

PART III

FEASIBILITY STUDY

FOR

URBAN WATER SUPPLY SYSTEM

APPENDIX (E)

BASIC CONDITIONS OF THE PROJECT

E-1 Water Demand Forecast

APPENDIX E-1 Water Demand Forecast

(a) Data of Water Demand Forecast of the New
Development Area

(b) Accounted for Water

Data of Water Demand Forecast of the New Development Area

New Business Center (Case I)

Total area	200	ha.		
Population density	200	100pp/ha		
p.p.	40,000	habitants		
Domestic water	6,600	m ³ /d		165 l/c/d
Small industry	990	m ³ /d		15 %
Public Building	1,650	m ³ /d		25 %
Irrigation	660	m ³ /d		10 %
Total	9,900	m ³ /d		

(Source : URP)

New Business Center (Case II)

Total area	200	ha.		
Residential area	70	ha.		2,310
Commercial area	100	ha		7,000 7 lit/m ² /d
Other public area	30	ha		601 26% of domestic use
Total				9,911 m ³ /d

(Source : URP)

CBD (Central Business District)

Category	Area		Water Consumer		Unit Water Demand		Water Demand m ³ /d
	(ha.)	m ²	Q'ty	Unit	Q'ty	Unit	
Hospital	5.5	55,000	400	bed *1	400	l/c/d	160
School	9.1	90,600	11,000	pp*2	13	l/c/d	143
Convention center	8.3	82,900	82,900	m ²	7	l/m ² /d	580
Commercial & Business	55	549,800	549,800	m ²	6	l/m ² /d	3,299
Park, Road	73	734,000		*3	2	%	165
Resident	36	355,000	55,000	pp*4	150	l/c/d	8,250
Others	16	156,000	N/A	N/A	N/A	N/A	0
Total	202						12,597

(Notes)

*1 : Area per facility (200beds/30,000m²)

*2 : The percentage of school attendance is estimated 20% of total p.p

*3 : The water demand is accounted for 2 % of domestic water use.

*4 : 165,000(total p.p.)/3Phases=55,000(Population in Phase-1)

(Source : Hanoi Urban Transportation Report, JICA)

ACCOUNTED FOR WATER

Group	District	Commune	1. POPULATION										
			1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
U	Cau Giay	Mai Dich	0	38	75	113	150	188	226	264	301	339	377
		Dich Vong	0	248	497	745	994	1,242	1,491	1,739	1,988	2,236	2,485
		Trung Hoa & Yen Hoa	0	364	728	1,091	1,455	1,819	2,183	2,546	2,910	3,273	3,637
	Tu Lie	Me Tri	11,750	12,324	12,898	13,473	14,047	14,621	15,195	15,769	16,343	16,917	17,491
		My Dinh	6,622	6,876	7,130	7,384	7,638	7,892	8,146	8,400	8,654	8,908	9,162
D5	Tu Lie	Thuy Phuo	2,973	3,024	3,076	3,127	3,179	3,230	3,281	3,333	3,384	3,436	3,487
		Dong Ngac	17,982	18,333	18,684	19,035	19,386	19,737	20,088	20,439	20,789	21,140	21,491
		Co Nhue	7,419	7,615	7,810	8,006	8,201	8,397	8,593	8,789	8,984	9,180	9,376
Total			46,746	48,822	50,898	52,974	55,050	57,126	59,202	61,278	63,354	65,430	67,506

Group	District	Commune	2. DOMESTIC WATER DEMAND (m ³ /d)										
			1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
U	Cau Giay	Mai Dich	0	5	10	16	22	28	35	41	48	55	62
		Dich Vong	0	31	66	103	143	186	228	271	316	362	410
		Trung Hoa & Yen Hoa	0	46	96	151	210	273	334	397	463	530	600
	Tu Lie	Me Tri	1,410	1,553	1,703	1,859	2,023	2,193	2,325	2,460	2,599	2,741	2,886
		My Dinh	795	866	941	1,019	1,100	1,184	1,246	1,310	1,376	1,443	1,512
D5	Tu Lie	Thuy Phuo	208	233	258	285	312	339	364	390	416	443	471
		Dong Ngac	1,259	1,412	1,569	1,732	1,900	2,072	2,230	2,391	2,557	2,727	2,901
		Co Nhue	519	586	656	729	804	882	954	1,028	1,105	1,184	1,266
Total			4,191	4,732	5,299	5,893	6,512	7,158	7,716	8,290	8,880	9,486	10,108
Unit Demand :U			120	126	132	138	144	150	153	156	159	162	165
Unit Demand :D			70	77	84	91	98	105	111	117	123	129	135

Group	District	Commune	3. NON-DOMESTIC WATER DEMAND (m ³ /d)										
			1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
U	Cau Giay	Mai Dich	0	1	3	5	6	8	10	12	14	16	19
		Dich Vong	0	9	20	31	43	56	68	81	95	109	123
		Trung Hoa & Yen Hoa	0	14	29	45	63	82	100	119	139	159	180
	Tu Lie	Me Tri	423	466	511	558	607	658	697	738	780	822	866
		My Dinh	238	260	282	306	330	355	374	393	413	433	454
D5	Tu Lie	Thuy Phuo	36	41	45	50	55	59	64	68	73	78	82
		Dong Ngac	220	247	275	303	332	363	390	418	447	477	508
		Co Nhue	91	103	115	127	141	154	167	180	193	207	222
Total			1,010	1,141	1,279	1,425	1,577	1,737	1,871	2,011	2,154	2,301	2,454

Unit Demand :30% of domestic water for U

Unit Demand :17.5% of domestic water for D

Group	District	Commune	4. TOTAL WATER DEMAND (m3/d)										
			1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
U	Cau Giay	Mai Dich	0	6	13	20	28	37	45	53	62	71	81
		Dich Vong	0	41	85	134	186	242	296	353	411	471	533
		Trung Hoa & Yen Hoa	0	60	125	196	272	355	434	516.37	601	689	780
	Tu Lie	Me Tri	1,833	2,019	2,213	2,417	2,630	2,851	3,022	3,198	3,378	3,563	3,752
		My Dinh	1,033	1,126	1,224	1,325	1,430	1,539	1,620	1,704	1,789	1,876	1,965
D5	Tu Lie	Thuy Phuo	245	274	304	334	366	399	428	458	489	521	553
		Dong Ngac	1,479	1,659	1,844	2,035	2,232	2,435	2,620	2,810	3,005	3,204	3,409
		Co Nhue	610	689	771	856	944	1,036	1,121	1,208	1,298	1,391	1,487
Total			5,200	5,873	6,578	7,317	8,089	8,894	9,587	10,300	11,034	11,787	12,562

	5. ADMINISTRATION LOSS (m3/d)										
	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Water supply											
Project Area	0	0	0	0	0	0	0	0	1,504	1,504	1,504

	6. SUMMARY OF ACCOUNTING FOR WATER (m3/d)										
	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Water supply											
Project Area	0	0	0	0	0	0	0	0	8,521	8,846	10,678
To Mai Dich	0	0	0	0	0	0	0	0	20,000	20,000	20,000
To New Developing Area	0	0	0	0	0	0	0	0	6,450	9,675	12,900
Total	0	0	0	0	0	0	0	0	34,971	38,521	43,578

APPENDIX (F) PRELIMINARY DESIGN

- F-1 Existing Well List
- F-2 Existing Geological Column around the Proposed Wellfield
- F-3 Groundwater Quality in the Priority Project Area
- F-4 Study for the Design of Contact and Sedimentation Tank

APPENDIX F-1 Existing Well List

Existing Well List around the Proposed Wellfield (1/3)

No.	Name of Well	Location		Owner	Constructed Date	Elevation		Depth		Dia. (mm)	Screen		Water Level		Remarks
		X	Y			(m)	(m)	(m)	(m)		From	To	Lowest(m)	Highest(m)	
1	Q23a	35.670	82.200	K2	May/'86	8.193	100	108	-	19.8	-	3.72 / 4.47	+1.15 / 9.34		
2	Q57a	32.960	74.554	K2	Jun./92	6.789	45	-	-	6.0	-	2.36 / 4.38	0.17 / 6.57		
3	Q58a	28.559	73.004	K2	Mar/'88	6.368	45.3	146	-	9.3	-	2.50 / 3.87	1.57 / 4.80		
4	Q62a	31.085	77.703	K2	Jan./92	7.238	50	90	-	9.0	-	5.84 / 2.46	2.05 / 5.89		
5	Q63a	27.593	81.168	K2	Nov./89	6.210	37	90	-	6.0	-	22.98 / -16.77	18.55 / -12.34		
6	P 8a	25.062	83.625	K2	Sep/'89	6.810	50	50	-	1.0	-	13.87 / -7.06	10.53 / -3.72		
7	P 9a	28.730	80.588	K2	Aug./91	7.180	58	110	-	16.0	-	21.54 / -14.36	20.36 / -13.18		
8	P10a	29.618	83.672	K2	Sep/'89	6.270	45	50	-	3.0	-	10.70 / -4.44	9.12 / -2.85		
9	P12a	24.125	84.685	K2	Jan./90	6.260	54.5	50	-	3.0	-	13.26 / -7.00	11.76 / -5.50		
10	P16a	28.628	82.253	K2	Sep/'89	6.480	46	50	-	3.0	-	16.62 / -10.48	15.96 / -9.48		
11	P21a	31.409	80.208	K2	Sep/'89	6.880	52	50	47	50	-	8.63 / -1.75	6.18 / 0.70	broken 1992(?)	
12	P 22	33.000	80.000	K2	Jul/'89	7.720	55	-	-	46.5	-	-	-		
13	P29a	27.609	83.117	K2	Oct/'91	6.620	52	90	-	6.0	-	16.52 / -9.90	15.72 / -9.10		
14	P30a	27.707	84.263	K2	Aug./92	7.000	52	110	-	6.0	-	22.17 / -15.17	19.97 / -12.97		
15	P43a	28.564	83.906	K2	Oct/'91	7.480	65.5	110	-	15.0	-	16.27 / -8.79	14.68 / -7.20		
16	P44a	23.968	77.803	K2	Aug/'91	5.450	57	90	-	6.0	-	7.15 / -1.70	6.70 / -1.25		
17	P47a	32.976	84.144	K2	Jun./92	7.570	49	110	-	6.0	-	4.49 / 3.08	+0.70 / 8.27		
18	P52a	25.300	81.500	K2	Jun./92	7.570	49	110	-	6.0	-	14.47 / -6.90	13.67 / -6.10		
19	P55a	33.900	76.650	K2	Jun./93	9.890	45	90	-	6.0	-	5.24 / 4.65	+0.11 / 10.00		
20	P65a	34.750	82.025	K2	Jul/'95	9.980	50	90	-	6.0	-	5.68 / 4.30	+0.99 / 10.20		

**"Screen Depth" means "Screen Length" except for "P21a" and "P22"

***"Water Level" measured in 1955

Existing Well List around the Proposed Wellfield (2/3)

2. Test Well

No.	Name of Well	Location		Owner	Constructed Date	Elevation (m)	Depth (m)	Screen Depth (m)		Water Level (Depth/Elevation)		Remarks
		X	Y					Dia. (mm)	From To	Lowest(m)	Highest(m)	
1	T.TD 3	27.840	84.650	K2	-	-	-	-	-	(13.50)	-	-
2	T.TD 12	33.422	80.674	K2	-	-	70	203	38.48	63.20	(2.50)	-
3	T.TD 13	32.750	82.620	K2	-	-	70	146	36.87	58.29	(4.40)	-
4	T.TD 14	32.960	84.250	K2	-	-	68.9	146	36.12	53.37	(4.46)	-
5	T.LK 44	29.828	80.845	K2	-	-	60	146	40.80	53.80	(3.70)	-
6	T.LK 46	30.550	84.201	K2	-	-	95	126	50.00	84.00	(1.16)	-
7	T.LK 54	33.478	82.753	K2	-	-	130	127	52.00	87.00	(4.59)	-
8	T.LK813	31.615	84.622	K2	-	-	58	127	41.80	55.50	(4.00)	-
9	T.LK816	32.645	80.146	K2	-	-	70	127	34.30	59.10	(6.00)	-
10	T.LK 5a	27.850	84.080	K2	-	-	-	-	-	-	(8.96)	-
11	T.LK N6	34.130	76.427	K2	-	-	40	127	21.30	34.90	-	-
12	T.LKTI1	30.951	77.733	K2	-	-	30	108	6.00	12.00	-	screen set for Ob

