

## **Appendix F**

### **Intersection Safety Improvement Plans**

This appendix contains information for 20 junctions, where existing physical and traffic conditions are gathered, traffic problems are analyzed and improvement plan is formulated and cost is estimated. Information was gathered through site visit and field observation, traffic volume count survey, queue length survey, and pedestrian count survey. In addition, some information was gathered through interview with persons who are familiar with the junction.

Information for each junction consists of four (4) sheets. First sheet is made up of the following seven sections:

- Intersection code and signalization
- Intersection name
- Physical conditions
- Traffic conditions
- Analysis
- Improvement
- Estimated cost

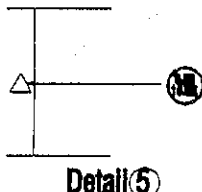
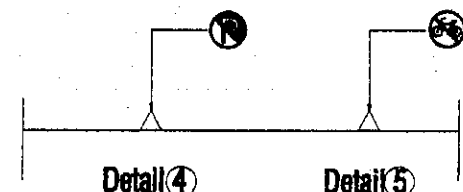
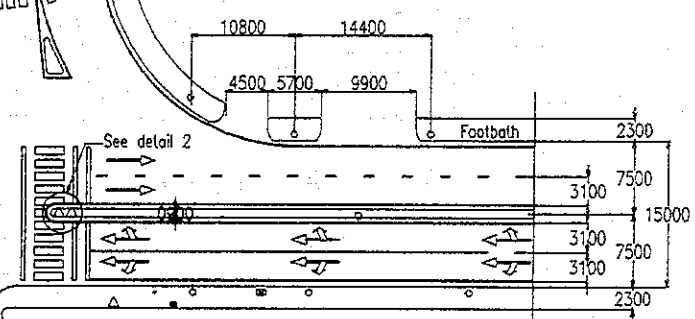
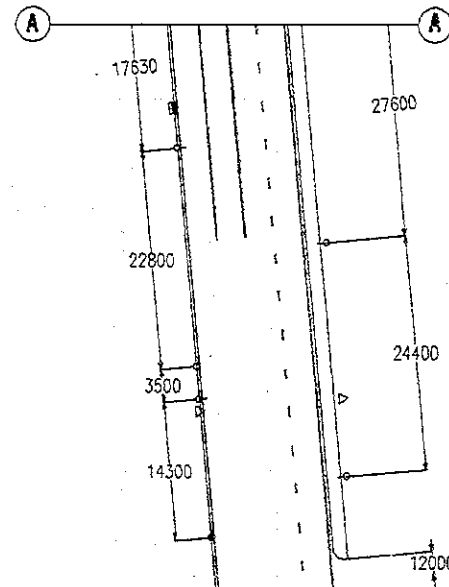
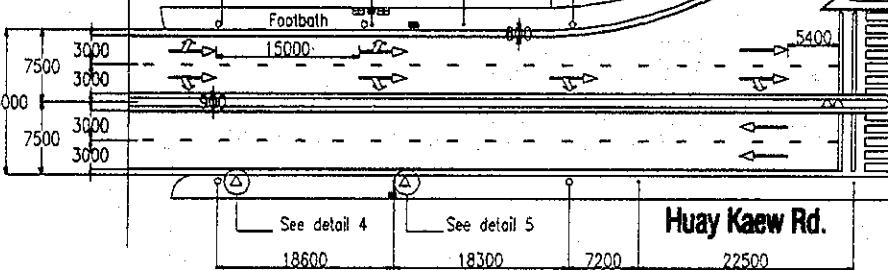
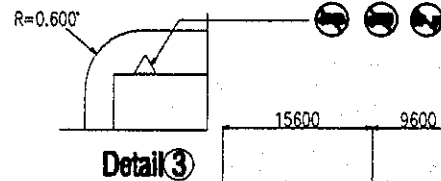
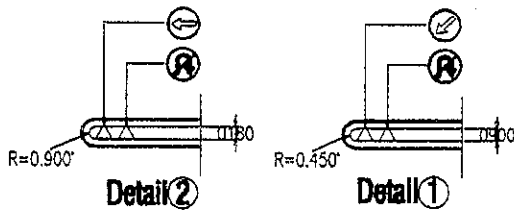
Cost section shows three components; geometric improvement and pavement marking, signal installation/improvement and engineering services. The last item includes the cost of geographic survey, traffic survey, detailed design, cost estimate, and construction supervision.

Second sheet is a drawing showing the existing conditions of junction. Improvement plan is shown in the drawing on the third sheet. Finally fourth sheet is the peak hour traffic volume in PCU counted by the Study Team in August and September 2001.

Breakdown of the project cost indicated on each sheet is attached at the end of the appendix.

Code	J-1	Signalization	Signalized															
Name	Super Highway, Nimmanhamin Road and Huay Kaew Road																	
Physical conditions	<ol style="list-style-type: none"> <li>4-leg junction at the west end of Super Highway. Main junction in the west side of the city.</li> <li>Super Highway is an 8-lane divided road, Huay Kaew Road a 4-lane divided and Nimmanhamin Road a 4-lane undivided.</li> <li>U-turn opening is provided about 200 upstream of the Junction.</li> <li>Pedestrian crossing is installed at all legs except Nimmanhamin Road. But no path is provided on the island.</li> <li>Pedestrian signals are not installed.</li> <li>Lightings are installed.</li> </ol>																	
Traffic conditions	<ol style="list-style-type: none"> <li>High traffic from all approaches of the junction except Nimmanhamin, which has lower volume than others.</li> <li>High ratio (approx. 45 %) of right turn flow from Huay Kaew to Super Highway and similarly high ratio (approx. 40 %) of left turn from Super Highway to Huay Kaew.</li> <li>Small number (less than 100 PCU per hour) of right turn from northwest approach.</li> <li>Large vehicles prohibited to enter city area from this junction during daytime.</li> <li>Junction operates near or in excess of saturate condition. Queue develops along four approaches. Maximum queue length in meter observed is (+ indicates more than): <table style="margin-left: 40px; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left;">Approach</th> <th style="text-align: center;">North</th> <th style="text-align: center;">East</th> <th style="text-align: center;">South</th> <th style="text-align: center;">West</th> </tr> </thead> <tbody> <tr> <td>AM peak</td> <td style="text-align: center;">300+</td> <td style="text-align: center;">200</td> <td style="text-align: center;">300+</td> <td style="text-align: center;">100</td> </tr> <tr> <td>PM peak</td> <td style="text-align: center;">300+</td> <td style="text-align: center;">300+</td> <td style="text-align: center;">300+</td> <td style="text-align: center;">200</td> </tr> </tbody> </table> </li> <li>Queue length suggests that signal timing is not balanced.</li> <li>Signal is manually controlled by enforcer when junction is congested.</li> <li>U-turn is prohibited at the end of Super Highway.</li> </ol>			Approach	North	East	South	West	AM peak	300+	200	300+	100	PM peak	300+	300+	300+	200
Approach	North	East	South	West														
AM peak	300+	200	300+	100														
PM peak	300+	300+	300+	200														
Analysis	<ol style="list-style-type: none"> <li>The junction is located at the end point of high grade Super Highway. Thus large volume of traffic entering and leaving Super Highway concentrates at this Junction.</li> <li>Two lanes are provided for left turn from Super Highway into Huay Kaew and left turn is not controlled by the signal so that no queue develops for this direction.</li> <li>On the other hand, through and right turn from Super Highway shares two lanes while exit side has two lanes each for Nimmanhamin and Huay Kaew.</li> <li>Signal phasing is separate approach, in which green is given to each approach allowing movement in all directions. More throughout is expected if overlapping phase is introduced. Alternatively right turn from northwest (Huay Kaew) may be band and signal phase of simultaneous through followed by through and right turn from southeast approach may be applied.</li> </ol>																	
Improvements	<ol style="list-style-type: none"> <li>Shifting of median along Super Highway for additional one lane for approach side.</li> <li>Re-application of pavement marking including provision of pedestrian crossing across Nimmanhamin and relocation of pedestrian crossing across Super Highway near to the junction.</li> <li>Re-adjustment of signal timing.</li> <li>Addition of pedestrian signal.</li> <li>Modification of signal phase.</li> </ol>																	
Cost (thousand Baht)	<table style="width: 100%; border-collapse: collapse;"> <tbody> <tr> <td style="width: 60%;">Geometric improvement and pavement marking:</td> <td style="text-align: right;">1,470</td> <td></td> </tr> <tr> <td>Signal installation/improvement:</td> <td style="text-align: right;">1,151</td> <td></td> </tr> <tr> <td>Engineering services:</td> <td style="text-align: right;">524</td> <td></td> </tr> <tr> <td><b>Total project cost:</b></td> <td style="text-align: right;"><b>3,145</b></td> <td style="text-align: right;"><b>thousand Baht</b></td> </tr> </tbody> </table>			Geometric improvement and pavement marking:	1,470		Signal installation/improvement:	1,151		Engineering services:	524		<b>Total project cost:</b>	<b>3,145</b>	<b>thousand Baht</b>			
Geometric improvement and pavement marking:	1,470																	
Signal installation/improvement:	1,151																	
Engineering services:	524																	
<b>Total project cost:</b>	<b>3,145</b>	<b>thousand Baht</b>																

North



Existing Plan  
not to scale

0 2 4 8 Meter

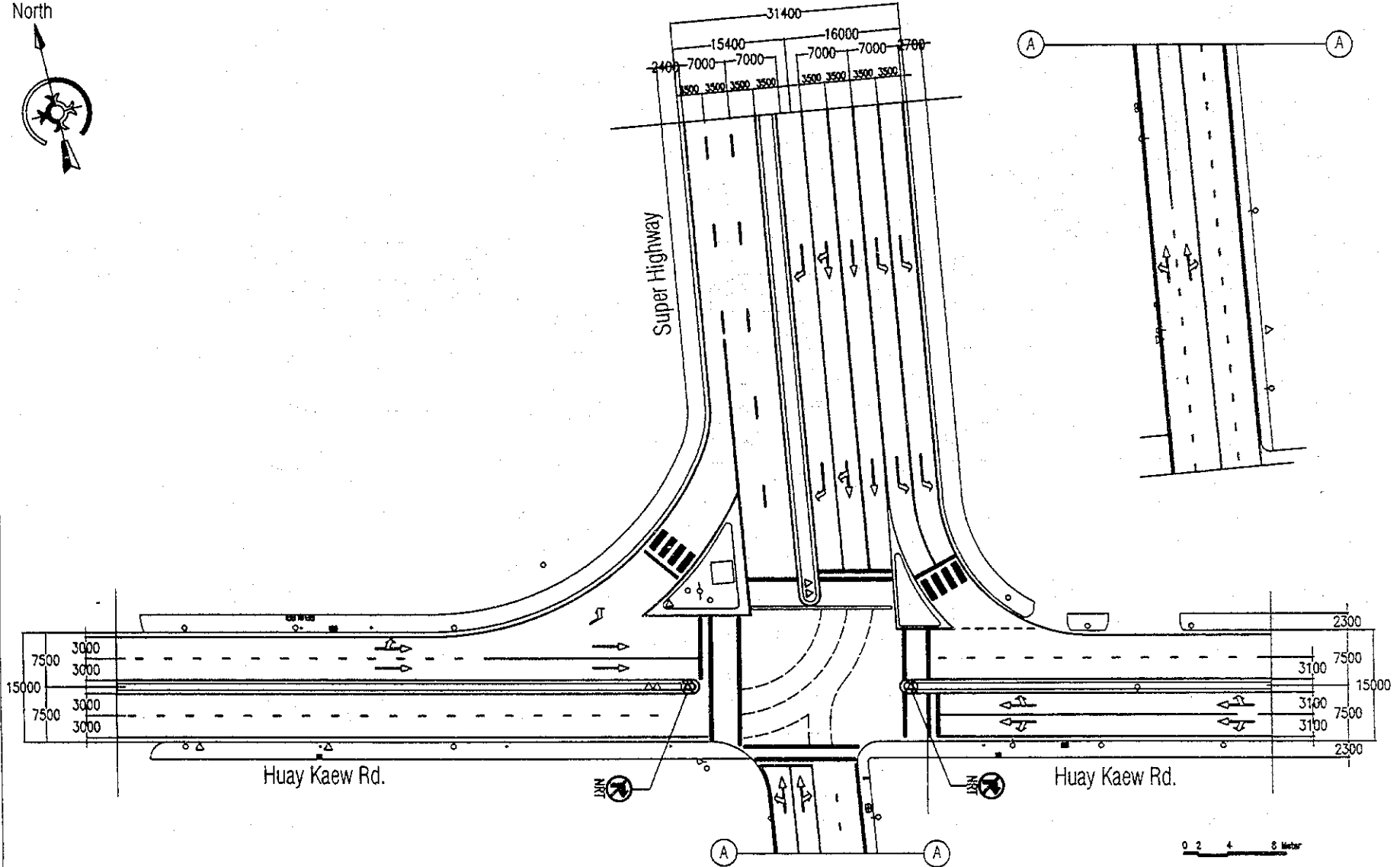
<b>JICA</b> THE STUDY ON IMPROVEMENT OF ROAD TRAFFIC ENVIRONMENT IN CHANG MI CITY		
Information No. 1		
Huay Kaew Rd - Super Highway Rd		
Designed by:	Drawn by: Chaitanon	Checked by:
Date: August 24 2001	Date:	Date:
File Name:	Drawing No.	

F-3


North



F-4

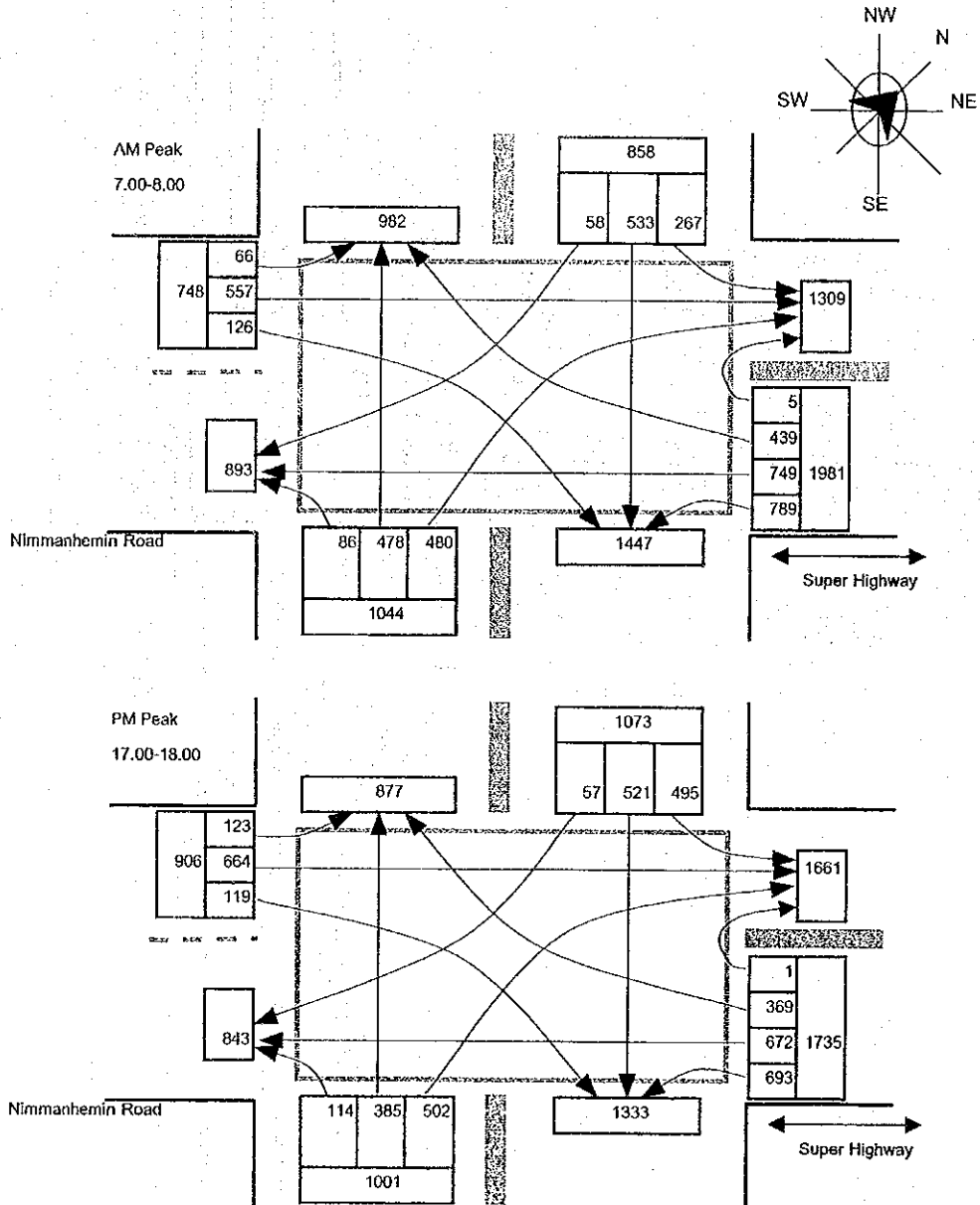


Improvement Plan  
not to scale

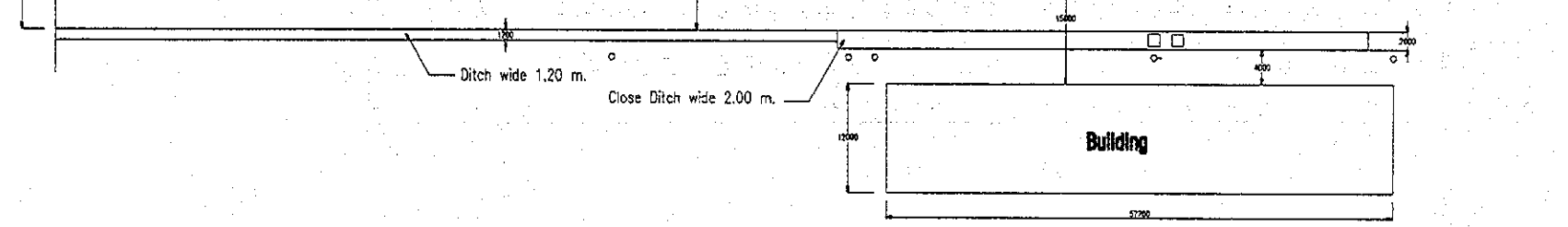
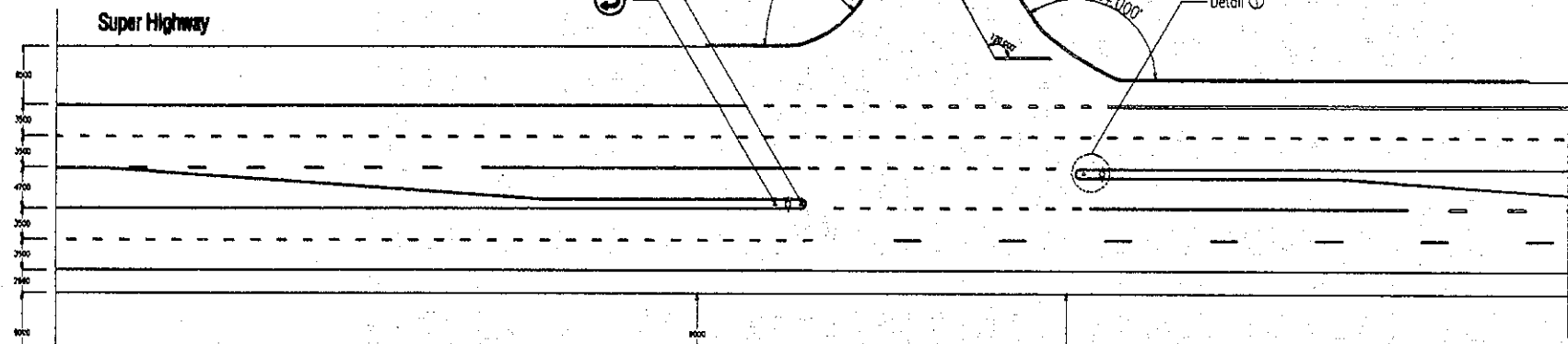
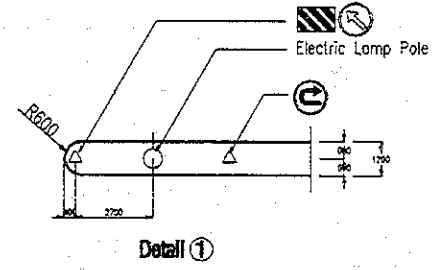
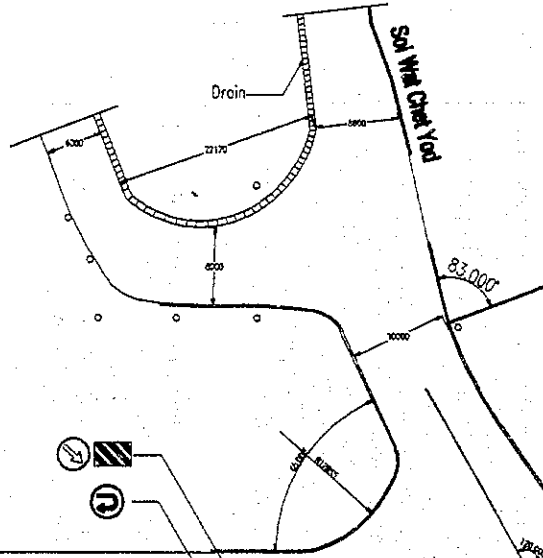
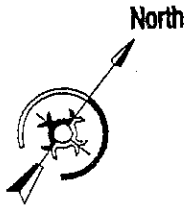
 THE STUDY ON IMPROVEMENT OF ROAD TRAFFIC ENVIRONMENT IN CHIANG MAI CITY		
Intersection No. 1		
Huay keaw Rd - Super highway Rd		
Designed by:	Drawn by: Chitakorn	Checked by:
Date: August 24 2001	Date:	Date:
File Name:	Drawing No.	

Peak Flow in PCU Junction No. J1 Intersecting Streets ... Huay Kaew Road-Super Highway

Peak Periods	from Northeast approach					from Southeast approach				from Southwest approach				from Northwest approach				Total inbound	Total
	To SW	To SE	To NW	To U-Turn	From NE	To NW	To SW	To NE	From SE	To NE	To NW	To SE	From SW	To SE	To NE	To SW	From NW		
AM: 7.00-8.00	749	789	439	5	1981	478	86	480	1044	557	66	126	748	533	267	58	858	4631	
PM: 17.00-18.00	672	693	369	1	1735	385	114	502	1001	664	123	119	906	521	495	57	1073	4715	



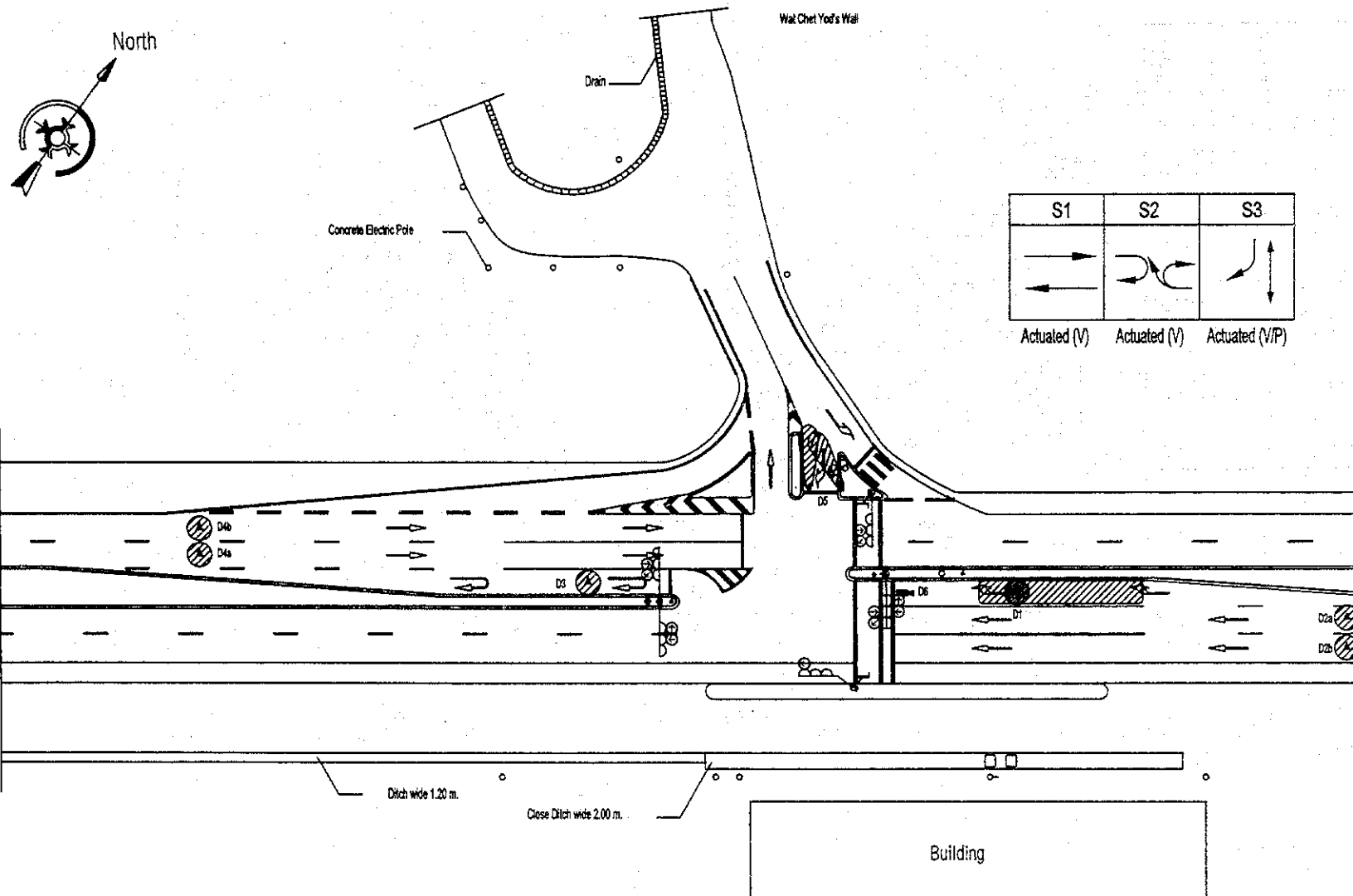
Code	J-2	Signalization	Not signalized
Name	Super Highway and Soi Wat Chet Yod		
Physical conditions	<ol style="list-style-type: none"> <li>1. T-junction of high grade Super Highway (4-lane divided road with wide shoulder) and a local collector road of 10 meter wide.</li> <li>2. Another collector road which is a continuation of Wat Chet Yod connects with Super Highway about 80 m from the junction.</li> <li>3. Right/U turn lane of 30 m long is provided along Super Highway for both directions.</li> <li>4. Open space of about 9 m wide is provided along Super Highway in front of the building fronting junction. The space is used as parking lot.</li> <li>5. Collector road flares to 30 m wide and connects with Super Highway.</li> <li>6. Elevation of collector road is lower than Super Highway and the grade of approach is about 10%.</li> <li>7. Sodium type lightings are installed on median of the highway.</li> <li>8. No pedestrian crossing is provided across Super Highway and pavement markings of the access Soi are not clear.</li> <li>9. Pot holes are found on the collector road.</li> </ol>		
Traffic conditions	<ol style="list-style-type: none"> <li>1. Extremely dangerous junction due to many crossings of local traffic consisting mostly of motorcycle with high speed traffic along Super Highway.</li> <li>2. Motorcycles coming from collector road cross Super Highway and run against the flow on the open space to reach another collector road.</li> <li>3. Traffic from the second collector road has to cross two lanes to right turn lane in a short distance of less than 100 m to make right or U-turn.</li> <li>4. Dangerous merging maneuver of U-turn traffic with high speed traffic on Super Highway. Large vehicles are unable to make u-turn without backing up.</li> <li>5. The most accident prone site in the study area. According to the data from hospital, 106 persons were involved in traffic accidents in one year.</li> <li>6. Manual control of traffic by policeman is executed during peak hours.</li> <li>7. Nearest junction where u-turn is possible is about 800 m south-west or 1.5 km north-east along Super Highway.</li> </ol>		
Analysis	<ol style="list-style-type: none"> <li>1. Construction of Super Highway divided the pre-existing collector road while local traffic demand between two divided collector road remains as before.</li> <li>2. No alternative route for local traffic to cross Super Highway.</li> <li>3. There is no junction or U-turn opening between the junction and the adjacent junction of Super Highway – Chotana Road, which is 1.5 km away.</li> </ol>		
Improvements	<ol style="list-style-type: none"> <li>1. Installation of a traffic signal.</li> <li>2. Geometric improvement to regulate movement of traffic in and out of collector road. The work includes construction of corner islands and a center island on Wat Chet Yod approach, extension of median on the northeast approach of Super Highway and sidewalk along southeast side of Super Highway.</li> </ol>		
Cost	Cost is not estimated as the improvements were already implemented as a pilot project.		



**Existing Plan**  
not to scale

THE STUDY ON IMPROVEMENT OF ROAD TRAFFIC ENVIRONMENT IN CHANG MAI CITY		
Intersection No. 2 Super Highway - Wat Chak Yod		
Designed by: Date: September 19 2001	Drawn by: Asewale Date: September 24 2001	Checked by: Date:
File Name:		Drawing No.2

F-7



Detector	D1	D2	D3	D4	D5	D6
Type	Ultrasonic	Ultrasonic	Ultrasonic	Ultrasonic	Doppler	Image
Symbol	▲	▲	▲	▲	▲	■
Sensor position	Longitudinal	Approx. 20m from stop line	Approx. 60m from stop line	Approx. 20m from stop line	Approx. 60m from stop line	Stop line
	Lateral	Center of right turn lane	Center of innerouter lane	Center of right turn lane	Center of innerouter lane	Curb side and approx. 4m from curb
	Height	6.0m	6.0m	6.0m	6.0m	5.0m
Detection Zone (shown by hatched area)	Shape	Cone	Cone	Cone	Ellipsoid	Rectangular
	Size	Height: 6.0m Bottom diameter: 3.0m	Height: 6.0m Bottom diameter: 3.0m	Height: 6.0m Bottom diameter: 3.0m	Height: 6.0m Bottom diameter: 3.0m	Approx. 6m long and 2m wide

**JICA** THE STUDY ON IMPROVEMENT OF ROAD TRAFFIC ENVIRONMENT IN CHIANG MAI CITY

Intersection No. 2 Super Highway - Wat Chet Yod

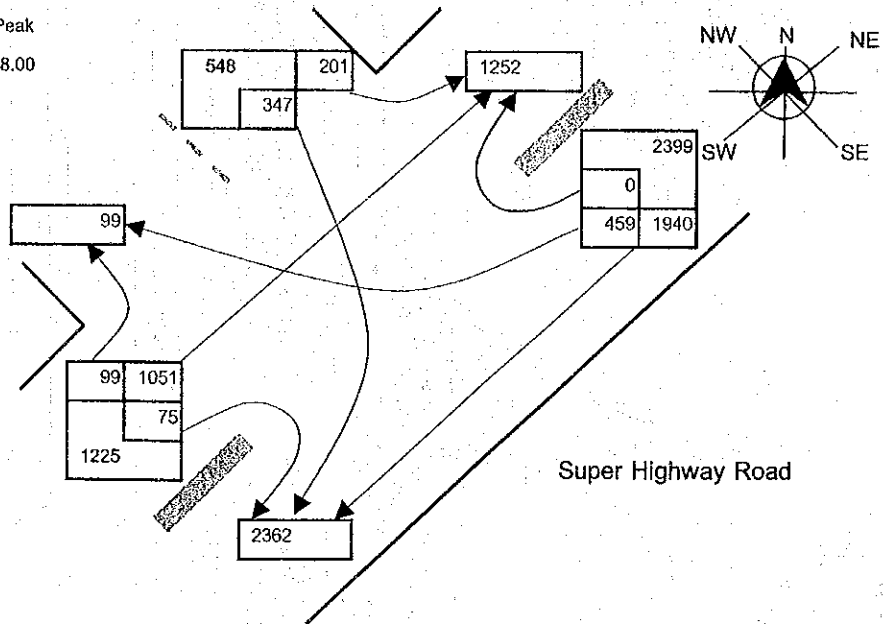
Designed by:	Drawn by:	Checked by:
Date: September 10 2001	Date:	Date:
File Name:	Drawing No.	



