane					Sandstone, shals, tuff cracky (clayey)			
	D	CL	D	CL	D	CL	D	CL	CM	CL	D	CL	D-CL	D	D-CL	CL	CM	D-CL	CM	CL	D	CL	CM	CL	D
Tunnel type	E2	D2(30%) E1(70%)	E2	D2(50%) E1(50%)	E2	D2(50%) E1(50%)	E2	D2(50%) E1(50%)	D1	D2(50%) E1(50%)	D-CL	E2	D	D-CL	CL	CM	D-CL	D1	D2(50%) E1(50%)	D1	D2(20%), E1(30%), E2(50%)	D1	D2	E1	E2

D2(50%), E1(50%)

THE STUDY ON KOK-ING-NAN WATER DIVERSION PROJECT	
GEOLOGICAL PROFILE OF ALTERNATIVE TUNNEL ROUTE KOK-ING NO.2 TUNNEL (B-J ROUTE)	MAP & Drawing No.
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	
SANYU CONSULTANTS INC. & NIPPON KOEI CO.,LTD.	
Figure 11.1.4. (3)-5	



Ing-Yot Diversion Canal

Reach	Canal Type	Alternative Route (km)		
		A	B	C
Reach-1,2	Open Canal (C)	2.0	2.5	1.5
	Culvert	10.0	10.0	9.6
	Tunnel	-	1.0	2.0
Total		12.0	13.5	13.1

THE STUDY ON THE KOK-ING-NAN WATER DIVERSION PROJECT

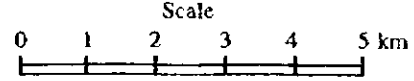
ALTERNATIVE ROUTES ING-YOT DIVERSION CANAL

JAPAN INTERNATIONAL COOPERATION AGENCY(JICA)

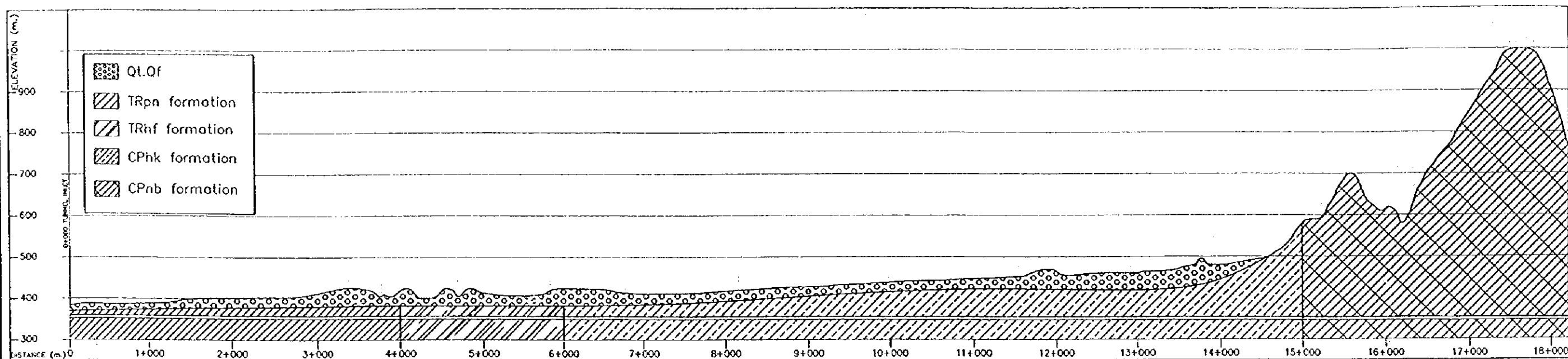
SANYU CONSULTANTS INC. & NIPPON KOEI CO.,LTD.

Map & Drawing No.

Figure 11.14 (6)



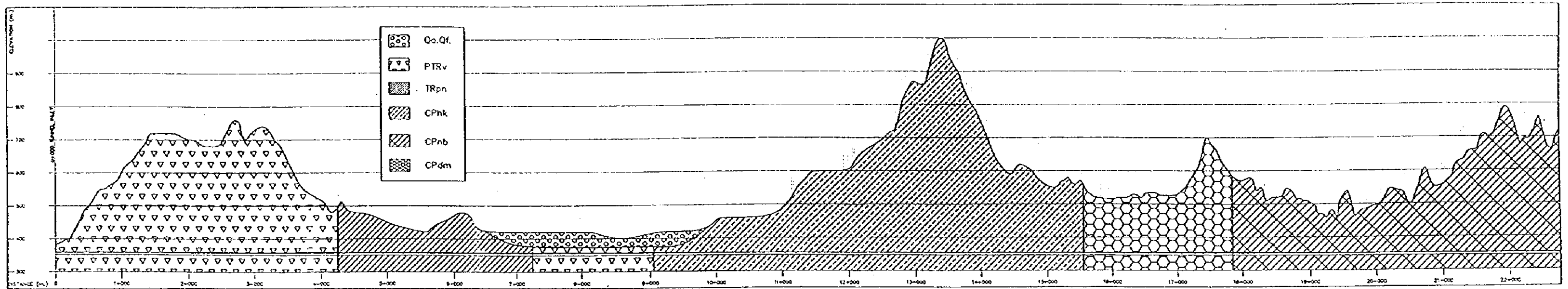
GEOLOGICAL PROFILE OF ALTERNATIVE TUNNEL ROUTE ING-YOT NO.2 TUNNEL (A ROUTE)



	Alluvial deposits, unconsolidated gravel, sand, silt and clay	
Geological Condition	Slate, sandstone and conglomerate reddish brown, reddish purple, fine grained	Shale (slate) greenish-gray, grayish brown interbedded with sandstone and tuffaceous sandstone Meta-sandstone interbedded with meta-shale, brown and grayish brown Slate, quartzite, phyllite gray and grayish black, brown, folding, recrystalline limestone lens
	Basement rocks are associated with thick weathered rock zone at the surface part. It is noticed that the most significant problem in the tunnel construction is removal of groundwater which might be encountered at many places.	