**Water Level measured just after constructed. "Low" or "High" is unknown

*All Test Wells have been abandoned after test performance

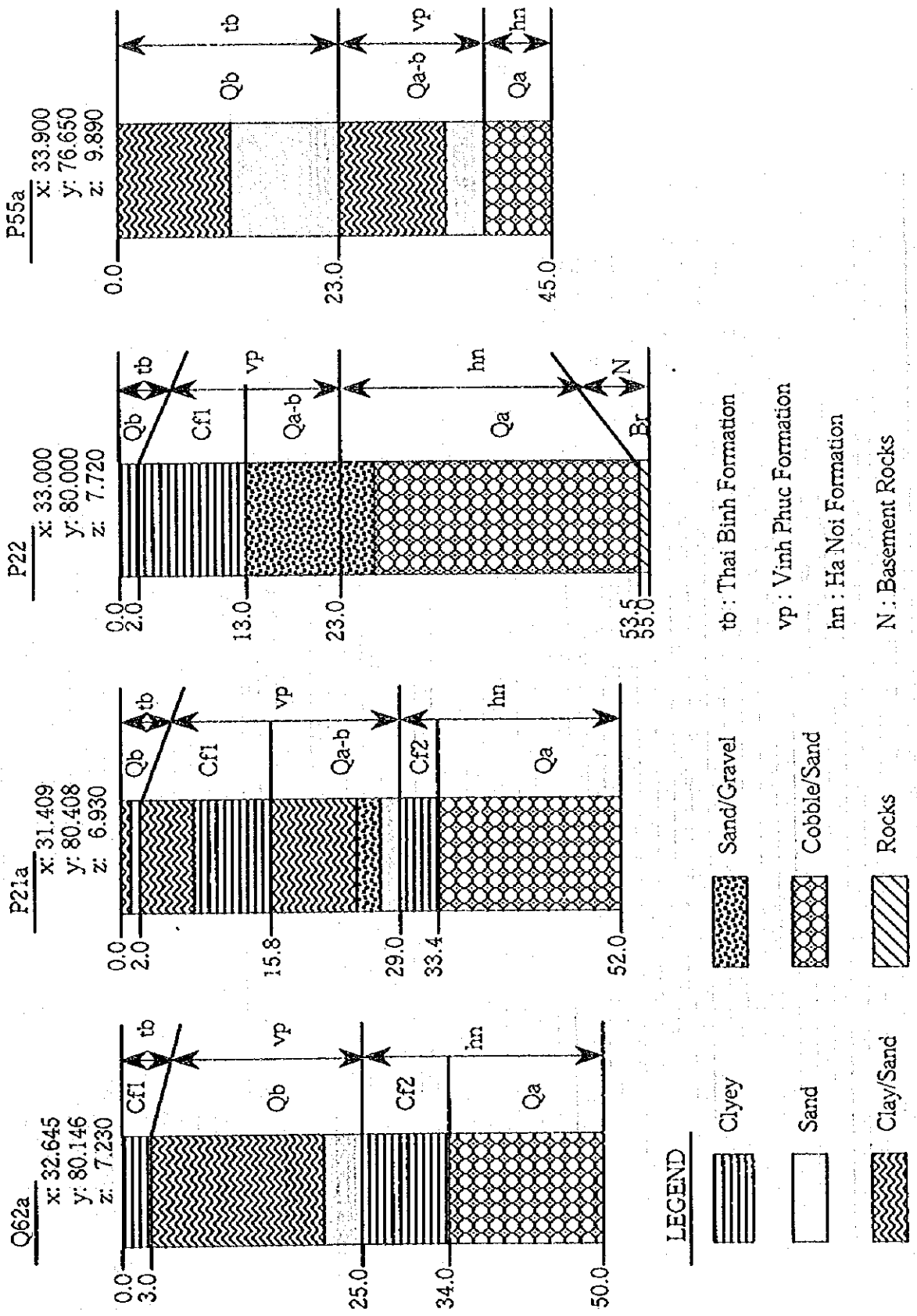
Existing Well List around the Proposed WellField (3/3)

3. Private Well	No.	Name of Well	Location		Owner	Date Constructed	Elevation (m)	Depth (m)	Screen		Water Level		Remarks	
			X	Y					Dia. (mm)	Depth (m)	Lowest (m)	Highest (m)		
1	P- 1		31	72	Veterinary Med.							650		
2	P- 2		31	73	Center No.75								270	
3	P- 8		27	74	Army Fac. No.34								155	
4	P- 15		28	78	Fac. Z.191								150	
5	P- 16		28	79	Paint Fac.								240	
6	P- 17		26	78	Freeze Fac.								600	
7	P- 18		27	78	Geolog. Subdiv.10								105	
8	P- 24		23	75	Au Khlang Farm								289	
9	P- 25		23	75	Army Unit								285	
10	P- 26		28	78	Chemical Insti.								360	
11	P- 28		26	78	Concrete Enter.								150	
12	P- 30		28	77	Army Quarter								120	
13	P- 32		26	78	Breed Company								105	
14	P- 45		31	79	Unit 144								120	
15	P- 48		25	79	Unit 2910								210	
16	P- 50		24	80	Breed Test Center								100	
17	P- 51		28	70	Air Regiment 280								100	
18	P- 52		24	77	Mechanic Fac.								285	
19	P- 53		26	80	Army Univ.								100	
20	P- 54		31	80	Army Insti.								210	
21	P- 56		31	80	MOL Station 190								360	
22	P- 57		31	80	Forest Insti.								220	
23	P- 58		32	80	Concrete Fac.								800	
24	P- 60		30	79	Police Univ.								240	
25	P- 63		31	83	Package Company								180	
26	P- 64		31	80	Geological Univ.								350	
27	P- 67		31	82	Chemical Enter.								180	
28	P- 72		26	78	Hanoi Jail								380	
29	P- 76		28	83	Science Insti.								350	
30	P- 77		31	80	Geological Univ.								420	
31	P- 78		31	80	Finance Univ.								100	
32	P- 79		30	78	Poultry Breed Co.								480	
33	P- 81		31	83	Army Area								240	
34	P-116		25	82	Orphan School								180	
35	P-119		25	84	Tool Fac.								400	
36	P-123		23	84	Rubber Fac.								6,000	

*Discharge of the list wells are more than 100 m³/d in 1994

**APPENDIX F-2 Existing Geological Column around
the Proposed Wellfield**

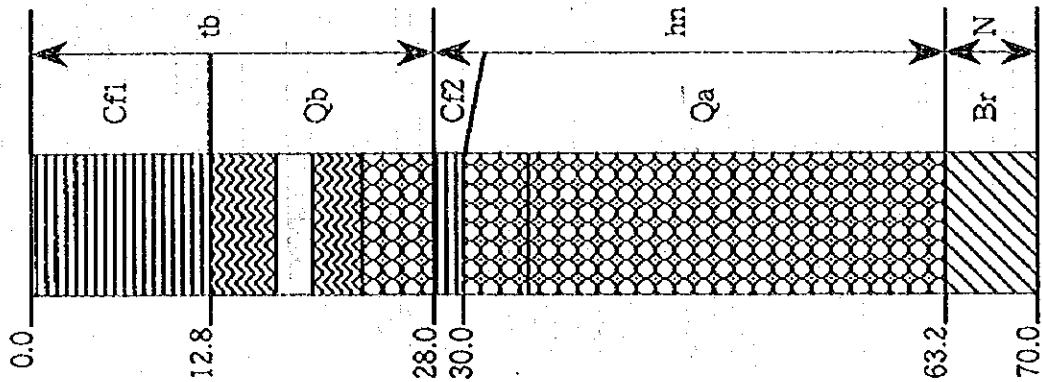
Existing Geological Column around the Proposed Wellfield (1/2)



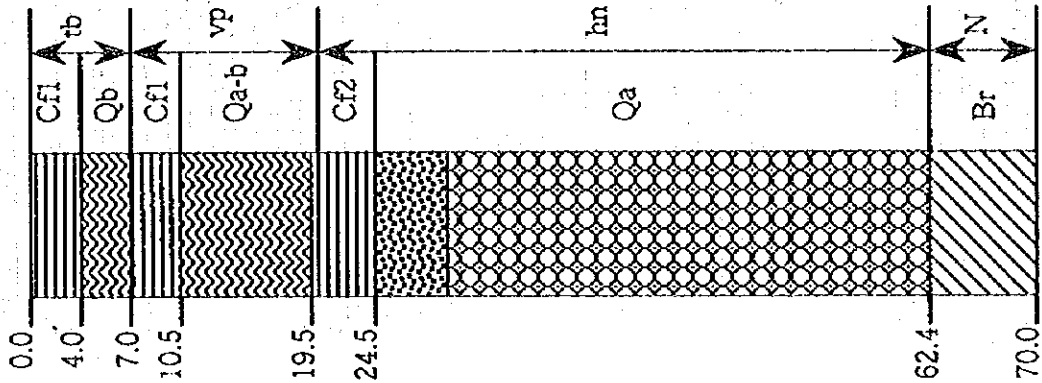
F2 - 1

Existing Geological Column around the Proposed Wellfield (2/2)

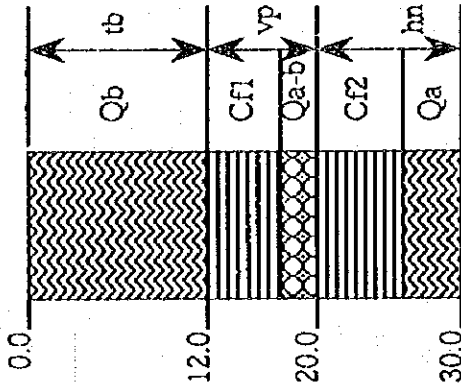
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 y: 80.674
 z: 8.265



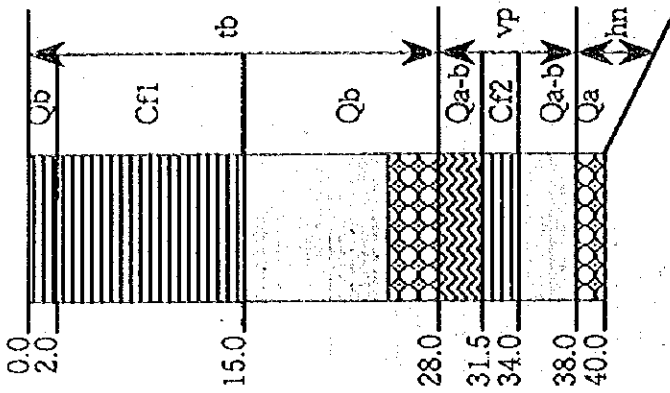
T.LK816
 x: 32.645
 y: 77.704
 z: 7.320



T.LKT11
 x: 30.951
 y: 77.733
 z: 7.937



T.LKN6
 x: 34.130
 y: 76.427
 z: 9.818



**APPENDIX F-3 Groundwater Quality
in the Priority Project Area**

Groundwater Quality in the Priority Project Area (1/4)

Parameter	Unit	Monitoring Well : P21a										Criteria	
		Groundwater Quality on each Sampling Day							Statistical Values			Drinking Water	WHO Guideline
		7/92	12/92	4/93	8/93	3/94	9/94	9/95	Min.	Max.	Ave.		
pH		6.2	6.3	5.7	6.1	6.0	6.2	6.6	5.7	6.6	6.1	6.5~8.5	-
NH ₄ ⁺	(mg/l)	1.0	1.8	1.2	0.9	0.5	0.1	0.3	0.1	1.8	0.8	3.0	1.5
Fe ²⁺	(mg/l)	6.7	6.3	6.6	0.1	5.4	0.1	2.5	0.1	6.7	4.0		
Fe ³⁺	(mg/l)	2.0	1.9	0.6	7.3	1.9	11.3	3.0	0.6	11.3	4.0		
Total Iron	(mg/l)	8.7	8.2	7.2	7.4	7.4	11.5	5.5	5.5	11.5	8.0	0.3	0.3

Groundwater Quality in the Priority Project Area (2/4)

Parameter	Unit	Monitoring Well : Q62a										Criteria	
		Groundwater Quality on each Sampling Day							Statistical Values			Drinking Water	WHO Guideline
		8/92	12/92	5/93	9/93	3/94	9/94	9/95	Min.	Max.	Ave.		
pH		6.5	5.8	6.4	5.9	5.9	6.7	6.5	5.8	6.7	6.2	6.5~8.5	-
NH ₄ ⁺	(mg/l)	0.8	1.9	0.0	0.1	-	-	3.3	0.0	3.3	1.2	3.0	1.5
Fe ²⁺	(mg/l)	1.4	0.2	1.0	0.1	0.6	0.0	0.0	0.0	1.4	0.5		
Fe ³⁺	(mg/l)	2.6	1.8	25.2	0.2	0.4	2.4	2.5	0.2	25.2	5.0		
Total Iron	(mg/l)	4.0	2.0	26.2	0.3	1.0	2.5	2.5	0.3	26.2	5.5	0.3	0.3

Groundwater Quality in the Priority Project Area (3/4)

Parameter	Unit	Monitoring Well : P47a										Criteria	
		Groundwater Quality on each Sampling Day							Statistical Values			Drinking Water	WHO Guideline
		7/92	12/92	4/93	9/93	3/94	9/94	9/95	Min.	Max.	Ave.		
pH		8.0	7.4	7.3	7.8	7.3	6.3	6.5	6.3	8.0	7.2	6.5~8.5	-
NH ₄ ⁺	(mg/l)	2.3	0.1	0.1	3.2	2.8	3.9	1.0	0.1	3.9	1.9	3.0	1.5
Fe ²⁺	(mg/l)	-	3.6	5.6	4.3	7.8	4.5	13.5	3.6	13.5	6.6		
Fe ³⁺	(mg/l)	33.0	1.3	1.6	0.2	0.4	16.2	0.5	0.2	33.0	7.6		
Total Iron	(mg/l)	33.0	4.9	7.2	4.6	8.2	20.7	14.0	4.6	33.0	13.2	0.3	0.3

Groundwater Quality in the Priority Project Area (4/4)

Parameter	Unit	Monitoring Well : P55a										Criteria	
		Groundwater Quality on each Sampling Day							Statistical Values			Drinking Water	WHO Guideline
		-/92	-/92	-/93	9/93	3/94	9/94	9/95	Min.	Max.	Ave.		
pH		-	-	-	6.7	6.6	6.2	7.3	6.2	7.3	6.7	6.5~8.5	-
NH ₄ ⁺	(mg/l)	-	-	-	5.7	9.2	9.4	8.0	5.7	9.4	8.0	3.0	1.5
Fe ²⁺	(mg/l)	-	-	-	0.6	4.4	3.4	11.6	0.6	11.6	5.0		
Fe ³⁺	(mg/l)	-	-	-	1.1	0.2	5.8	1.4	0.2	5.8	2.2		
Total Iron	(mg/l)	-	-	-	1.7	4.6	9.2	13.0	1.7	13.0	7.1	0.3	0.3

Source : Inventory of water quality of monitoring wells (HWBC)

Groundwater Quality in the Priority Project Area (1/2)