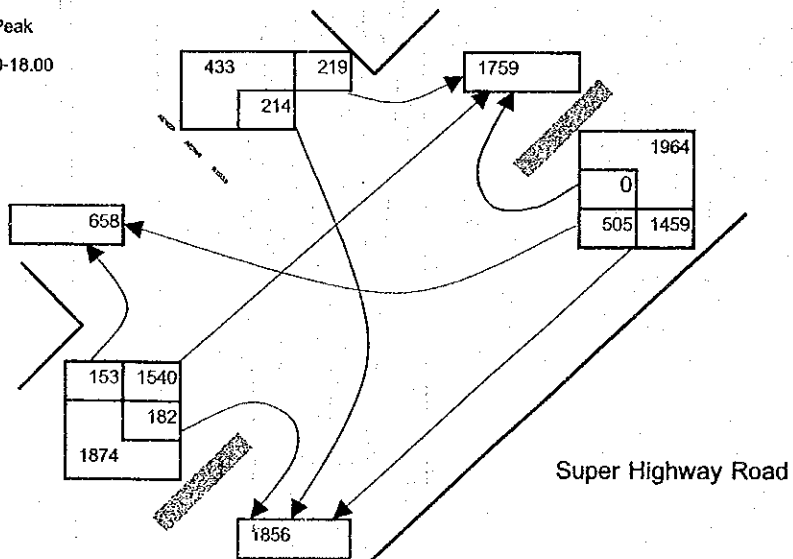
Peak Flow In PCU Junction No. J2 Super Highway-Soi Wat Chet Yod

Peak Periods	from Northeast approach				from Southeast approach				from Southwest approach				from Northwest approach				Total inbound
	To SW	To U-Turn	To NW	Total From NE	To NW	To SW	To NE	Total From SE	To NE	To NW	To U-Turn	Total From SW	To SE	To NE	To SW	Total From NW	
	AM: 7.00-8.00	1940	0	459	2399	-	-	-	-	1051	99	75	1225	-	201	347	
PM: 17.00-18.00	1459	0	505	1964	-	-	-	-	1540	153	182	1874	-	219	214	433	4272

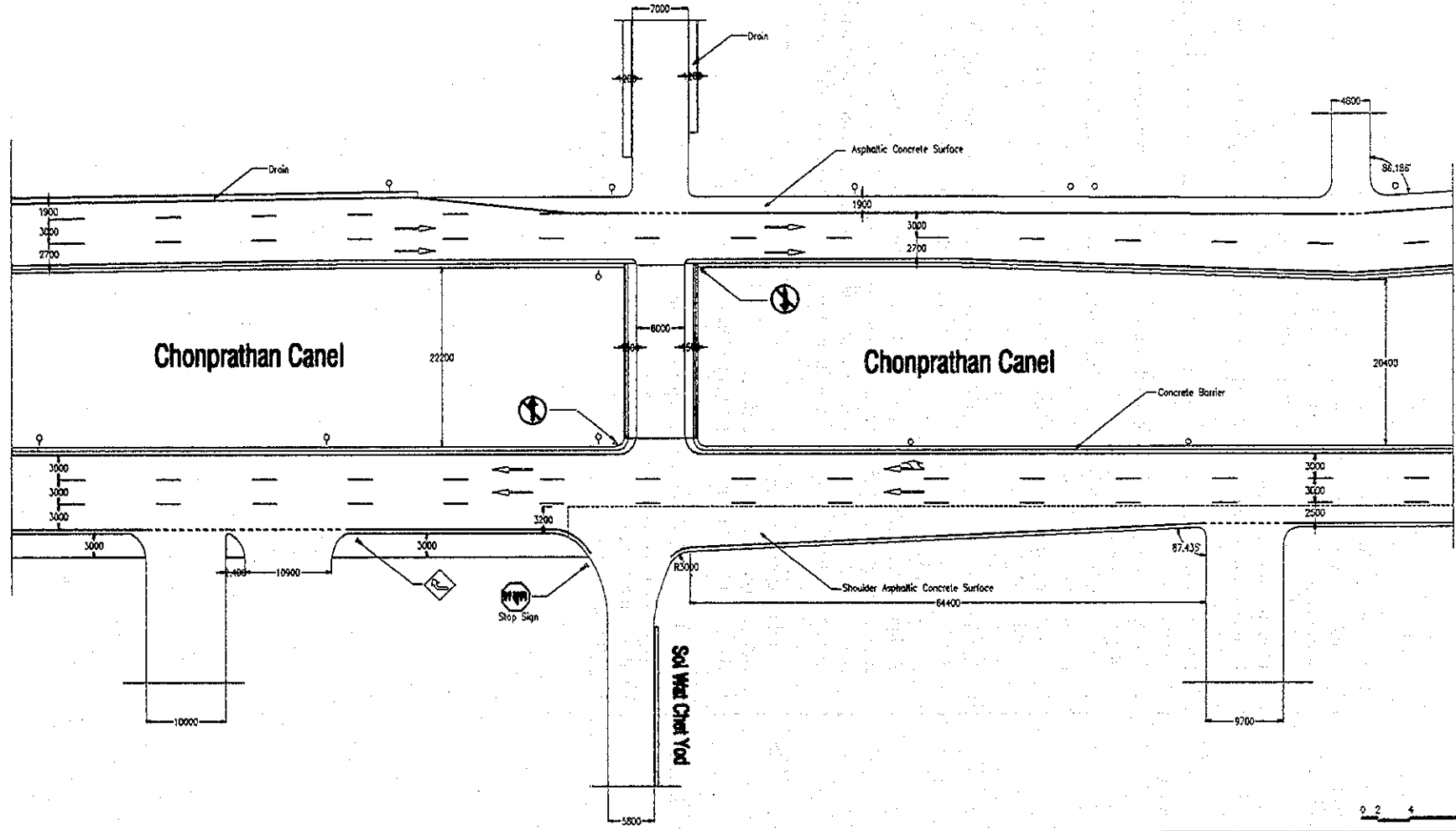
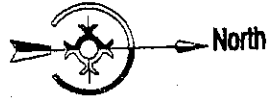
AM Peak  
7.00-8.00



PM Peak  
17.00-18.00




Code	J-3	Signalization	Not signalized
Name	Canal Road and Soi Chet Yod Khlan		
Physical conditions	<ol style="list-style-type: none"> <li>1. Canal road being divided by the canal with a two lanes narrow bridge as crossing section and sharp curve section from canal road.</li> <li>2. Soi Chet Yod Khlan slants uphill to Canal Road at junction.</li> <li>3. Lightings are installed.</li> <li>4. Canal road will become a very important ring when outer ring road is completed.</li> </ol>		
Traffic conditions	<ol style="list-style-type: none"> <li>1. Due to good visibility and few road side facilities, vehicles tend to speed along canal road.</li> <li>2. Although through traffic is prohibited from the minor street, majority movement is one that crosses Canal Road.</li> <li>3. Large motorcycle traffic crosses Canal Road from east to go to schools on the west during school hours.</li> <li>4. Dangerous junction due to conflicts between crossing motorcycle traffic and high speed traffic on Canal road</li> </ol>		
Analysis	<ol style="list-style-type: none"> <li>1. Canal Road is the road made on the bank of both sides of irrigation canal. Not much attention was paid to traffic management with the crossing roads, in particular small collector roads.</li> <li>2. As long as the path is physically available, it is impossible to control the movement of local traffic by regulation unless alternative route exists at a reasonable distance. If crossing movement is to be banned, bridge should have been constructed at the mid block point. Crossing of Canal Road will be allowed.</li> </ol>		
Improvements	<ol style="list-style-type: none"> <li>1. Installation of warning flasher.</li> <li>2. Application of pavement markings.</li> <li>3. Removal of no through traffic sign and installation of stop sign.</li> </ol>		
Cost (thousand Baht)	Geometric improvement and pavement marking:	149	
	Signal installation/improvement:	1,322	
	Engineering services:	294	
	Total project cost:	1,765	thousand Baht

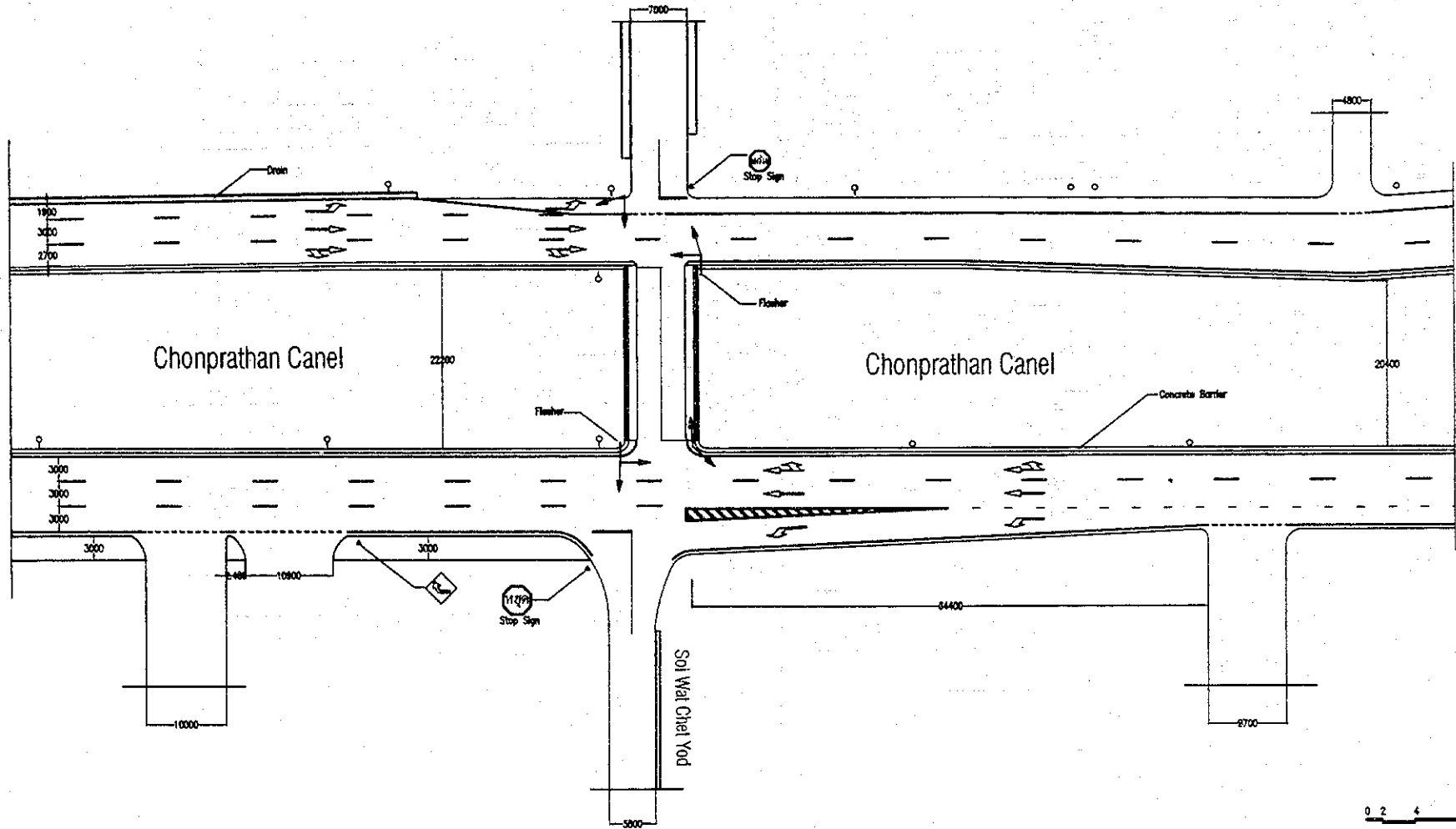
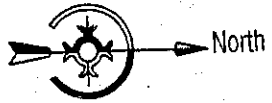


F-11

Existing Plan  
not to scale


0 2 4 8 Meter

 <b>THE STUDY ON IMPROVEMENT OF ROAD TRAFFIC ENVIRONMENT IN CHANG MIU CITY</b>		
<b>Intersection No. 3</b> <b>Chonprathan Rd. - Soi Wat Chai Yod Rd.</b>		
Designed by: Date: September 17 2001	Drawn by: Asanda Date:	Checked by: Date:
File Name:	Drawing No.	



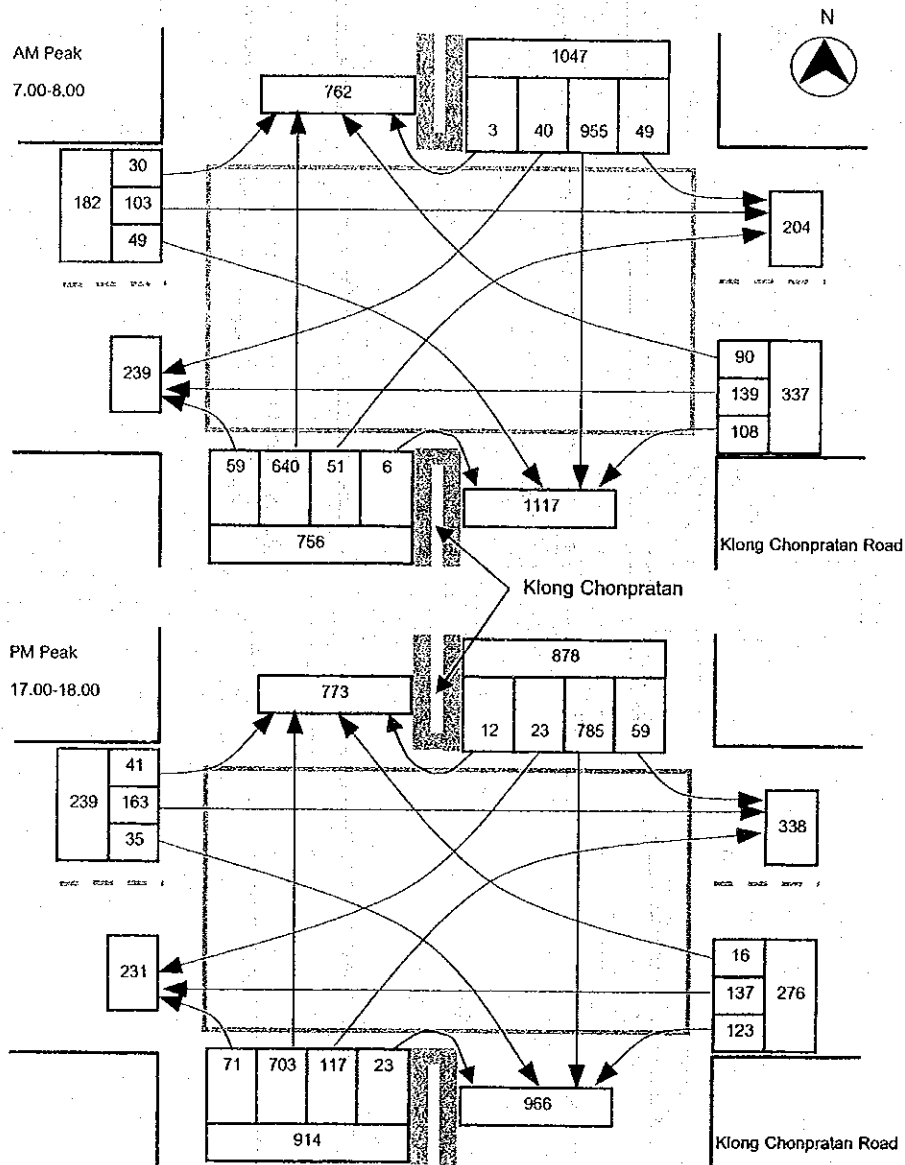
P-12

Improvement Plan  
not to scale

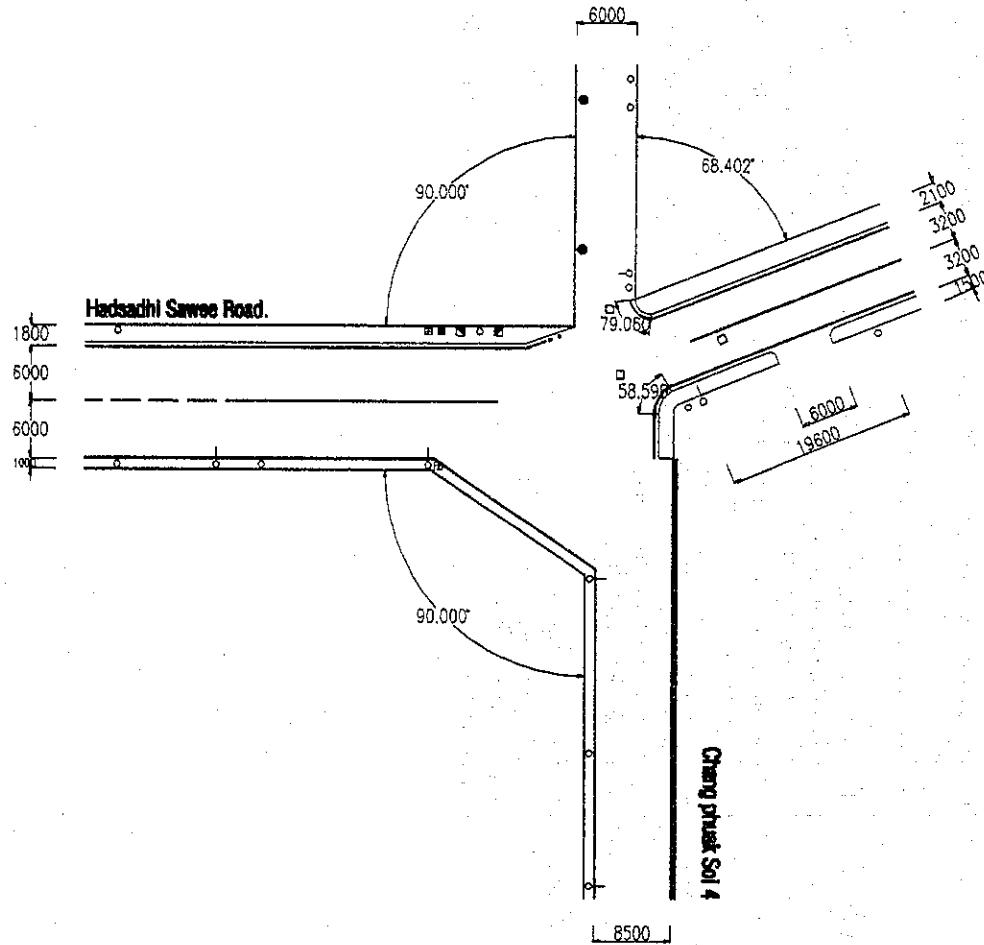
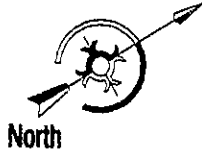
 THE STUDY ON IMPROVEMENT OF ROAD TRAFFIC ENVIRONMENT IN CHIANG MAI CITY		
Intersection No. 3		
Chonprathan Rd. - Soi Wat Chet Yod Rd.		
Designed by:	Drawn by: Assawin	Checked by:
Date:	Date: September 17 2001	Date:
File Name:	Drawing No.	

Peak Flow in PCU Junction No. J3 Klong Chonpratan Road - Soi Chet Yod Khian

Peak Periods	from North approach				Total	from East approach				Total	from South approach				Total	from West approach				Total inbound	
	To South	To East	To West	To U-Turn		From West	To South	To North	From East		To North	To West	To East	To U-Turn		From South	To East	To North	To South		From West
	AM: 7.00-8.00	955	49	40		3	1047	139	108		90	337	640	59		51	6	751	103		30
PM: 17.00-18.00	785	59	23	12	878	137	123	16	276	703	71	117	23	891	163	41	35	239	2285		




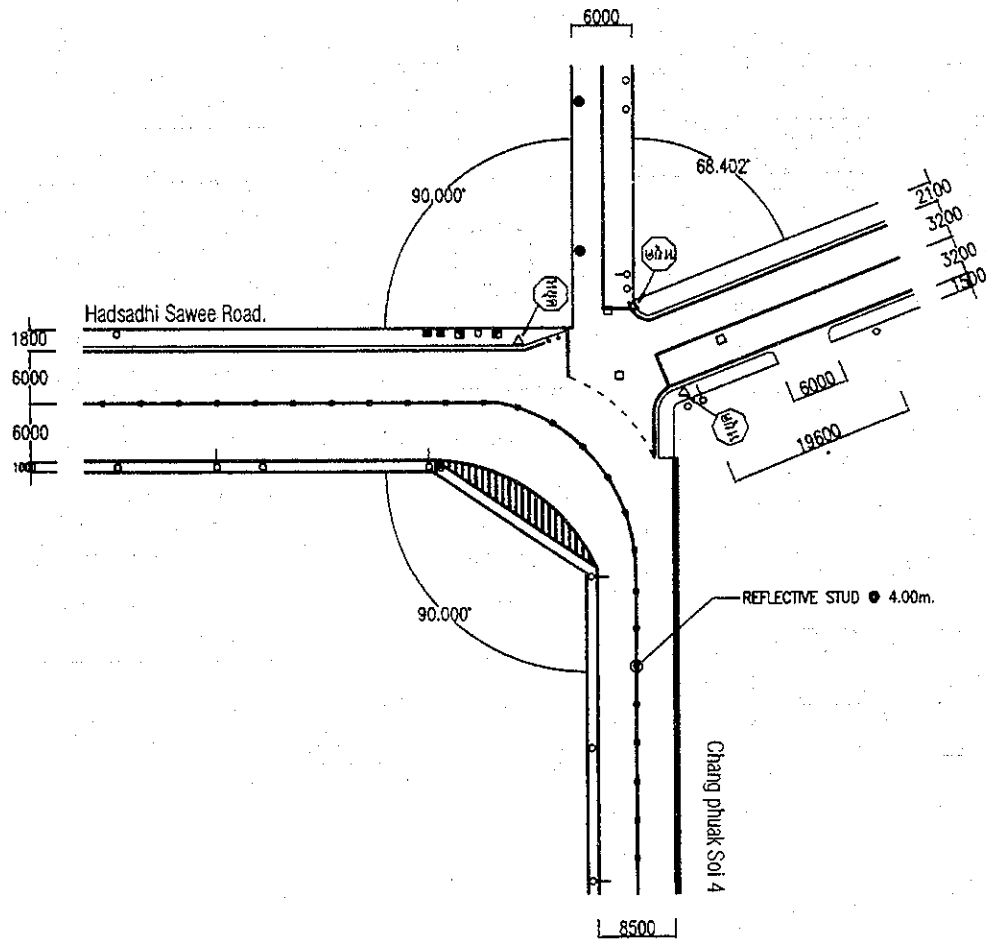
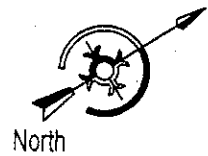
Code	J-4	Signalization	Not signalized
Name	Hadsadhi Sawee Road and Chang Phuak Soi 4		
Physical conditions	<ol style="list-style-type: none"> <li>1. 4-leg junction in the west area of Chang Phuak Road.</li> <li>2. Hadsadhi Sawee is a 2-lane undivided road with carriageway width of 12 meter plus 1.5 meter wide side walk on one side. The carriageway becomes 6.4 meter north of junction.</li> <li>3. Chang Phuak Soi 4 has a road width of 8.5 meter without sidewalk. West approach, Morakot Road, is the narrowest with 6 meter width without sidewalk.</li> <li>4. Different width of approaches renders the junction difficult and danger to pass.</li> <li>5. Very poor markings. No pedestrian crossing markings and signals. No stop sign.</li> <li>6. Lightings are installed at corner of junction.</li> </ol>		
Traffic conditions	<ol style="list-style-type: none"> <li>1. Main route connecting west moat area and Chotana Road. Thus main movement is between south and east approaches.</li> <li>2. Traffic from the north is about half that on east and south approach. Traffic from west is small.</li> <li>3. Motorcycles, which occupy large proportion, do not stop at junction.</li> <li>4. Hospital records show that accidents involving a total of 23 persons happened in a year.</li> <li>5. The need for signalization is high.</li> </ol>		
Analysis	<ol style="list-style-type: none"> <li>1. 4-leg junction but the main flow is between east and south legs, which are much wider than north and west legs.</li> <li>2. As a result of right angle of main flow and difference in width, movements conflict at wide area inside the junction making it one of the accident-prone locations.</li> </ol>		
Improvements	<ol style="list-style-type: none"> <li>1. Application of pavement markings (center line, stop line and pedestrian crossing).</li> <li>2. Installation of reflective stud.</li> <li>3. Installation of STOP sign.</li> </ol>		
Cost (thousand Baht)	Geometric improvement and pavement marking:	162	
	Signal installation/improvement:		
	Engineering services:	32	
	Total project cost:	194	thousand Baht



Existing plan


0 2 4 8 Meter

 <b>THE STUDY ON IMPROVEMENT OF ROAD TRAFFIC ENVIRONMENT IN CHANG MIN CITY</b>		
Intersection No. 4 <b>Hadsadhi Sawee Rd - Chang phrak Soi 4</b>		
Designed by: Date: August 20 2001	Drawn by: <i>Chongrat</i> Date:	Checked by: Date:
File Name:	Drawing No.	



0 2 4 8 Meter

F-16

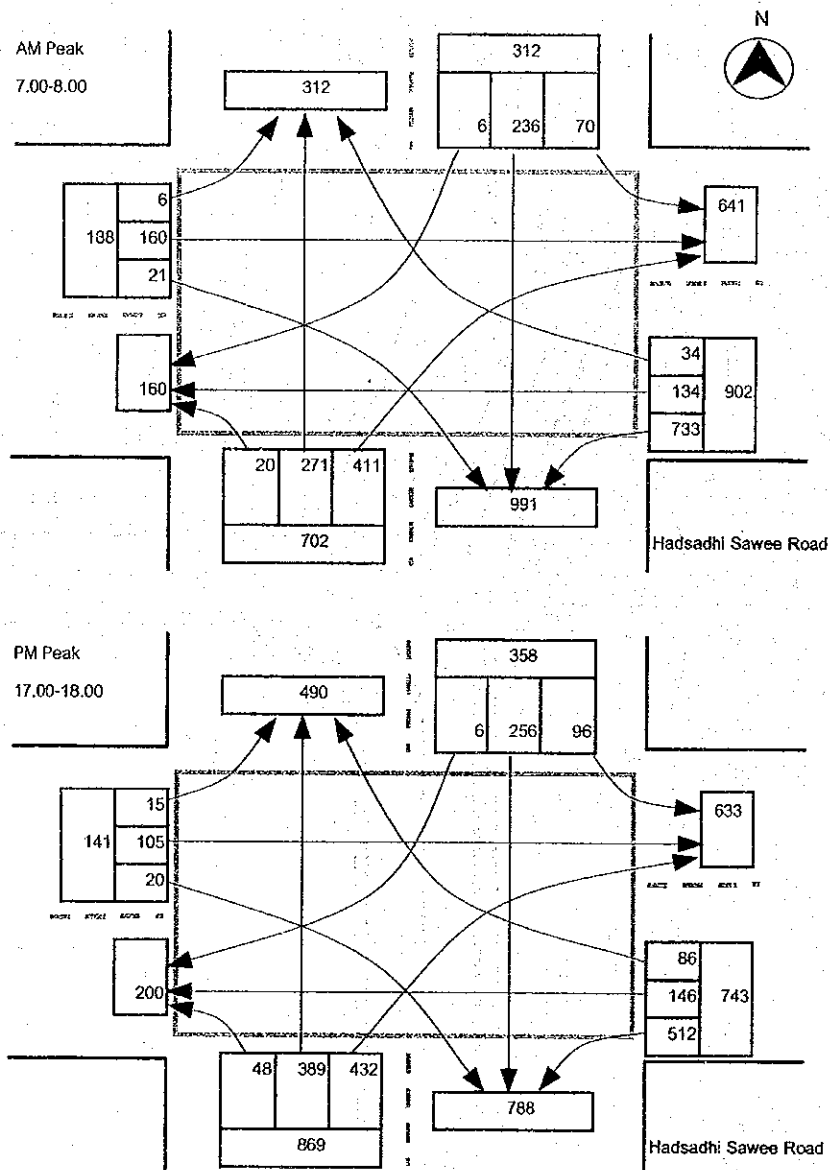
 THE STUDY ON IMPROVEMENT OF ROAD TRAFFIC ENVIRONMENT IN CHIANG MAI CITY		
Intersection No. 4 Hadsadhi Sawee Rd - Chang phrak Soi 4		
Designed by: Date: August 30 2001	Drawn by: Girengra Date:	Checked by: Date:
File Name:		Drawing No.