THE STUDY ON KOK-ING-NAN WATER DIVERSION PROJECT	
GEOLOGICAL PROFILE OF ALTERNATIVE TUNNEL ROUTE ING-YOT NO.2 TUNNEL (A ROUTE)	MAP & Drawing No.
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	Figure 11.14.
SANYU CONSULTANTS INC. & NIPPON KOEI CO.,LTD.	(7)-1

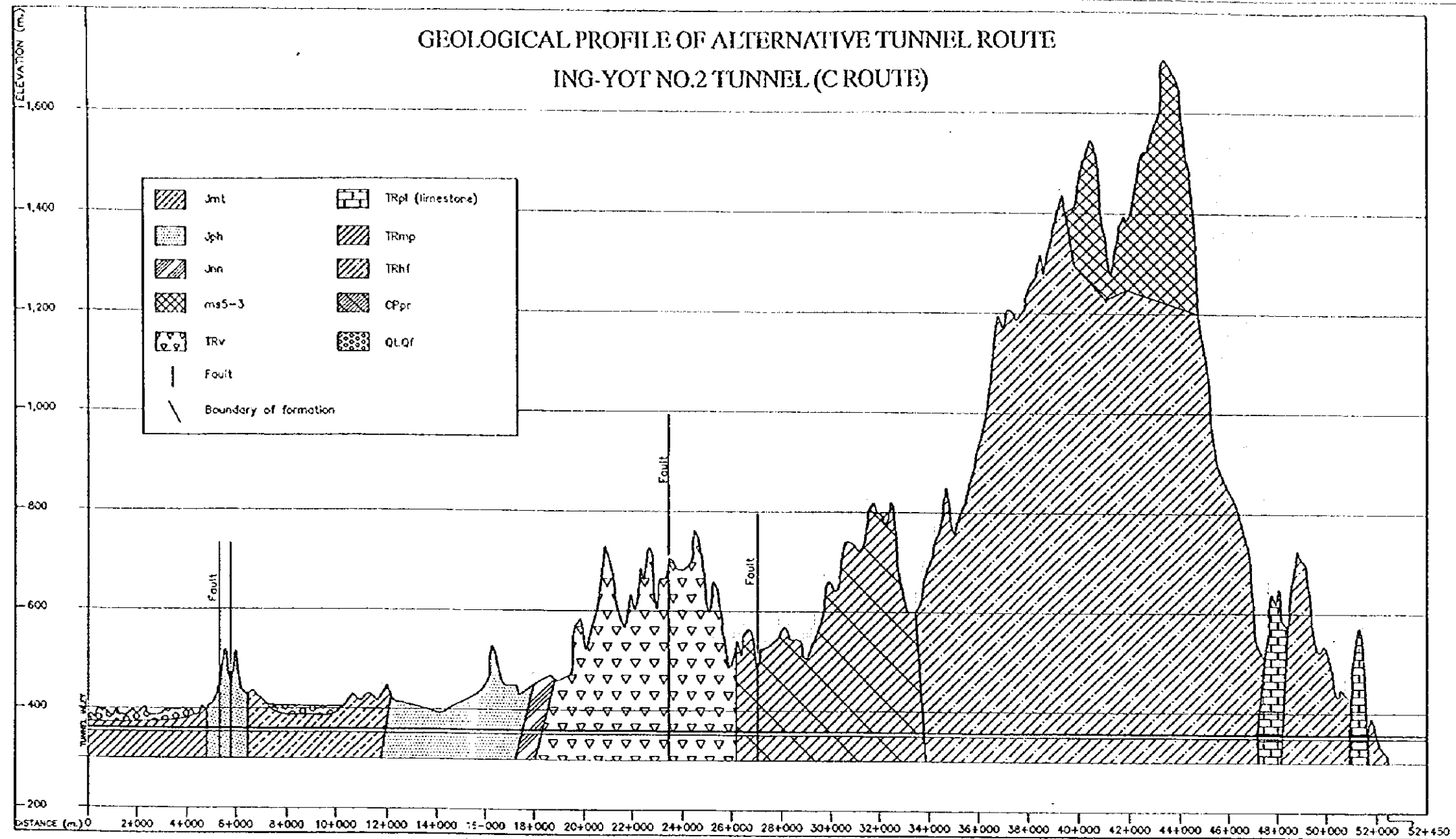
**GEOLOGICAL PROFILE OF ALTERNATIVE TUNNEL ROUTE
ING-YOT NO.2 TUNNEL (LOWER B ROUTE)**