Well	Parameter Unit	Fe mg/l	Mn mg/l	NH ₄ ⁺ mg/l	NO ₂ ⁻ mg/l	NO ₃ ⁻ mg/l	Hardness mg/l	Al mg/l	Sampling Date
TD12		11.9	0.1	-	-	-	1	-	Jan.,1996
TD13		47.4	-	0.6	0.0	0.0	2	-	Jan.,1996
TD14		7.4	0.0	-	-	-	3	-	Jan.,1996
CD9		7.4	0.4	0.4	0.0	0.1	-	0.5	Apr.25,1996
CD13		19.7	1.1	0.1	0.0	1.6	-	0.4	Jul.8,1996
		0.7	1.1	-	-	-	-	0.5	Jul.16,1996
CD17		1.6	0.4	0.1	0.0	0.0	-	0.1	Apr.14,1996
P58 (Chem Concrete Factory)		2.9	0.3	0.5	0.0	0.4	-	0.0	Feb.1,96/Mar.21,97
Hoang Long Hotel		1.2	0.1	0.2	0.2	0.3	-	-	Feb.1,1996
P67 (Chemical Factory) near TD13		3.0	0.5	0.9	0.3	0.6	-	-	Feb.1,1996
P61 (Xuan Ding Knitting Factory)		0.7	0.1	0.0	0.0	0.2	-	-	Feb.1,1996
		0.4	0.1	0.2	-	0.7	121	-	Aug.1,1996
P77 (Mining-geological University)		0.8	0.3	0.7	0.1	0.4	-	-	Feb.1,1996
Average		8.1	0.4	0.4	0.1	0.4	32	0.3	
Max.		47.4	1.1	0.9	0.3	1.6	121	0.5	
Min.		0.4	0.0	0.0	0.0	0.0	1	0.0	
Criteria (for drinking water)		0.3	0.1	3.0	0.0	10.0	500	0.2	
Criteria (for water supply (min. req.))		10.0	0.5	-	-	50.0	500	-	
WHO Guidelines		0.3	0.5	1.5	-	50.0	-	0.2	

Groundwater Quality in the Priority Project Area (2/2)

Well	Parameter Unit	As mg/l	Zn mg/l	Cd mg/l	Pb mg/l	CN mg/l	Hg mg/l	Cu mg/l	Cr mg/l	Phenol mg/l
TD12		-	-	-	-	-	-	-	-	-
TD13		-	-	-	-	-	-	-	-	-
TD14		-	-	-	-	-	-	-	-	-
CD9		0.01	0.0	0.000	0.01	0.01	0.000	0.0	0.00	0.000
CD13		0.00	0.0	0.000	0.00	0.00	0.000	0.0	0.00	0.001
		0.00	0.0	0.000	0.00	0.00	0.000	0.0	0.00	0.001
CD17		0.02	0.0	0.000	0.00	0.01	0.000	0.0	0.00	0.000
P58 (Chem Concrete Factory)		-	-	0.005	0.00	-	-	-	-	-
Hoang Long Hotel		-	-	-	-	-	-	-	-	-
P67 (Chemical Factory) near TD13		-	-	-	-	-	-	-	-	-
P61 (Xuan Ding Knitting Factory)		-	-	-	-	-	-	-	-	-
		0.00	0.0	0.005	0.02	0.00	0.000	0.2	0.00	0.000
P77 (Mining-geological University)		-	-	-	-	-	-	-	-	-
Average		0.01	0.0	0.002	0.00	0.01	0.000	0.0	0.00	0.001
Max.		0.02	0.0	0.005	0.02	0.01	0.000	0.2	0.00	0.001
Min.		0.00	0.0	0.000	0.00	0.00	0.000	0.0	0.00	0.000
Criteria (for drinking water)		0.05	5.0	0.005	0.05	0.10	0.001	1.0	0.05	(0.001)
Criteria (for water supply (min. req.))		0.10	5.0	0.010	0.05	0.05	0.001	1.5	-	Water Quality
WHO Guidelines		0.01	3.0	0.003	0.01	0.07	0.001	2.0	0.05	Standard

Source : 1) Preliminary Report on Hydrogeological Results in Cao Dinh - Chem area.

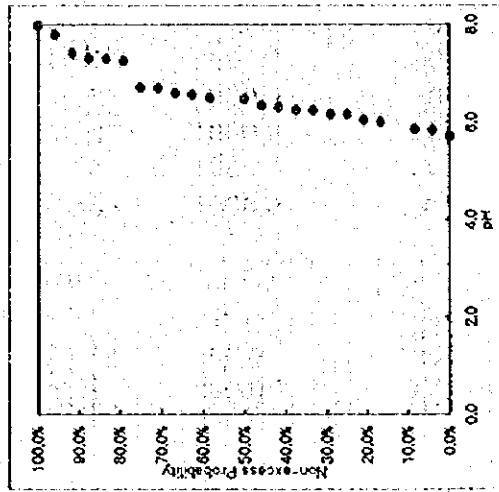
Subdivision 64, Hydrogeological Division II, Viet Nam Geological Survey, January 1996

2) Report on the Feasibility Study for Groundwater Exploitation of Cao Dinh Well Field in Hanoi Area.

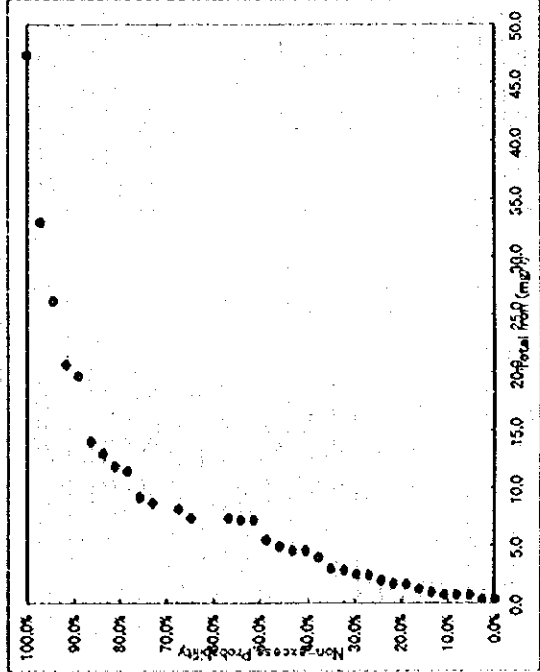
Subdivision 64, Hydrogeological Division II, Viet Nam Geological Survey, June 1996

Note : As for the well P58 (Chem Concrete Factory), supplementary water sampling was done in March 1997 to check Al, Cd and Pb of the nearest well to the project site.

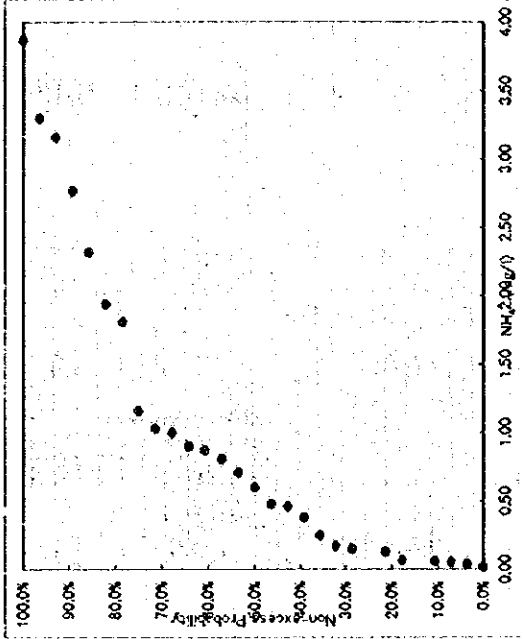
pH Order	Non-exceedance Probability
6.0	100.0%
7.8	96.8%
7.4	91.0%
7.3	87.5%
7.3	83.3%
7.3	79.1%
6.7	75.0%
6.7	70.8%
6.8	66.6%
6.6	62.5%
6.5	58.3%
6.5	50.0%
6.5	50.0%
6.4	45.8%
6.3	41.6%
6.3	37.5%
6.2	33.3%
6.2	29.1%
6.2	25.0%
6.1	20.8%
6.0	16.6%
5.9	8.3%
5.8	4.1%
5.7	0.0%



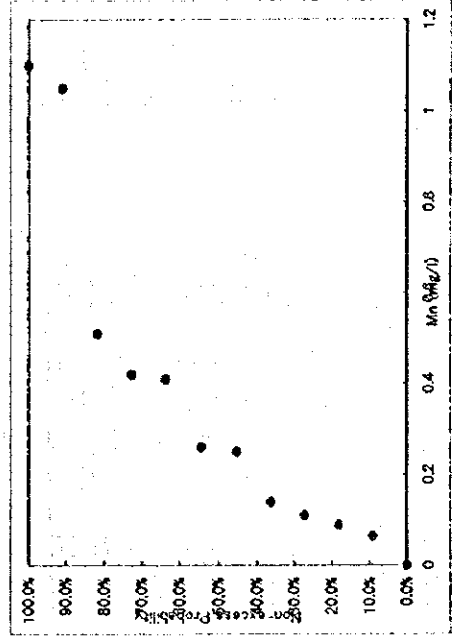
F ₀ Order	Non-exceedance Probability
47.4	100.0%
33.0	97.2%
28.2	94.5%
20.7	91.8%
19.7	89.1%
14.0	86.4%
13.0	83.7%
11.9	81.0%
11.5	78.3%
9.2	75.6%
8.7	72.9%
8.2	70.2%
8.2	67.5%
7.4	64.8%
7.4	62.1%
7.4	59.4%
7.4	56.7%
7.4	54.0%
7.2	51.3%
5.5	48.6%
4.9	45.9%
4.9	43.2%
4.6	40.5%
4.0	37.8%
3.0	35.1%
2.9	32.4%
2.5	29.7%
2.5	27.0%
2.0	24.3%
1.7	21.6%
1.6	18.9%
1.2	16.2%
1.0	13.5%
0.8	10.8%
0.7	8.1%
0.7	5.4%
0.4	2.7%
0.3	0.0%



NH ₄ Order	Non-exceedance Probability
3.9	100.0%
3.3	96.4%
3.2	92.8%
2.8	89.2%
2.3	85.7%
1.9	82.1%
1.8	78.5%
1.2	75.0%
1.0	71.4%
1.0	67.8%
0.9	64.2%
0.9	60.7%
0.8	57.1%
0.7	53.5%
0.6	50.0%
0.5	46.4%
0.5	42.8%
0.4	39.2%
0.3	35.7%
0.2	32.1%
0.2	28.5%
0.1	21.4%
0.1	21.4%
0.1	17.8%
0.1	10.7%
0.1	10.7%
0.0	7.1%
0.0	3.5%
0.0	0.0%



Min Order	Non-exceedance Probability
1.10	100.0%
1.05	90.9%
0.51	81.8%
0.42	72.7%
0.41	63.6%
0.28	54.5%
0.25	45.4%
0.14	36.3%
0.11	27.2%
0.09	18.1%
0.07	9.0%
0.00	0.0%



Probable Quality of Raw Groundwater (Concentration Appearance Probability)

Probable Quality of Raw Groundwater (other than pH, Fe, NH₄⁺ and Mn)

NO ₂ ⁻ (mg/l)	Order	Ion-excess Probability
0.26	1	100.0%
0.23	2	87.5%
0.09	3	75.0%
0.03	4	62.5%
0.02	5	50.0%
0.01	6	37.5%
0.00	7	.0%
0.00	7	.0%
0.00	7	.0%

Al (mg/l)	Order	Ion-excess Probability
0.51	1	100.0%
0.45	2	75.0%
0.44	3	50.0%
0.07	4	25.0%
0.04	5	.0%

Cd (mg/l)	Order	Ion-excess Probability
0.0050	1	80.00%
0.0050	1	80.00%
0.0003	3	60.00%
0.0002	4	40.00%
0.0001	5	.00%
0.0001	5	.00%

Cu (mg/l)	Order	Ion-excess Probability
0.18	1	100.00%
0.01	2	75.00%
0.01	3	50.00%
0.00	4	25.00%
0.00	5	.00%

NO ₃ ⁻ (mg/l)	Order	Ion-excess Probability
1.64	1	100.0%
0.70	2	88.8%
0.61	3	77.7%
0.44	4	66.6%
0.36	5	55.5%
0.28	6	44.4%
0.20	7	33.3%
0.09	8	22.2%
0.00	9	.0%
0.00	9	.0%

As (mg/l)	Order	Ion-excess Probability
0.016	1	100.0%
0.007	2	75.0%
0.003	3	50.0%
0.002	4	25.0%
0.000	5	.0%

Pb (mg/l)	Order	Ion-excess Probability
0.017	1	100.00%
0.007	2	80.00%
0.002	3	60.00%
0.001	4	40.00%
0.001	5	20.00%
0.000	6	.00%

Cr (mg/l)	Order	Ion-excess Probability
0.003	1	100.00%
0.003	2	75.00%
0.002	3	50.00%
0.002	4	25.00%
0.000	5	.00%

Hardness (mg/l)	Order	Ion-exces Probability
121	1	100.0%
3	2	66.6%
2	3	33.3%
1	4	.0%

Zn (mg/l)	Order	Ion-exces Probability
0.04	1	100.0%
0.01	2	75.0%
0.01	3	50.0%
0.01	4	25.0%
0.01	5	.0%

CN (mg/l)	Order	Ion-exces Probability
0.011	1	100.00%
0.010	2	75.00%
0.004	3	50.00%
0.003	4	25.00%
0.000	5	.00%

Hg (mg/l)	Order	Ion-exces Probability
0.0002	1	100.00%
0.0001	2	75.00%
0.0001	3	50.00%
0.0001	4	25.00%
0.0001	5	.00%

Phenol (mg/l)	Order	Ion-exces Probability
0.001	1	100.00%
0.001	2	75.00%
0.000	3	50.00%
0.000	4	25.00%
0.000	5	.00%

**APPENDIX F-4 Study for the Design of Contact
and Sedimentation Tank**

Study for the Design of Contact and Sedimentation Tank

In the iron removal process, the contact tank is designed between aeration tower and filter. Its purpose is primarily to provide sufficient time for the oxidation reaction to reach completion and for the iron to come out of solution.

The contact tank which has some detention time can be used for sedimentation tank. The settling efficiency of the tank will depend on the volume of the tank. The most effective contact/sedimentation tank will contribute to reduce the filter operation load.

The water quality analysis of the existing facilities has been conducted in order to compare with the efficiency of the tanks in each water treatment plant. The result of the analysis is shown in the attached table.