Improvement plan  
not to scale



Peak Flow in PCU Junction No. J4 Hadsadhi Sawee Road-Chang Phuak Sol 4

Peak Periods	from North approach				from East approach				from South approach				from West approach				Total Inbound
	To South	To East	To West	Total From North	To West	To South	To North	Total From East	To North	To West	To East	Total From South	To East	To North	To South	Total From West	
	AM: 7.00-8.00	236	70	6	312	134	733	34	902	271	20	411	702	160	6	21	
PM: 17.00-18.00	256	96	6	358	146	512	86	743	389	48	432	869	105	15	20	141	2112



Code	J-5	Signalization	Not signalized
Name	Mahidol Road and Haiya Road		
Physical conditions	<ol style="list-style-type: none"> <li>1. T-type junction where an access road of 9.3 meter wide connects to Mahidol Road, a 6-lane divided high grade highway.</li> <li>2. Median along Mahidol Road has an opening with a right/U turn lane.</li> <li>3. Markings on minor road are faded.</li> <li>4. There is a small difference of ground level on Haiya Road approach but it is not a traffic obstacle or hazard</li> <li>5. Haiya approach is slightly uphill toward the junction.</li> <li>6. A pedestrian overpass is provided 30 meter south of the junction.</li> <li>7. Lightings and stop traffic sign are installed.</li> </ol>		
Traffic conditions	<ol style="list-style-type: none"> <li>1. Main movement is north bound traffic going toward city center. North bound traffic along Mahidol is 1300 – 1900 PCU per hour throughout the day. It becomes 2500 PCU per hour during morning peak</li> <li>2. Right turn from south approach is small (5 %) in the morning peak but becomes high (12 %) during afternoon peak.</li> <li>3. There is a factory with approx. 1000 workers in front of the junction. Because of this there are large crossing traffic in of Mahidol Road by motorcycle, car or on foot.</li> <li>4. Pedestrian overpass is not much used.</li> <li>5. High volume along Mahidol Road renders the crossing into and out of Haiya Road difficult and dangerous. Policeman controls traffic movements during peak hours.</li> <li>6. Right turn from Haiya Road is banned and no right turn sign is installed at the approach but the regulation is ignored.</li> </ol>		
Analysis	<ol style="list-style-type: none"> <li>1. Mahidol is an arterial road feeding traffic to the CBD. Northbound traffic is 1.8 times more than southbound. Southbound takes from the CBD takes Thip Janet.</li> <li>2. At the moment, northbound traffic is not a continuous flow. Once the flyover at Mahidol Road and Aom Muang Road is completed, the U-turning movement by southbound traffic will become difficult.</li> </ol>		
Improvements	<ol style="list-style-type: none"> <li>1. Signalization</li> <li>2. Removal of no right turn sign.</li> <li>3. Application of pavement marking.</li> <li>4. Installation of no pedestrian crossing sign.</li> </ol>		
Cost (thousand Baht)	Geometric improvement and pavement marking:	232	
	Signal installation/improvement:	2,218	
	Engineering services:	489	
	Total project cost:	2,939	thousand Baht

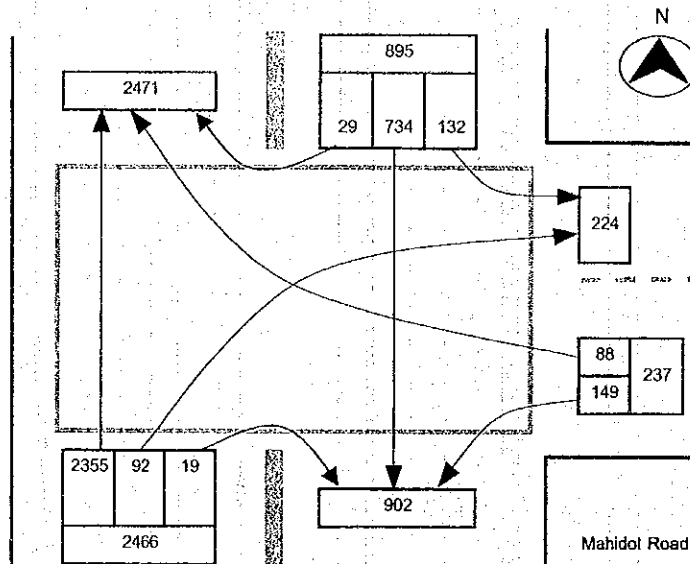




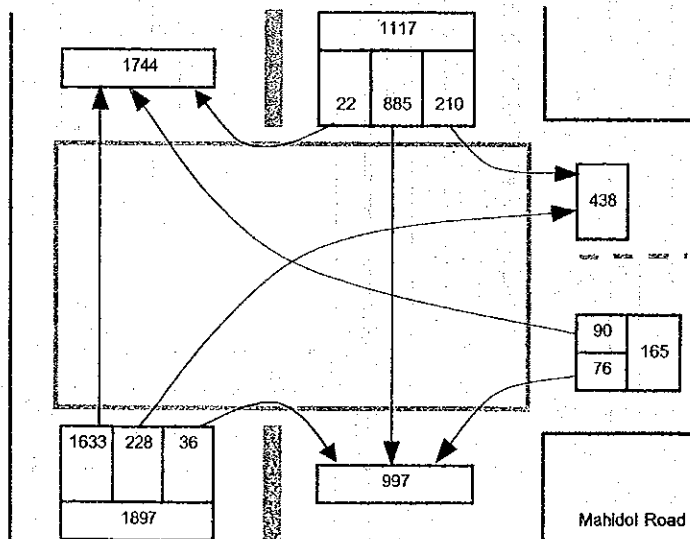
Peak Flow in PCU Junction No. J5 Intersecting Streets.....Mahidol Road - Halya Road

Peak Periods	from North approach				from East approach				from South approach				from West approach				Total Inbound		
	To South	To East	To West	To U-Turn	Total From North	To West	To South	To North	Total From East	To North	To West	To East	To U-Turn	Total From South	To East	To North		To South	Total From West
AM: 7.00-8.00	734	132	-	29	895	-	149	88	237	2355	-	92	19	2447	-	-	-	-	3578
PM: 17.00-18.00	885	210	-	22	1117	-	76	90	165	1633	-	228	36	1860	-	-	-	-	3143

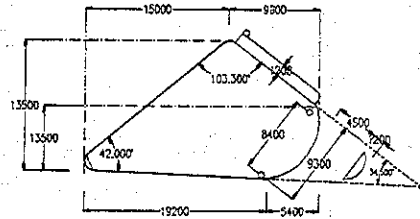
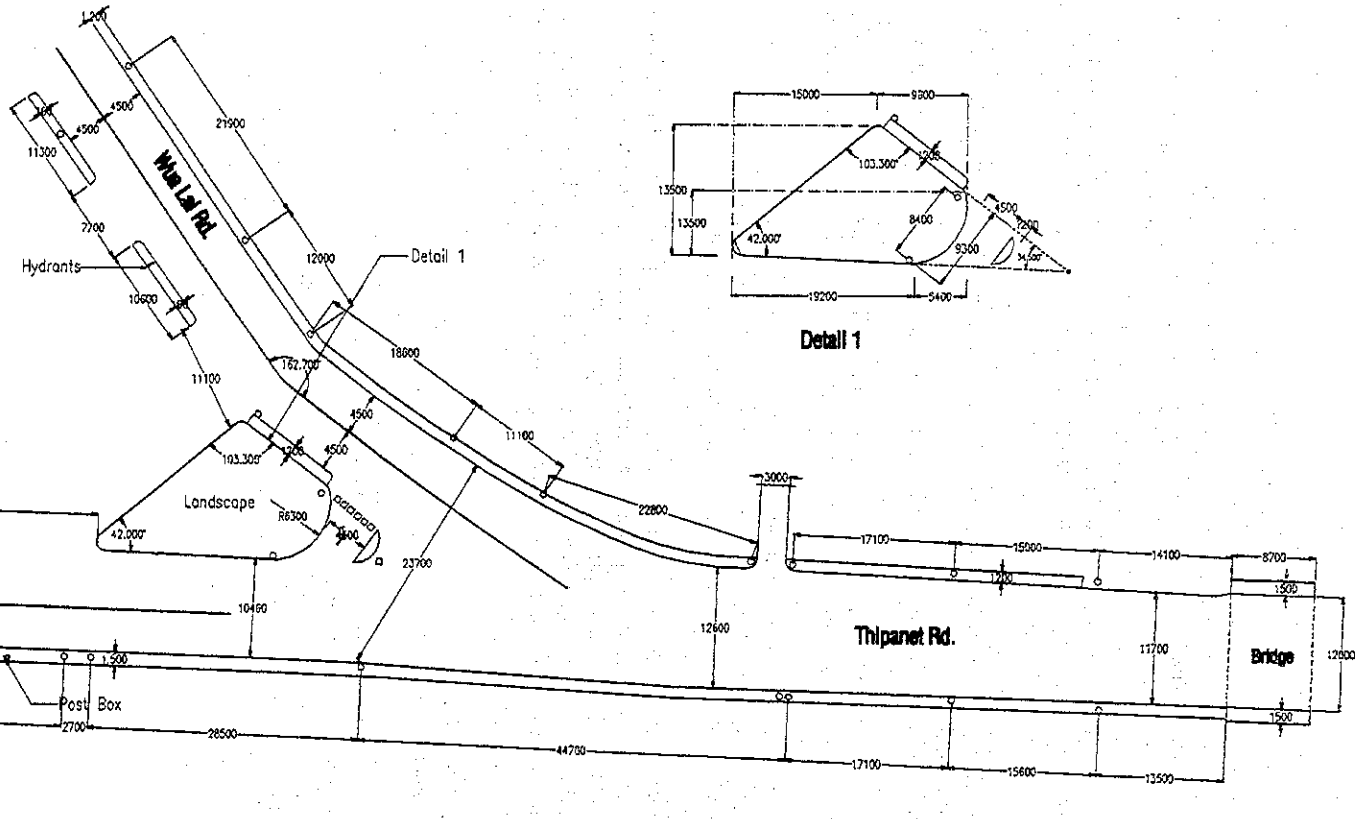
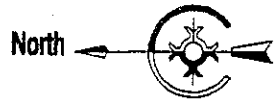
AM Peak  
7.00-8.00



PM Peak  
17.00-18.00



Code	J-6	Signalization	Not signalized
Name	Wua Lai Road and Thip Janet Road		
Physical conditions	<ol style="list-style-type: none"> <li>1. Y-type junction of an arterial of 12 meter wide (Thip Janet) with another arterial of 9 meter wide (Wua Lai). Two branches merge with small angle.</li> <li>2. A signalized junction is located about 150 meters south of the junction.</li> <li>3. No pedestrian crossing facility. No markings visible.</li> <li>4. A small island is constructed at the nose for left turn from Thip Janet to Wua Lai. A steel pipe barrier is placed on the island to make it more conspicuous.</li> <li>5. Lightings are installed.</li> </ol>		
Traffic conditions	<ol style="list-style-type: none"> <li>1. Traffic is moderately high (total volume of more than 2000 PCU per hour) from morning till night.</li> <li>2. 60 % to 65 % of north bound traffic makes right turn to Wua Lai road. Crossing south bound traffic.</li> <li>3. Right turn from Wua Lai toward north is very small but exists.</li> <li>4. Occasionally queue of more than 100 meters develops along Wua Lai Road during afternoon peak.</li> <li>5. Priority of the movements is not clear.</li> <li>6. Parked cars constrict traffic flow from south to north on Thip Janet road.</li> <li>7. Food stalls occupy the site of closed fuel station at the nose.</li> </ol>		
Analysis	<ol style="list-style-type: none"> <li>1. Wua Lai and Thip Janet are a major route connecting south moat with Hang Don Road. Because of one-way system around moat, there is 1.6 times more southbound traffic than northbound passing this junction.</li> <li>2. North and northeast approaches connect at a small angle. In addition, lack of guidance as to the priority flow makes maneuvering through this junction difficult and hazardous.</li> </ol>		
Improvements	<ol style="list-style-type: none"> <li>1. Signalization.</li> <li>2. Geometric improvement.</li> </ol>		
Cost (thousand Baht)	Geometric improvement and pavement marking:	303	
	Signal installation/improvement:	1,689	
	Engineering services:	398	
	Total project cost:	2,390	thousand Baht



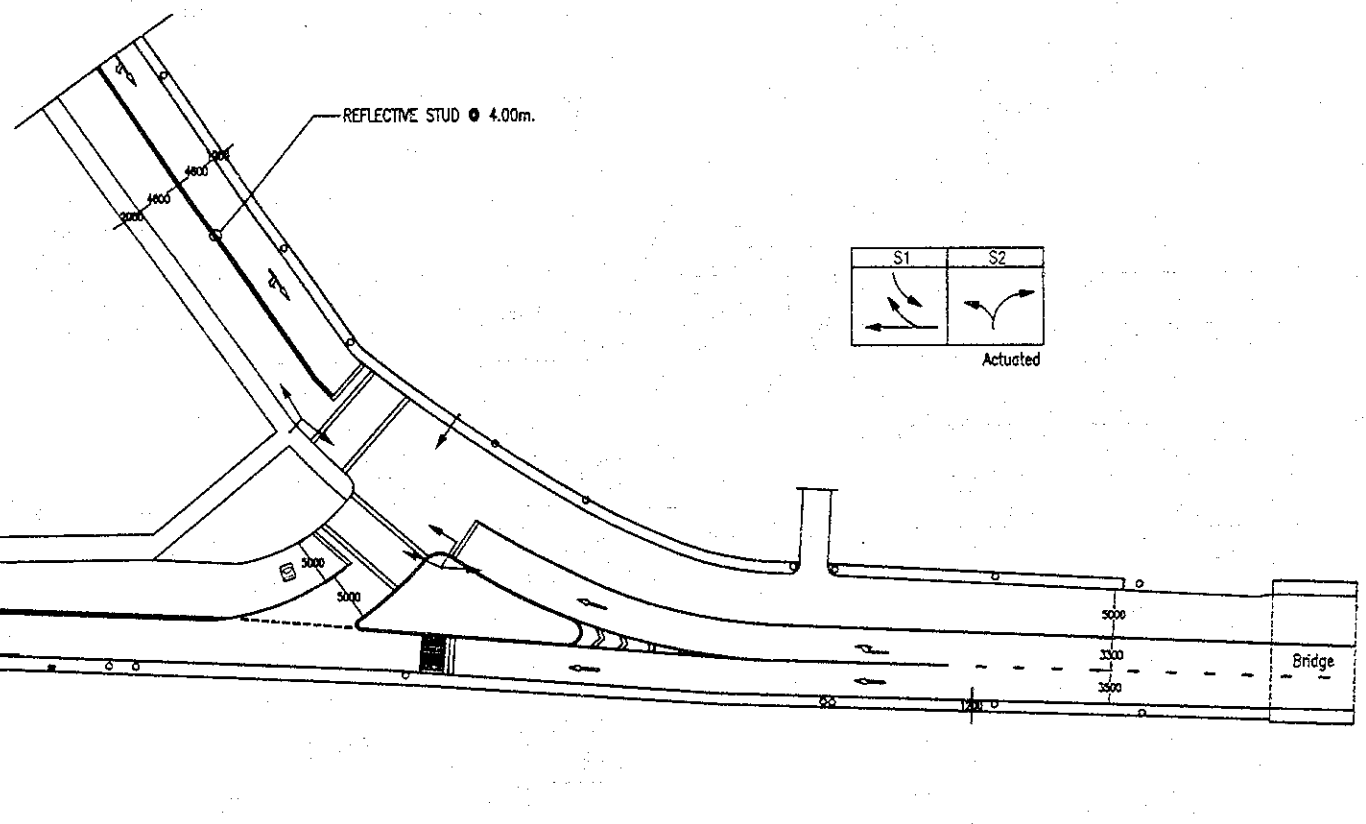
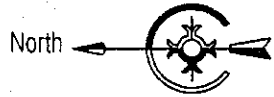
Detail 1

F-23

**Existing Plan**  
not to scale

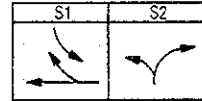
0 2 4 8 Meter

THE STUDY ON IMPROVEMENT OF ROAD TRAFFIC ENVIRONMENT IN CHANG MAI CITY		
Intersection No. 8 Thiparet Road - Wua Lai Road		
Designed by: Date: August 4, 2001	Drawn by: Anandh Date:	Checked by: Date:
File Name:		Drawing No.



REFLECTIVE STUD  $\phi$  4.00m

REFLECTIVE STUD  $\phi$  4.00m



Actuated

Bridge

F-24

Improvement Plan  
scale 1 : 500



		THE STUDY ON IMPROVEMENT OF ROAD TRAFFIC ENVIRONMENT IN CHIANG MAI CITY
Intersection No. 6		Thipanet Road - Wua Lai Road
Designed by:	Drawn by:	Checked by:
Date: August 4 2001	Date:	Date:
File Name:		Drawing No.

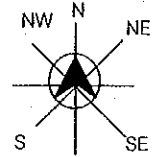


Intersecting Streets...Thip Janet Road - Wua Lai Road

Peak Flow in PCU

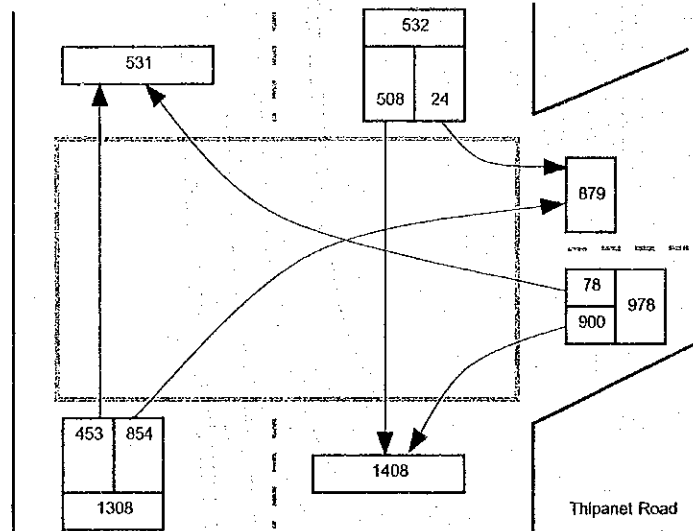
Junction No. J6

Peak Periods	from North approach				from Northeast approach				from South approach				Total Inbound
	To South	To NE	To West	Total From North	To NW	To South	To North	Total From NE	To North	To West	To NE	Total From South	
AM: 7.00-8.00	508	24	-	532	-	900	78	978	453	-	854	1308	2817
PM: 17.00-18.00	784	26	-	810	-	1154	54	1209	341	-	528	868	2887



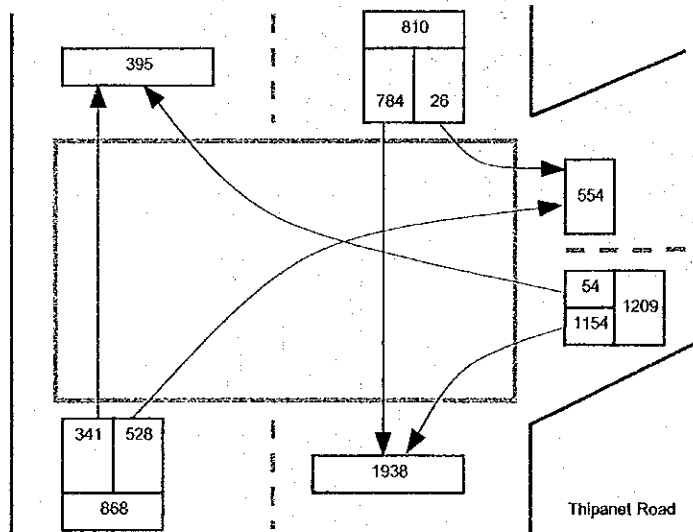
AM Peak

7.00-8.00



PM Peak

17.00-18.00



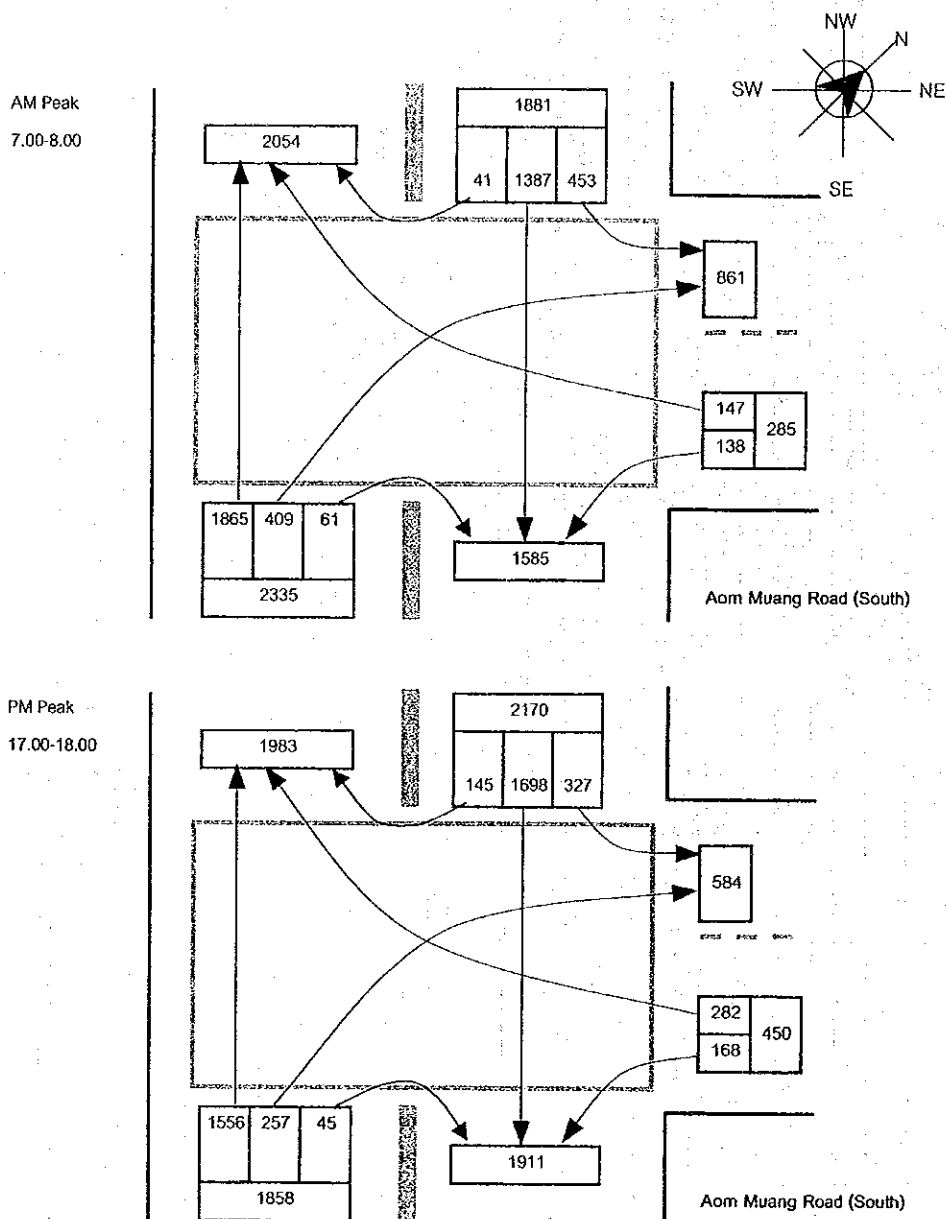
Code	J-7	Signalization	Not signalized												
Name	Super Highway (Aom Muang Road) and Chiang Mai Land Road														
Physical conditions	<ol style="list-style-type: none"> <li>1. T-Type junction of a 6-lane divided high grade arterial (Super Highway) with a minor collector road.</li> <li>2. A median opening without right turn lanes on Super Highway, not originally intended as a junction.</li> <li>3. A gate is constructed on Chiang Mai Land Road near the junction.</li> </ol>														
Traffic conditions	<ol style="list-style-type: none"> <li>1. High traffic volume (2500 – 4500 PCU/hour) throughout the day on Super Highway.</li> <li>2. U-turn prohibited during peak hours (06:00-09:00, 15:00-18:00) from both directions but ignored by many vehicles.</li> <li>3. High percentage of right turn (9-14 %) from Super Highway to Chiang Mai Land Road. Right turn ratio jumps to 17% in the morning peak. U-turn ratio from the same approach is 3-6 %.</li> <li>4. U-turn ratio from north-west approach is moderate (5-6 %) through out the day.</li> <li>5. Queue develops up to 200 meter along Super Highway eastbound and up to 150 meter along Chiang Mai Land during afternoon peak.</li> <li>6. Extremely dangerous junction due to conflicting movements and high speed on Super Highway.</li> <li>7. Poor visibility for vehicles from minor road attempting right turn.</li> <li>8. Because of stores along the highway, outer lanes are occupied by parked vehicles. Only one lane is left for traveling.</li> <li>9. A blinking warning light on sidewalk is of no effect.</li> </ol>														
Analysis	<ol style="list-style-type: none"> <li>1. The junction locates at a strategic point at the south of Municipality connecting Aom Muang (Super Highway) and CBD. It is a short cut compared with Chang Klan Road, which also connects with Aom Muang some 600 meters east of the junction.</li> <li>2. The problem stems from the fact that the junction was not planned here in the original design of Aom Muang.</li> <li>3. Because of the above, there are some deficiencies as junction such as lack of right turn and U-turn lane, and insufficient approach width and existence of gate of Chiang Mai Land.</li> </ol>														
Improvements	<ol style="list-style-type: none"> <li>1. Signalization.</li> <li>2. Provision of right turn lane by shifting through lanes to the left.</li> <li>3. Parking prohibition along Aom Muang.</li> <li>4. Removal of gate limiting road width of Chiang Mai Land.</li> </ol>														
Cost (thousand Baht)	<table> <tr> <td>Geometric improvement and pavement marking:</td> <td>280</td> <td></td> </tr> <tr> <td>Signal installation/improvement:</td> <td>2,647</td> <td></td> </tr> <tr> <td>Engineering services:</td> <td>585</td> <td></td> </tr> <tr> <td>Total project cost:</td> <td>3,512</td> <td>thousand Baht</td> </tr> </table>			Geometric improvement and pavement marking:	280		Signal installation/improvement:	2,647		Engineering services:	585		Total project cost:	3,512	thousand Baht
Geometric improvement and pavement marking:	280														
Signal installation/improvement:	2,647														
Engineering services:	585														
Total project cost:	3,512	thousand Baht													



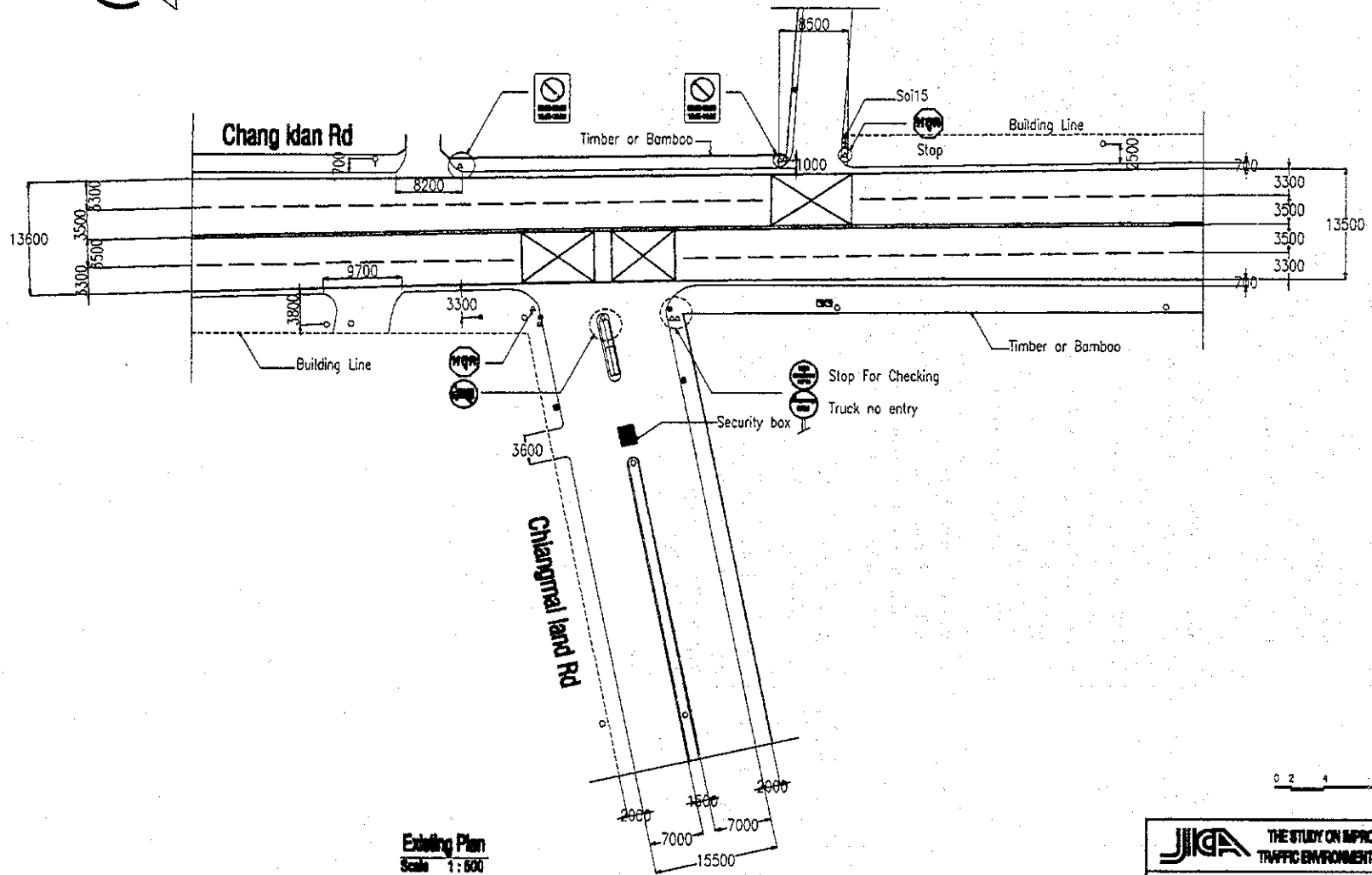
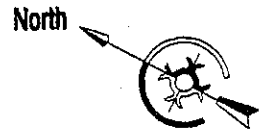


Peak Flow in PCU Junction No. J7 Intersecting Streets...Chiang Mai Land Road-Aom Muang Road

Peak Periods	from Northwest approach					from Northeast approach				from Southeast approach				from Southwest approach				Total Inbound	
	To SE	To NE	To SW	To U-Turn	Total From NW	To SW	To SE	To NW	Total From NE	To NW	To SW	To NE	To U-Turn	Total From SE	To NE	To NW	To SE		Total From SW
AM: 7.00-8.00	1387	453	-	41	1881	-	138	147	285	1865	-	409	61	2274	-	-	-	-	4439
PM: 17.00-18.00	1698	327	-	145	2170	-	168	282	450	1556	-	257	45	1813	-	-	-	-	4433