Geological Condition	Volcanic rocks, rhyolite, andesite, tuff, agglomerate light purple to brownish-purple and white	Shale, sandstone and conglomerate reddish brown, reddish purple, fine grained	Alluvial deposits, unconsolidated gravel sand, silt and clay Tuff and agglomerate. There is a large possibility that this valley was eroded along the fault on a large scale. And it is judged that this area is rich in groundwater which is existing in a relatively shallow subsurface.	Meta-sandstone interbedded with meta-shale brown and grayish-brown	Schist, phyllite and meta-volcanic rocks	Slate, quartzite, phyllite, gray and grayish black, brown, folding, recrystalline limestone lens
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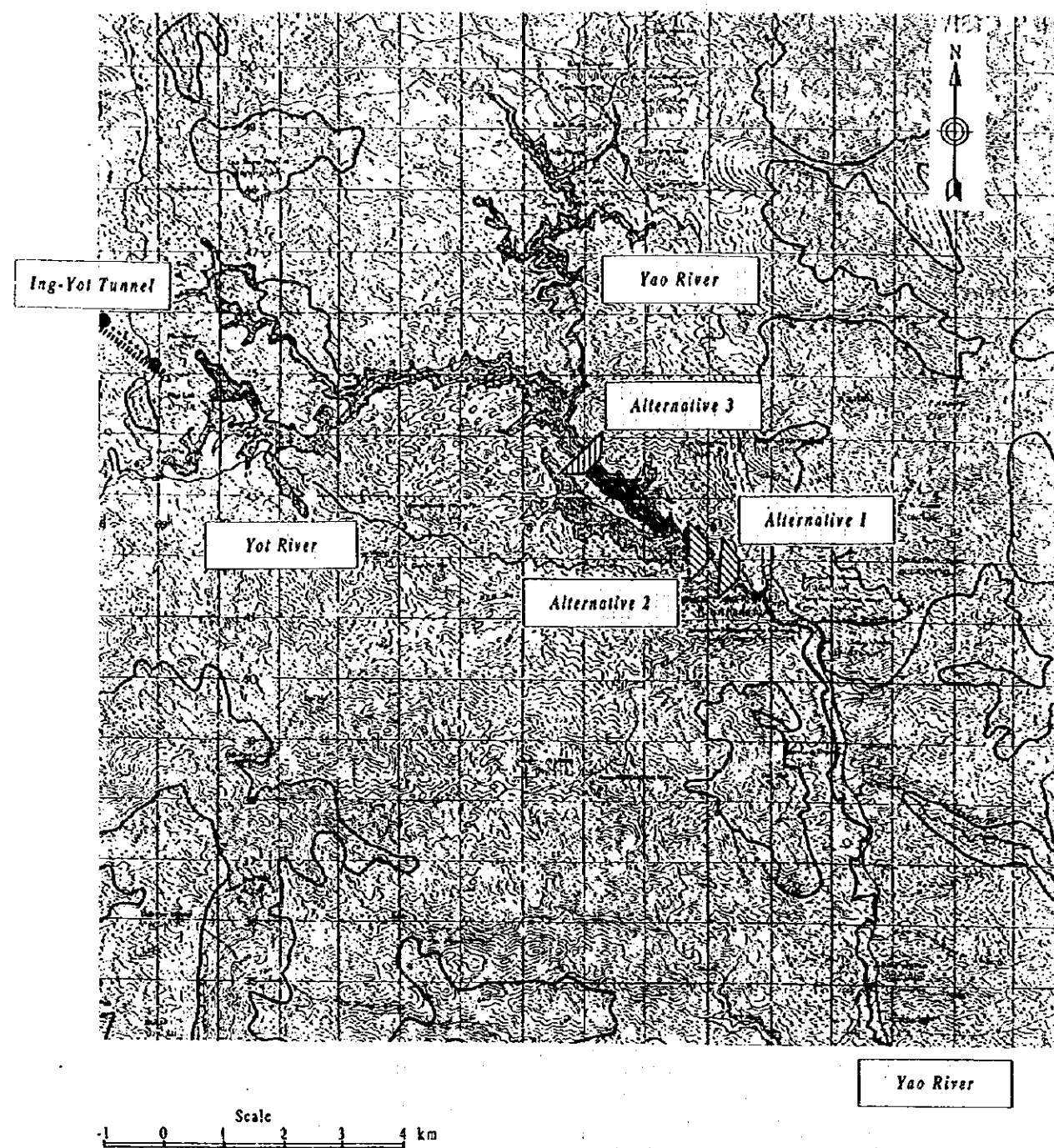
THE STUDY ON KOK-ING-NAN WATER DIVERSION PROJECT	
GEOLOGICAL PROFILE OF ALTERNATIVE TUNNEL ROUTE ING-YOT NO.2 TUNNEL (LOWER B ROUTE)	MAP & Drawing No.
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	Figure 11.14.
SANYU CONSULTANTS INC. & NIPPON KOEI CO.,LTD.	(7)-2