Results

- (1) The retention time for each contact tank in the existing water treatment plant is shown as below ;
Mai Dich, Yen Phu, Ngo Si Lien, Tuong Mai : 30 to 40 minutes
Gia Lam : 60 minutes
- (2) In case of mix iron and manganese, the aeration with contact / sedimentation tank has no effect for manganese removal.
- (3) From the result, maximum rate of oxidizing of ferrous ion is to be 88% under the 30 to 40 minutes retention time and 92% under the 60 minutes retention time. The contact/sedimentation tank which has more than 30 minutes detention time is able enough to oxidize iron.
- (4) The rate of iron removal by the contact tank 26 % with 60 minutes detention time.
16 % with 30 to 40 minutes detention time.

Conclusion (Design Criteria for F/S)

The detention time for the contact / sedimentation tank takes 60 minutes. Under this condition, the rate of iron removal by the contact / sedimentation tank will be estimate about 26%.

Water Analysis for The Equipment Efficiency (Contact & Sedimentation Tank)

Substance	Mn (mg/l)		Fe ²⁺ (mg/l)		Fe ³⁺ (mg/l)		Total Fe (mg/l)		Rate of Fe Remv. (%)
	Raw Water	*1	Raw Water	*1	Raw Water	*1	Raw Water	*1	
Water Treatment Plant (Date of Analysis)									
Mai Dich (7 Mar. 1997)	0.58	0.58	0.07	0.031	0.29	0.29	0.36	0.32	10
Yen Phu (7 Mar. 1997)	0.48	0.47	6.83	0.683	0.06	1.94	6.89	2.63	62
Ngo Si Lien (7 Mar. 1997)	0.66	0.57	1.73	0.23	0.02	1.66	1.75	1.89	-8
Tuong Mai (7 Mar. 1997)	0.29	0.28	13.15	1.55	0.20	9.10	13.35	10.55	21
Ave.									16
Gia Lam (15 Aug. 1996)							2.57	1.81	30
" (16 Aug. 1996)							3.44	2.67	22
" (19 Aug. 1996)							3.82	2.88	25
" (Test run data)	0.54	0.54	1.75	0.14	0.92	2.89	2.14	2.14	26
Ave.									26

*1 : Outlet of the contact tank

PART IV

DRAWINGS

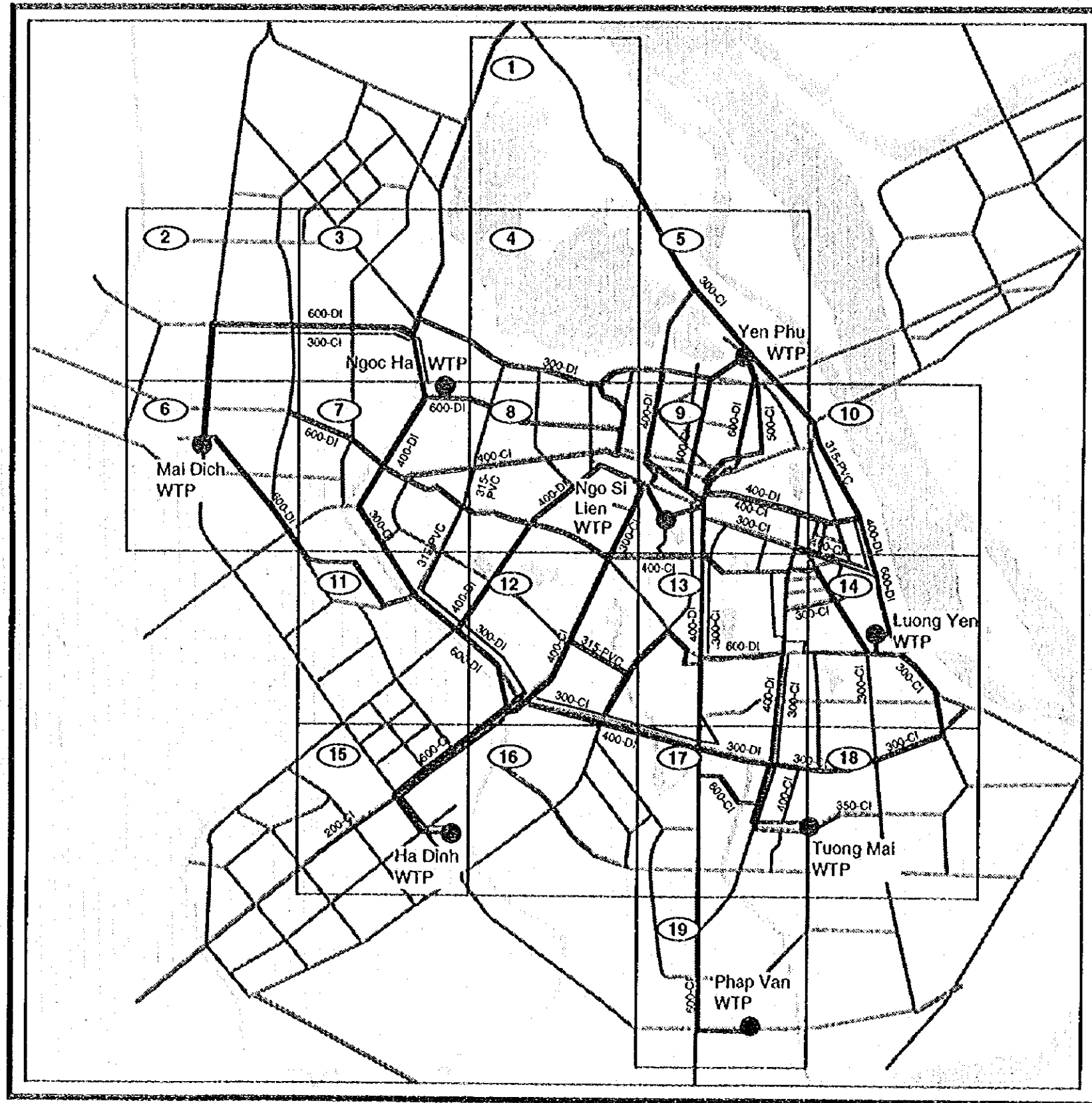
APPENDIX (G) DRAWINGS PREPARED IN M/P

G-1 Existing Distribution Networks

APPENDIX G-1 Existing Distribution Networks

HÁ NỘI - TRANSMISSION NETWORK

F-48-104-D-c



GENERAL NOTES

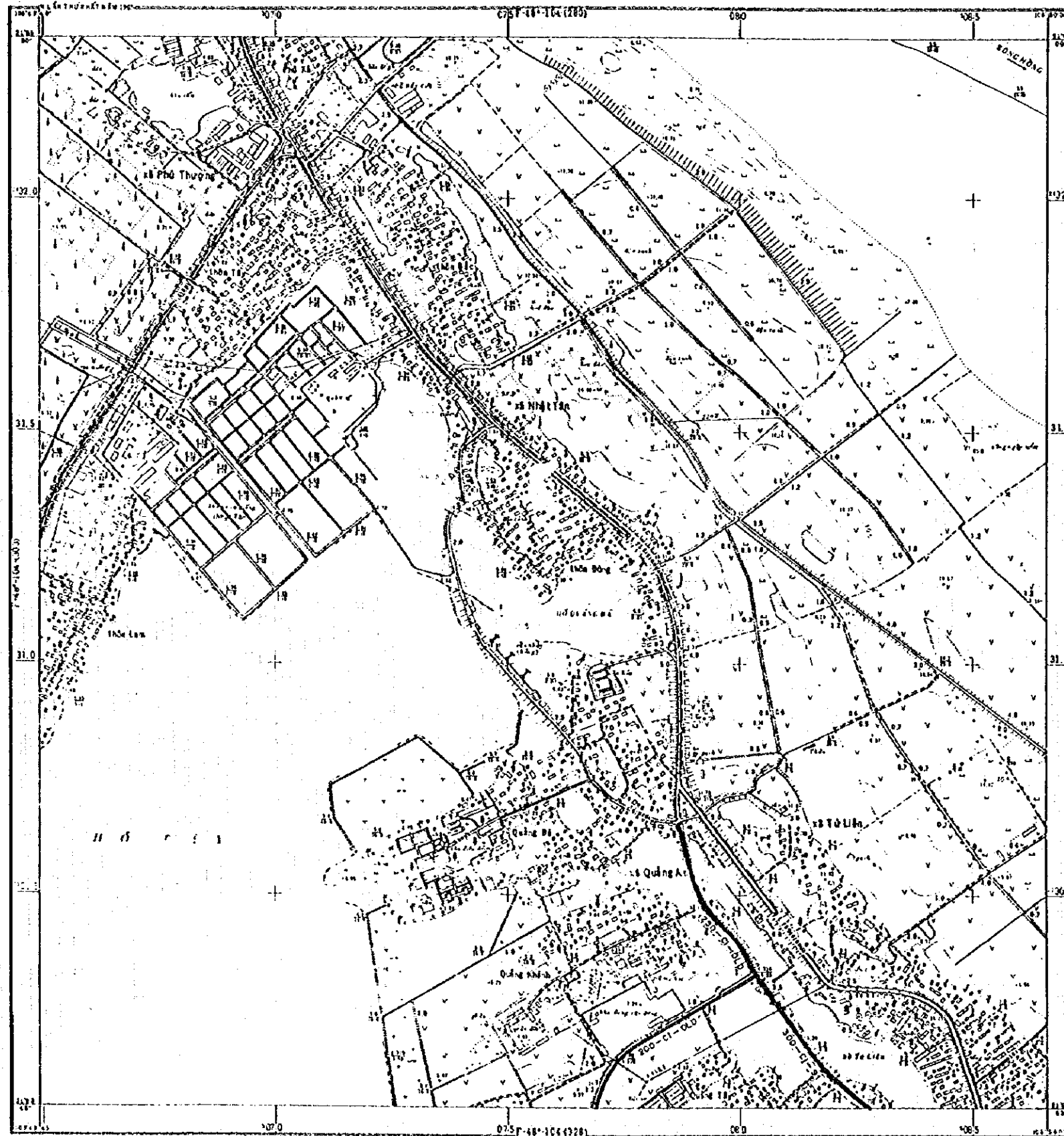
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QUOC OAI	HA DONG	BAT TRANG

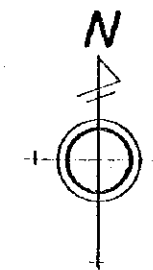
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JICA JAPAN INTERNATIONAL COOPERATION AGENCY				
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DWG. NO.	APPROVED	SUBMITTED	REV. NO.	

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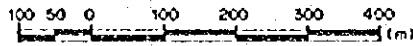
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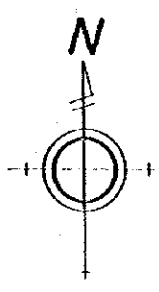
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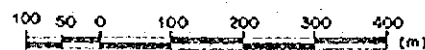
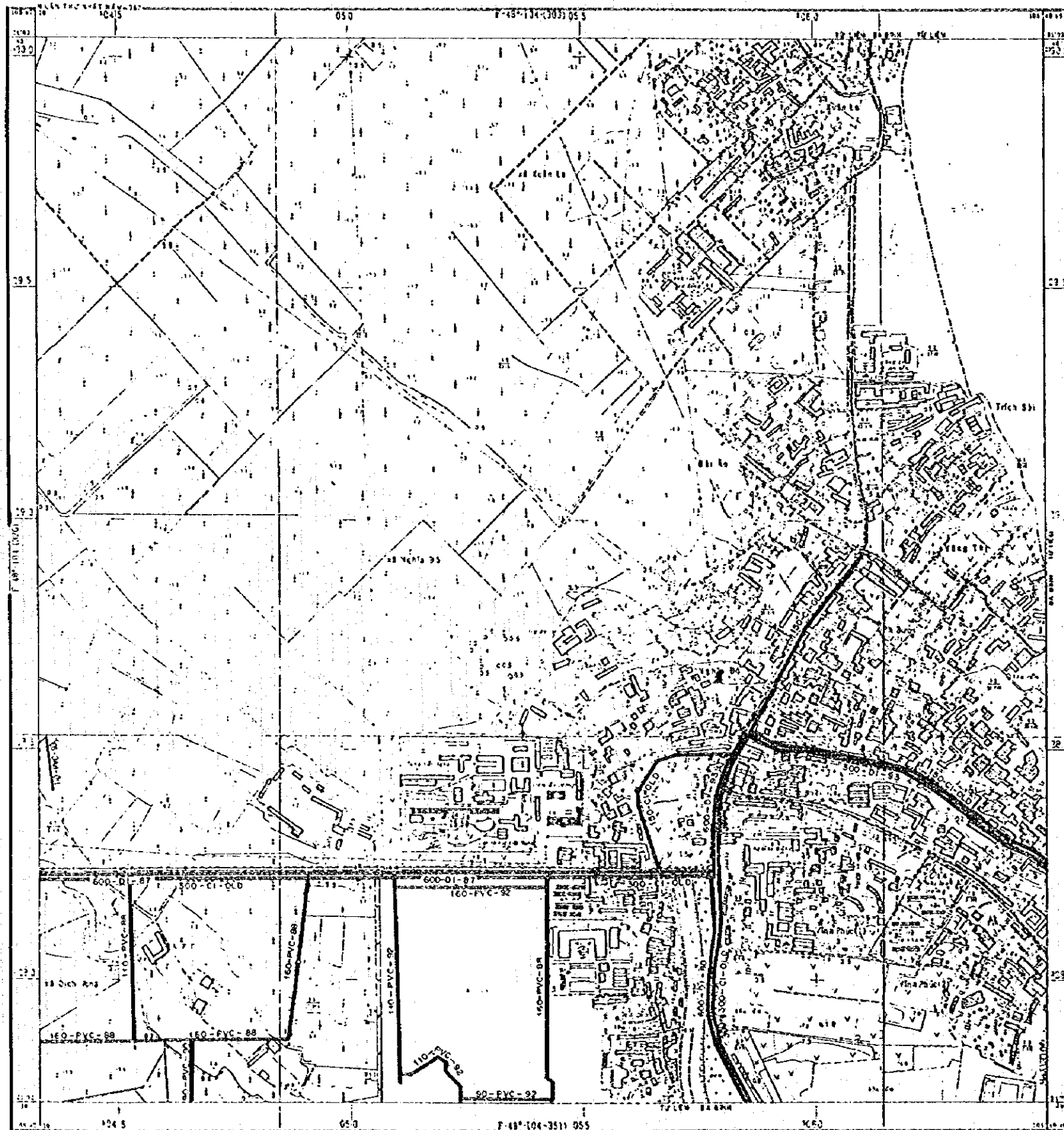
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REVISIONS				