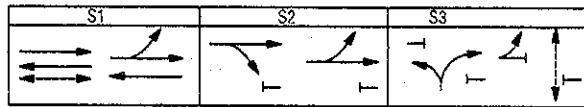
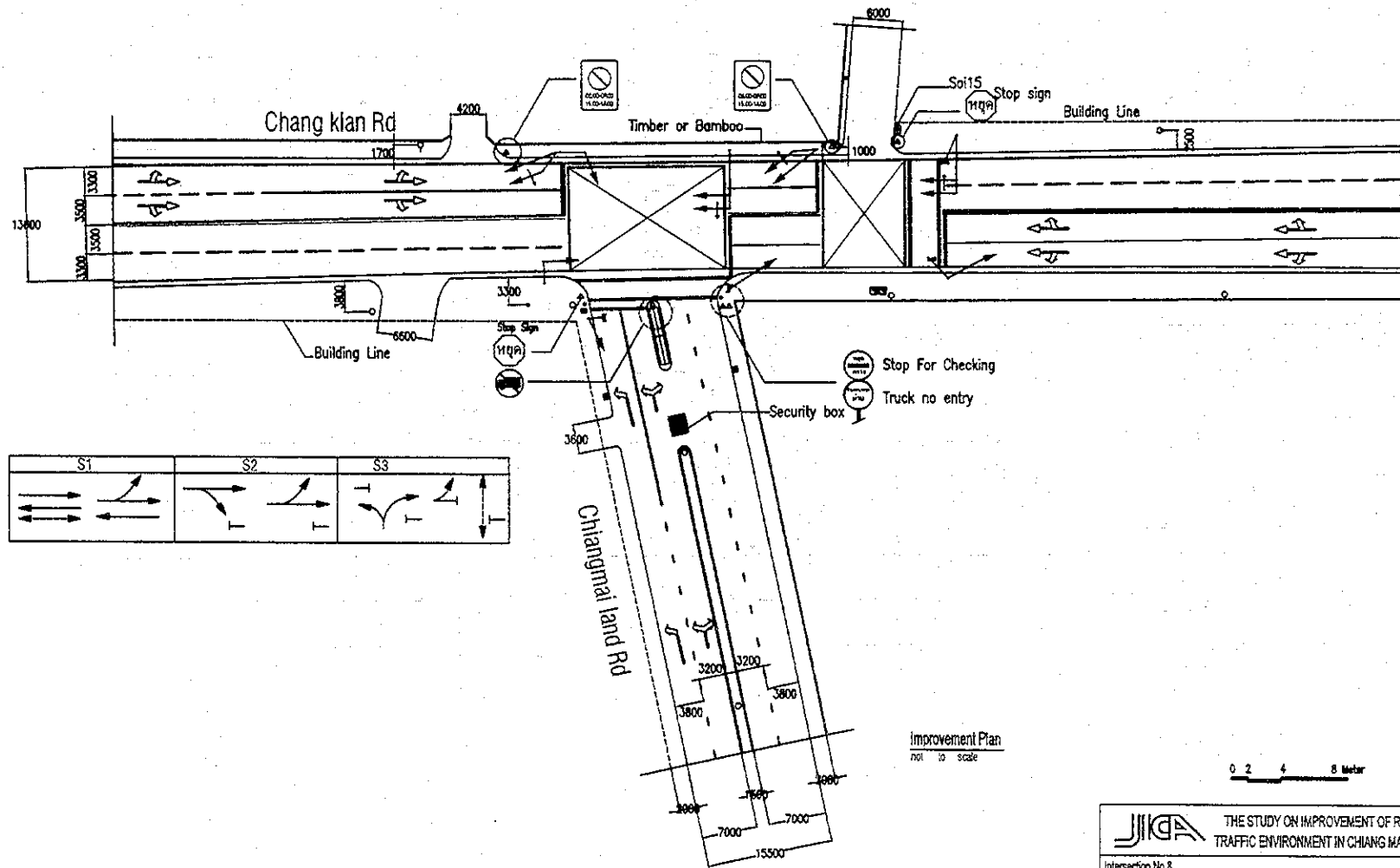
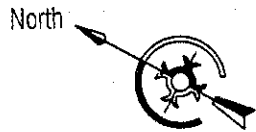


Code	J-8	Signalization	Not signalized
Name	Chang Khlan Road and Chiang Mai Land Road (Soi 15)		
Physical conditions	<ol style="list-style-type: none"> <li>1. T-type junction with a 2-lane Soi connected at offset position.</li> <li>2. Poor and faded markings (lane line and yellow box) on main road.</li> <li>3. No pedestrian crossing facility.</li> <li>4. Lightings are installed.</li> </ol>		
Traffic conditions	<ol style="list-style-type: none"> <li>1. Major commuter road to CBD and have sharp peaks in the morning and afternoon.</li> <li>2. Soi 15 is one-way out-going during peak hours. The road is a route to Charoen Prathet school area.</li> <li>3. Extremely high percentage (60-90 %) of left turn from Chiang Mai Land to Chang Khlan northbound</li> <li>4. Similarly high percentage (15-30 %) of right turn from north approach to west approach.</li> <li>5. Occasionally queue develops along north approach during afternoon peak.</li> <li>6. Parking is prohibited 6:00-9:00 and 15:00-18:00 on Chang Klan Road</li> </ol>		
Analysis	<ol style="list-style-type: none"> <li>1. Major route connecting south leg of Aom Muang (Super Highway) and business and commercial district between east moat and Ping River.</li> <li>2. Also a main route to school area along Charoen Prathet, which is one-way north-bound during school start and dismissal hours.</li> </ol>		
Improvements	<ol style="list-style-type: none"> <li>1. Signalization</li> <li>2. Application of pavement marking.</li> </ol>		
Cost (thousand Baht)	Geometric improvement and pavement marking:	291	
	Signal installation/improvement:	3,432	
	Engineering services:	745	
	Total project cost:	4,468	thousand Baht




Existing Plan  
Scale 1:500

THE STUDY ON IMPROVEMENT OF ROAD TRAFFIC ENVIRONMENT IN CHANG MAI CITY		
Information No. 3 <b>Changklan Rd-Changma land Rd / Soi 15</b>		
Studied by: Date: September 11, 2001	Drawn by: Chittawan Date:	Checked by: Date:
File Name:		Drawing No.



Improvement Plan  
not to scale

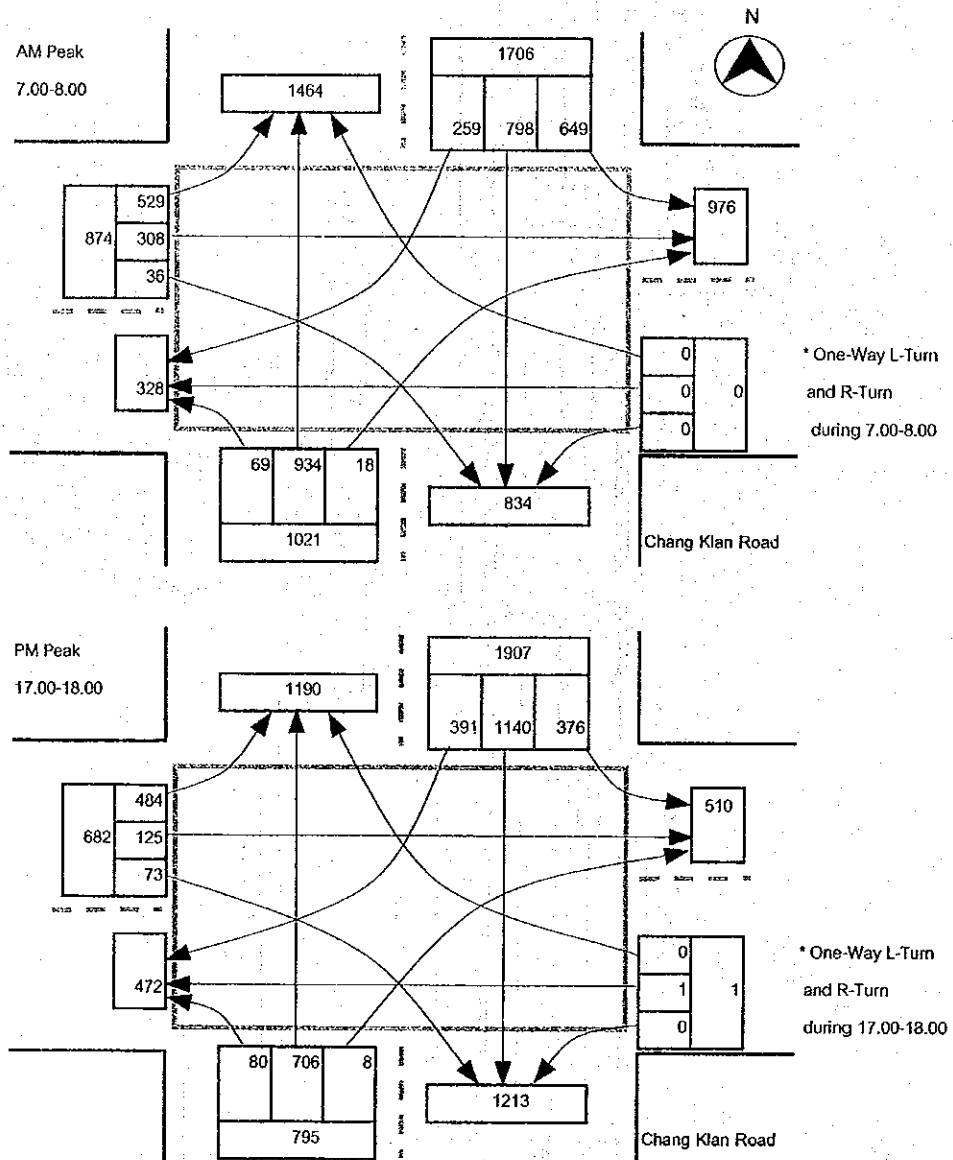
0 2 4 8 Meter

 THE STUDY ON IMPROVEMENT OF ROAD TRAFFIC ENVIRONMENT IN CHIANG MAI CITY		
Intersection No.8 Chang klan Rd-Chiangmai land Rd / Soi 15		
Designed by: Date: September 11 2001	Drawn by: Chitakorn Date:	Checked by: Date:
File Name:		Drawing No.

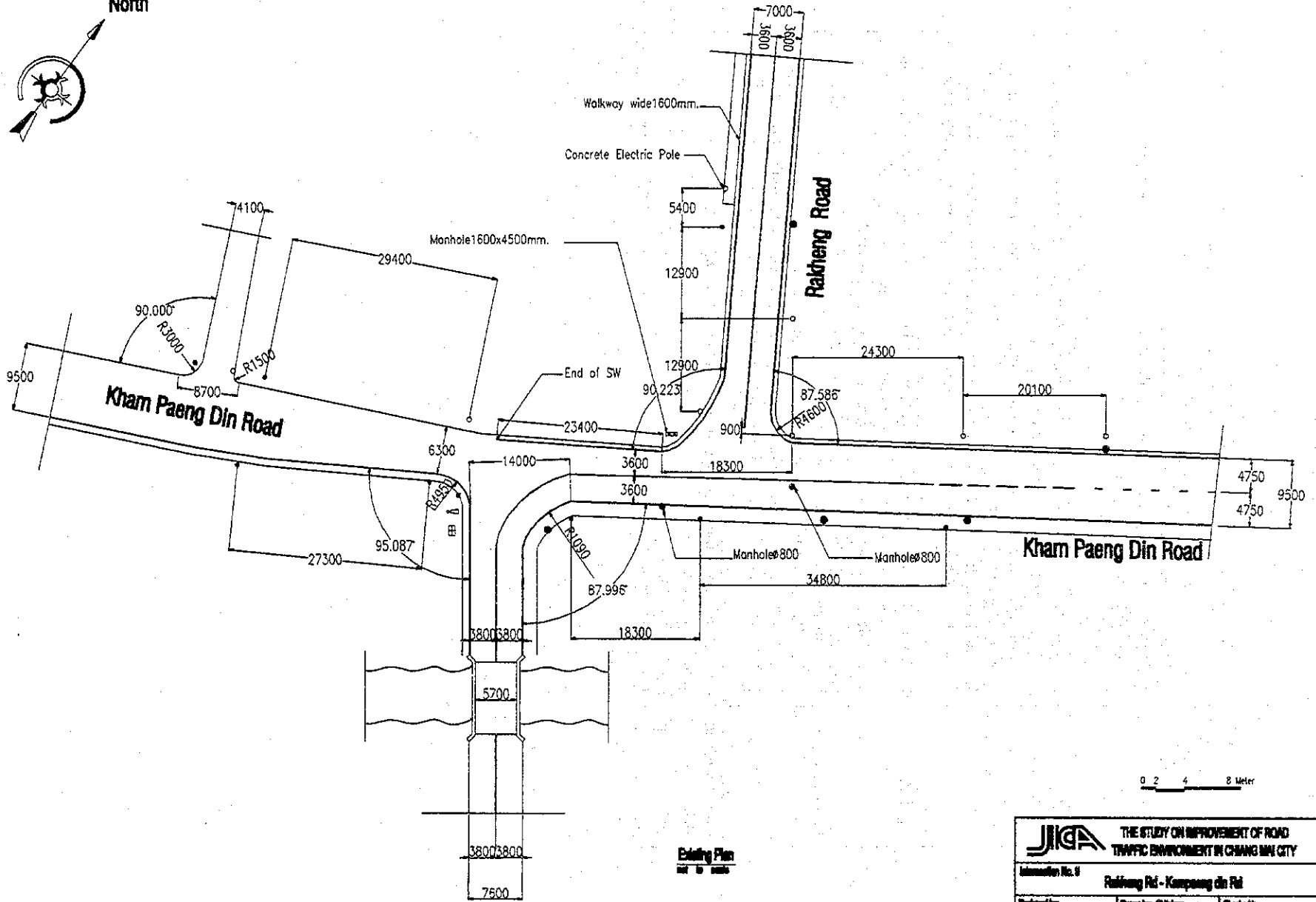
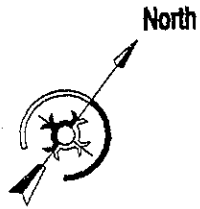


Peak Flow in PCU Junction No. J8 Chiang Mai Land Rd./Sol 15-Chang Klan Road

Peak Periods	from North approach			from East approach				from South approach			from West approach				Total inbound		
	To South	To East	To West	Total From North	To West	To South	To North	Total From East	To North	To West	To East	Total From South	To East	To North		To South	Total From West
	AM: 7.00-8.00	798	649	259	1706	0	0	0	0	934	69	18	1021	308		529	36
PM: 17.00-18.00	1140	376	391	1907	1	0	0	1	706	80	8	795	125	484	73	682	3385



Code	J-9	Signalization	Not signalized
Name	Rakheng Road and Kampheng Din Road		
Physical conditions	<ol style="list-style-type: none"> <li>1. Poorly shaped junction with offset approaches.</li> <li>2. No visible markings except yellow color center line and no stop signs.</li> <li>3. No sidewalks.</li> <li>4. Lightings are installed.</li> </ol>		
Traffic conditions	<ol style="list-style-type: none"> <li>1. Main flow is between two offset approaches (inbound and outbound directions).</li> <li>2. Morning peak is sharp on south east approach toward city center.</li> <li>3. Although traffic volume is not high, junction is messy due to offset approaches and irregular movements.</li> <li>4. Small shops line up along north side of junction attracting customer who park their motorcycle or vehicle in front of shop making useful road space narrower.</li> </ol>		
Analysis	<ol style="list-style-type: none"> <li>1. Although Rakheng is 7 meter wide road without sidewalk, it connects Chang Klan Road and southeast corner of moat thus it serves as commuter road.</li> <li>2. Rakheng is a local road in structure but it is used as arterial.</li> </ol>		
Improvements	<ol style="list-style-type: none"> <li>1. Application of pavement markings.</li> <li>2. Installation of reflective stud along center line.</li> <li>3. Center line will be drawn along Rakheng Road., which carries main flow.</li> <li>4. Installation of stop lines and stop signs for minor movements.</li> </ol>		
Cost (thousand Baht)	Geometric improvement and pavement marking: 83 Signal installation/improvement: Engineering services: 17 Total project cost: 100 thousand Baht		

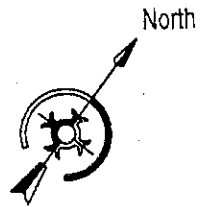


F-35

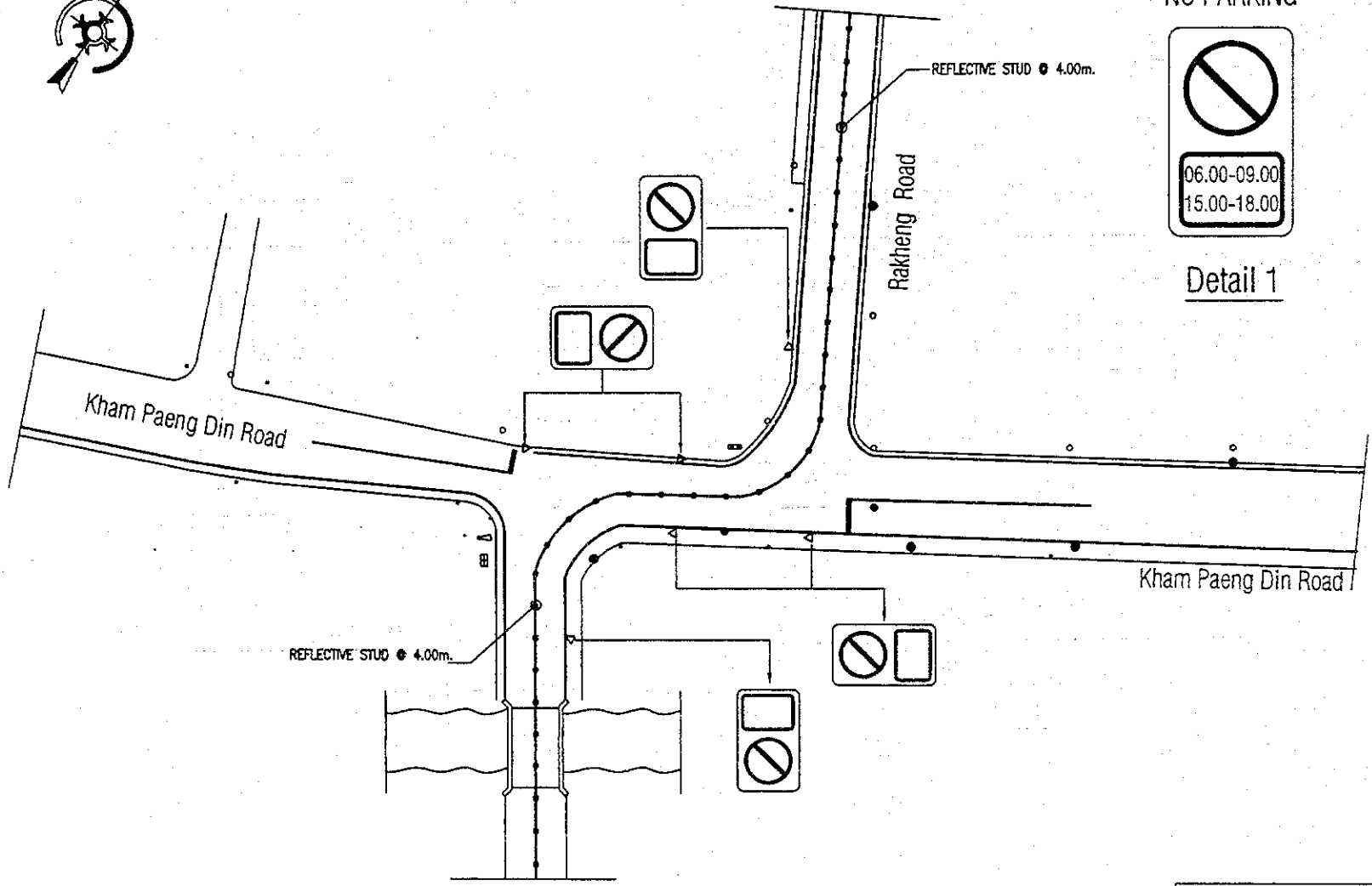
0 2 4 8 Meter

Existing Plan  
not to scale

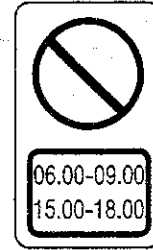
<b>JICA</b> THE STUDY ON IMPROVEMENT OF ROAD TRAFFIC ENVIRONMENT IN CHIANG MAI CITY		
Information No. 6 Rakkrong Rd - Kampanang din Rd		
Designed by:	Drawn by: Chittan	Checked by:
Date: August 08 2007	Date:	Date:
File Name:	Drawing No.	



F-36



NO PARKING




Detail 1

REFLECTIVE STUD ● 4.00m.

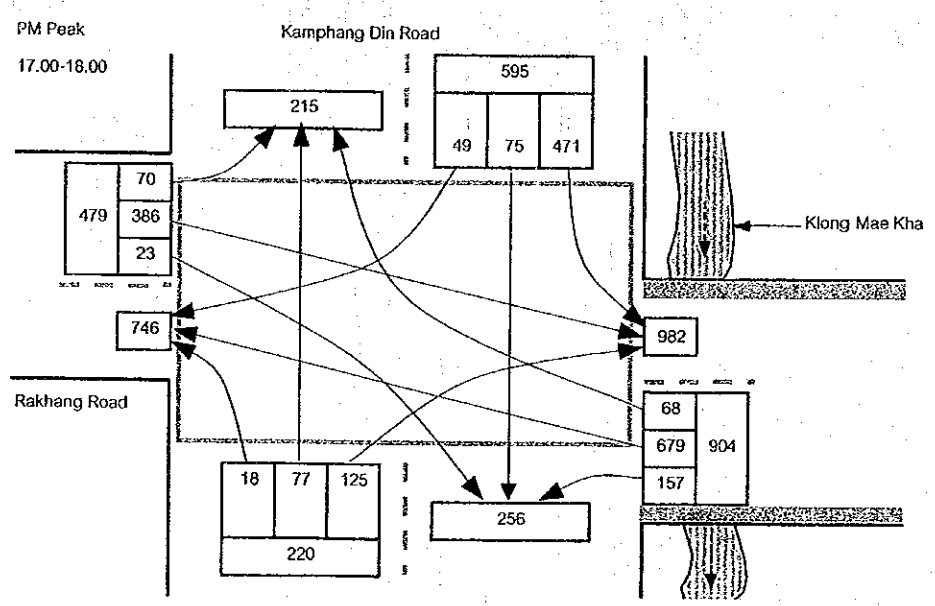
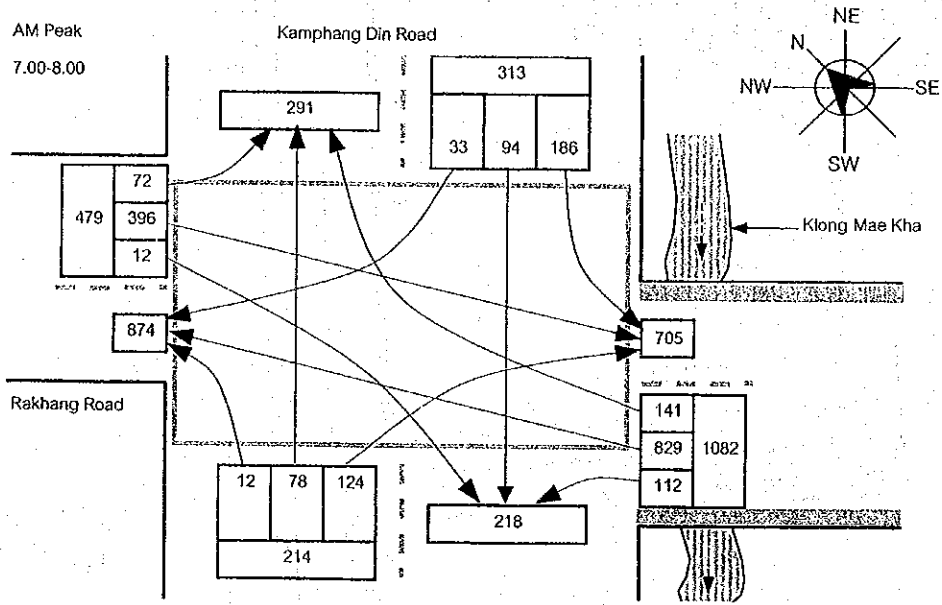
REFLECTIVE STUD ● 4.00m.

Improvement plan  
scale 1:500

 THE STUDY ON IMPROVEMENT OF ROAD TRAFFIC ENVIRONMENT IN CHIANG MAI CITY		
Intersection No. 9 Rakheng Rd - Kampaeng din Rd		
Designed by:	Drawn by: Chotaborn	Checked by:
Date: August 16 2001	Date:	Date:
File Name:	Drawing No.	

Peak Flow In PCU Junction No. J9 Intersecting Streets....Rakhang Road - Kamphang Din Road

Peak Periods	from Northeast approach				from Southeast approach				from Southwest approach				from Northwest approach				Total inbound
	To SW	To SE	To NW	Total From NE	To NW	To SW	To NE	Total From SE	To NE	To NW	To SE	Total From SW	To SE	To NE	To SW	Total From NW	
	AM: 7.00-8.00	94	186	33	313	829	112	141	1082	78	12	124	214	396	72	12	
PM: 17.00-18.00	75	471	49	595	679	157	68	904	77	18	125	220	386	70	23	479	2198



Code	J-10	Signalization	Not signalized
Name	Rattanakosin Road and Tat Wong Road		
Physical conditions	<ol style="list-style-type: none"> <li>1. T-junction with a small dead-end road connected to junction. Tat Wong Road is slightly slanted from T-shape.</li> <li>2. Turning movement markings are provided within junction without priority sign (stop sign) creating confusion on priority.</li> <li>3. Two flashers, one for Rattanakosin and another for Thung Hotel Road are installed but they are not working. The visibility of the latter is blocked by the tree.</li> <li>4. Poor visibility for left turn traffic from Thung Hotel Road due to obstructions on carriageway and tree.</li> <li>5. Wide lane width along Thung Hotel Road and Rattanakosin Road but trees and utility poles exist at the fringe of carriageway. Effective lane width is still sufficient.</li> <li>6. No pedestrian crossing provided.</li> </ol>		
Traffic conditions	<ol style="list-style-type: none"> <li>1. Major flow is between Rattanakosin Road and Thung Hotel Road.</li> <li>2. High left turn from Thung Hotel to Rattanakosin; 78 % and 75 % for morning peak (7:00 – 8:00) and afternoon peak (17:00 – 18:00), respectively.</li> <li>3. Likewise, right turn from Rattanakosin to Thung Hotel is 66 % and 76 % for morning and afternoon, respectively.</li> <li>4. Traffic volume of Tat Wong Road is small at the level of 70 – 130 PCU per hour except morning peak during which volume is 374 PCU per hour.</li> <li>5. Queue of up to 150 meter is observed along Rattanakosin during afternoon peak.</li> </ol>		
Analysis	<ol style="list-style-type: none"> <li>1. Rattanakosin and Thung Hotel serve as a route between east part of the Municipality and the area north of moat.</li> <li>2. It is also an alternative route for Kaew Nawarat Road, which is congested during school hours.</li> <li>3. Although volume is not large, Tat Wong Road is a short cut from Chiang Mai Prao Road to CBD, particularly for commuting in the morning.</li> <li>4. Wide space inside junction and major flow turning at right angle render the junction difficult to maneuver and hazardous</li> </ol>		
Improvements	<ol style="list-style-type: none"> <li>1. Construction of corner island.</li> <li>2. Widening of sidewalk along Rattanakosin and Thung Hotel.</li> <li>3. Installation of signal.</li> <li>4. Application of pavement markings (pedestrian crossing, stop line, etc.)</li> </ol>		
Cost (thousand Baht)	Geometric improvement and pavement marking: 221 Signal installation/improvement: 2,630 Engineering services: 570 Total project cost: 3,421 thousand Baht		

North



End of WL=400mm.

End of SY=400mm.

Wall concrete of metal

12,300

6,900

5,400

Tatwong Rd.

R26630

R4110

WL=300mm.

8,400

Single Blinking Warning Signal

1,110

A

1,500

4,250

4,250

4,250

4,250

8,500

8,500

17,000

End of WL3



Detail 1

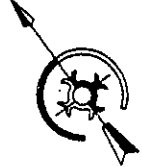
Existing Plan  
not to scale

0 2 4 8 Meter

<b>JICA</b> THE STUDY ON IMPROVEMENT OF ROAD TRAFFIC ENVIRONMENT IN CHANG MAI CITY		
Interchange No. 10 Rattanakosin Rd - Tatwong Rd		
Designed by:	Drawn by: CHITRAN	Checked by:
Date: August 17 2001	Date:	Date:
File Name:	Drawing No.	

F-39

North



Stop Sign



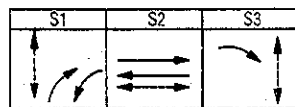
12,300  
6900  
5400

Tat wong Rd.

8400

1500			
3600	4675	8500	17000
3825			
3825			
3600	4675	8500	

F-40



Actuated

4390

Rattanakosin Rd

0 2 4 8 Meter

Improvement Plan  
not to scale

2100 3900 1500  
7800  
1530

**JICA** THE STUDY ON IMPROVEMENT OF ROAD TRAFFIC ENVIRONMENT IN CHIANG MAI CITY

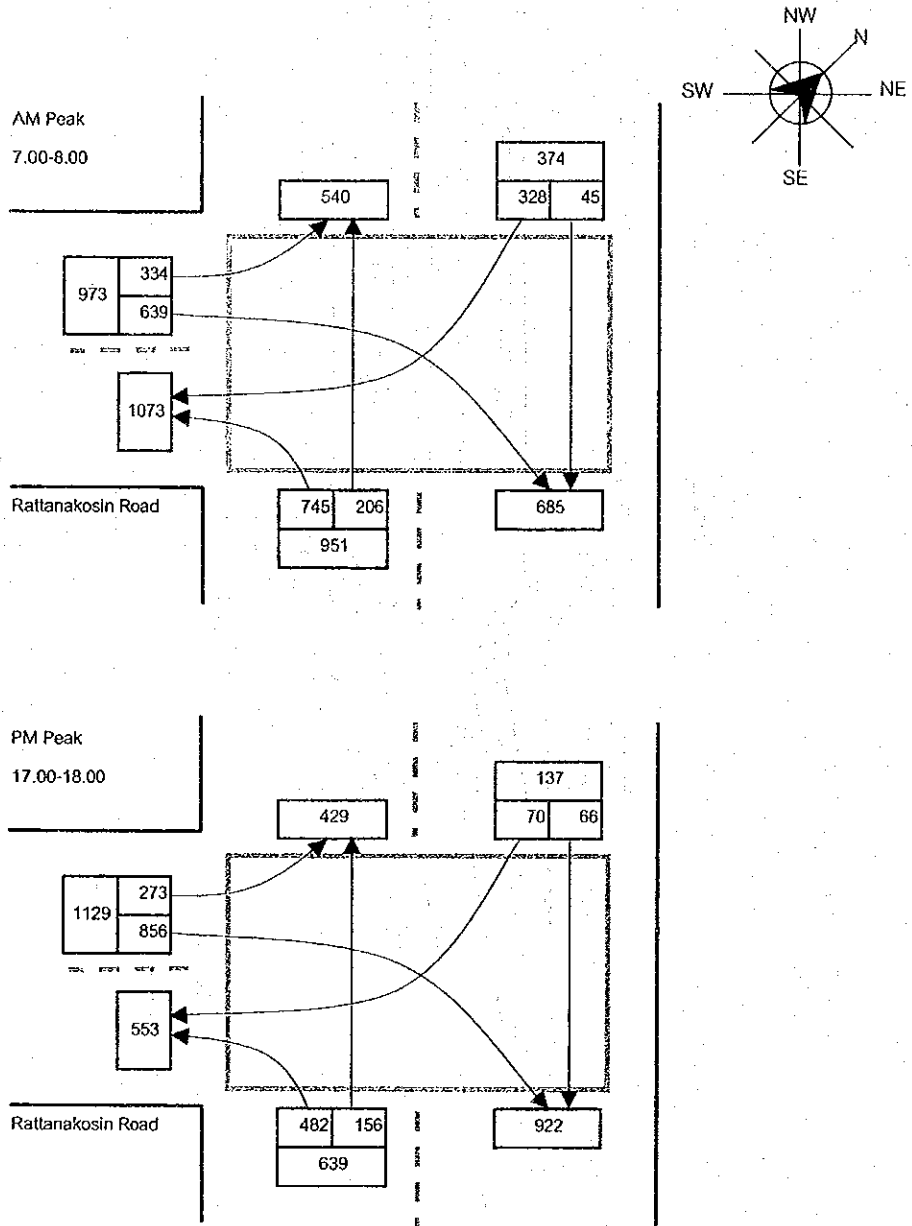
Intersection No.10 Rattanakosin Rd - Tat Wong Rd

Designed by:	Drawn by: Chitatom	Checked by:
Date: August 17 2001	Date:	Date:
File Name:	Drawing No.	