**GEOLOGICAL PROFILE OF ALTERNATIVE TUNNEL ROUTE
ING-YOT NO.2 TUNNEL (C ROUTE)**

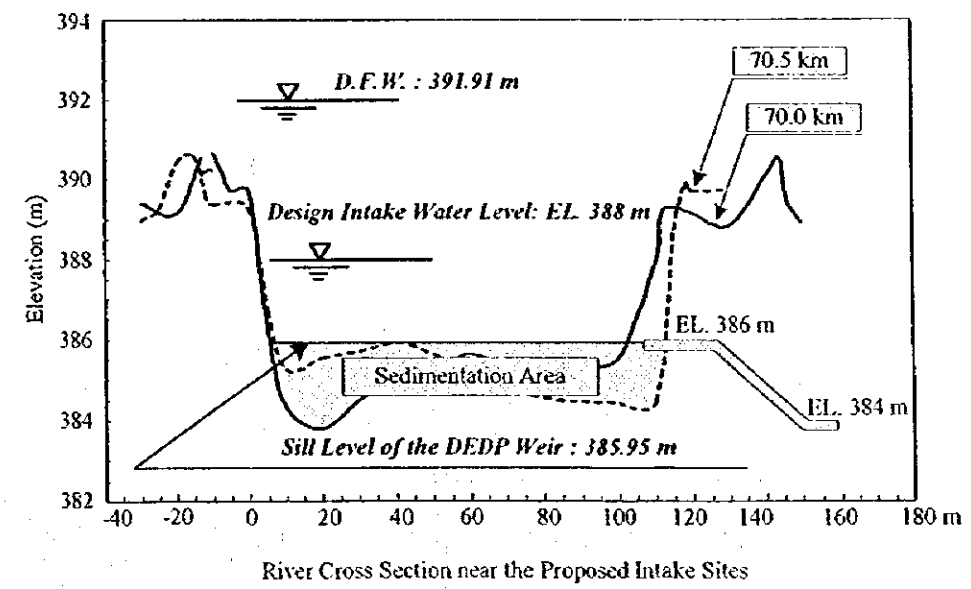
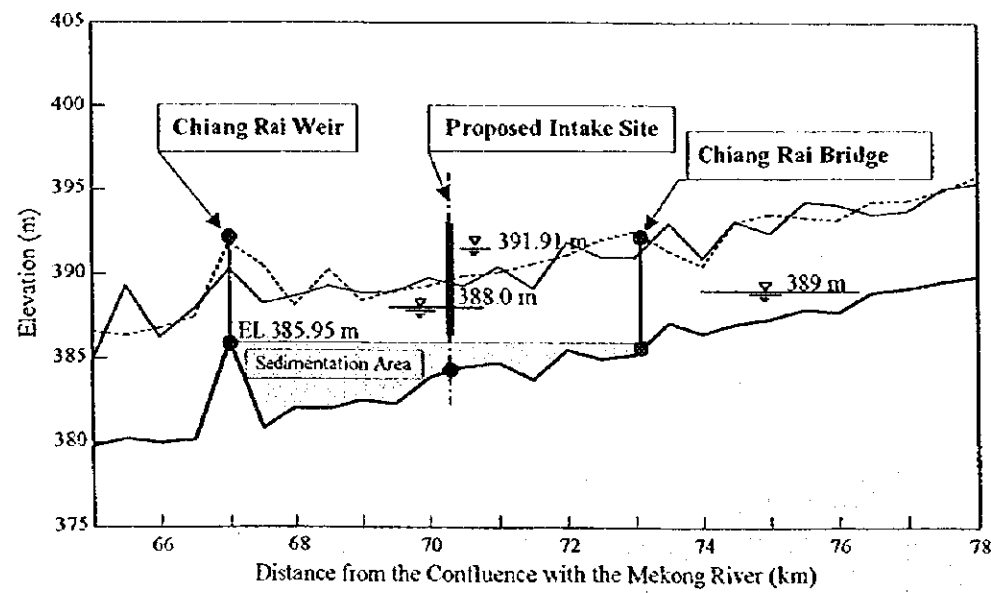
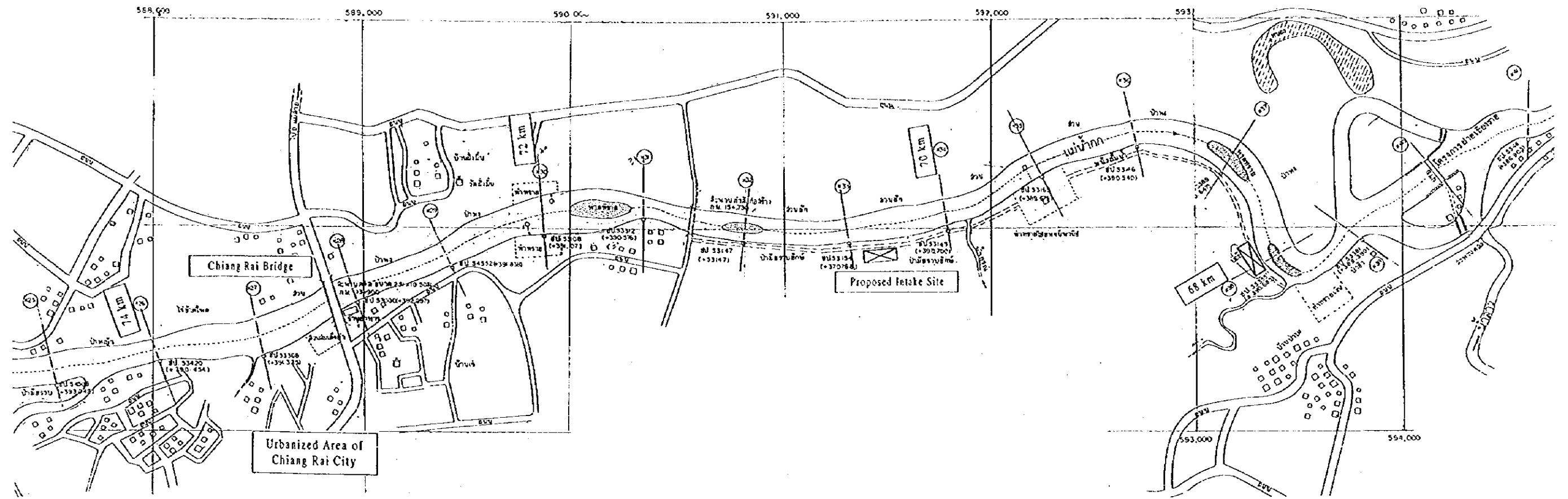


Geological Condition	Pelitic shale interbedded with meta-sandstone weathered. (cracky)	Sandstone interbedded with shale and conglomerate cracky along fault	Slate (shale) interbedded with sandstone weathered (cracky)	Sandstone interbedded with shale and conglomerate weathered (cracky)	Rhyolitic and andesitic tuff, rhyolite, andesite hard and massive	Pelitic shale interbedded with meta-sandstone hard, breakable bedding plane	Sandstone, tuff, interbedded with shale hard and massive	Limestone, sandstone and tuff interbedded with shale hard, breakable, cracky along bedding plane
Rock mass classification	D	D-CL	D	D	CL-CM	CL-CM	CL-CM	CL-CM, CL, D
Tunnel type	E2	E1(30%), E2(70%)	E1(10%), E2(90%)	E2(10%), E1(30%), D2(60%)	E2(10%), E1(20%), D2(70%)	C2(50%), D1(50%)	B(10%), C1(40%), C2(50%)	E2(50%), D1(50%), C2(30%), D1(70%), C1(50%), E2