Distribution Network
No. 2

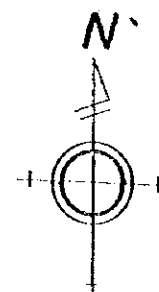
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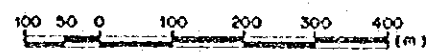
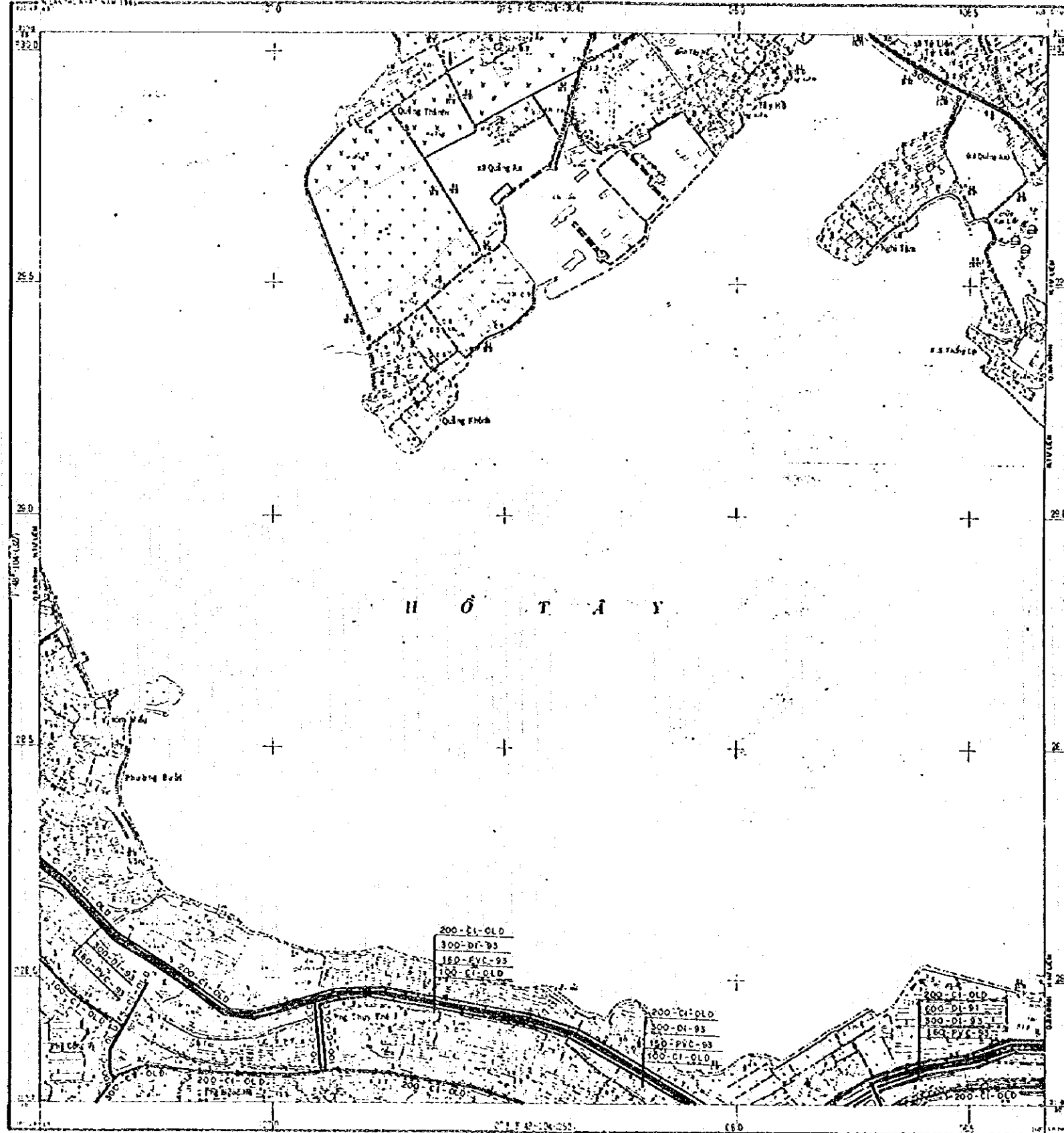
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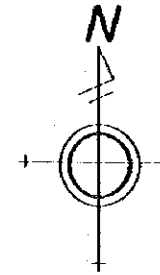
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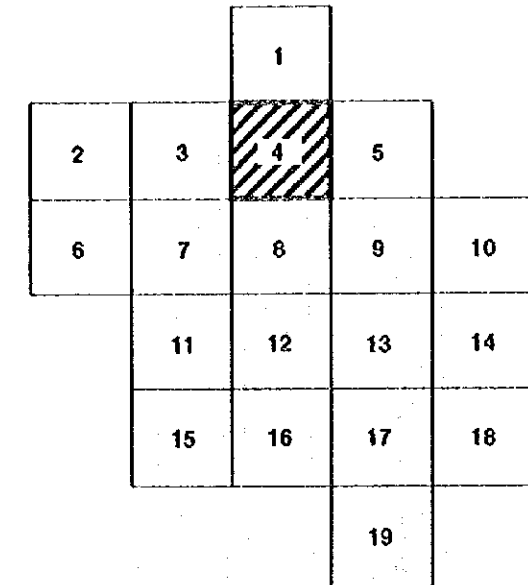


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REVISIONS

THE STUDY
ON
HANOI WATER SUPPLY SYSTEMS
IN THE SOCIALIST REPUBLIC
OF VIET NAM

Distribution Network No. 4

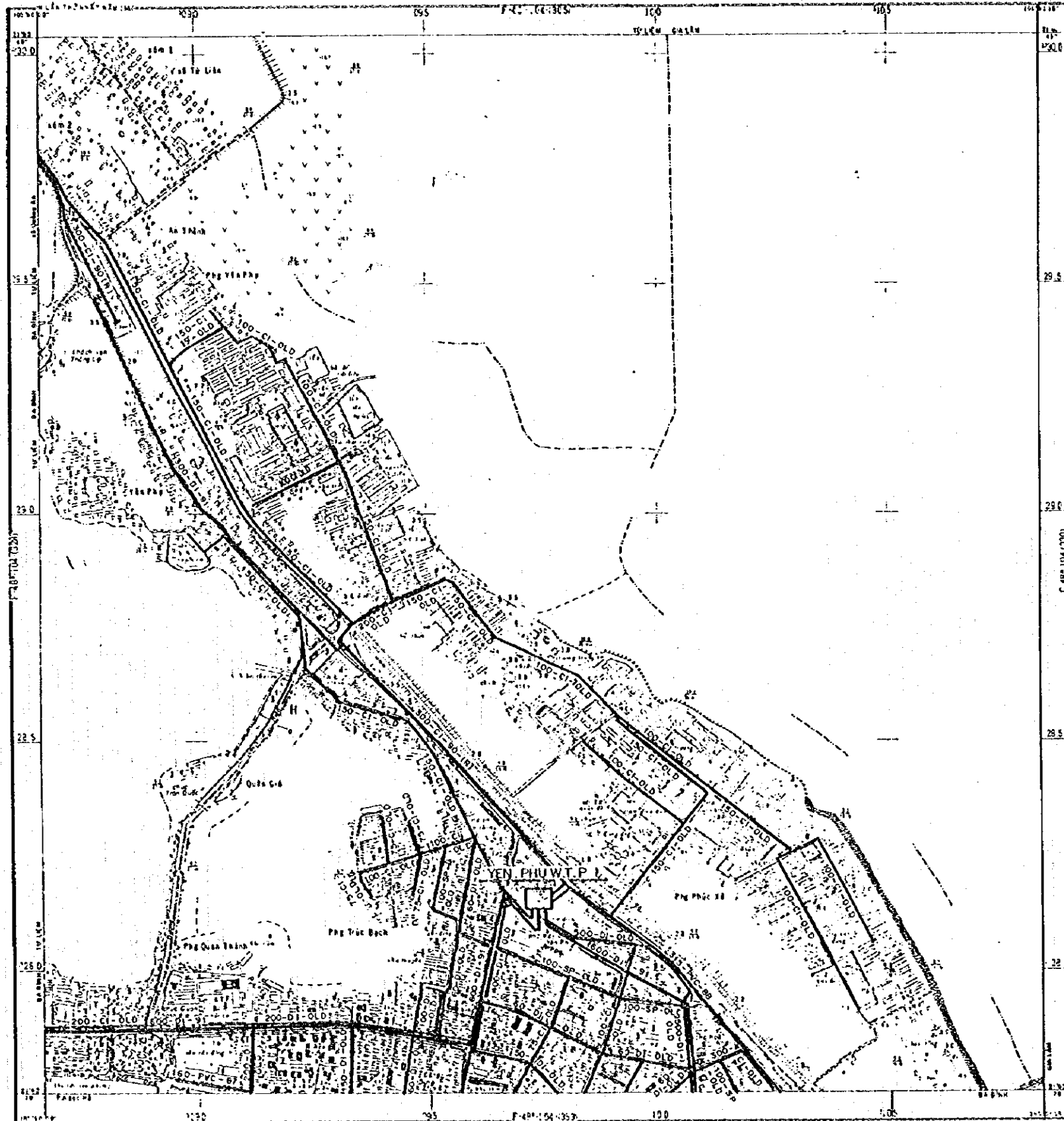
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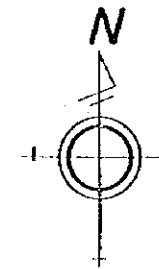
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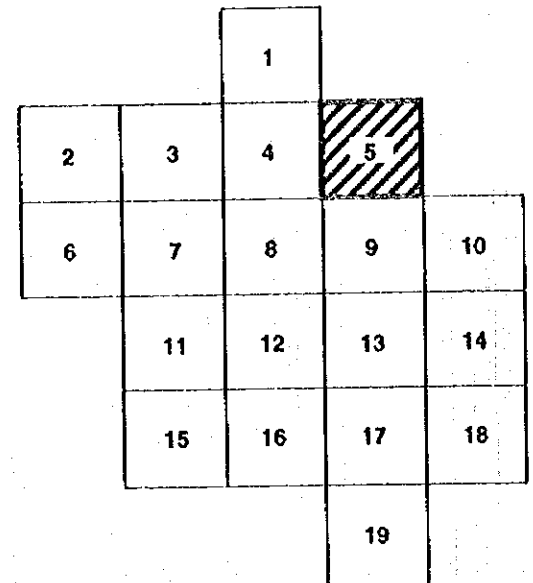


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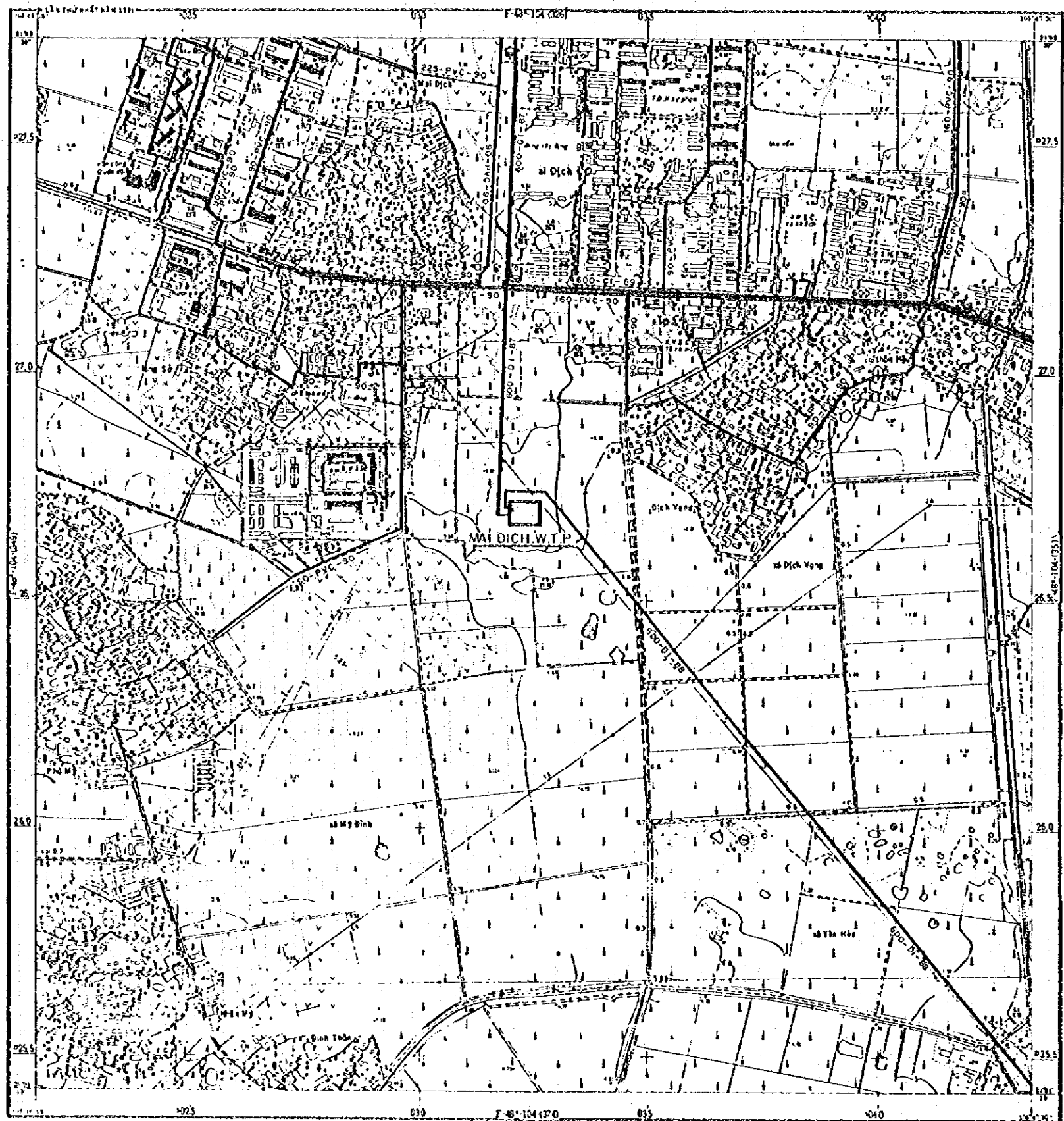
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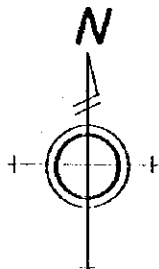
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HÁ NỘI — TỪ LIÊM