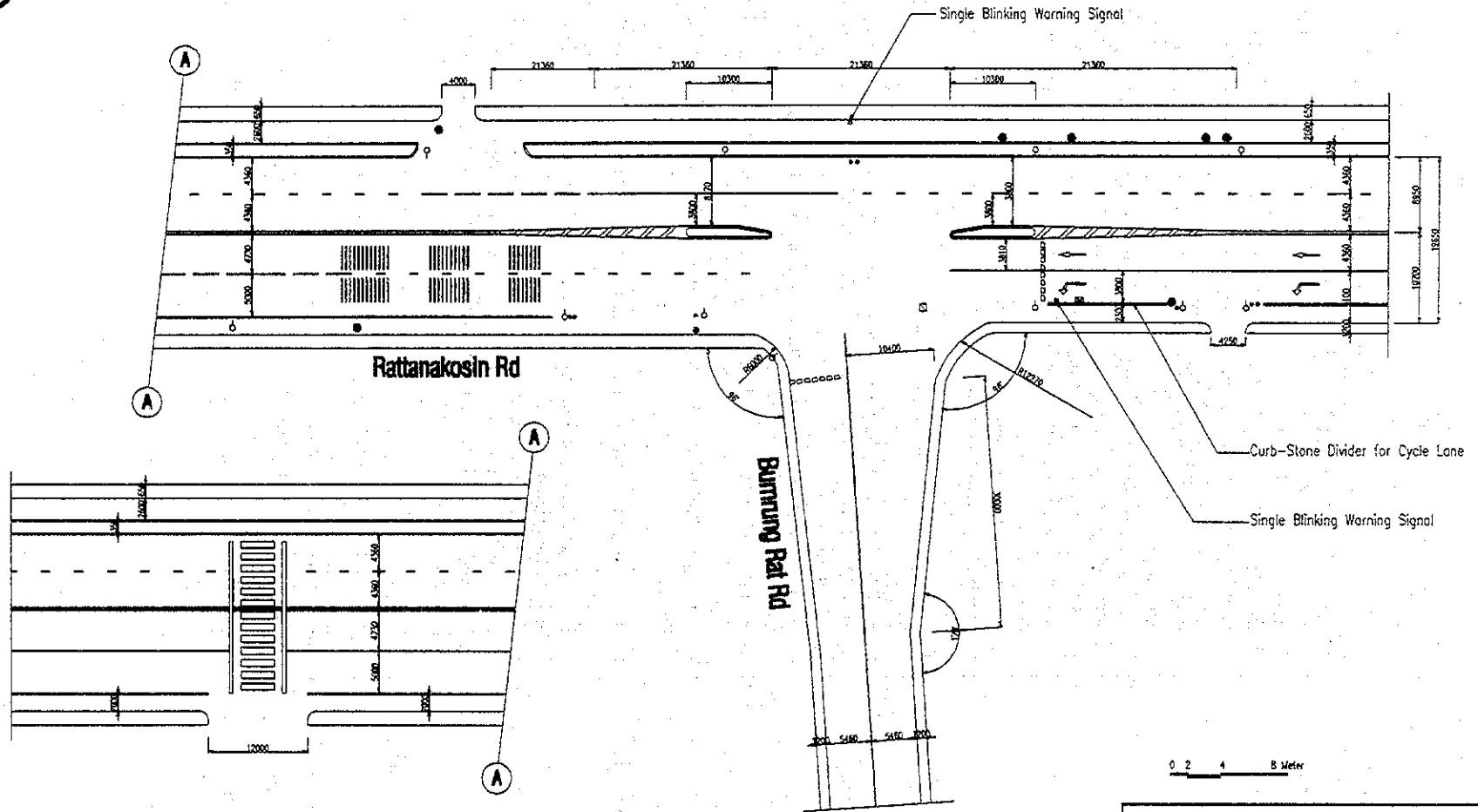
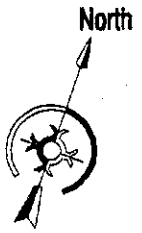


Peak Flow in PCU Junction No. J10 Intersecting Streets.....Rattanakosin Road - Tai Wong Road

Peak Periods	from Northwest approach				from Northeast approach				from Southeast approach				from Southwest approach				Total inbound
	To SE	To NE	To SW	From NW	To SW	To SE	To NW	From NE	To NW	To SW	To NE	From SE	To NE	To NW	To SE	From SW	
AM: 7.00-8.00	45	-	328	374	-	-	-	-	206	745	-	951	-	334	639	973	2298
PM: 17.00-18.00	66	-	70	137	-	-	-	-	156	482	-	639	-	273	856	1129	1904



Code	J-11	Signalization	Not signalized												
Name	Rattanakosin Road and Bumrung Rat Road														
Physical conditions	<ol style="list-style-type: none"> <li>1. T-junction of a 4-lane arterial (Rattanakosin) with a 2-lane collector (Bumrung Rat).</li> <li>2. Bicycle lane divided by curb stone is provided along west bound direction and bicycle lane divided by separator along east bound direction on Rattanakosin Road. They are not properly maintained and are little used.</li> <li>3. Small center islands with approach zebra marking are provided on Rattanakosin approaches.</li> <li>4. East side of Bumrung flares out toward junction making left turn from east approach easier to maneuver but dangerous to pedestrian crossing Bumrung.</li> <li>5. Two blinking warning lights are provided for all directions but they are not working. In addition, warning light for eastbound traffic is not visible because of branches.</li> <li>6. Markings are faded. No pedestrian crossing markings.</li> <li>7. Mid block pedestrian crossing is provided about 90 meter west of the junction.</li> <li>8. No stop signs.</li> <li>9. Lightings are installed.</li> </ol>														
Traffic conditions	<ol style="list-style-type: none"> <li>1. High traffic volume during school hours particularly in the morning. Queue of up to 100 meter is observed on all approaches. A police man controls traffic during school hours.</li> <li>2. High percentage (25-40 %) of right turn from Rattanakosin Road west approach into Bumrung Rat.</li> <li>3. Majority (72 -85 %) of traffic from Bumrung Rat make left turn throughout the day.</li> <li>4. Because of wide road width and small traffic volume, vehicle speed is generally high.</li> </ol>														
Analysis	<ol style="list-style-type: none"> <li>1. Rattanakosin is a route connecting east part of the Municipality and the area north of moat.</li> <li>2. It works as alternative route of Kaew Nawarat, which runs parallel to Rattanakosin and is congested during school hours.</li> <li>3. Rattanakosin and Bumrung are access roads to the school located in the area south of the road. High ratio of traffic on Bumrung is school related traffic.</li> <li>4. High speed of vehicles along Rattanakosin makes the junction a hazardous location.</li> </ol>														
Improvements	<ol style="list-style-type: none"> <li>1. Installation of signal.</li> <li>2. Application of pavement marking including pedestrian crossing..</li> </ol>														
Cost (thousand Baht)	<table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 60%;">Geometric improvement and pavement marking:</td> <td style="text-align: right;">231</td> <td></td> </tr> <tr> <td>Signal installation/improvement:</td> <td style="text-align: right;">2,847</td> <td></td> </tr> <tr> <td>Engineering services:</td> <td style="text-align: right;">615</td> <td></td> </tr> <tr> <td><b>Total project cost:</b></td> <td style="text-align: right;"><b>3,693</b></td> <td style="text-align: right;"><b>thousand Baht</b></td> </tr> </table>			Geometric improvement and pavement marking:	231		Signal installation/improvement:	2,847		Engineering services:	615		<b>Total project cost:</b>	<b>3,693</b>	<b>thousand Baht</b>
Geometric improvement and pavement marking:	231														
Signal installation/improvement:	2,847														
Engineering services:	615														
<b>Total project cost:</b>	<b>3,693</b>	<b>thousand Baht</b>													




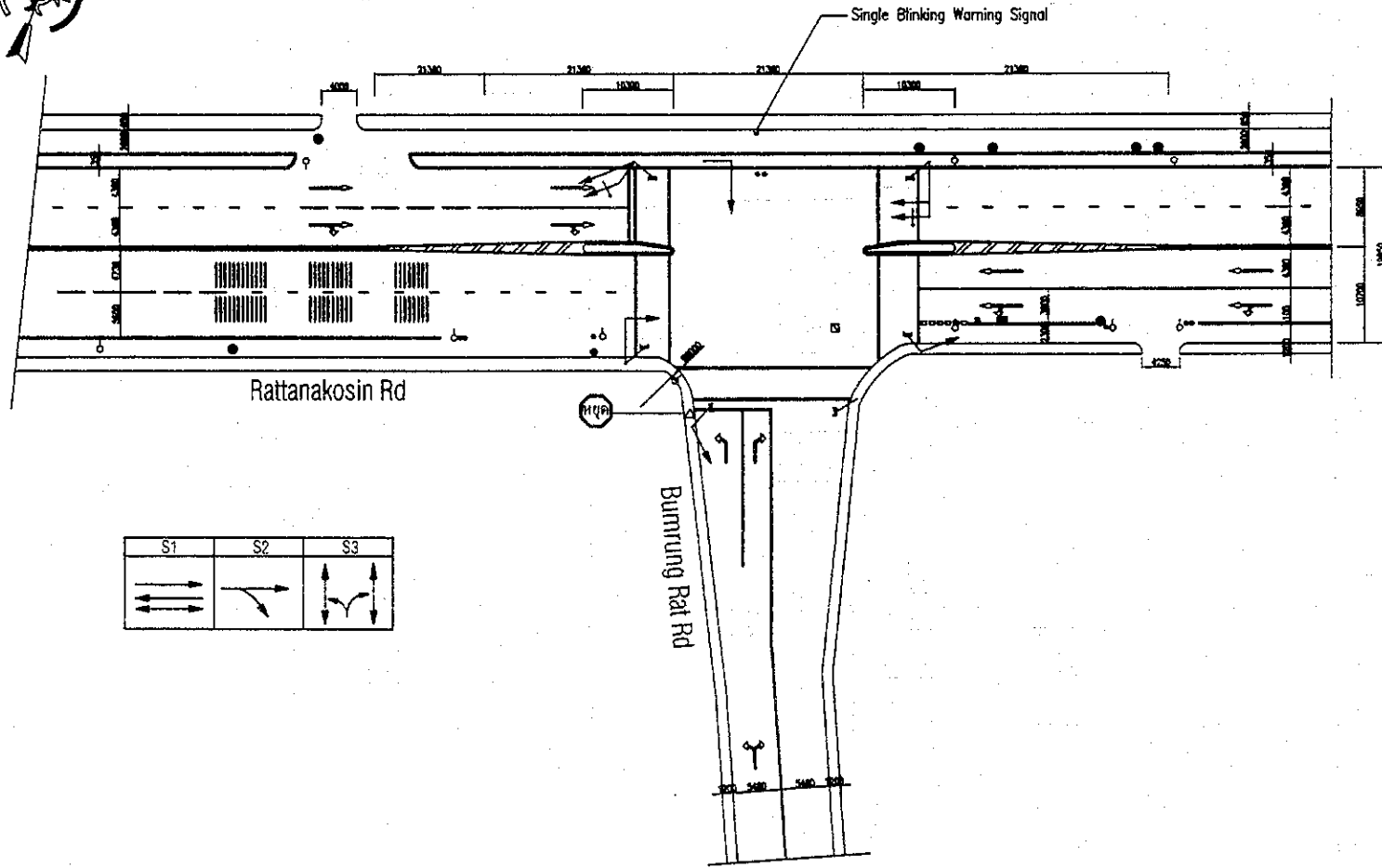
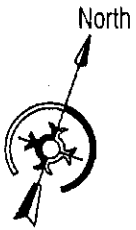
Rattanakosin Rd

Burirung Rd

Existing Plan

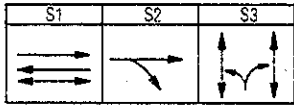
0 2 4 8 Meter

 <b>THE STUDY ON IMPROVEMENT OF ROAD TRAFFIC ENVIRONMENT IN CHANG MIH CITY</b>		
Intersection No. 11 Rattanakosin Road - Burirung Road		
Designed by: Date: August 4, 2001	Drawn by: Anuchin Date:	Checked by: Date:
File Name:		Drawing No.:



Rattanakosin Rd

Bumrung Rat Rd



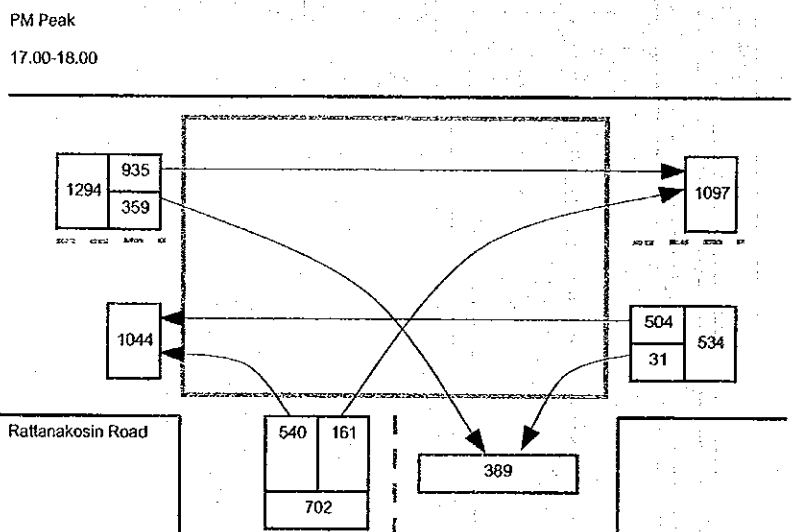
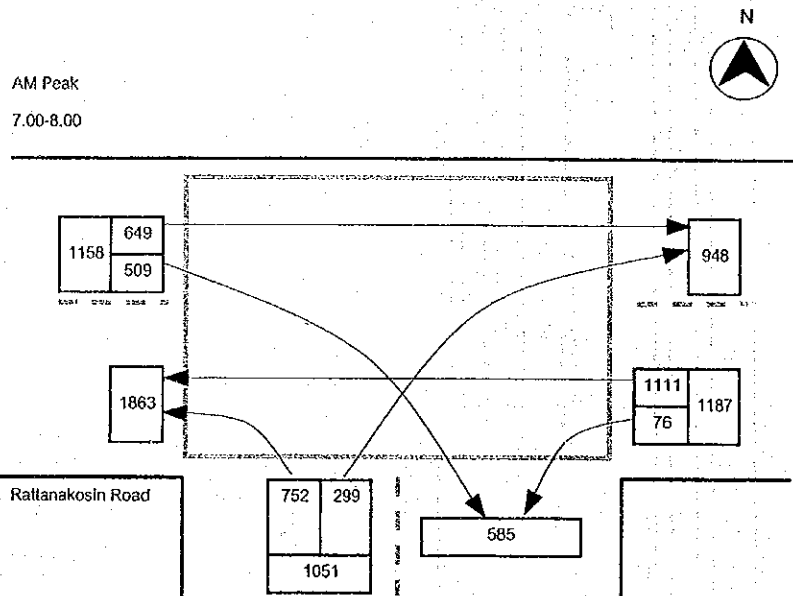
Improvement Plan  
not to scale

0 2 4 8 Meter

THE STUDY ON IMPROVEMENT OF ROAD TRAFFIC ENVIRONMENT IN CHIANG MAI CITY		
Intersection No. 11 Charoenmoung Rd. - Charoeturat Rd.		
Designed by:	Drawn by: Assawin	Checked by:
Date: August 30 2001	Date:	Date:
File Name:	Drawing No.	

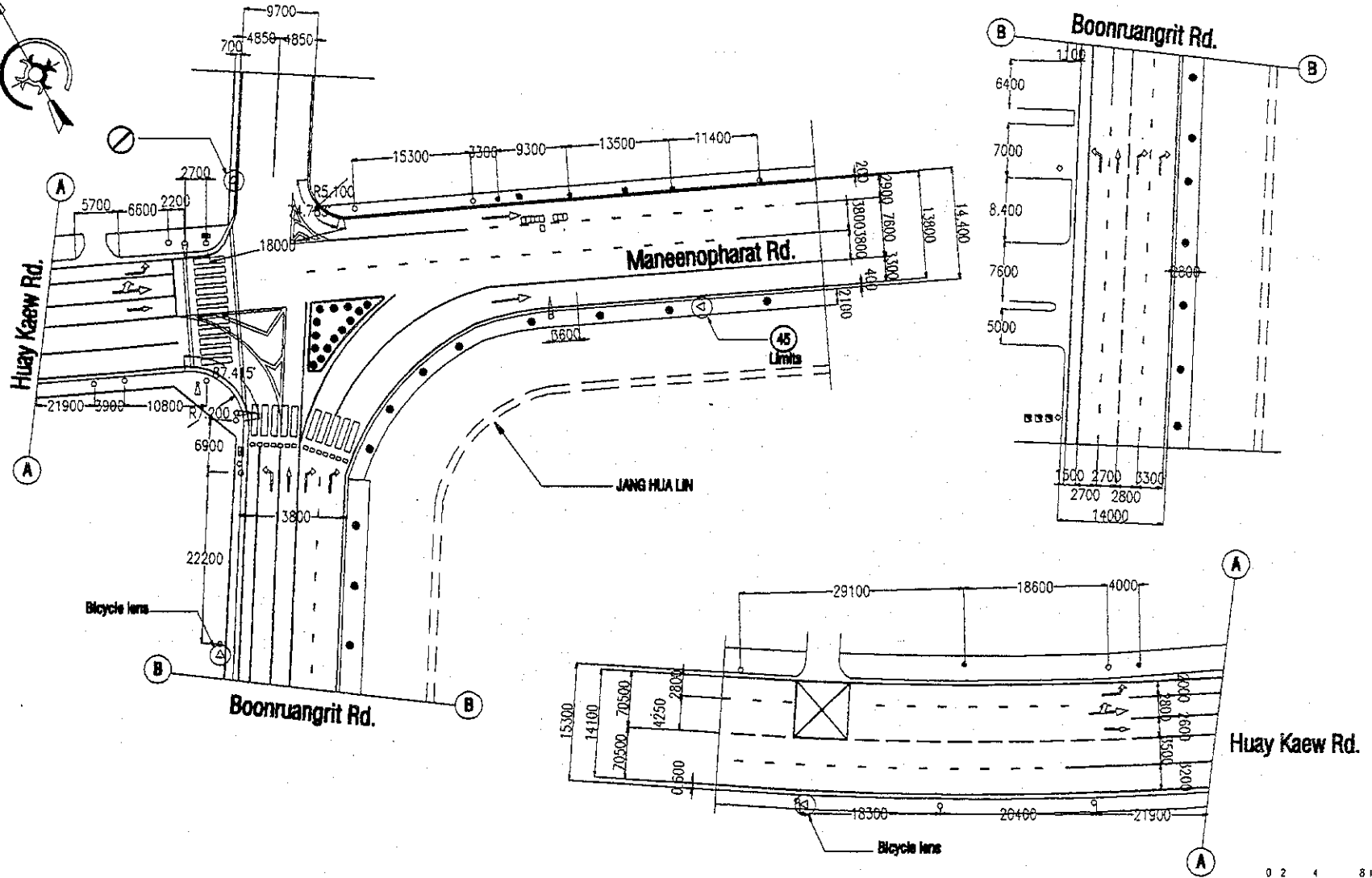
Peak Flow in PCU Junction No. J11 Intersecting Streets...Rattanakosin Road - Bumrung Rat Road

Peak Periods	from North approach				from East approach				from South approach				from West approach				Total inbound
	To South	To East	To West	Total From North	To West	To South	To North	Total From East	To North	To West	To East	Total From South	To East	To North	To South	Total From West	
	AM: 7.00-8.00	-	-	-	1158	1111	76	-	1187	-	752	299	1051	649	-	509	
PM: 17.00-18.00	-	-	-	504	504	31	-	534	-	540	161	702	935	-	359	1294	2530



Code	J-12	Signalization	Signalized												
Name	Bunruangrit Road, Huay Kaew Road and Hadsadhi Sawee Road														
Physical conditions	<ol style="list-style-type: none"> <li>1. Signalized 4-leg junction at the north-west corner of the moat.</li> <li>2. Planted corner island is provided to segregate right turn traffic from Bunruangrit approach.</li> <li>3. Imaginary (painted) corner island is provided for left turn from Bunruangrit and Hadsadhi Sawee.</li> <li>4. Pedestrian crossing markings exist on one way approach and Huay Kaew Road approach. No markings on Hadsadhi Sawee road approach.</li> <li>5. No sidewalk along Hadsadhi Sawee, which is slightly uphill toward junction.</li> <li>6. Partially deteriorated pavement.</li> <li>7. Lightings are installed.</li> </ol>														
Traffic conditions	<ol style="list-style-type: none"> <li>1. Bunruangrit is one way toward junction while Maneeppharat is one-way outgoing from junction.</li> <li>2. Very high traffic volume from Bunruangrit Road (one way) at the level of more than 2500 PCU/hour throughout the day. The flow is divided roughly left turn (35-40 %), straight (15-20 %) and right turn (40-45 %).</li> <li>3. Queue develops on all approaches. Observed maximum queue length in meter are (+ indicates more than): <table style="margin-left: 40px; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left;">Approach</th> <th style="text-align: center;">North</th> <th style="text-align: center;">South</th> <th style="text-align: center;">West</th> </tr> </thead> <tbody> <tr> <td>AM peak</td> <td style="text-align: center;">150</td> <td style="text-align: center;">100</td> <td style="text-align: center;">100</td> </tr> <tr> <td>PM peak</td> <td style="text-align: center;">200</td> <td style="text-align: center;">300</td> <td style="text-align: center;">100</td> </tr> </tbody> </table> </li> <li>4. Because of continuous left turn from Bunruangrit, crossing of Bunruangrit and Huay Kaew by pedestrian is difficult and dangerous. The number of pedestrian is small.</li> <li>5. Queue caused by loading/unloading of mini-bus at central department store complex on the west side of junction sometimes extends up to junction.</li> <li>6. Traffic from north is divided approximately 55 % left turn and 45 % right turn.</li> <li>7. Queue develops more than 200 meter along north approach. Similarly queue is observed sometime on south approach.</li> </ol>			Approach	North	South	West	AM peak	150	100	100	PM peak	200	300	100
Approach	North	South	West												
AM peak	150	100	100												
PM peak	200	300	100												
Analysis	<ol style="list-style-type: none"> <li>1. In spite of the large traffic volume (65,000 PCU for 14 hours, second among 20 junctions surveyed), junction is only slightly congested. This is due to the continuous left and right turn flow from Bunruangrit Road, and also continuous left turn from Hadsadhi Sawee.</li> <li>2. On the other hand, crossing of pedestrians is hazardous.</li> <li>3. No short term measures that increase the capacity without sacrificing safety.</li> <li>4. Cutting north-east corner and/or widening of Hadsadhi Sawee is median or long term measure.</li> </ol>														
Improvements	<ol style="list-style-type: none"> <li>1. Overlay of pavement.</li> <li>2. Re-application of pavement markings.</li> <li>3. Widening of Hadsadhi Sawee on the east side and cutting north-east corner to provide left turn lane.</li> <li>4. Modification of green signal for Bunruangrit Road through movement from full circle to straight arrow and addition of left turn green arrow.</li> </ol>														
Cost (thousand Baht)	Geometric improvement and pavement marking: 600 Signal installation/improvement: 553 Engineering services: 231 Total project cost: 1,384 thousand Baht Note: No land acquisition cost is included.														

North

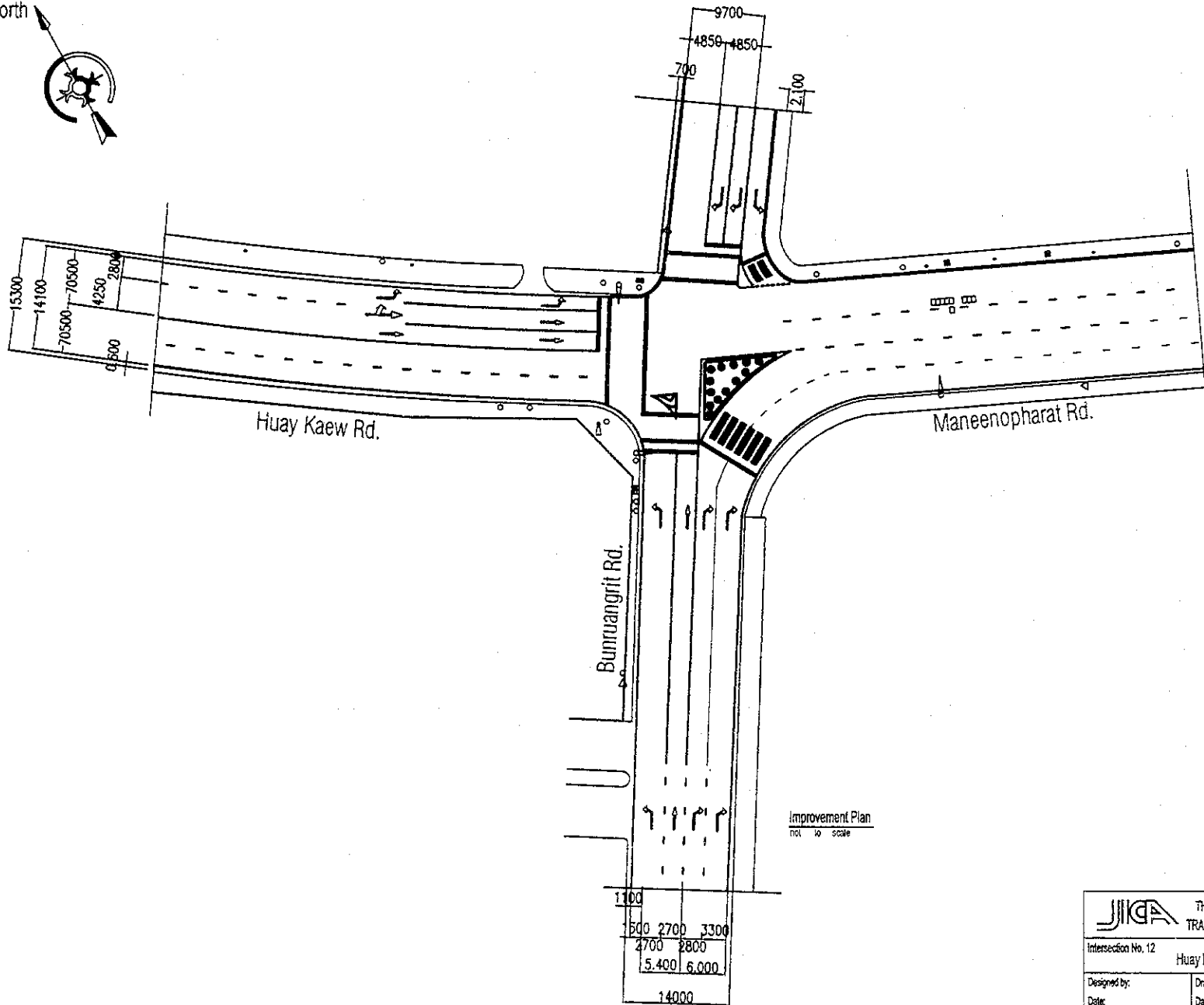


F-47


Existing Plan  
not to scale

<b>JICA</b>			THE STUDY ON IMPROVEMENT OF ROAD TRAFFIC ENVIRONMENT IN CHANG MAI CITY		
Intersection No. 12			Huay Kaew Rd. - Maneenoparat Rd.		
Designed by:	Drawn by:	Checked by:	Checked by:	Checked by:	Checked by:
Date: September 8 2001	Date:	Date:	Date:	Date:	Date:
File Name:	Drawing No.				