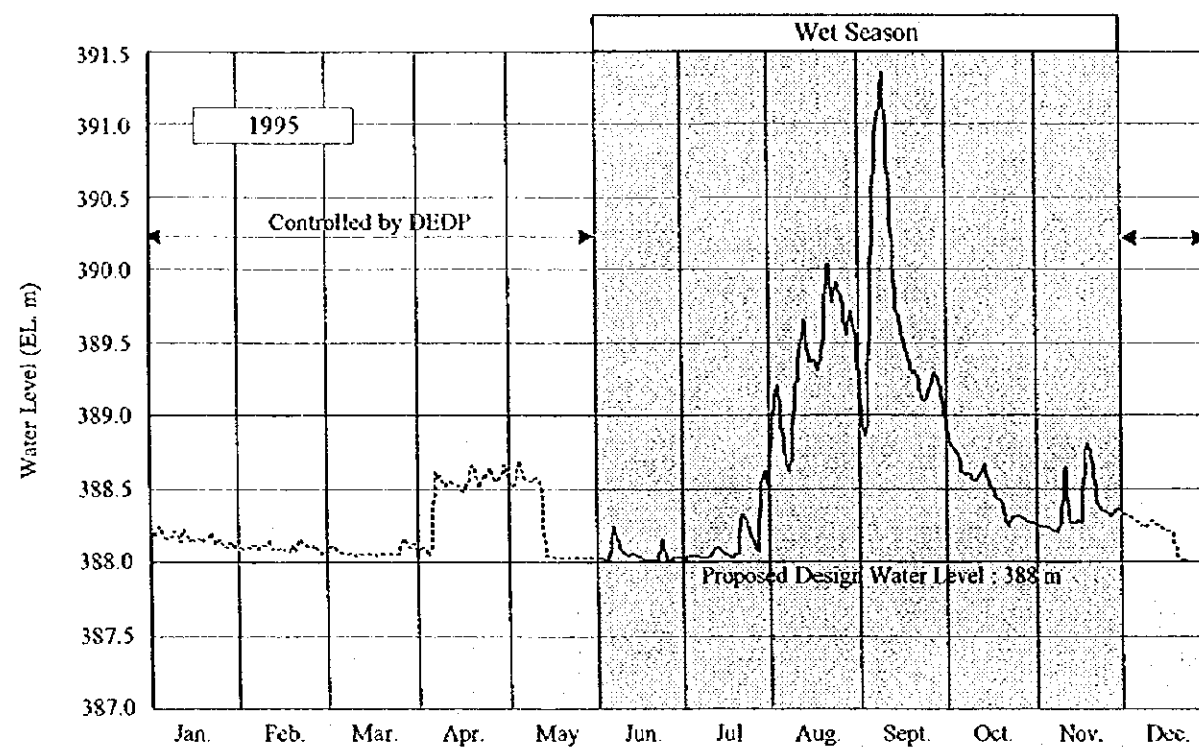
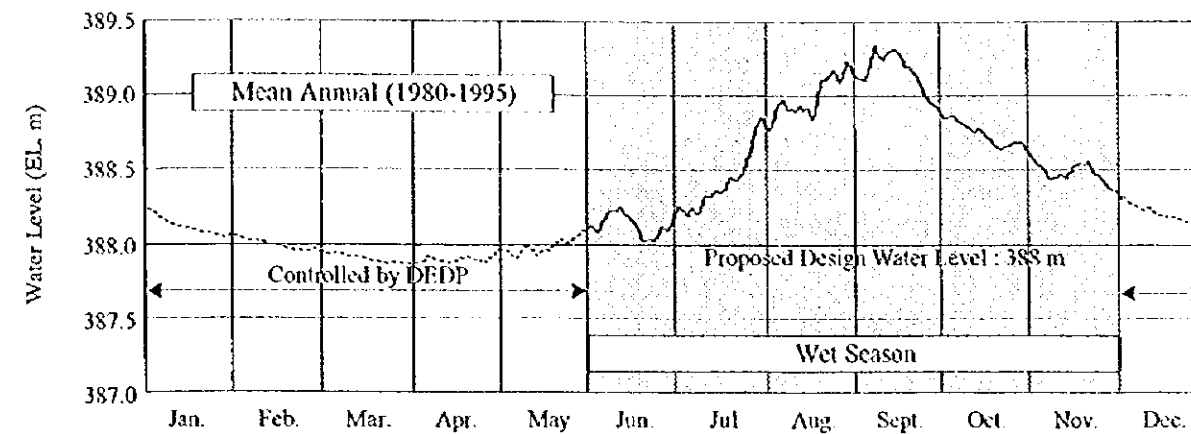
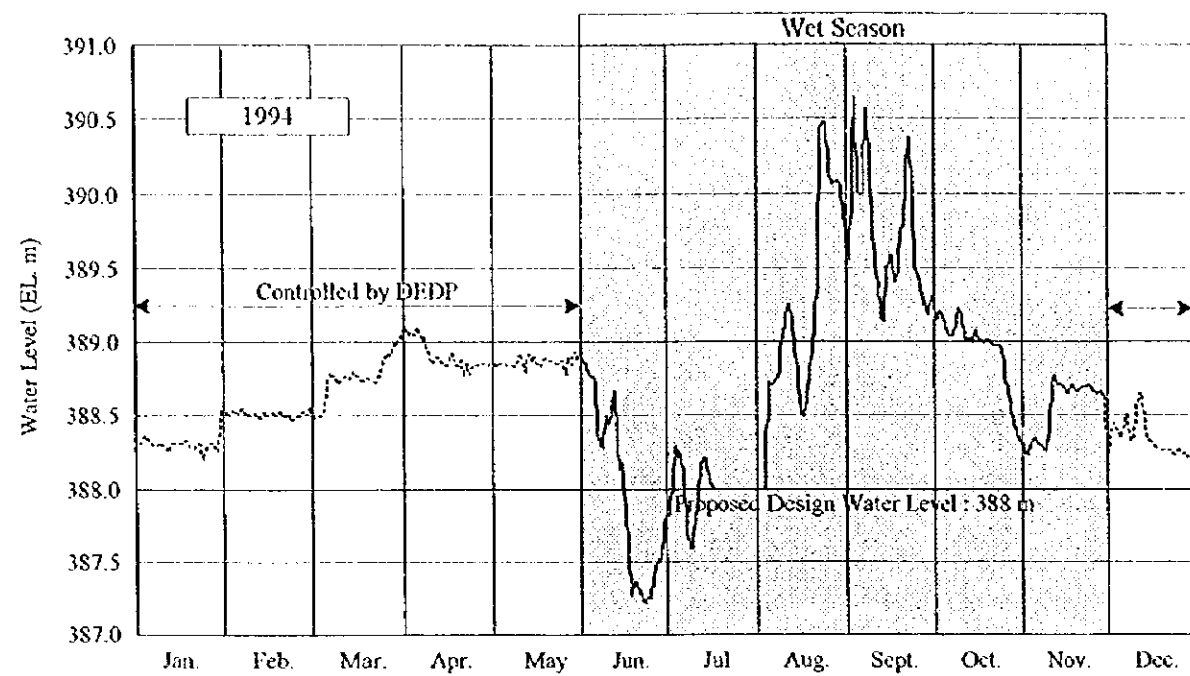
THE STUDY ON KOK-ING-NAN WATER DIVERSION PROJECT	
GEOLOGICAL PROFILE OF ALTERNATIVE TUNNEL ROUTE ING-YOT NO.2 TUNNEL (C ROUTE)	MAP & Drawing No.
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	Figure 11.1.4
SANYU CONSULTANTS INC. & NIPPON KOEI CO., LTD.	(7)-3