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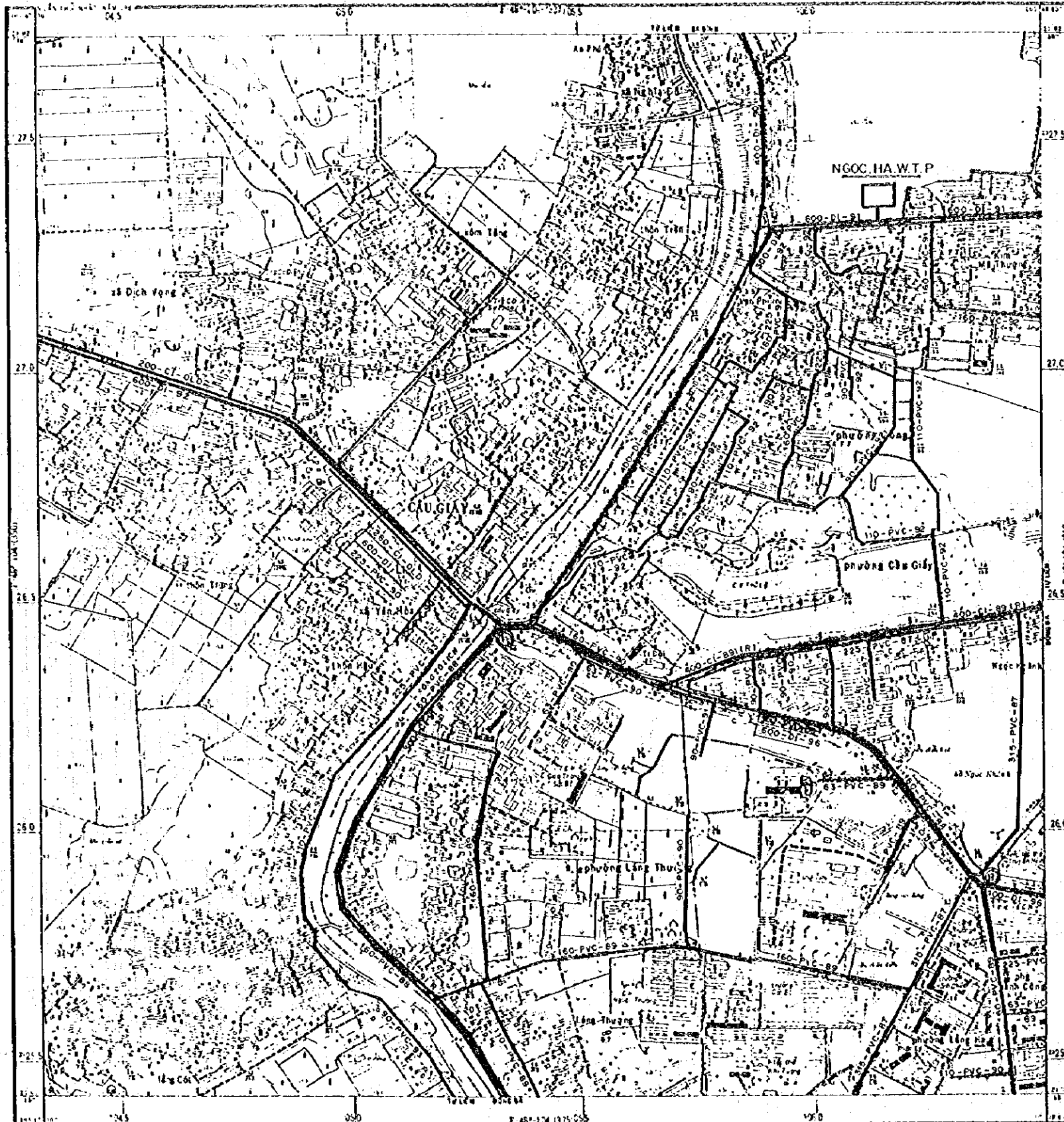
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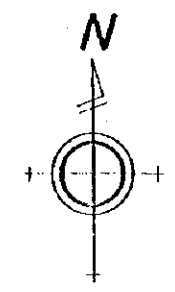
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GENERAL NOTES

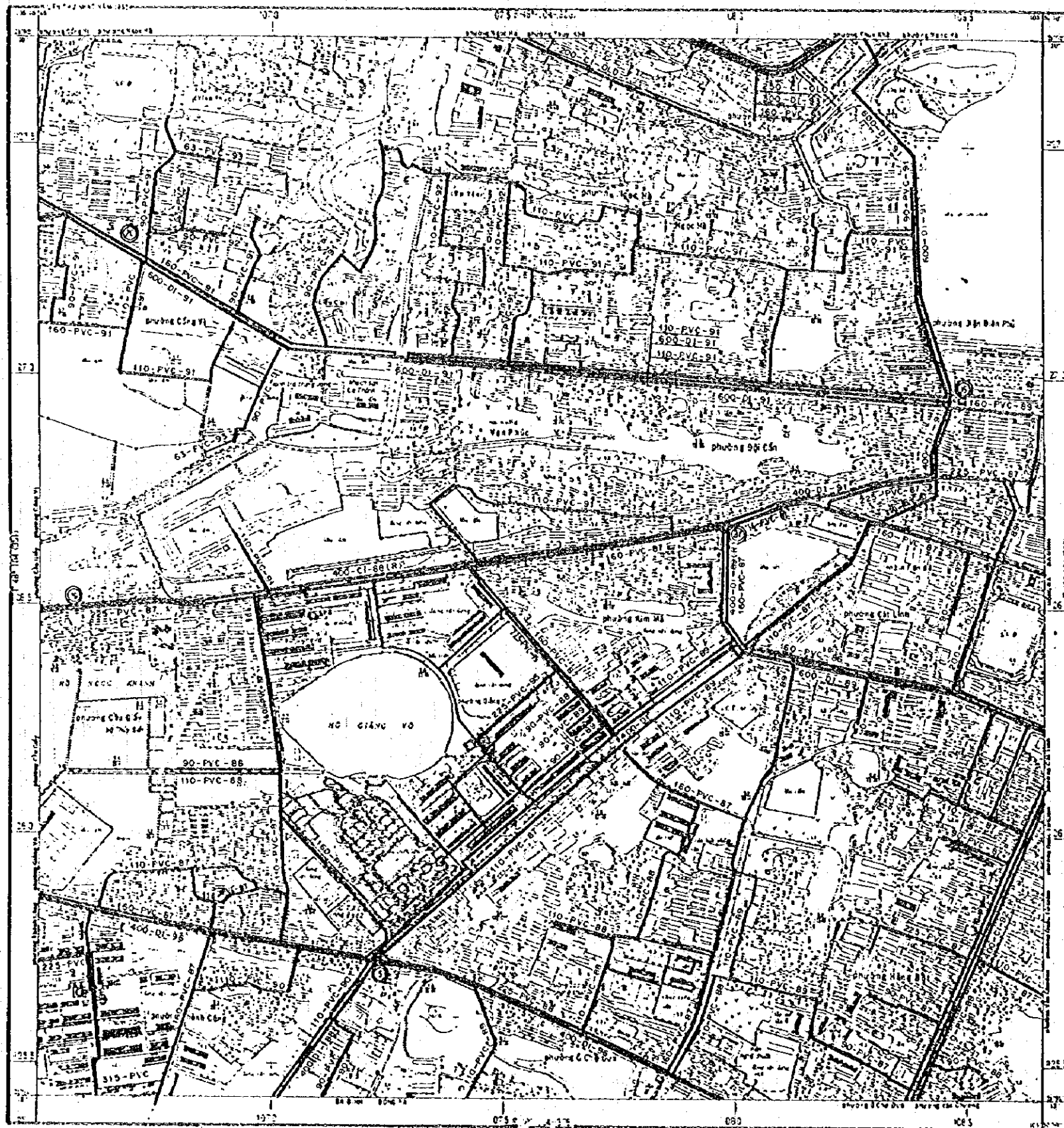
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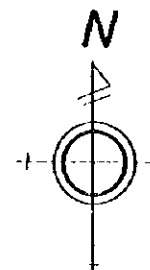
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F-48^a-104-(352)



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SCALE 1:10000



GENERAL NOTES

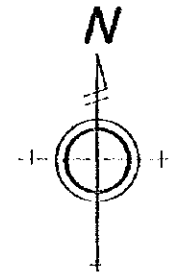
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HÁ NỘI — DŨNG DA, BA DÌNH, HOÀN KIẾM

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100 50 0 100 200 300 400 (m)
SCALE 1 : 10000

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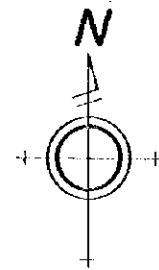
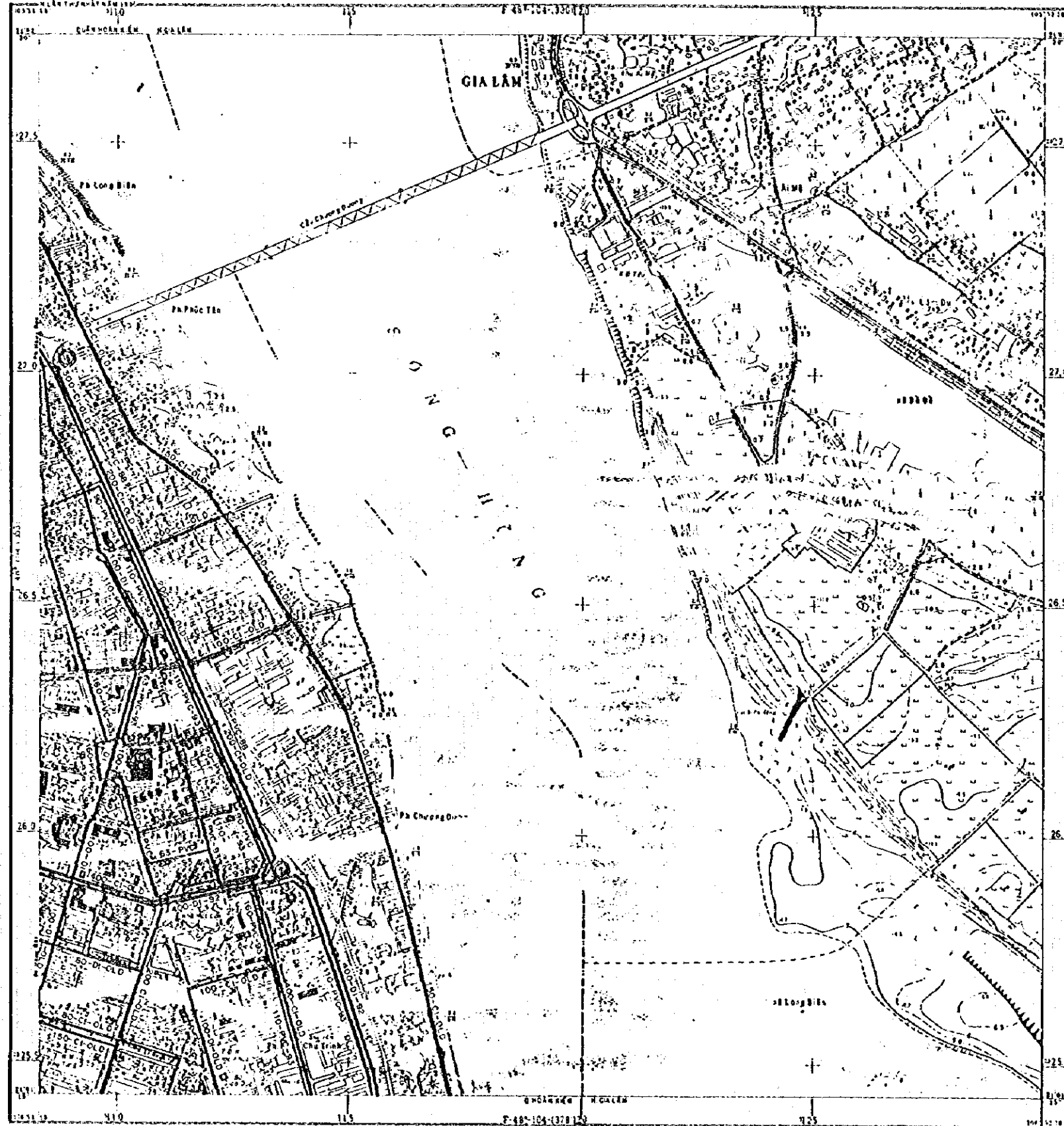
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100 50 0 100 200 300 400 (m)
SCALE 1 : 10000