North



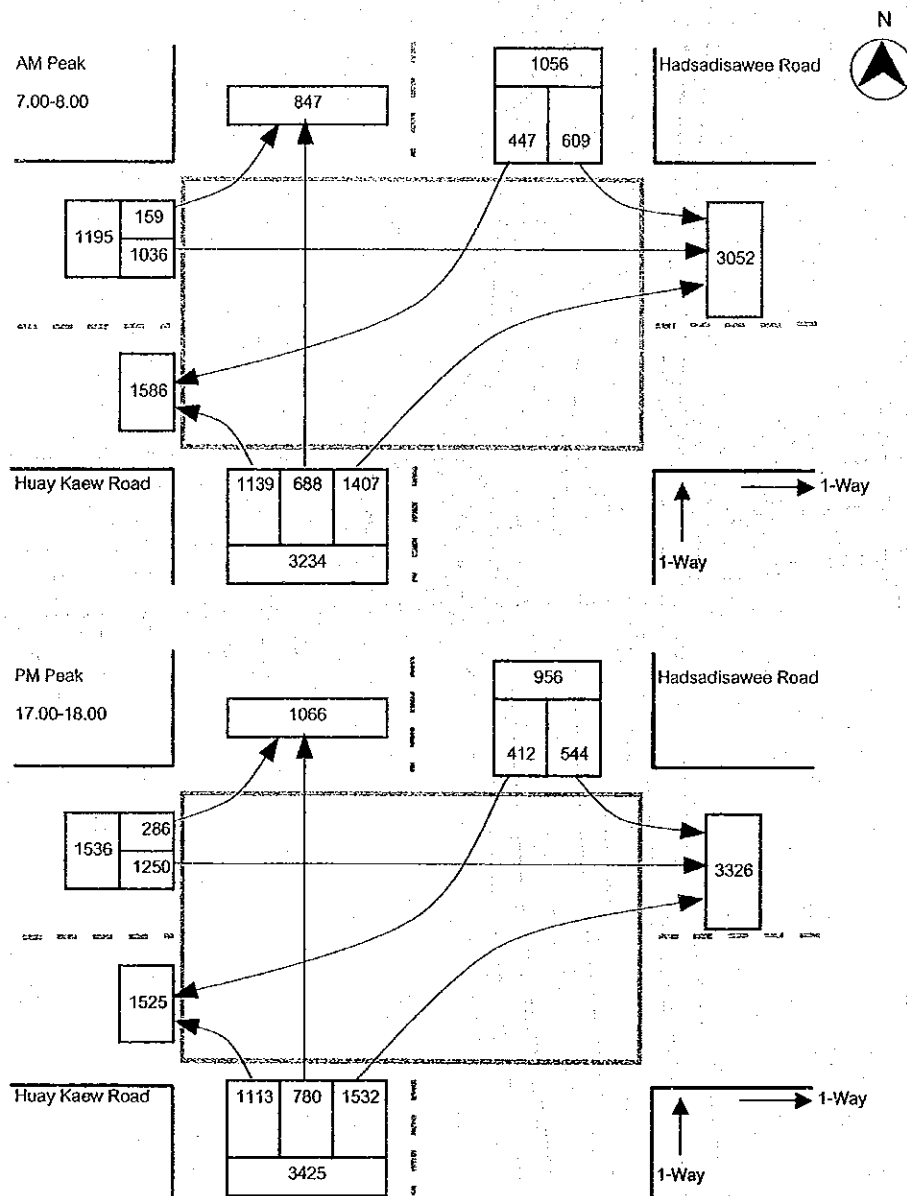
F-48

 THE STUDY ON IMPROVEMENT OF ROAD TRAFFIC ENVIRONMENT IN CHIANG MAI CITY		
Intersection No. 12		
Huay kaew Rd. - Maneenoparat Rd.		
Designed by:	Drawn by: Chitakorn	Checked by:
Date:	Date: October 8 2001	Date:
File Name:	Drawing No.	



Peak Flow In PCU Junction No. J12 Intersecting Streets...Huay Kaew Road - Hadsadisawee Road

Peak Periods	from North approach				from East approach				from South approach				from West approach				Total Inbound
	To South	To East	To West	Total From North	To West	To South	To North	Total From East	To North	To West	To East	Total From South	To East	To North	To South	Total From West	
AM: 7.00-8.00	-	609	447	1056	-	-	-	-	688	1139	1407	3234	1036	159	-	1195	5486
PM: 17.00-18.00	-	544	412	956	-	-	-	-	780	1113	1532	3425	1250	286	-	1536	5917

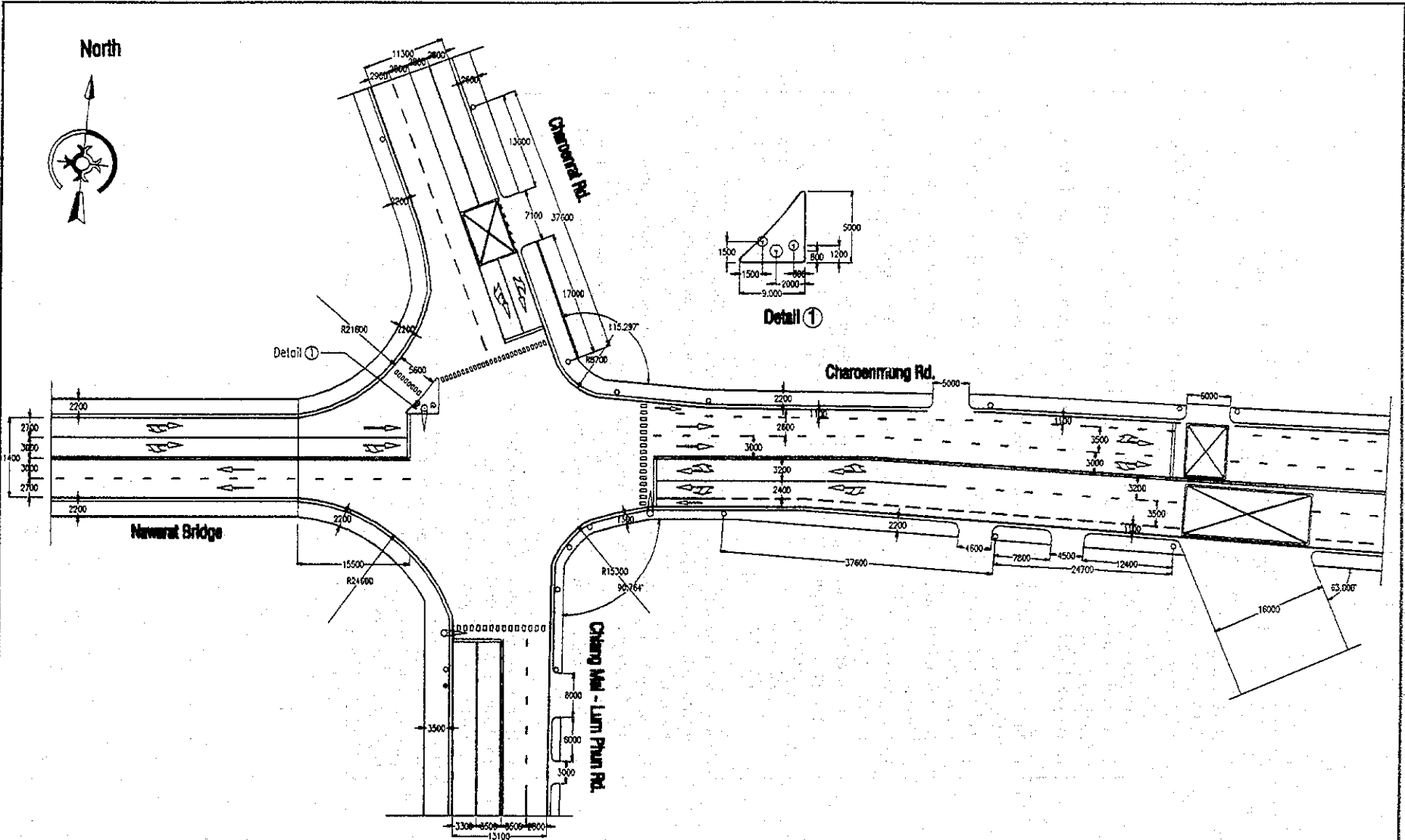


Code	J-13	Signalization	Signalized															
Name	Charoen Muang Road, Charoen Rat Road, Chiang Mai Lamphun Road																	
Physical conditions	<ol style="list-style-type: none"> <li>4-leg junction at the east side of Nawarat Bridge. A key junction of crossing Ping River from the east area of the city.</li> <li>All approaches are 4-lane undivided road.</li> <li>A small island is provided at north-west corner allowing left-turn-on-red from west approach.</li> <li>Three approach roads to the bridge have slant.</li> <li>No pedestrian signal. Crossing markings on two approaches, and fading..</li> <li>Lightings are installed.</li> <li>Bicycle lane is provided to Charoen Muang for both directions but rarely used.</li> </ol>																	
Traffic conditions	<ol style="list-style-type: none"> <li>Main flow is along Charoen Muang road with the volume of 2500-3000 PCU/hour.</li> <li>Tidal flow from east and south in the morning and from west during evening peak is evident.</li> <li>Right turn is allowed from all approaches requiring separate approach signal phasing.</li> <li>High ratio of right turn from north approach (35-45 %) and from west approach (20-25 %).</li> <li>Junction operates near or in excess of capacity. Queue develops on all approaches. Maximum queue length in meter observed is: <table border="1" data-bbox="526 952 1276 1052"> <thead> <tr> <th>Approach</th> <th>North</th> <th>East</th> <th>South</th> <th>West</th> </tr> </thead> <tbody> <tr> <td>AM peak</td> <td>100</td> <td>300</td> <td>100</td> <td>200</td> </tr> <tr> <td>PM peak</td> <td>100</td> <td>300</td> <td>100</td> <td>200</td> </tr> </tbody> </table> </li> </ol>			Approach	North	East	South	West	AM peak	100	300	100	200	PM peak	100	300	100	200
Approach	North	East	South	West														
AM peak	100	300	100	200														
PM peak	100	300	100	200														
Analysis	<ol style="list-style-type: none"> <li>Junction locates at a strategic point in the eastern side of Ping River.</li> <li>Traffic converges to this junction as the number of bridges crossing Ping River is limited.</li> <li>Charoen Muang is an arterial street connecting eastern part of Municipality as well as suburban area of San Kamphaeng in the east.</li> <li>Physically road widening is impossible because of Ping River and buildup area.</li> <li>Reduction of congestion is possible if one or more movements are removed and signal phases are overlapped.</li> </ol>																	
Improvements	<ol style="list-style-type: none"> <li>Banning of right turn from east approach and overlapping phase signal operation.</li> <li>Re-application of pavement markings.</li> <li>Addition of pedestrian signal.</li> </ol>																	
Cost (thousand Baht)	<table border="0"> <tr> <td>Geometric improvement and pavement marking:</td> <td>333</td> <td></td> </tr> <tr> <td>Signal installation/improvement:</td> <td>885</td> <td></td> </tr> <tr> <td>Engineering services:</td> <td>244</td> <td></td> </tr> <tr> <td>Total project cost:</td> <td>1,462</td> <td>thousand Baht</td> </tr> </table>			Geometric improvement and pavement marking:	333		Signal installation/improvement:	885		Engineering services:	244		Total project cost:	1,462	thousand Baht			
Geometric improvement and pavement marking:	333																	
Signal installation/improvement:	885																	
Engineering services:	244																	
Total project cost:	1,462	thousand Baht																

North



F-51



Existing Plan

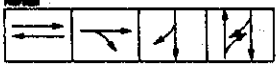
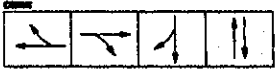
0 2 4 8 Meter

<b>JICA</b>		THE STUDY ON IMPROVEMENT OF ROAD TRAFFIC ENVIRONMENT IN CHIANG MAI CITY	
Memorandum No. 03		Charoenmang Rd. - Charoenat Rd.	
Designed by:	Drawn by: Ananta	Checked by:	
Date: August 20 2011	Date:	Date:	
File Name:	Drawing No.		

North

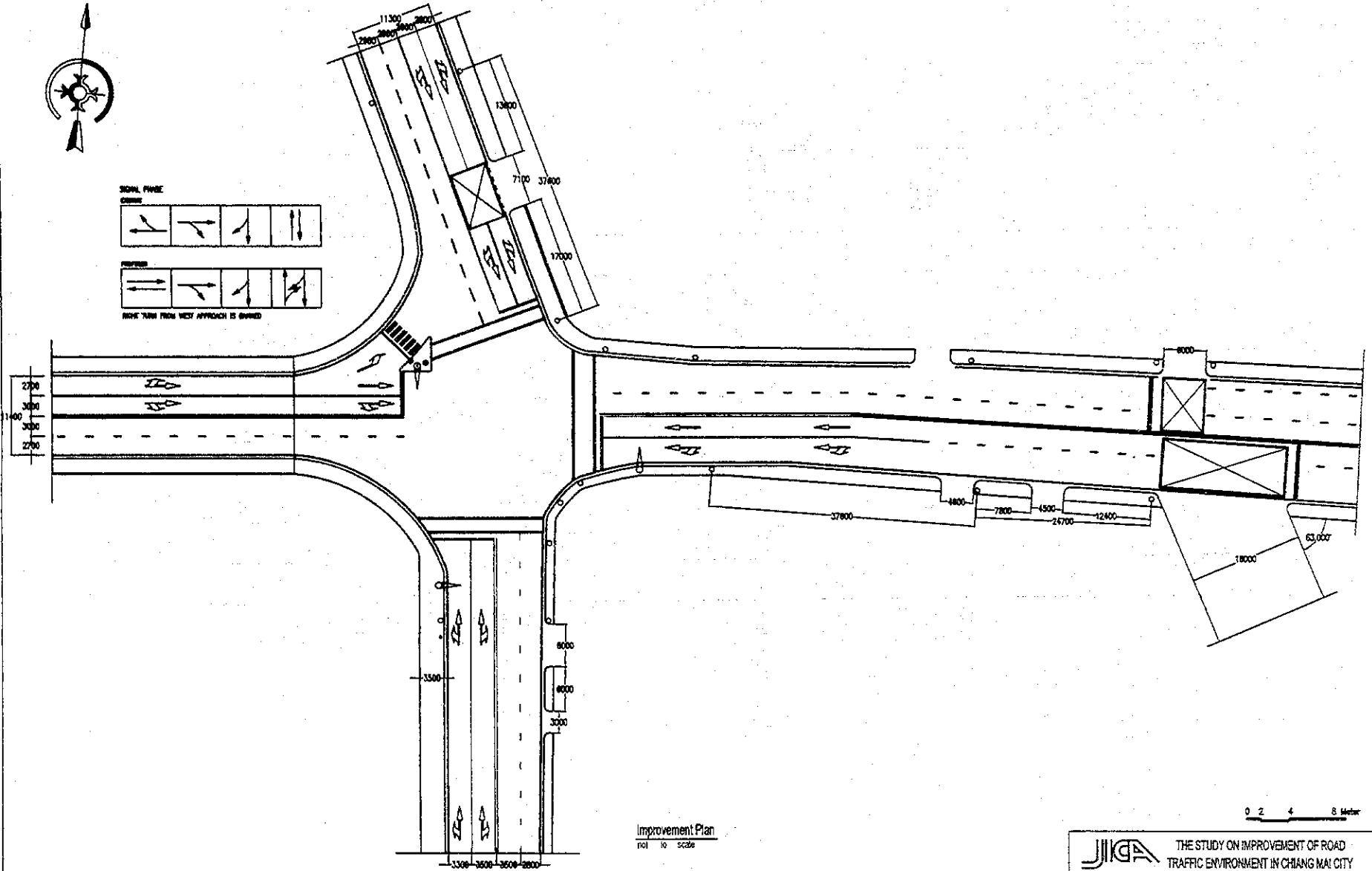


SIGNAL PHASE



RIGHT TURN FROM WEST APPROACH IS BANNED

P-52



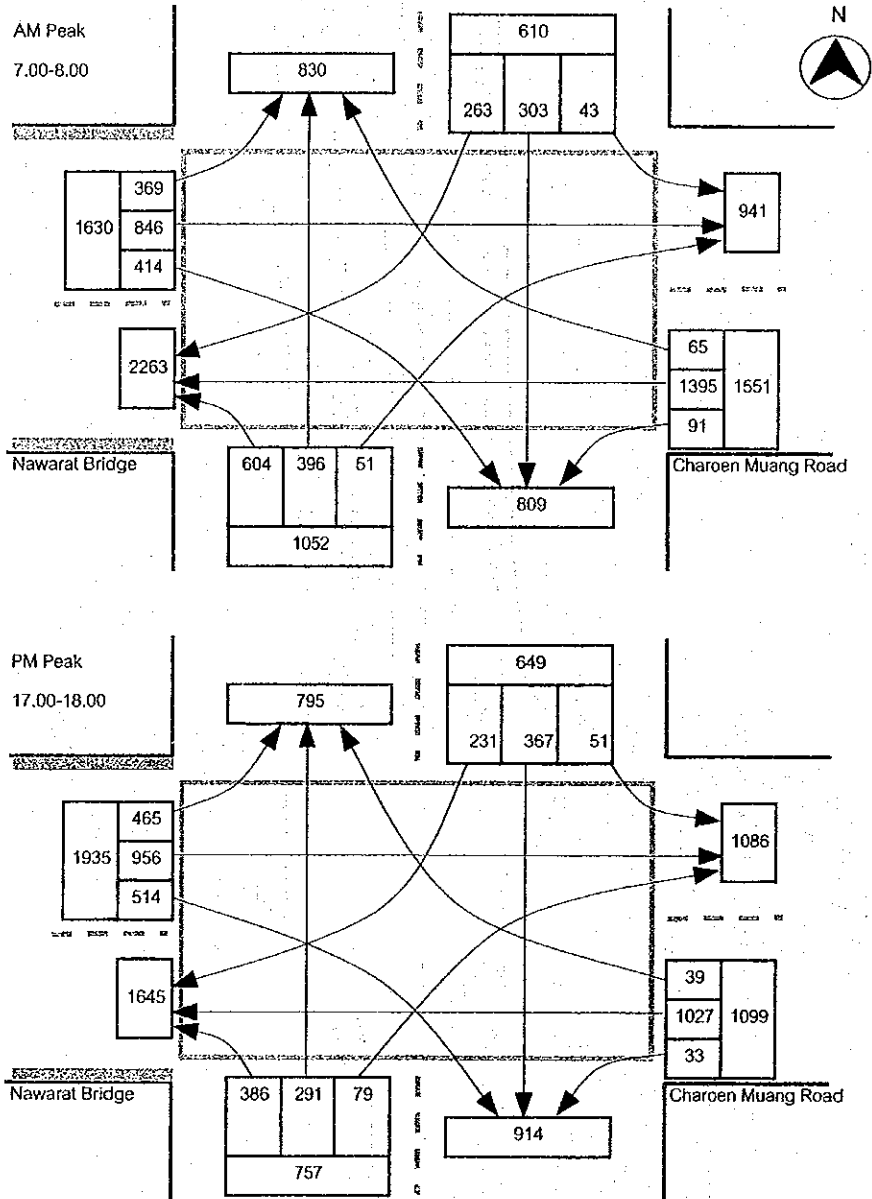
Improvement Plan  
not to scale

0 2 4 8 Meter

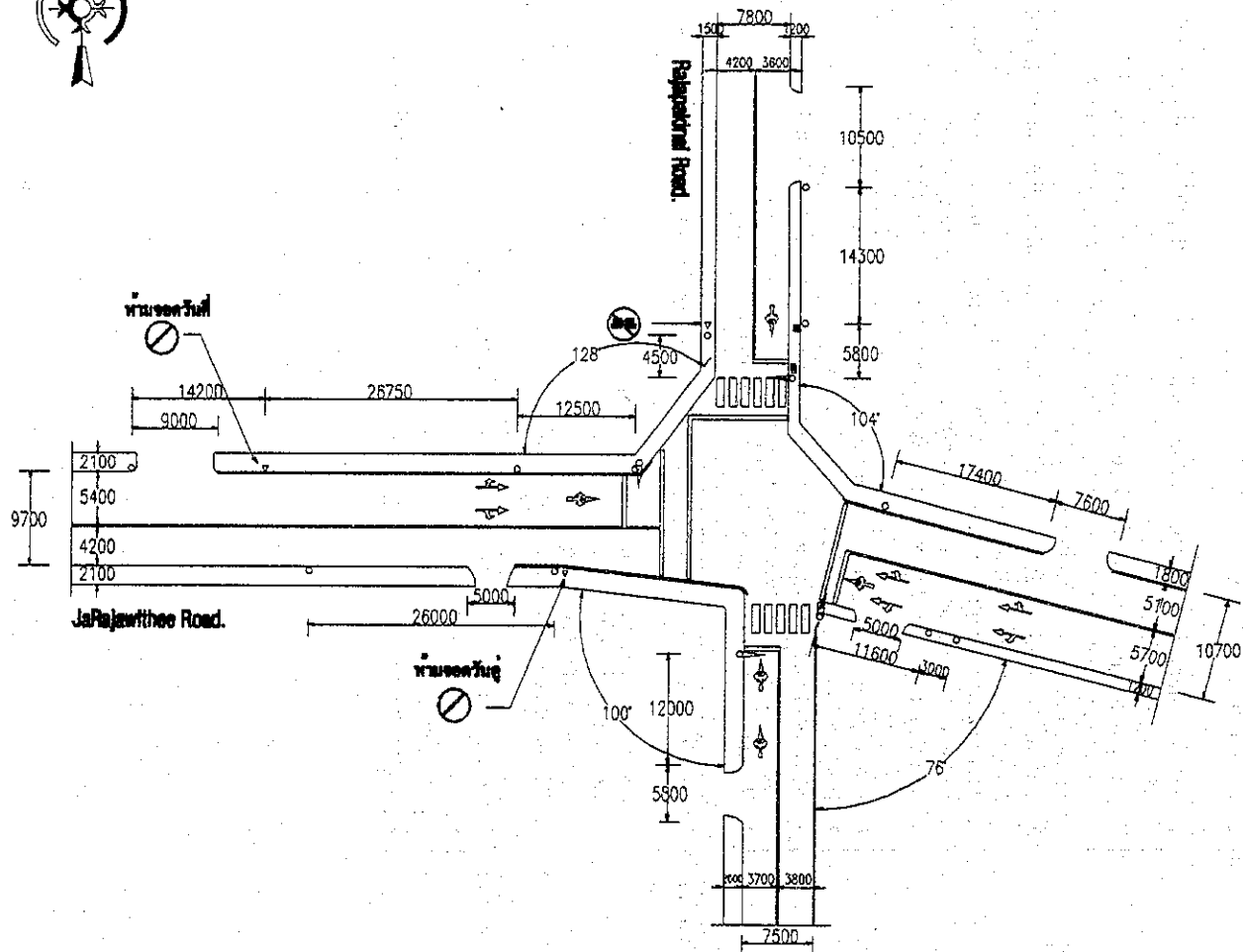
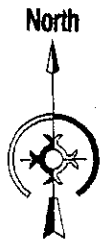
THE STUDY ON IMPROVEMENT OF ROAD TRAFFIC ENVIRONMENT IN CHIANG MAI CITY		
Intersection No. 13 Charoenmoung Rd. - Charoeruat Rd.		
Designed by:	Drawn by: Assawin	Checked by:
Date: August 30 2001	Date:	Date:
File Name:	Drawing No.	

Peak Flow In PCU Junction No. J13 Charoen Muang Road - Charoen Rat Road

Peak Periods	from North approach			from East approach				from South approach				from West approach				Total inbound	
	To South	To East	To West	From North	To West	To South	To North	From East	To North	To West	To East	From South	To East	To North	To South		From West
AM: 7.00-8.00	303	43	263	610	1395	91	65	1551	396	604	51	1052	846	369	414	1630	4842
PM: 17.00-18.00	367	51	231	649	1027	33	39	1099	291	386	79	757	956	465	514	1935	4441



Code	J-14	Signalization	Signalized (isolated)
Name	Ratchawithi Road and Ratchaphakhinai Road		
Physical conditions	<ol style="list-style-type: none"> <li>1. 4-leg junction (two collector roads in the old city).</li> <li>2. Two corners are slightly sliced and Ratchawithi east approach is connected to the junction not at right angle.</li> <li>3. Pedestrian crossing on two approaches only. No pedestrian lantern.</li> <li>4. Signal controller is misplaced or accidentally moved and stays diagonally on the platform.</li> <li>5. Poor markings, two different markings are overlapping.</li> <li>6. Good pavement.</li> <li>7. Lightings are installed.</li> </ol>		
Traffic conditions	<ol style="list-style-type: none"> <li>1. Traffic volume is not much; total junction volume is 18,600 PCU in 14 hours. Thus no congestion.</li> <li>2. Volume from north approach is much higher than that from south and right turn ratio from north is high (20-45 %). This leads to the confusion of priority between flows from north and south.</li> <li>3. Left turn arrow for west approach conflicts with crossing pedestrian movements. Large corner radius allows high speed turning movement.</li> <li>4. Morning and afternoon peaks are conspicuous due probably to the school nearby.</li> <li>5. More than 200 pedestrians cross north approach for 15:00-16:00 and 16:00-17:00, and also more than 200 pedestrian cross west approach 16:00-17:00.</li> </ol>		
Analysis	<ol style="list-style-type: none"> <li>1. Minor junction inside the old city and traffic volume is not high.</li> <li>2. Regarded as accident prone junction.</li> <li>3. Slightly oblique connection of an approach and wide junction area due to cut corner would be a cause of some accidents.</li> <li>4. Right turn by filtering may also contribute to the accident.</li> </ol>		
Improvements	<ol style="list-style-type: none"> <li>1. Application of pavement markings and removal of the existing pavement markings.</li> <li>2. Expansion of sidewalk at northwest corner.</li> <li>3. Removing of left turn arrow.</li> <li>4. Addition of pedestrian signal.</li> <li>5. Repair of signal controller position.</li> </ol>		
Cost (thousand Baht)	Geometric improvement and pavement marking:	263	
	Signal installation/improvement:	939	
	Engineering services:	240	
	Total project cost:	1,442	thousand Baht

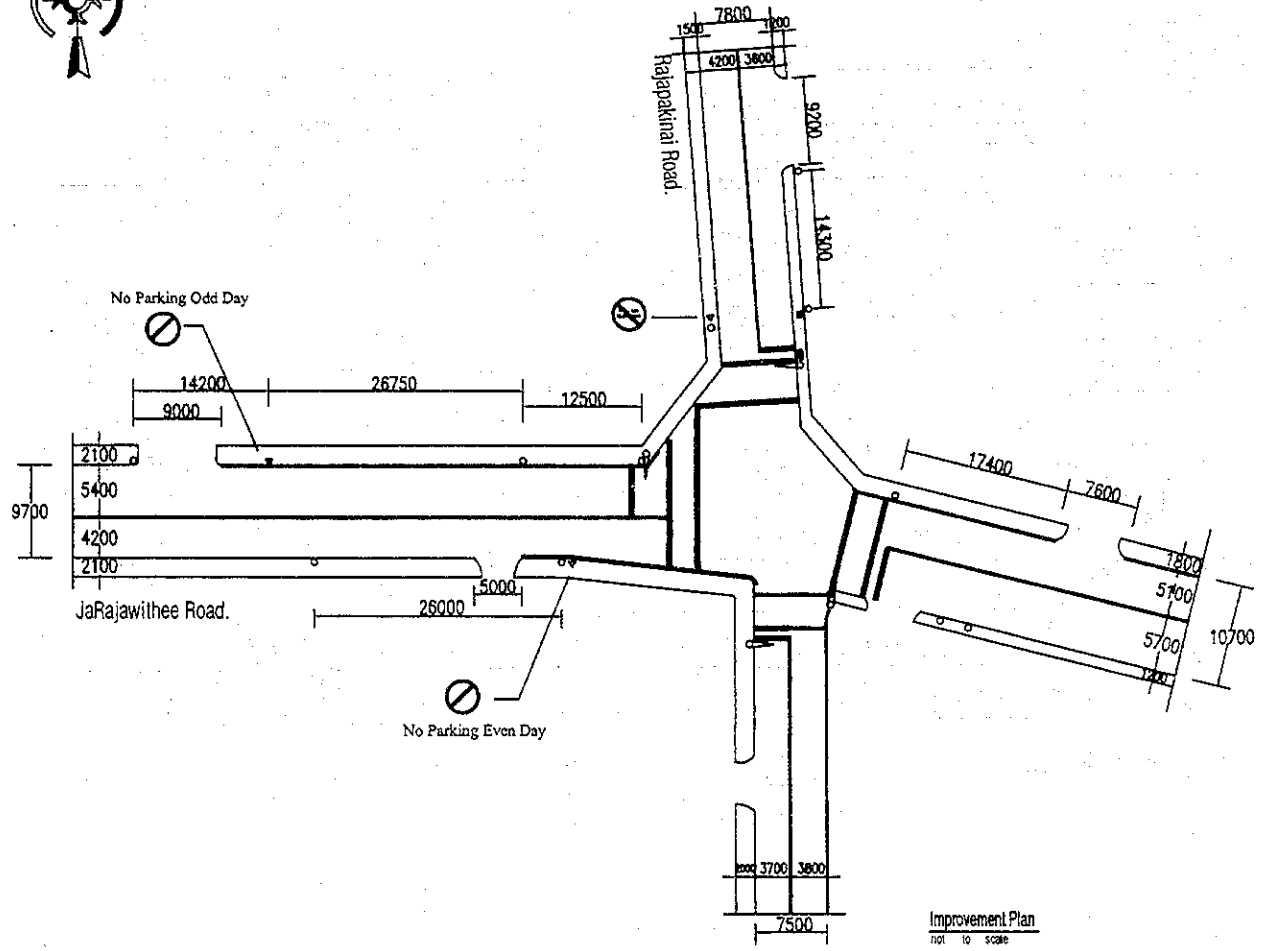
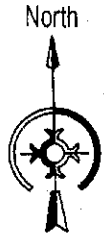


Existing plan  
not to scale

0 2 4 8 Meter

<b>JICA</b>		
THE STUDY ON IMPROVEMENT OF ROAD TRAFFIC ENVIRONMENT IN CHANG MAI CITY		
Intersection No. 14		
Rajawithee Rd. - Rajapattana Rd.		
Designed by:	Drawn by: Chongrat	Checked by:
Date: September 10 2001	Date: September 10 2001	Date:
File Name:	Drawing No.	

F-55



F-56

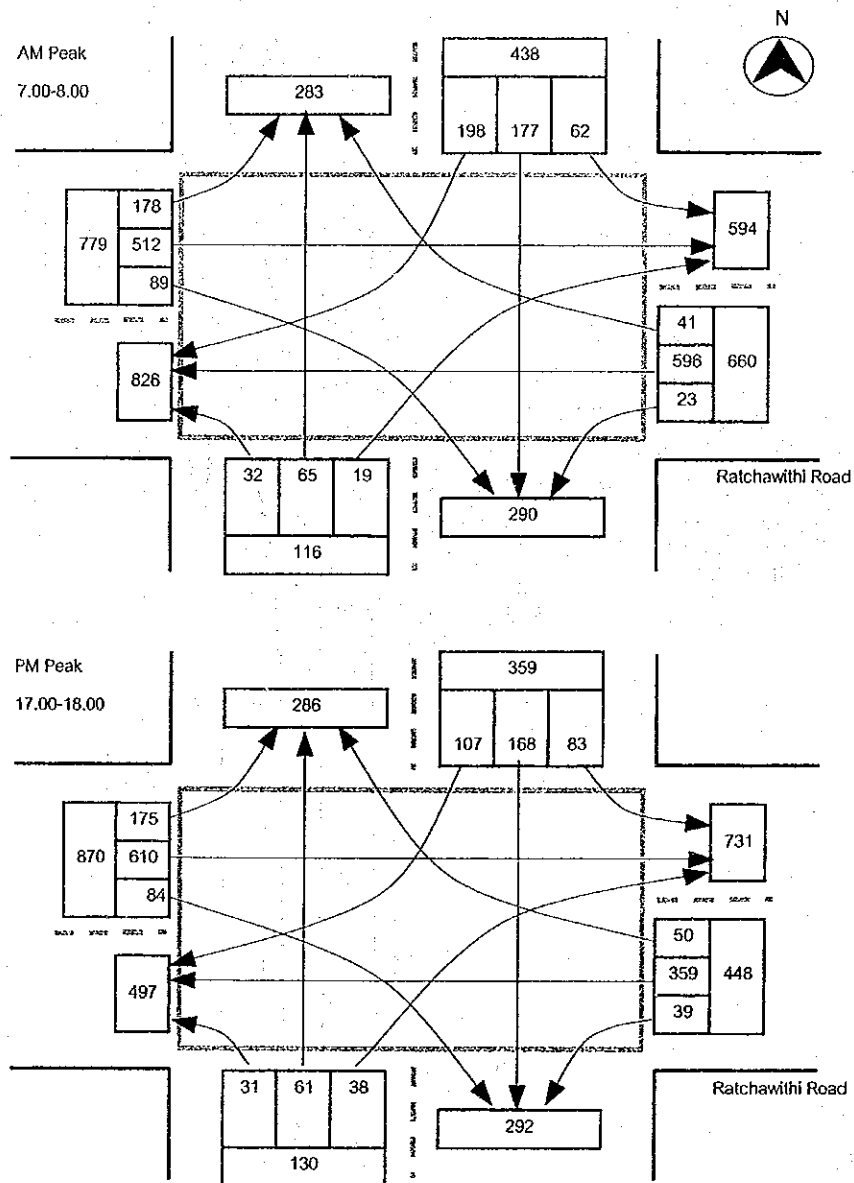
0 2 4 8 Meter

THE STUDY ON IMPROVEMENT OF ROAD TRAFFIC ENVIRONMENT IN CHIANG MAI CITY		
Intersection No. 14 Rajawilhee Rd. - Rajapakinai Rd.		
Designed by:	Drawn by: Greengrai	Checked by:
Date: September 19 2001	Date: September 19 2001	Date:
File Name:	Drawing No.	