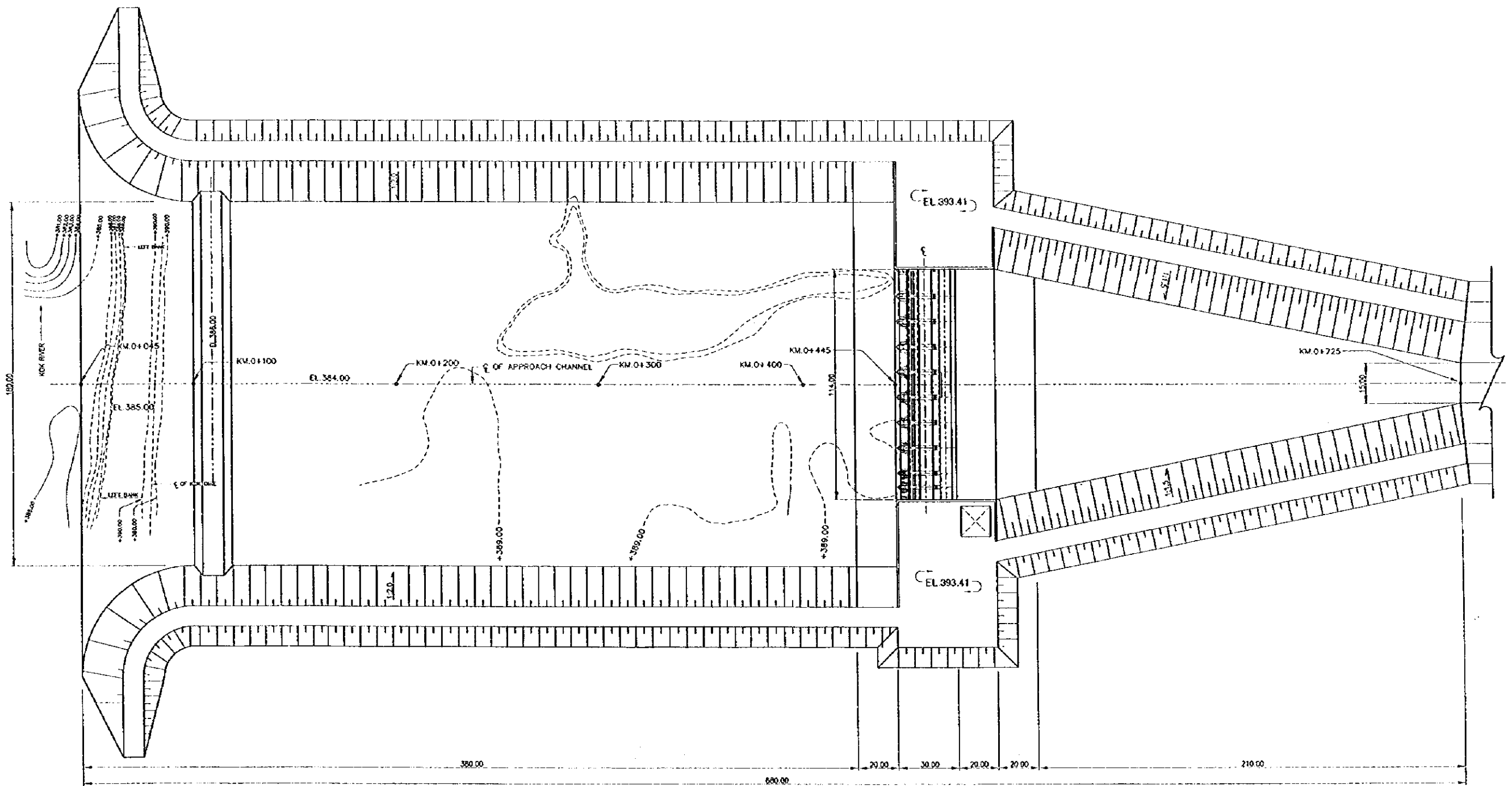
THE STUDY ON KOK-ING-NAN WATER DIVERSION PROJECT	
Alternative Dam Sites for Yao Flood Control Dam	MAP & Drawings No.
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	Figure
SANYU CONSULTANTS INC. & NIPPON KOEI CO., LTD.	11.1.4 (8)-1