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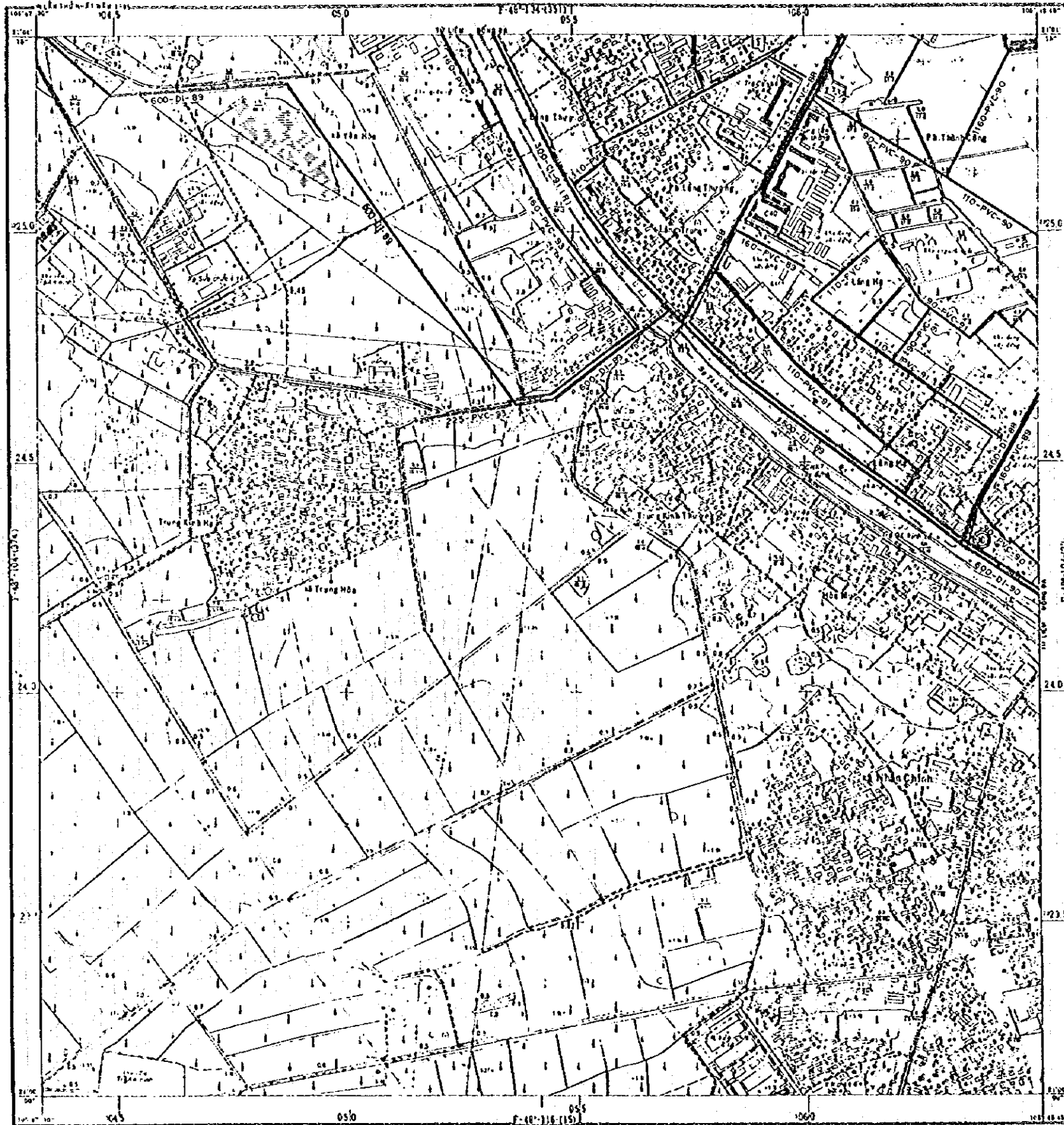
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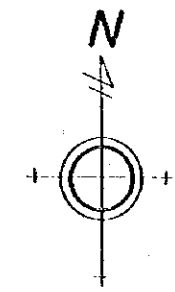
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HÁ NỘI - TỪ LIÊM, ĐÔNG ĐÀ
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SCALE 1:10000



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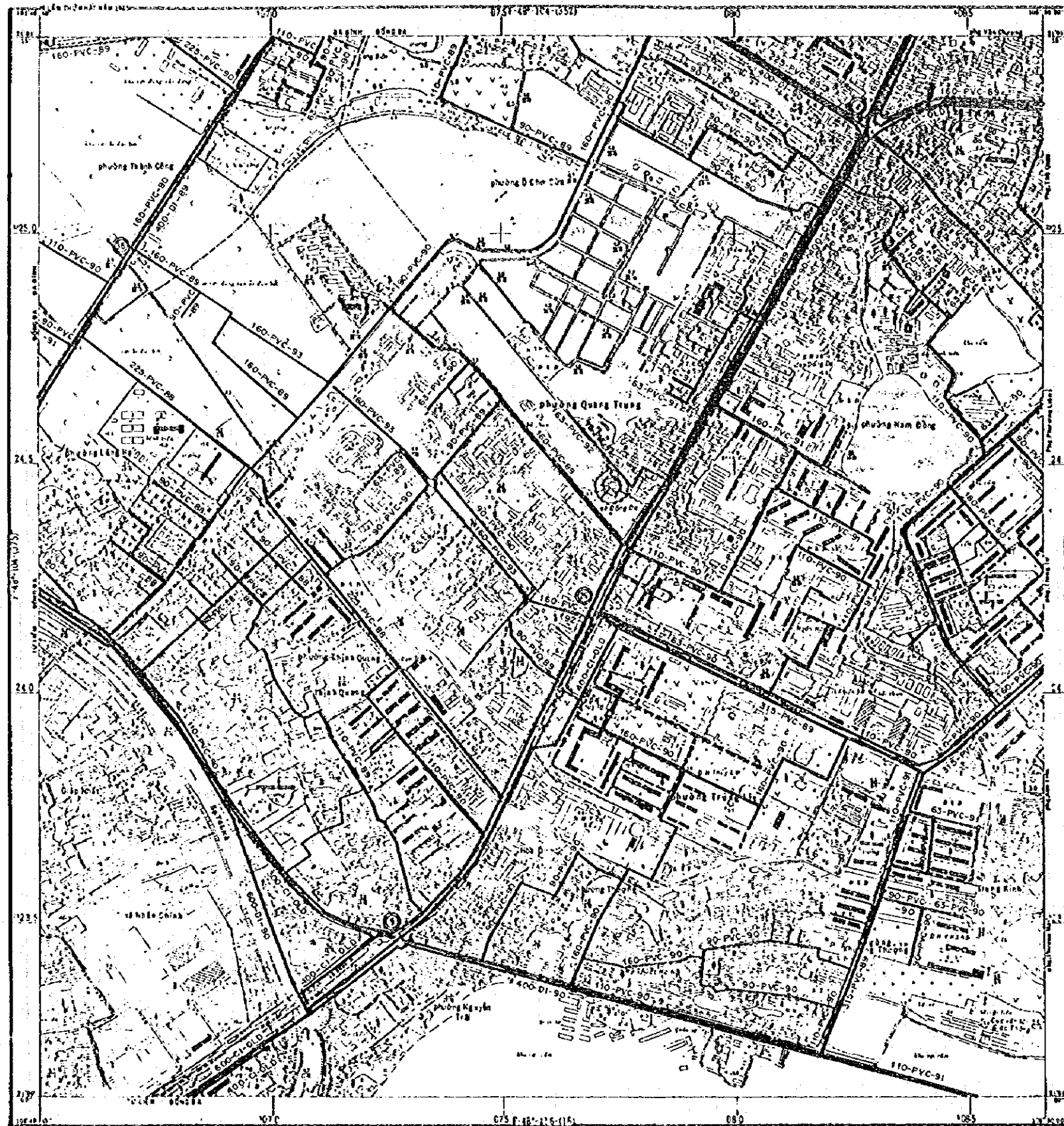
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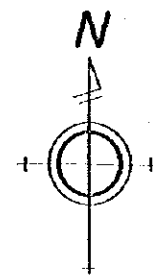
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SCALE 1:10000