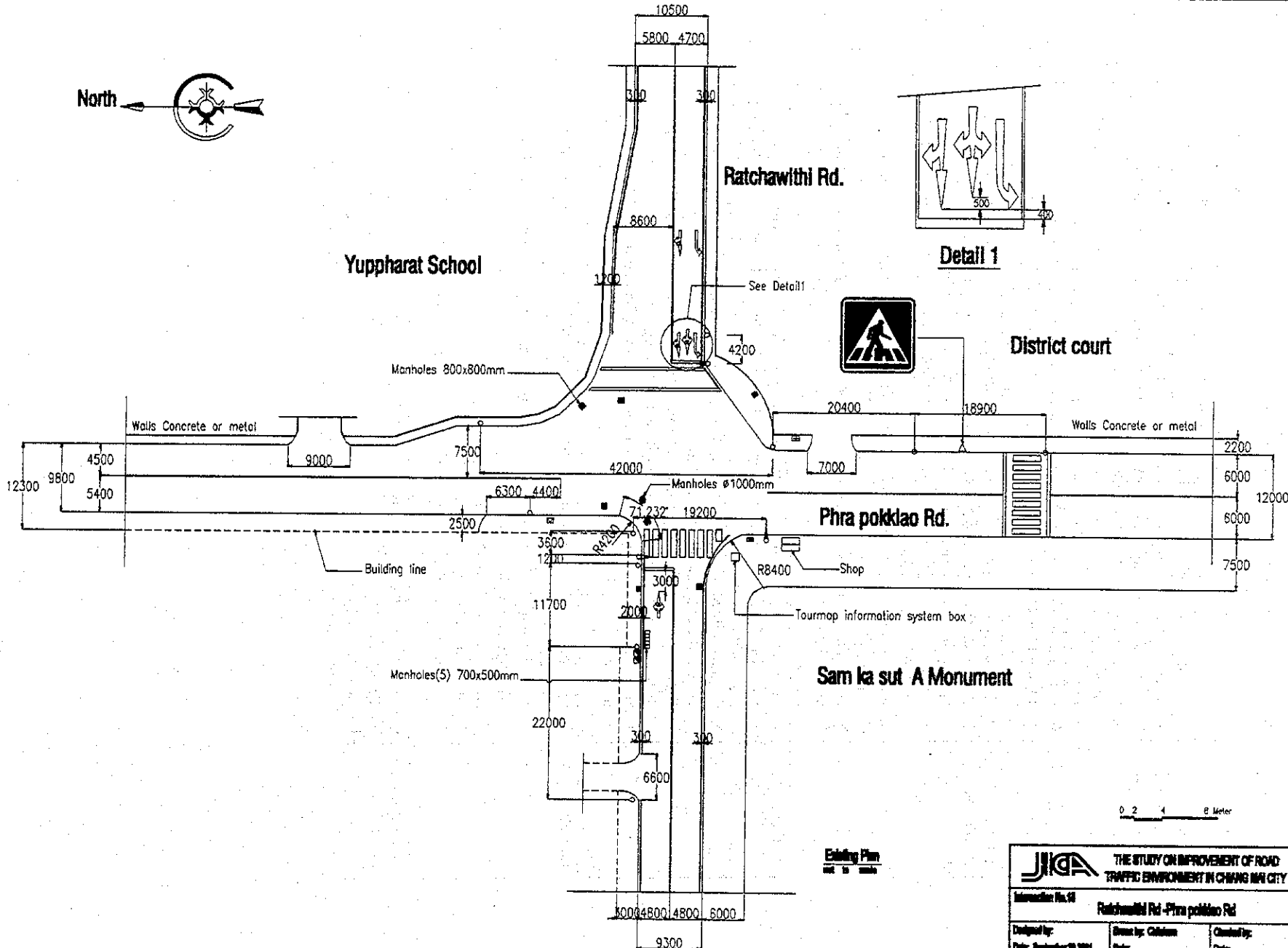
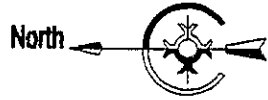


Peak Flow in PCU Junction No. J14 Ratchawithi Road-Ratchaphakhinal Road

Peak Periods	from North approach				from East approach				from South approach				from West approach				Total inbound
	To South	To East	To West	Total From North	To West	To South	To North	Total From East	To North	To West	To East	Total From South	To East	To North	To South	Total From West	
AM: 7.00-8.00	177	62	198	438	596	23	41	660	65	32	19	116	512	178	89	779	1993
PM: 17.00-18.00	168	83	107	359	359	39	50	448	61	31	38	130	610	175	84	870	1807



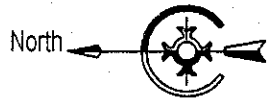
Code	J-15	Signalization	Signalized (isolated)
Name	Ratchawithi Road and Phra Pokklao Road		
Physical conditions	<ol style="list-style-type: none"> <li>1. 4-leg junction (an arterial with minor collector in front of Three Kings Gods )</li> <li>2. Large junction area with exclusive left turn lane on main road from north.</li> <li>3. Corner island at north east corner was removed.</li> <li>4. South-east corner is cut in a slant way.</li> <li>5. Pedestrian crossing across Phra Pokklao Road 40 south of junction.</li> <li>6. Crossing markings on three approaches but markings are not clear.</li> <li>7. Lightings are installed.</li> </ol>		
Traffic conditions	<ol style="list-style-type: none"> <li>1. School occupies northeast quadrant and traffic volume is high during peak hours.</li> <li>2. Queue develops along Phra Pokklao during peak hours; up to 300 m on north approach in the morning and 200 m on south approach in the afternoon.</li> <li>3. Signal operates in three (3) phases; 1) north approach, 2) south approach and 3) east and west approach.</li> <li>4. Parking is prohibited along east side of north approach but illegal parking is found.</li> <li>5. High pedestrian crossing; more than 300 persons cross north approach during AM and PM peak hours.</li> </ol>		
Analysis	<ol style="list-style-type: none"> <li>1. Phra Pokklao is one of the arterial streets within the old city connecting Chang Puak Gate at the north and Chiang Mai Gate at the south. Thus it carries relatively high volume.</li> <li>2. Yuppharat School at the northwest quadrant creates school traffic, which has clear peak at the start and dismissal time.</li> <li>3. Right turn from north approach is less than 100 PCU per hour but protected right turn is provided resulting in an inefficient signal operation.</li> <li>4. Junction is spacious with left turn lane from north and cut corner at southeast quadrant.</li> </ol>		
Improvements	<ol style="list-style-type: none"> <li>1. Construction of corner island at north-east corner and expansion of sidewalk at southeast quadrant.</li> <li>2. Modification of signal phase to allow simultaneous north and south through, and adjustment of signal timing.</li> <li>3. Addition of pedestrian signal.</li> <li>4. Application of pavement markings.</li> <li>5. Strict enforcement of no parking on the east side of Phra Pokklao.</li> </ol>		
Cost (thousand Baht)	Geometric improvement and pavement marking: 309 Signal installation/improvement: 848 Engineering services: 231 Total project cost: 1,388 thousand Baht		



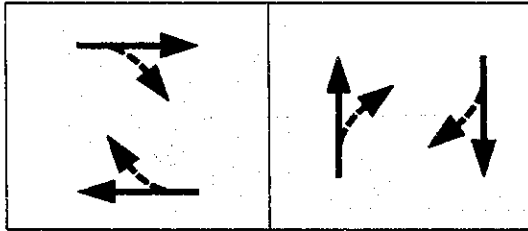
0 2 4 6 Meter

Existing Plan  
not to scale

<b>JICA</b>		
THE STUDY ON IMPROVEMENT OF ROAD TRAFFIC ENVIRONMENT IN CHIANG MAI CITY		
Information No. 18		
<b>Ratchawithi Rd - Phra pokklao Rd</b>		
Designed by:	Drawn by: Chulanan	Checked by:
Date: September 29, 2001	Date:	Date:
File Name:	Drawing No.	



Signal phase



10500  
5800 4700

Ratchawithi Rd.



District court

Walls Concrete or metal

Walls Concrete or metal

F-60

12300  
9800

4500  
5400

2200

6000

12000

6000

7500

Phra pokklao Rd.

3000 4800 4800 6000

9300

0 2 4 8 Meter

Improvement Plan  
not to scale



THE STUDY ON IMPROVEMENT OF ROAD  
TRAFFIC ENVIRONMENT IN CHIANG MAI CITY

Intersecion No.15

Ratchawithi Rd -Phra.pokklao Rd

Designed by:

Drawn by: Chitakorn

Checked by:

Date: September 20 2001

Date:

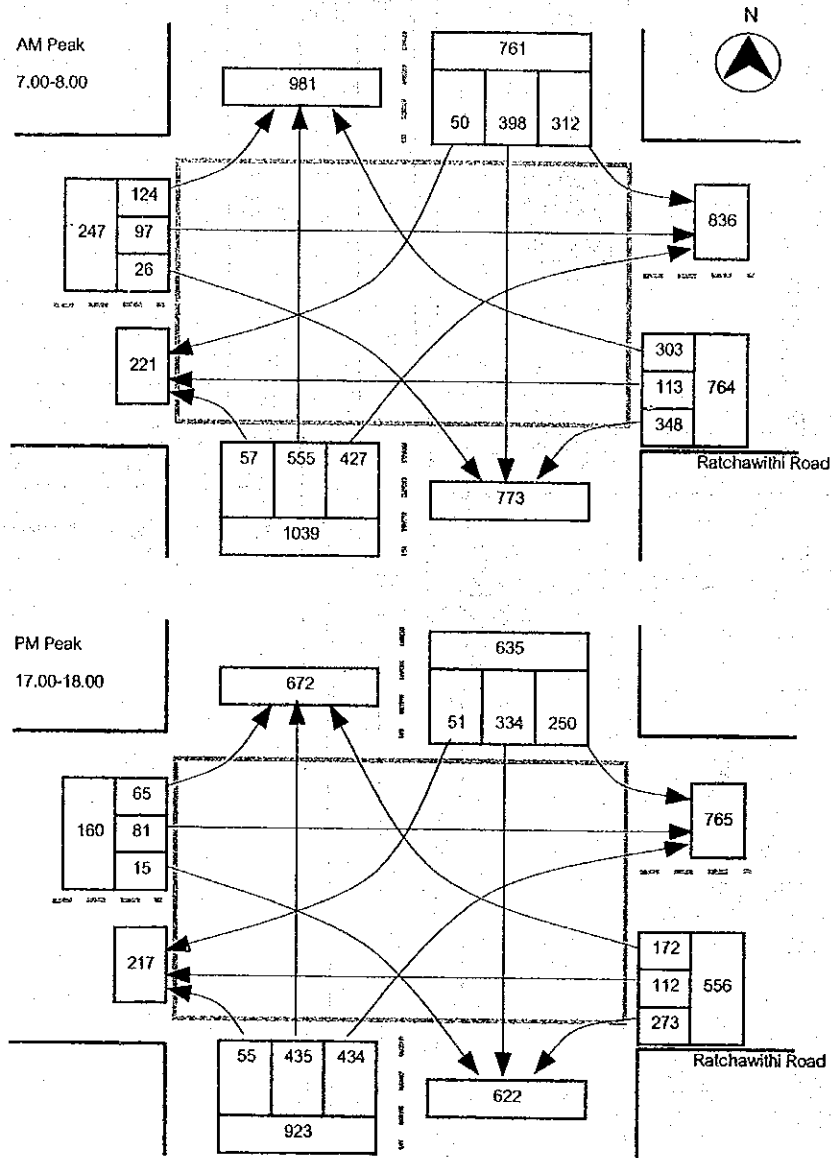
Date:

File Name:

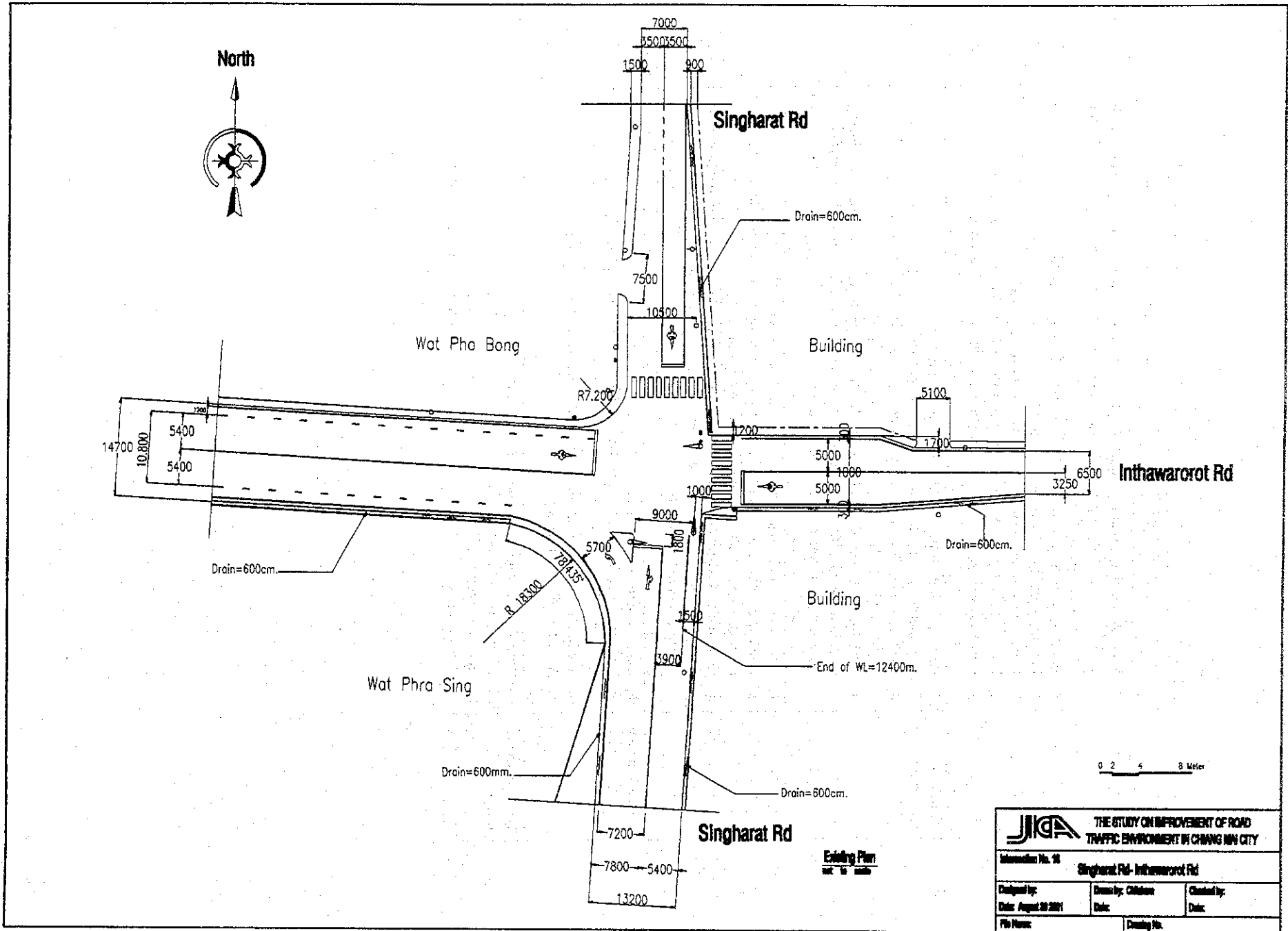
Drawing No.

Peak Flow In PCU Junction No. J15 Intersecting Streets...Ratchawithi Road - Phra Pokklao Road

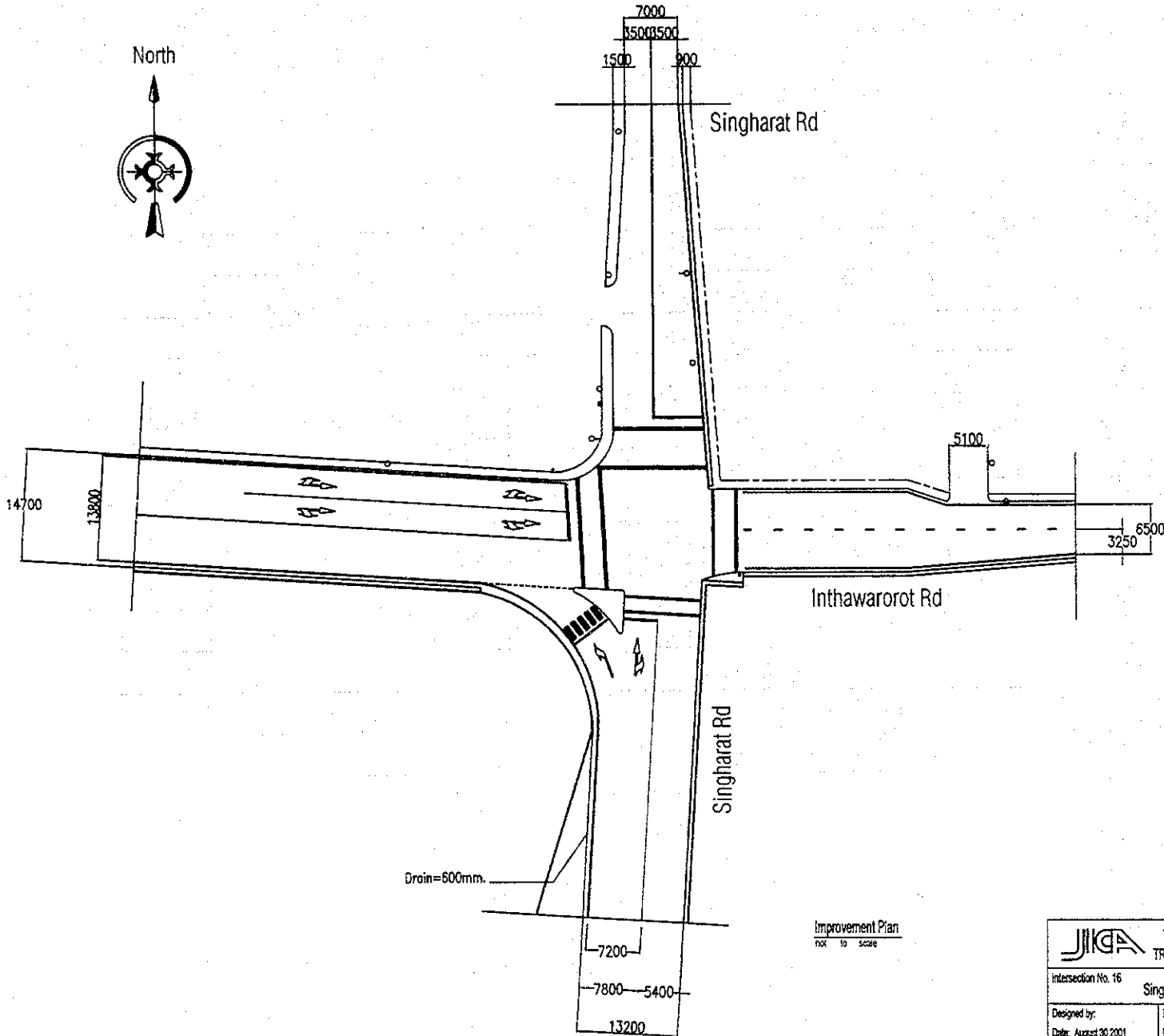
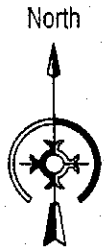
Peak Periods	from North approach				from East approach				from South approach				from West approach				Total inbound
	To South	To East	To West	Total From North	To West	To South	To North	Total From East	To North	To West	To East	Total From South	To East	To North	To South	Total From West	
AM: 7.00-8.00	398	312	50	761	113	348	303	764	555	57	427	1039	97	124	26	247	2810
PM: 17.00-18.00	334	250	51	635	112	273	172	556	435	55	434	923	81	65	15	160	2275



Code	J-16	Signalization	Signalized (isolated)
Name	Inthawarorot Road and Singharat Road		
Physical conditions	<ol style="list-style-type: none"> <li>1. Cross junction of two collector roads in old city.</li> <li>2. Road width changes at junction. West and south approaches are wider (14.7 and 13.2 meters, respectively), while east and north approaches are narrower (6.5 and 7.0 meters, respectively).</li> <li>3. A small island is provided for left turn from Singharat Road.</li> <li>4. Pavement markings are not very clear.</li> <li>5. Pedestrian crossing markings on east and north approaches.</li> <li>6. Bicycle lane is provided to Inthawarorot Road west side but not used.</li> <li>7. Low pedestal type of signal equipment operating in isolated mode.</li> </ol>		
Traffic conditions	<ol style="list-style-type: none"> <li>1. Relatively high traffic volume at small size junction.</li> <li>2. High percentage of right turn from west approach (30-40 %).</li> <li>3. High percentage of left turn from south approach (40-50 %) and from east approach (30-45 %).</li> <li>4. Very difficult to cross Singharat Road, which more than 200 persons cross during peak hour (15:00-16:00), due to lack of pedestrian crossing, continuous traffic flow and no custom to stop for pedestrians.</li> </ol>		
Analysis	<ol style="list-style-type: none"> <li>1. This is one on the junctions where main flow turns at right angle.</li> <li>2. Road width changes considerably along Inthawarorot and slightly along Singharat. Because of width change, junction shape deformed.</li> <li>3. Like many other junctions, no consideration is given to pedestrian in the junction design, although it is located at the corner of Wat Phra Sing, one of the most famous wats in Chiang Mai.</li> </ol>		
Improvements	<ol style="list-style-type: none"> <li>1. Expansion of corner island.</li> <li>2. Construction of sidewalk over covered ditch at southwest corner.</li> <li>3. Removal of bicycle lane.</li> <li>4. Application of pavement markings including pedestrian crossing.</li> <li>5. Addition of pedestrian signal.</li> </ol>		
Cost (thousand Baht)	Geometric improvement and pavement marking: 575 Signal installation/improvement: 972 Engineering services: 309 Total project cost: 1,856 thousand Baht		



<b>JICA</b>		
THE STUDY ON IMPROVEMENT OF ROAD TRAFFIC ENVIRONMENT IN CHANG MIN CITY		
Information No. 16		
Singharat Rd- Inthawarorot Rd		
Designed by:	Drawn by: Chaiwan	Checked by:
Date: August 20 2001	Date:	Date:
File Name:	Drawing No.	



0 2 4 8 Meter

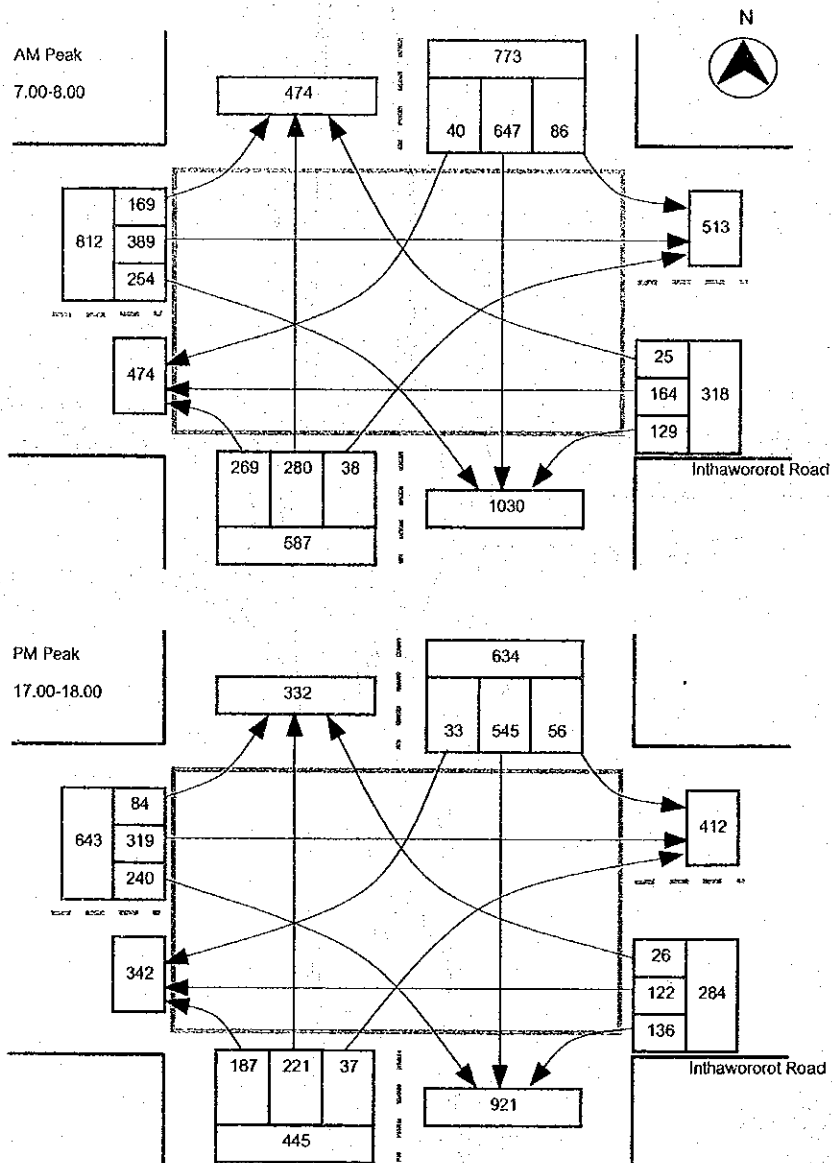
Improvement Plan  
not to scale

		THE STUDY ON IMPROVEMENT OF ROAD TRAFFIC ENVIRONMENT IN CHIANG MAI CITY	
Intersection No. 16		Singharat Rd- Inthawarot Rd	
Designed by:	Drawn by: Chitakorn	Checked by:	
Date: August 30 2001	Date:	Date:	
File Name:	Drawing No.		

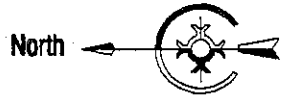


Peak Flow in PCU Junction No. J16 Intersecting Streets...Inthawororot Road - Singharat Road

Peak Periods	from North approach				from East approach				from South approach				from West approach				Total inbound
	To South	To East	To West	Total From North	To West	To South	To North	Total From East	To North	To West	To East	Total From South	To East	To North	To South	Total From West	
	AM: 7.00-8.00	647	86	40	773	164	129	25	318	280	269	38	587	389	169	254	
PM: 17.00-18.00	545	56	33	634	122	136	26	284	221	187	37	445	319	84	240	643	2007



Code	J-17	Signalization	Signalized (isolated)
Name	Phra Sing Road and Phra Pokklao Road		
Physical conditions	<ol style="list-style-type: none"> <li>1. Crisscross junction (two arterials in the old city).</li> <li>2. Small radii for turning.</li> <li>3. Signalized with low pedestal signal equipment.</li> <li>4. Markings are fair.</li> <li>5. Bicycle lane is provided along Phra Sing Road.</li> </ol>		
Traffic conditions	<ol style="list-style-type: none"> <li>1. Traffic volume is moderate; hour total volume is at a level of 1600-2800 PCU per hour and 14-hour total is 26000 PCU.</li> <li>2. Nonetheless, queue develops up to 200 meter during the morning peak and up to 100 meter during the afternoon peak along the east approach.</li> <li>3. Conspicuous increase in traffic volume during morning and afternoon peak hours.</li> <li>4. High ratio of right turn from all approach except south. 14-hour average right turn ratio is 20 % for north, 17 % for east and 26 % for west.</li> <li>5. South approach has high average left turn ratio of 25 %.</li> </ol>		
Analysis	<ol style="list-style-type: none"> <li>1. Although both roads are two-lane undivided road, they are arterial streets in the old city located nearly at the center of the old city. Thus they carry relatively more traffic in the old city.</li> <li>2. In average, more than 30 % make either right or left turn on all approaches at the junction. This contributes to the decrease in actual junction capacity.</li> <li>3. Right turn movement is made through filtering. If priority of through traffic is not observed, filtering is not only inefficient but also dangerous.</li> </ol>		
Improvements	<ol style="list-style-type: none"> <li>1. Introduction of one-way system along Phra Sing and Inthawarorot Road. Phra Sing will be one-way westbound from Phra Pokklao Road (or possibly from Moon Muang Road) to Samlan Road (Wat Phra Sing), and Inthawarorot Road will be one-way east bound from Singharat Road to Phra Pokklao Road.</li> </ol>		
Cost (thousand Baht)	Geometric improvement and pavement marking:	194	
	Signal installation/improvement:	49	
	Engineering services:	49	
	Total project cost:	292	thousand Baht



Treasury Pavilion

45  
วัดพระแก้ว

Phrapokkiao Rd


Wat Pan Tao

Ratchadammoen Rd

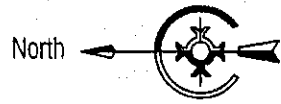
วัดพระเชตุพน

0 2 4 8 Meter

Existing Plan  
not to scale

		
THE STUDY ON IMPROVEMENT OF ROAD TRAFFIC ENVIRONMENT IN CHANG MAI CITY		
Information No. 17 Phrapokkiao Rd - Ratchadammoen Rd		
Designed by:	Drawn by: Suwath	Checked by:
Date: September 14 2001	Date: September 14 2001	Date:
File Name:	Drawing No.	