THE STUDY ON KOK-ING-NAN WATER DIVERSION PROJECT	
General Location Map of the Proposed Kok Diversion Weir and Intake	
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	MGAP & Drawings No.
SANYU CONSULTANTS INC. & NIPPON KOEI CO., LTD.	Figure 11.2.1-2

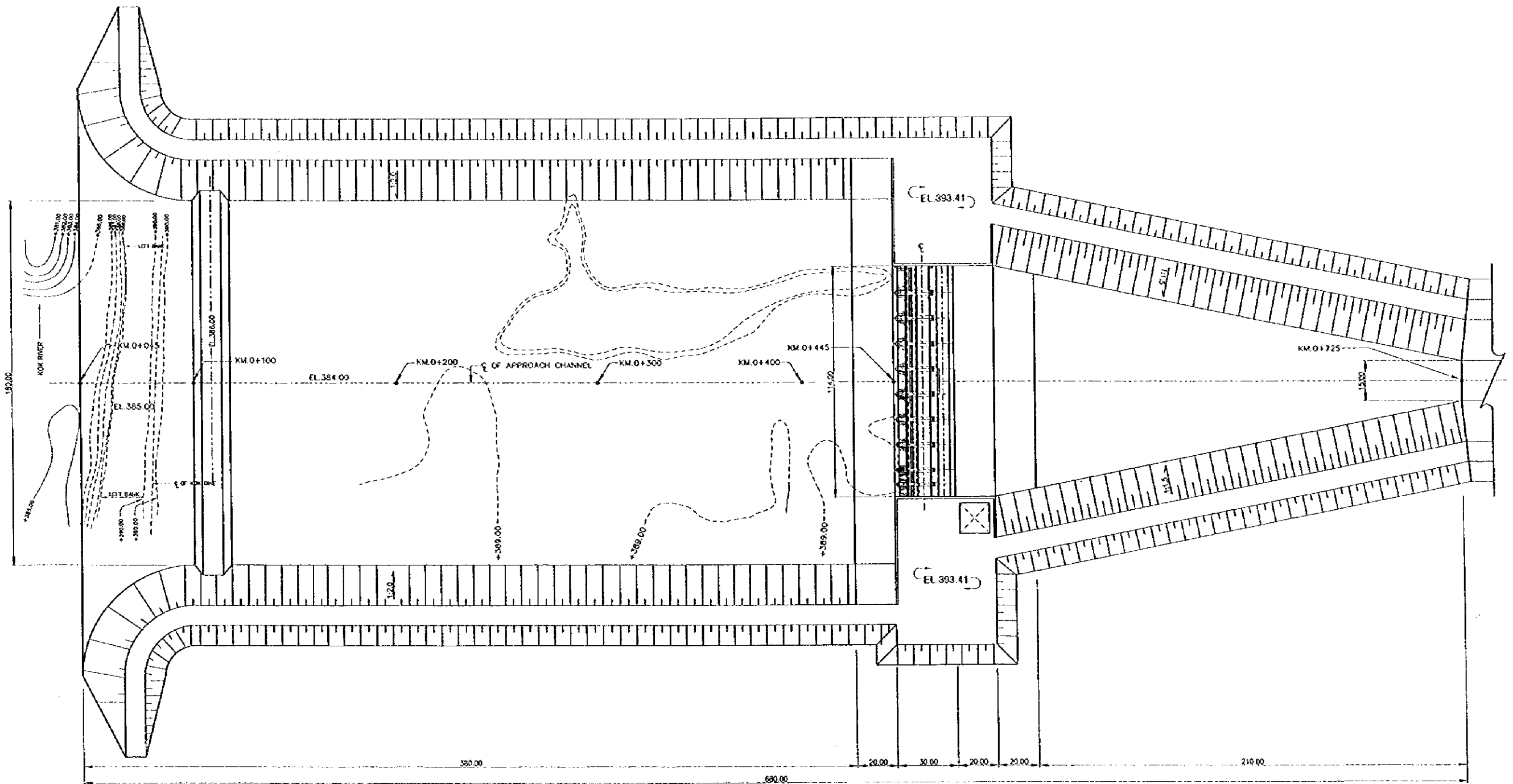


THE STUDY ON KOK-ING-NAN WATER DIVERSION PROJECT	
Water Level Hydrograph at Kok Intake Site	MAP & Drawings No.
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	Figure
SANYU CONSULTANTS INC. & NIPPON KOEI CO., LTD.	11.2.1-3