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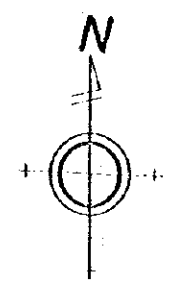
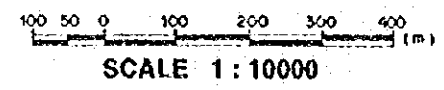
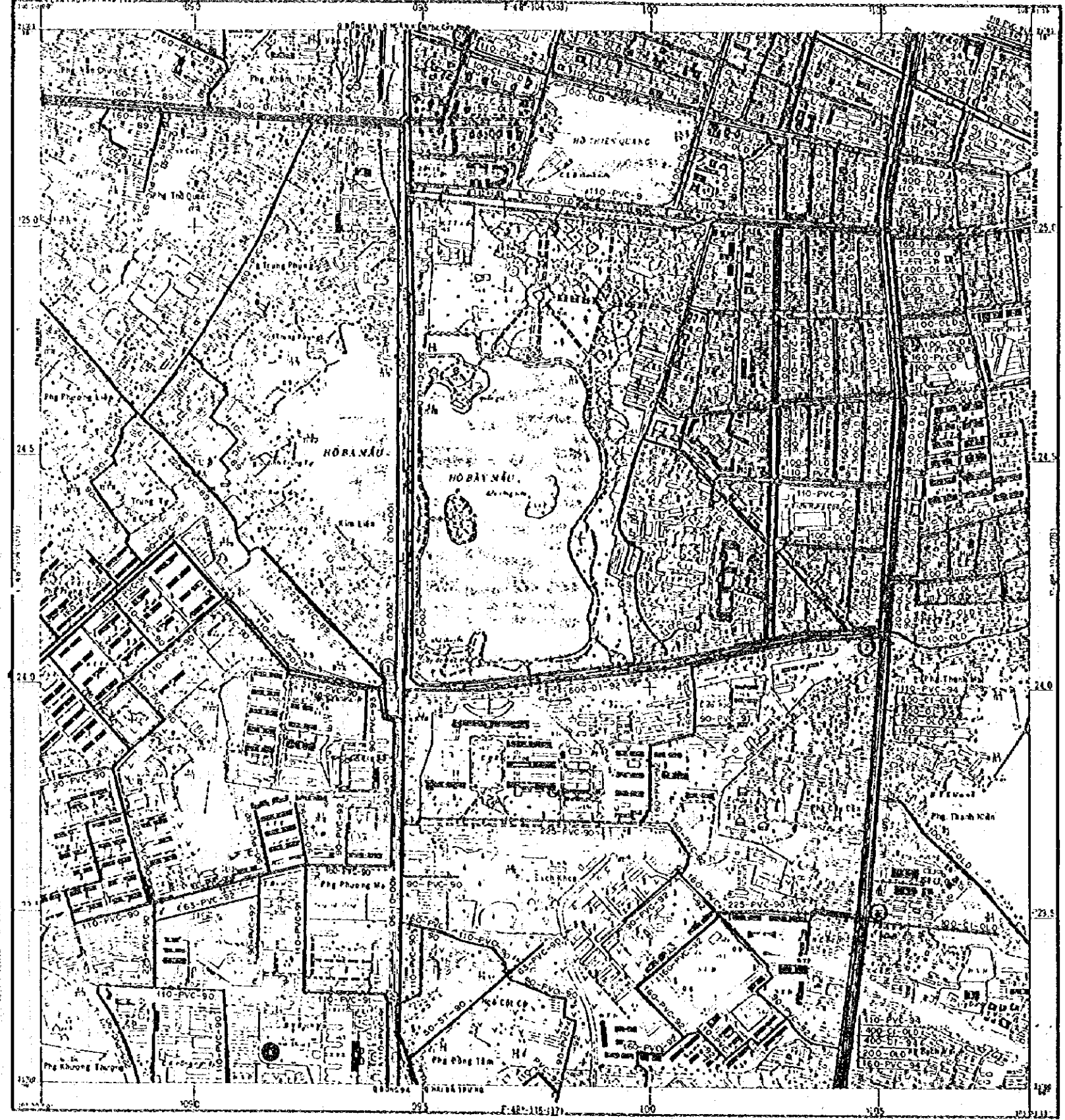
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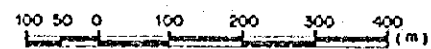
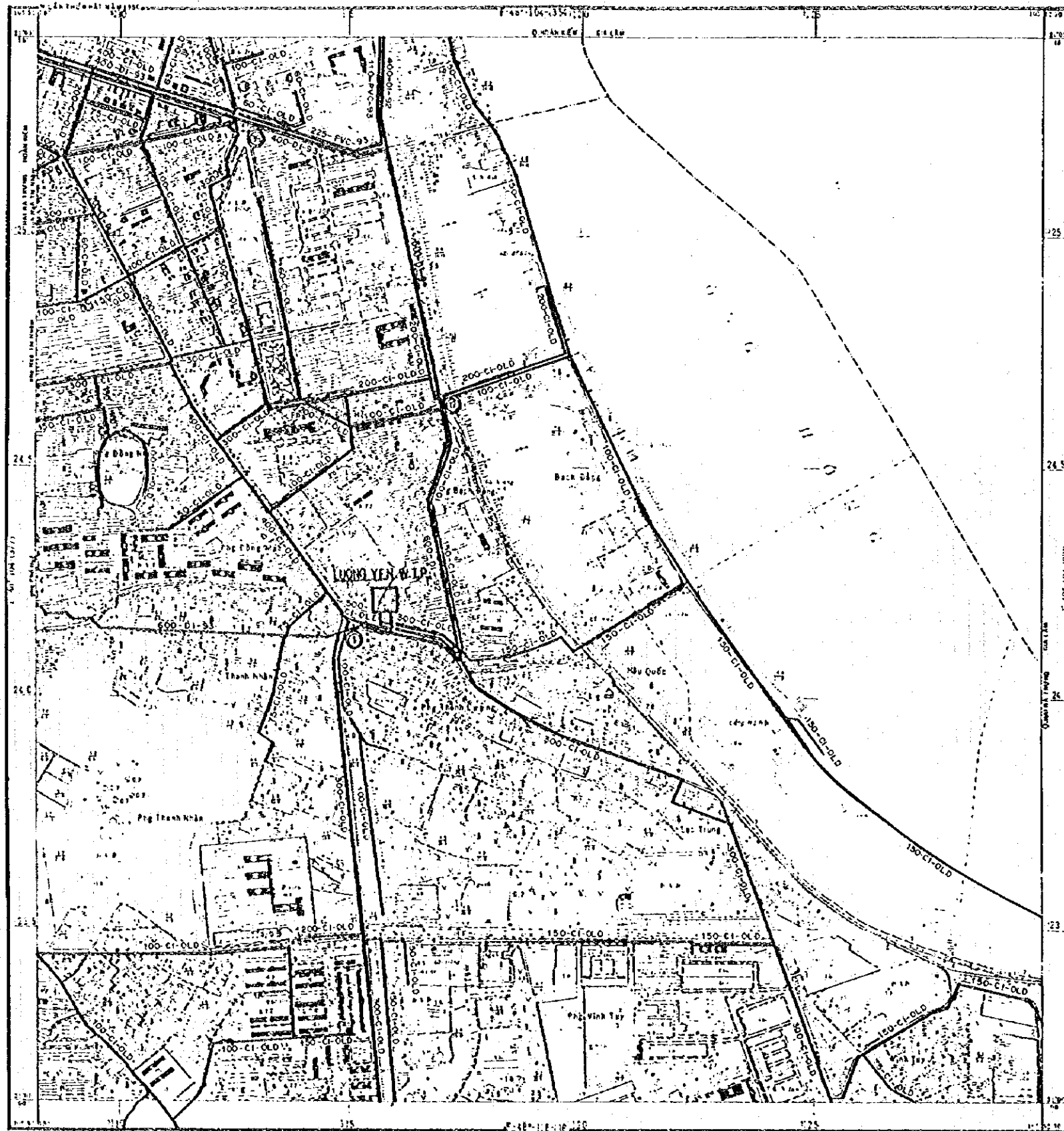
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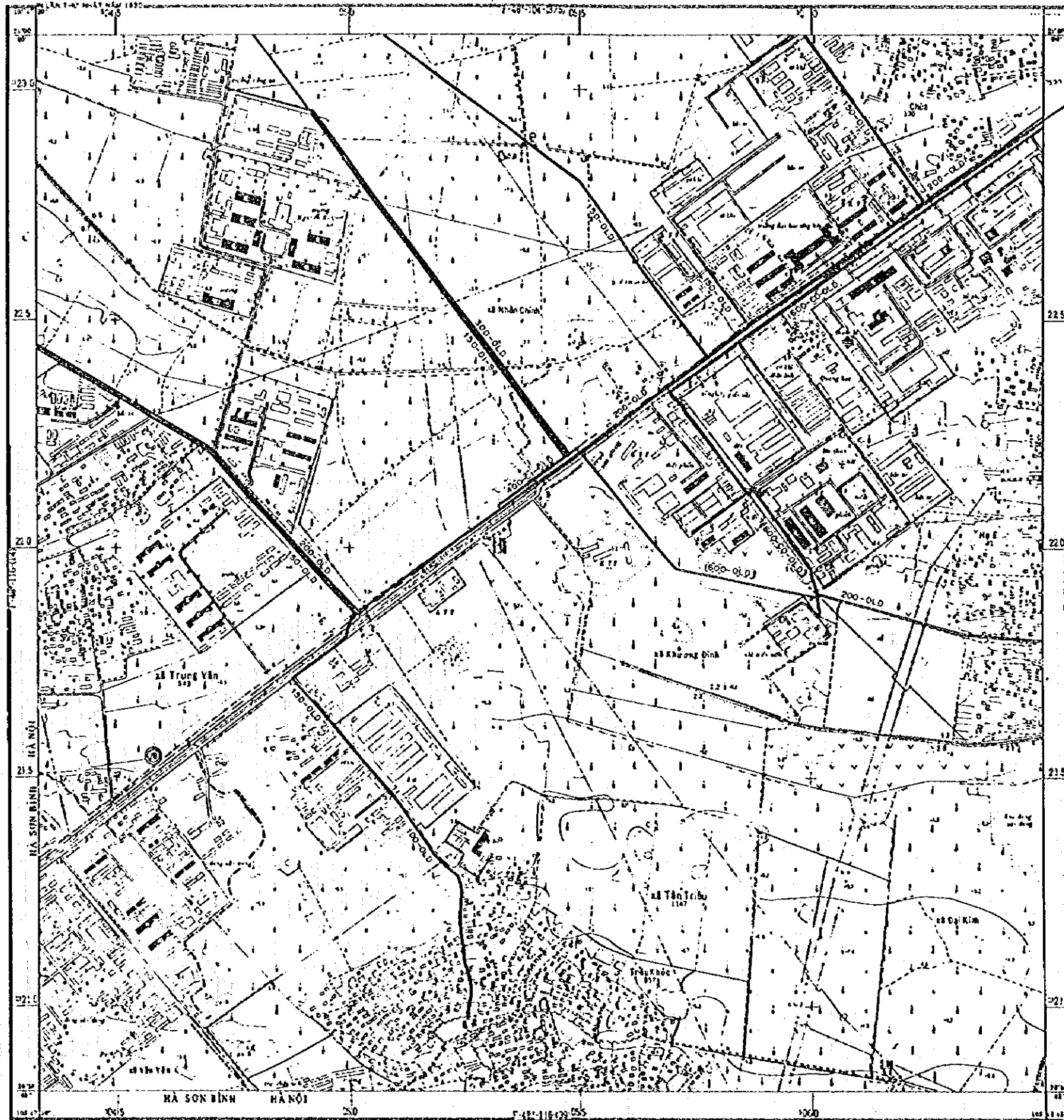
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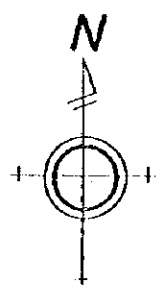
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100 50 0 100 200 300 400 (m)
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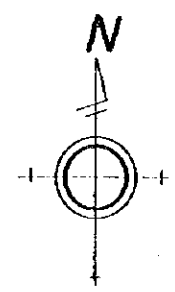
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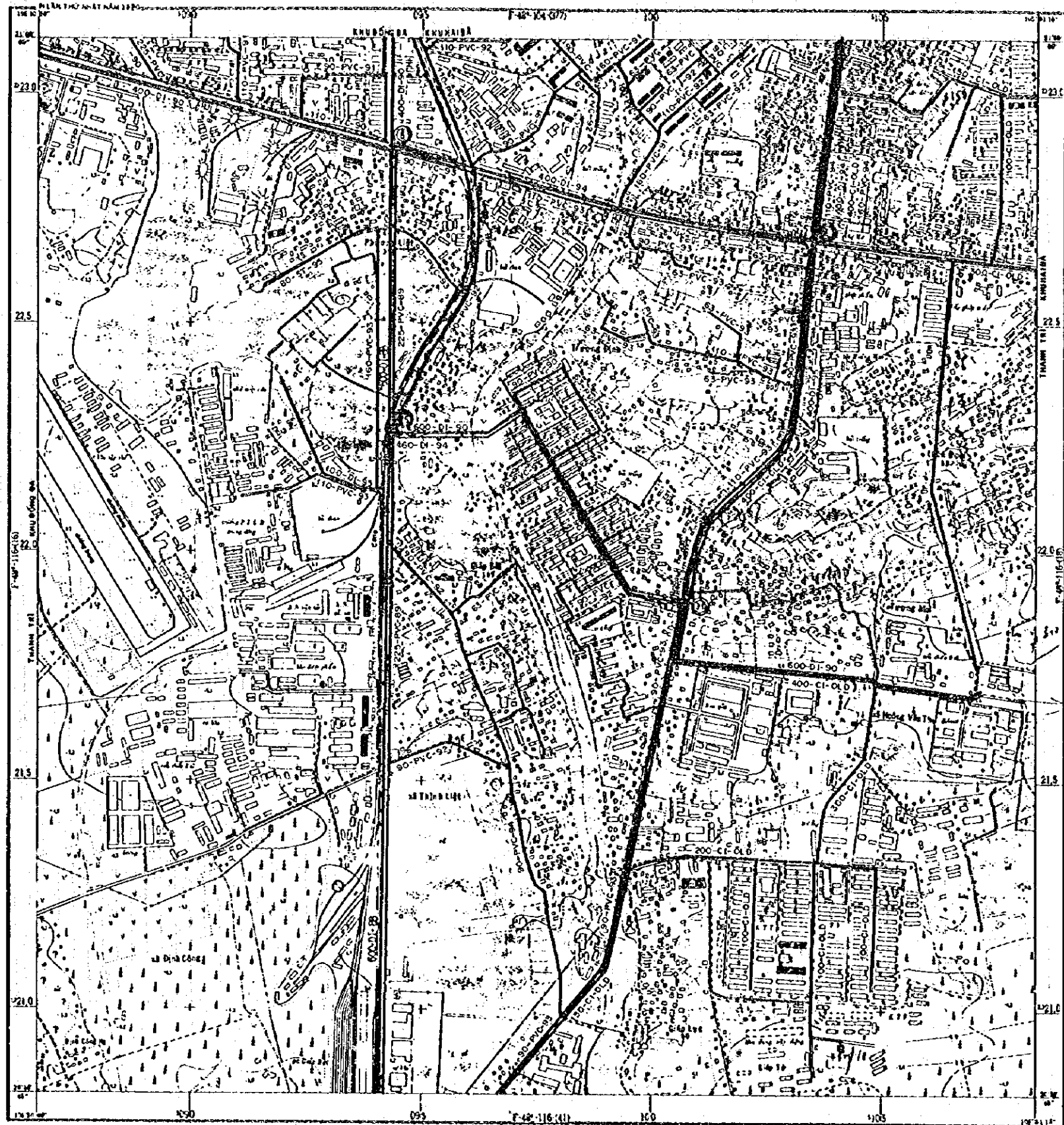
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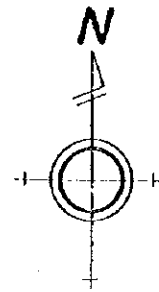
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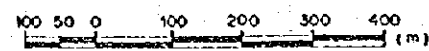
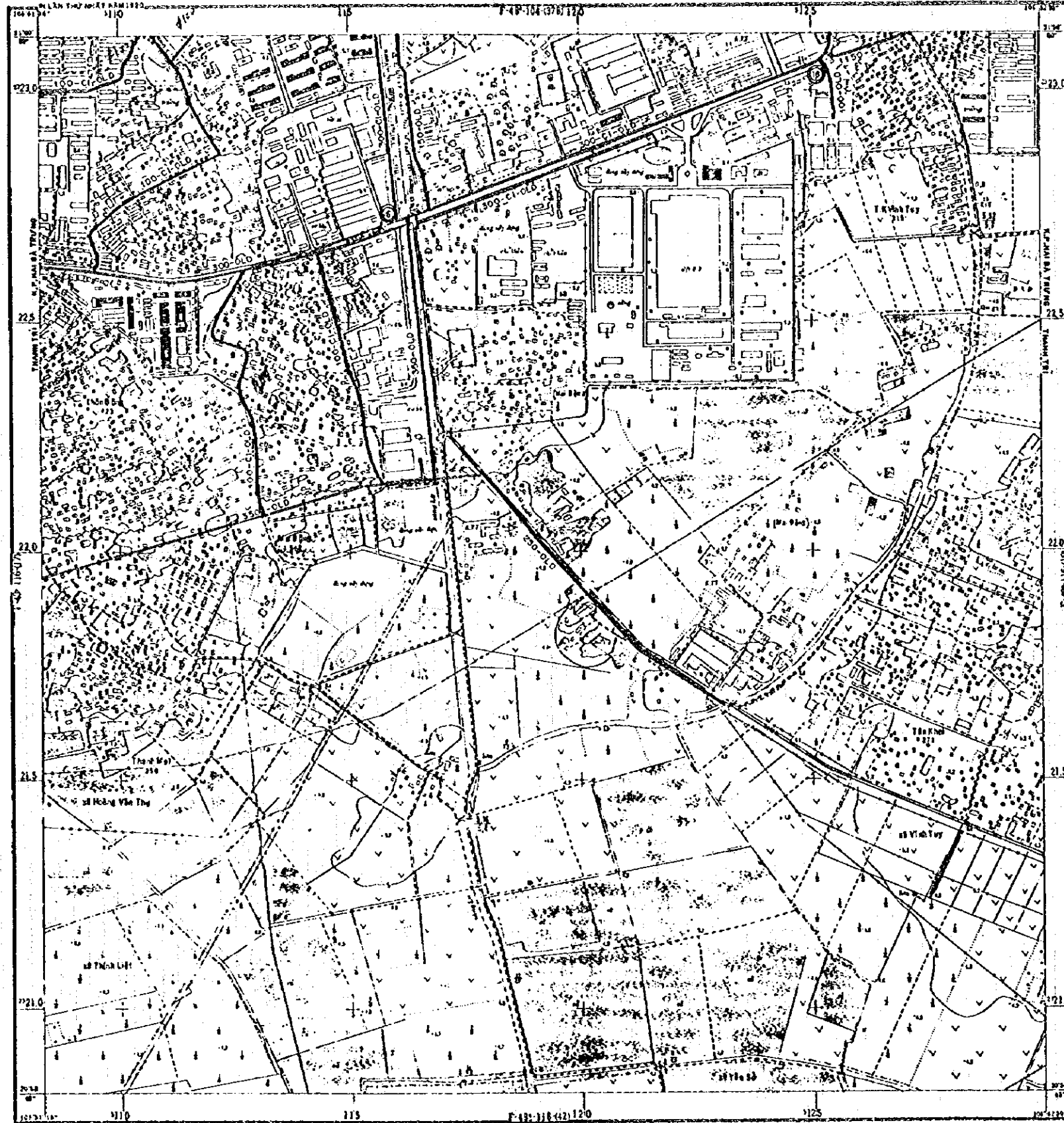
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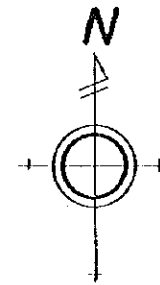
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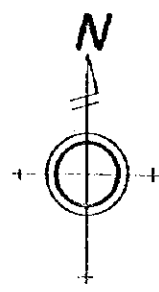
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