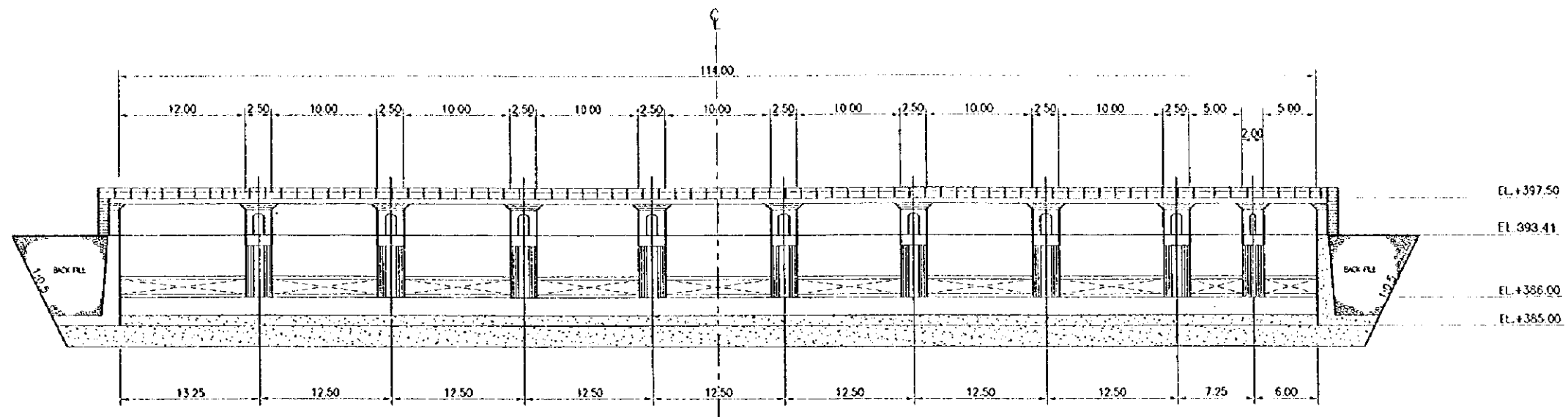
GENERAL LAYOUT

THE STUDY ON KOK-ING-NAN WATER DIVERSION PROJECT	
Plan of Kok Intake	MAP & Drawings No.
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	Figure
SANYU CONSULTANTS INC. & NIPPON KOEI CO., LTD.	11.2.1-5

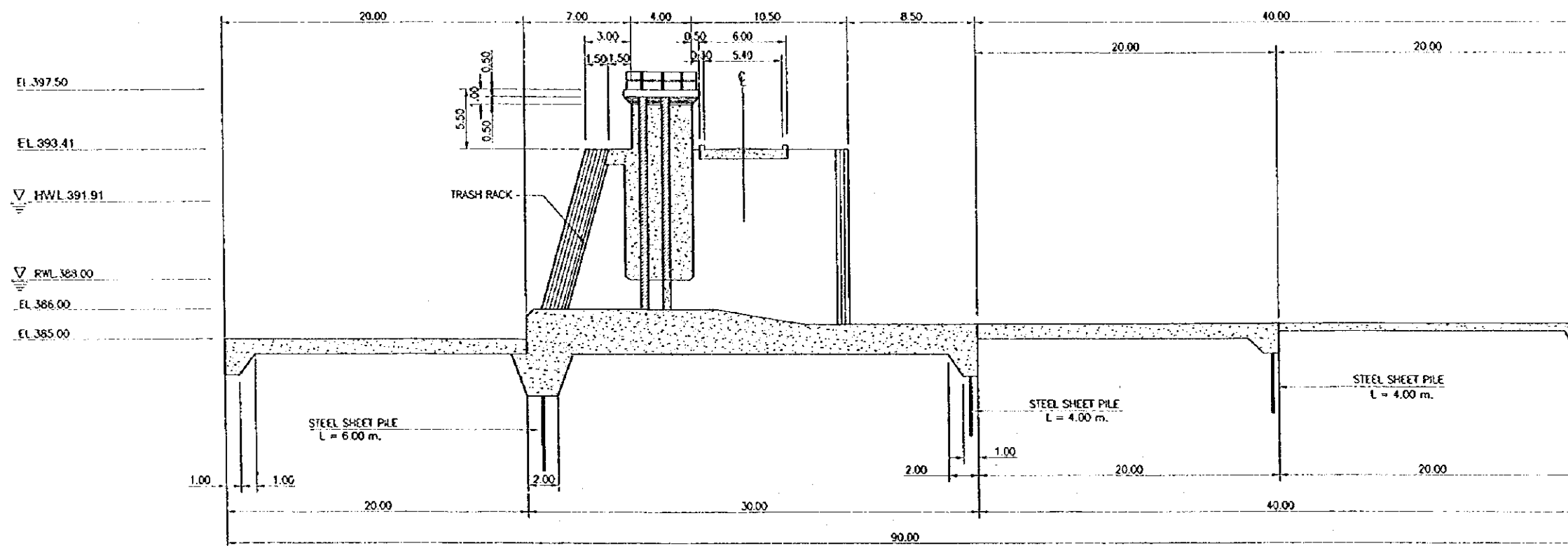


GENERAL LAYOUT

THE STUDY ON KOK-ING-NAN WATER DIVERSION PROJECT	
Plan of Kok Intake	MAP & Drawings No.
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	Figure
SANYU CONSULTANTS INC. & NIPPON KOEI CO., LTD.	11.2.1-5



UPSTREAM VIEW



PROFILE KOK INTAKE

THE STUDY ON KOK-ING-NAN WATER DIVERSION PROJECT	
Profile of Kok Intake	MAP & Drawings No.
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	Figure
SANYU CONSULTANTS INC. & NIPPON KOEI CO., LTD.	11.2.1-6