R-67



Treasury Pavilion

45  
Speed Limit

Phrapokklao Rd

Wat Pan Too

No Parking Odd Day

Ratchadamnoen Rd

Improvement Plan  
not to scale

0 2 4 8 Meter

JICA THE STUDY ON IMPROVEMENT OF ROAD TRAFFIC ENVIRONMENT IN CHIANG MAI CITY

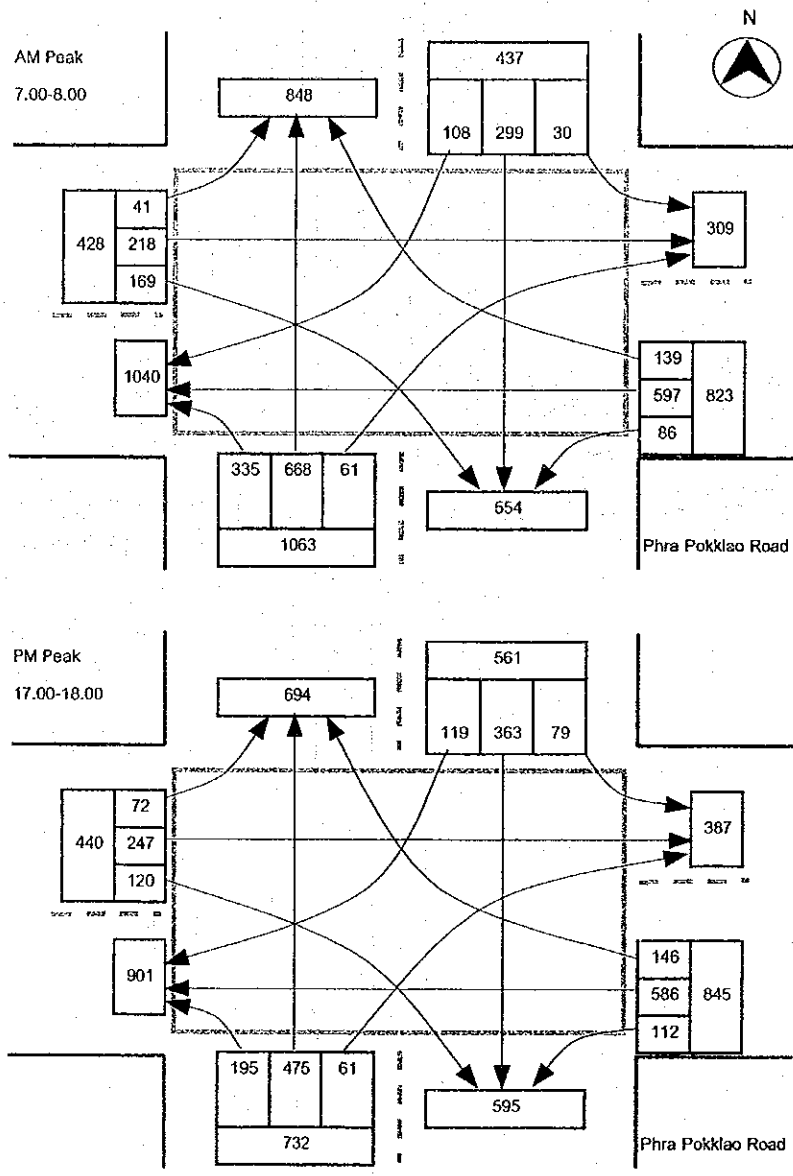
Intersection No. 17 Phrapokklao Rd - Ratchadamnoen Rd

Designed by:	Drawn by: Sumeth	Checked by:
Date: September 14 2001	Date: September 14 2001	Date:

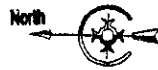
File Name:	Drawing No.
------------	-------------

Peak Flow in PCU      Junction No. J17      Intersecting Streets...Phra Sing Road - Phra Pokklao Road

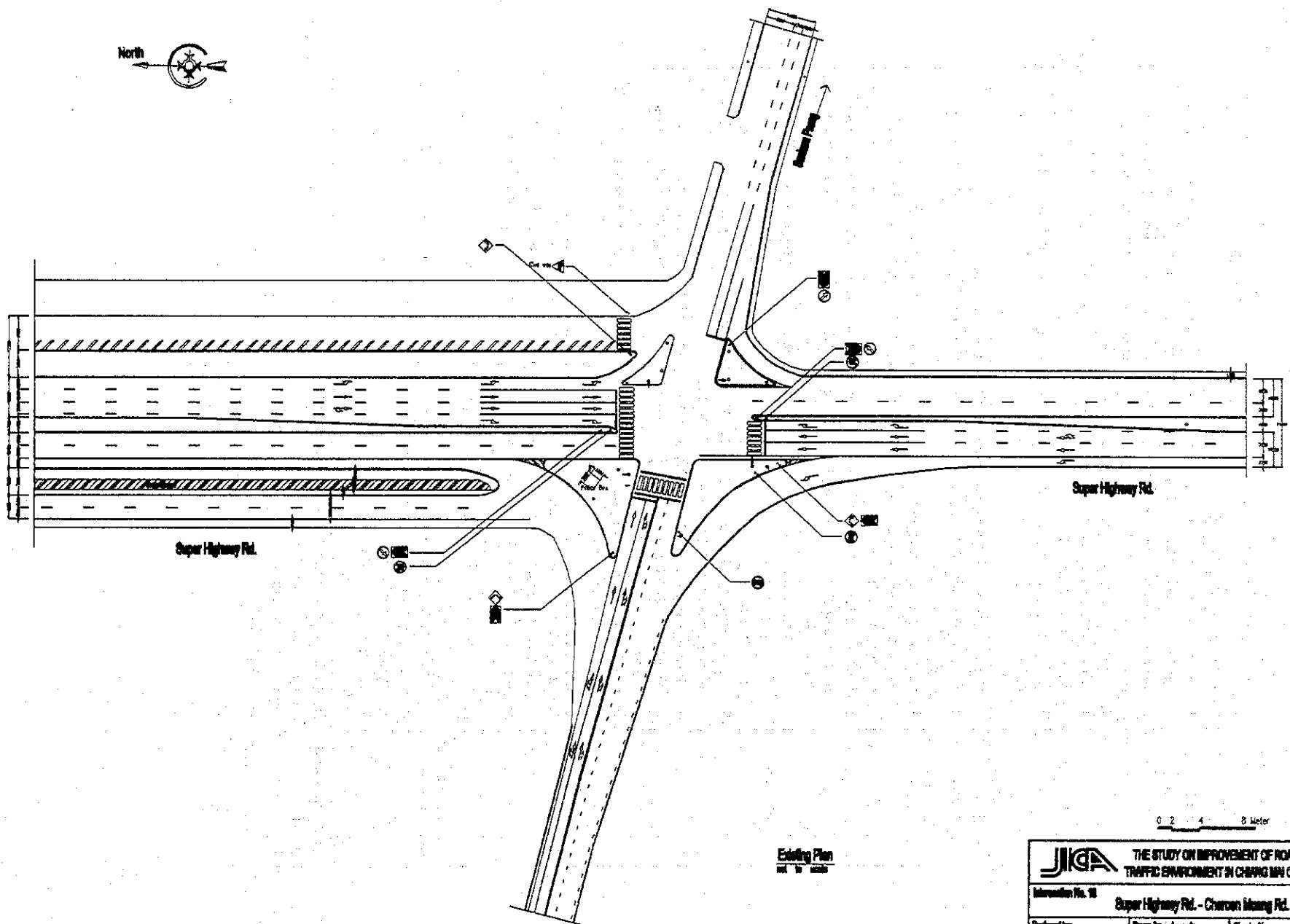
Peak Periods	from North approach				from East approach				from South approach				from West approach				Total inbound
	To South	To East	To West	Total From North	To West	To South	To North	Total From East	To North	To West	To East	Total From South	To East	To North	To South	Total From West	
AM: 7.00-8.00	299	30	108	437	597	86	139	823	668	335	61	1063	218	41	169	428	2751
PM: 17.00-18.00	363	79	119	561	586	112	146	845	475	195	61	732	247	72	120	440	2577



Code	J-18	Signalization	Signalized															
Name	Super Highway Road and Charoen Muang Road																	
Physical conditions	<ol style="list-style-type: none"> <li>1. Very large cross junction of Super Highway, 4-lane divided with service road, and a 4-lane undivided arterial. Key junction on the east side of the city.</li> <li>2. No service road is provided to Super Highway on the south side of junction. But right-of-way of the same width is secured. Junction is not fully developed.</li> <li>3. Right/U-turn lane is provided to Super Highway.</li> <li>4. All approaches have exclusive left turn with corner island.</li> <li>5. No Pedestrian signal.</li> <li>6. Pedestrian crossing markings are found on two approaches only but they are faded.</li> </ol>																	
Traffic conditions	<ol style="list-style-type: none"> <li>1. Heavy traffic with a total volume of 5000-8000 PCU/hour</li> <li>2. South approach carries highest volume of 2000-2500 PCU/hour throughout the day.</li> <li>3. High percentage of right turn from all approaches except south. Right turn occupies 35-40 % at east approach, 30-40 % at west approach and 10-18 % at north approach.</li> <li>4. Junction operates near or in excess of saturate condition. Queue develops along four approaches. Maximum queue length in meter observed is (+ indicates more than): <table style="margin-left: 40px; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left;">Approach</th> <th style="text-align: center;">North</th> <th style="text-align: center;">East</th> <th style="text-align: center;">South</th> <th style="text-align: center;">West</th> </tr> </thead> <tbody> <tr> <td>AM peak</td> <td style="text-align: center;">250+</td> <td style="text-align: center;">240</td> <td style="text-align: center;">300+</td> <td style="text-align: center;">220</td> </tr> <tr> <td>PM peak</td> <td style="text-align: center;">300</td> <td style="text-align: center;">230</td> <td style="text-align: center;">300+</td> <td style="text-align: center;">300+</td> </tr> </tbody> </table> </li> <li>5. Separate approach phase is adopted. Vehicles wait on the lane for opposing traffic at approach to take advantage of the phase.</li> <li>6. Merging lane for left turn traffic from west approach to Super Highway north bound is closed by cones. Vehicles have to take service road until next merging point.</li> <li>7. Due to the large size of junction and lack of pedestrian signal, pedestrians are not easy to cross approaches.</li> </ol>			Approach	North	East	South	West	AM peak	250+	240	300+	220	PM peak	300	230	300+	300+
Approach	North	East	South	West														
AM peak	250+	240	300+	220														
PM peak	300	230	300+	300+														
Analysis	<ol style="list-style-type: none"> <li>1. Agate to the central business district on the east side of Municipality, where vehicles from east, northeast and southeast concentrate. Thus the biggest junction in the study area in terms of traffic volume. 14-hour traffic volume is 81,500 PCU.</li> <li>2. Junction is already saturated creating queue on all approaches.</li> </ol>																	
Improvements	<ol style="list-style-type: none"> <li>1. Widening of Super Highway approach and reduction of corner islands to provide additional lane for through traffic along Super Highway.</li> <li>2. Application of pavement markings.</li> <li>3. Recalculation of signal timing.</li> </ol>																	
Cost (thousand Baht)	<table style="width: 100%; border-collapse: collapse;"> <tbody> <tr> <td style="width: 60%;">Geometric improvement and pavement marking:</td> <td style="width: 20%; text-align: right;">4,184</td> <td style="width: 20%;"></td> </tr> <tr> <td>Signal installation/improvement:</td> <td style="text-align: right;">714</td> <td></td> </tr> <tr> <td>Engineering services:</td> <td style="text-align: right;">980</td> <td></td> </tr> <tr> <td><b>Total project cost:</b></td> <td style="text-align: right;"><b>5,878</b></td> <td style="text-align: right;"><b>thousand Baht</b></td> </tr> </tbody> </table>			Geometric improvement and pavement marking:	4,184		Signal installation/improvement:	714		Engineering services:	980		<b>Total project cost:</b>	<b>5,878</b>	<b>thousand Baht</b>			
Geometric improvement and pavement marking:	4,184																	
Signal installation/improvement:	714																	
Engineering services:	980																	
<b>Total project cost:</b>	<b>5,878</b>	<b>thousand Baht</b>																




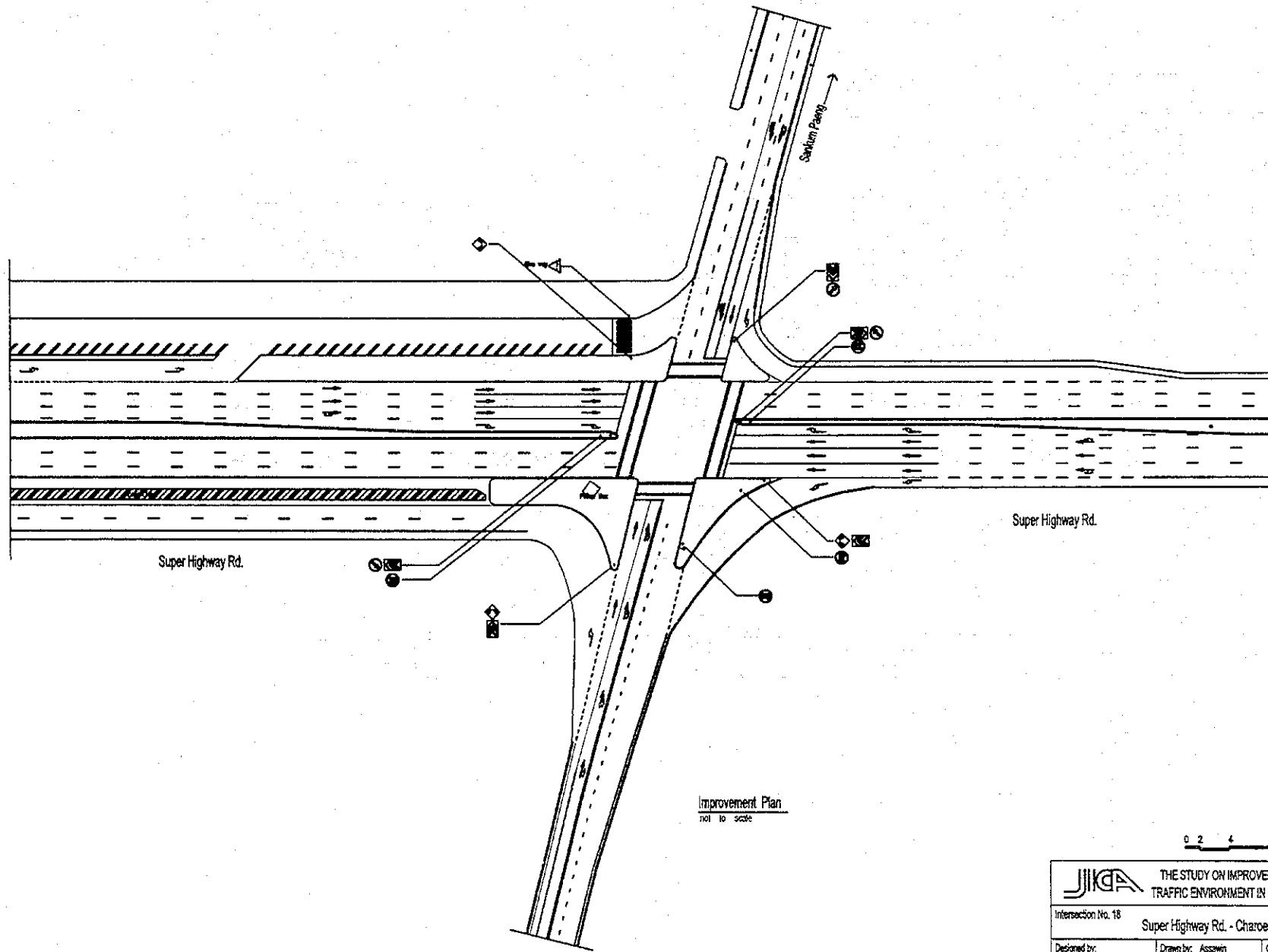
P-71



Existing Plan  
not to scale


0 2 4 8 Meter

 THE STUDY ON IMPROVEMENT OF ROAD TRAFFIC ENVIRONMENT IN CHANG MAI CITY		
Intervention No. 10 Super Highway Rd. - Charoon Meang Rd.		
Designed by:	Drawn by: Ananda	Checked by:
Date:	Date: September 15, 2007	Date:
File Name:	Drawing No.	



Improvement Plan  
Not to scale

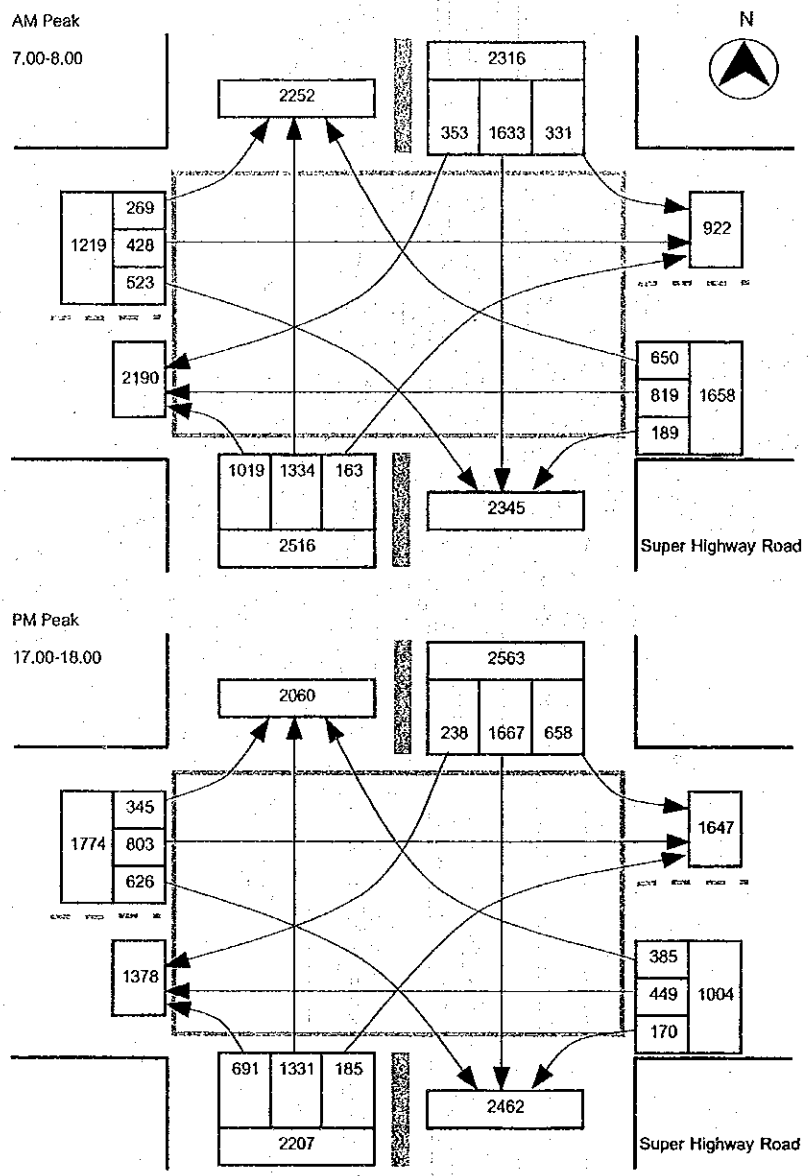
0 2 4 8 Meter

 THE STUDY ON IMPROVEMENT OF ROAD TRAFFIC ENVIRONMENT IN CHIANG MAI CITY		
Intersection No. 18		
Super Highway Rd. - Charoen Muang Rd.		
Designed by:	Drawn by: Assawin	Checked by:
Date:	Date: September 13 2001	Date:
File Name:	Drawing No.	

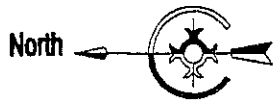


Peak Flow in PCU Junction No. J18 Intersecting Streets...Super Highway - Charoen Muang Road

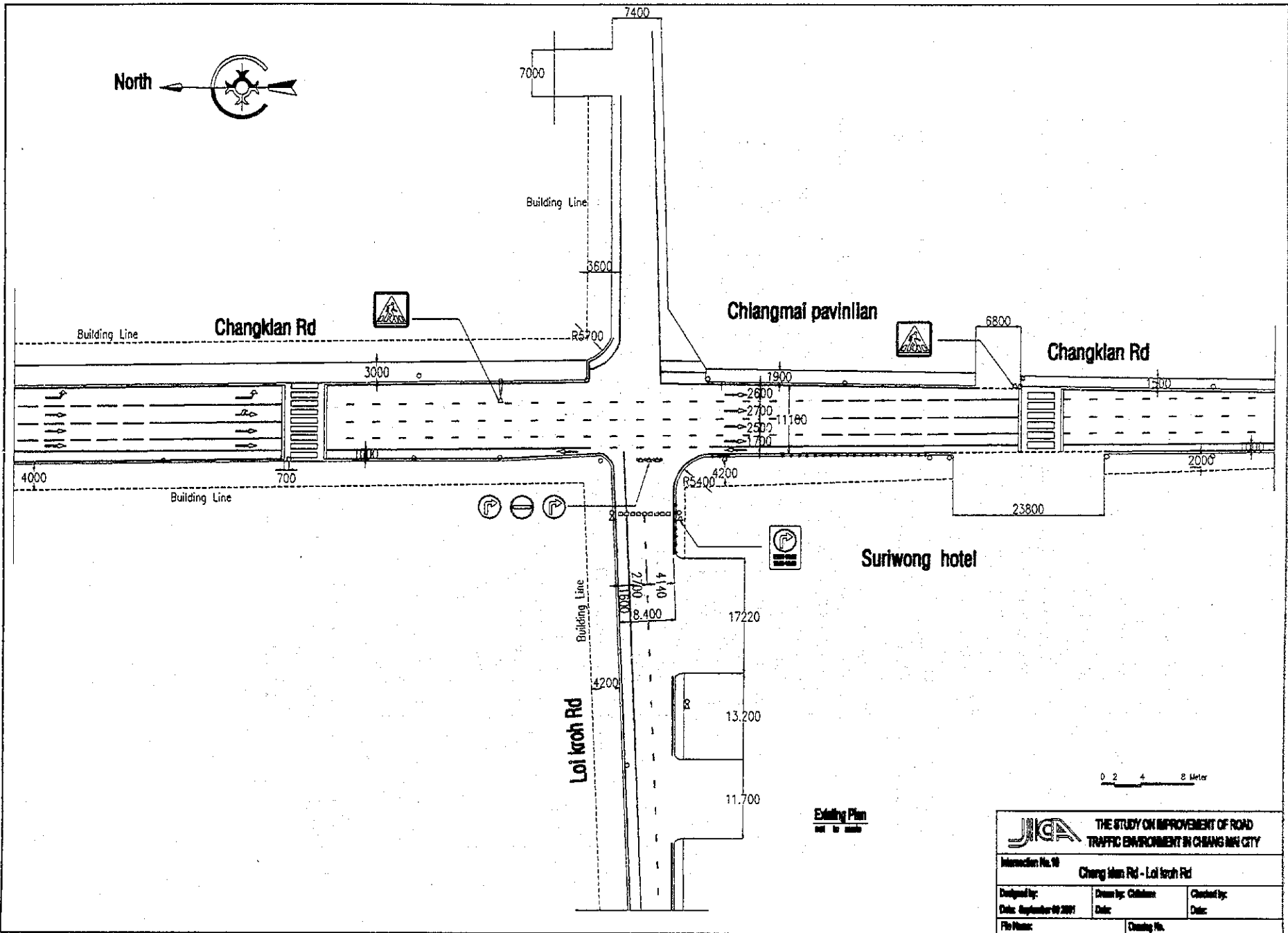
Peak Periods	from North approach				from East approach				from South approach				from West approach				Total inbound
	To South	To East	To West	From North	To West	To South	To North	From East	To North	To West	To East	From South	To East	To North	To South	From West	
	AM: 7.00-8.00	1633	331	353	2316	819	189	650	1658	1334	1019	163	2516	428	269	523	
PM: 17.00-18.00	1667	658	238	2563	449	170	385	1004	1331	691	185	2207	803	345	626	1774	7547



Code	J-19	Signalization	Not signalized
Name	Chang Khlan Road and Loi Kroh Road		
Physical conditions	<ol style="list-style-type: none"> <li>1. Crisscrossing junction of a main road with 4 lanes passing through Night Bazaar area and a minor road has two traffic lanes. Both roads are one-way but crossing Chang Klan from Loi Kroh is prohibited.</li> <li>2. Mountable curb is used on both sides of Chang Klan probably for stalls of street vendors.</li> <li>3. Pedestrian crossing and over head inner illuminated pedestrian crossing sign with street light and yellow flicker is provided to Chang Klan approach.</li> <li>4. Road markings such as pedestrian crossing, stopping line exist but are faded.</li> <li>5. Bicycle lane is provided to Loi Kroh in counter flow direction.</li> <li>6. Lightings are installed.</li> </ol>		
Traffic conditions	<ol style="list-style-type: none"> <li>1. Chang Klan, which has 14-hour volume of 16,000 PCU, penetrates tourism area in Chiang Mai, where many hotels, souvenir shops retail shops and restaurants are found.</li> <li>2. Effectively two (2) lanes for vehicles along Chang Klan.</li> <li>3. Traveling speed of vehicles along Chang Klan is relatively high making crossing the road difficult for pedestrians.</li> <li>4. Crossing Chang Klan from Loi Kroh is prohibited 6:00-9:00 and 15:00-18:00. But barrier with no crossing sign is placed at the junction all the time.</li> <li>5. Tuktuk, and songtaew wait inside and around junction for customers.</li> <li>6. Sidewalk along Chang Klan and roadside of Loi Kroh near the junction is occupied by street vendors during night bazaar time (18:00-23:00).</li> <li>7. Because of the above, sidewalk is difficult to walk and pedestrians spill over to carriageway.</li> <li>8. Many crossing pedestrians; about 270 persons cross north approach during peak hours (17:00-18:00).</li> <li>9. Bicycle lane is often occupied by parked or waiting vehicles.</li> <li>10. Policemen stand by at the junction, but, mostly do not control traffic.</li> </ol>		
Analysis	<ol style="list-style-type: none"> <li>1. Arterial street penetrate tourist area where many pedestrians are found.</li> <li>2. Moving vehicles, parked vehicles and pedestrians are mixed around the junction.</li> <li>3. Segregation of through traffic, loading/unloading, and waiting vehicles from pedestrians is necessary.</li> <li>4. Control of street vendors is said to be beyond the control of Municipality or Provincial Government.</li> </ol>		
Improvements	<ol style="list-style-type: none"> <li>1. Application of pavement marking.</li> <li>2. Installation of pedestrian crossing signal and removal of the existing pedestrian crossing and warning sign near to the intersection.</li> </ol>		
Cost (thousand Baht)	Geometric improvement and pavement marking: 177 Signal installation/improvement: 1,975 Engineering services: 430 Total project cost: 2,582 thousand Baht		



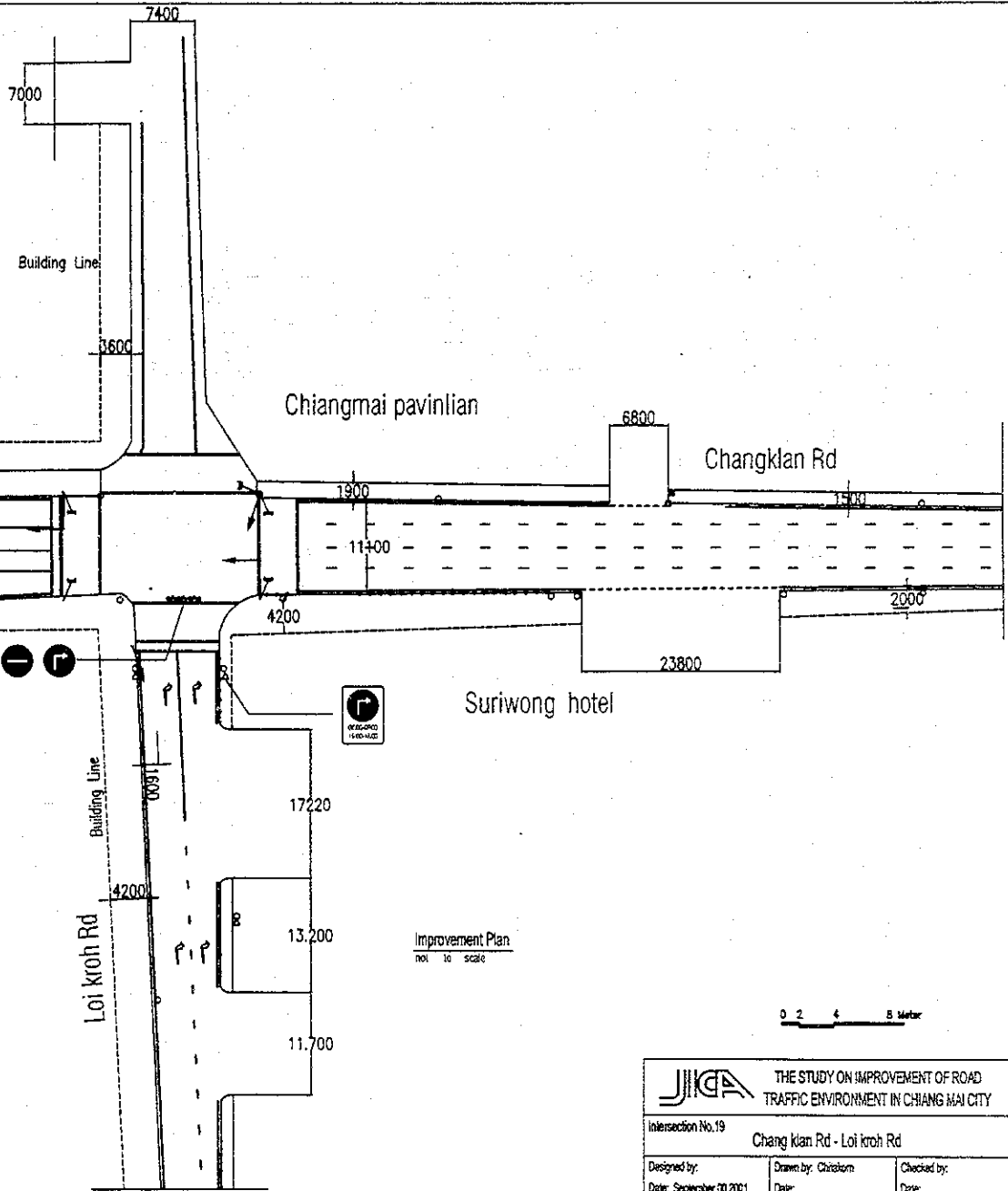
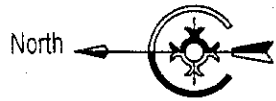
F-75



0 2 4 8 Meter


Existing Plan  
---

<b>JICA</b>		
THE STUDY ON IMPROVEMENT OF ROAD TRAFFIC ENVIRONMENT IN CHIANG MAI CITY		
Intersection No. 10 Changkian Rd - Loi Kroh Rd		
Designed by:	Drawn by: Chaitan	Checked by:
Date: September 09 2007	Date:	Date:
File Name:	Drawing No.	



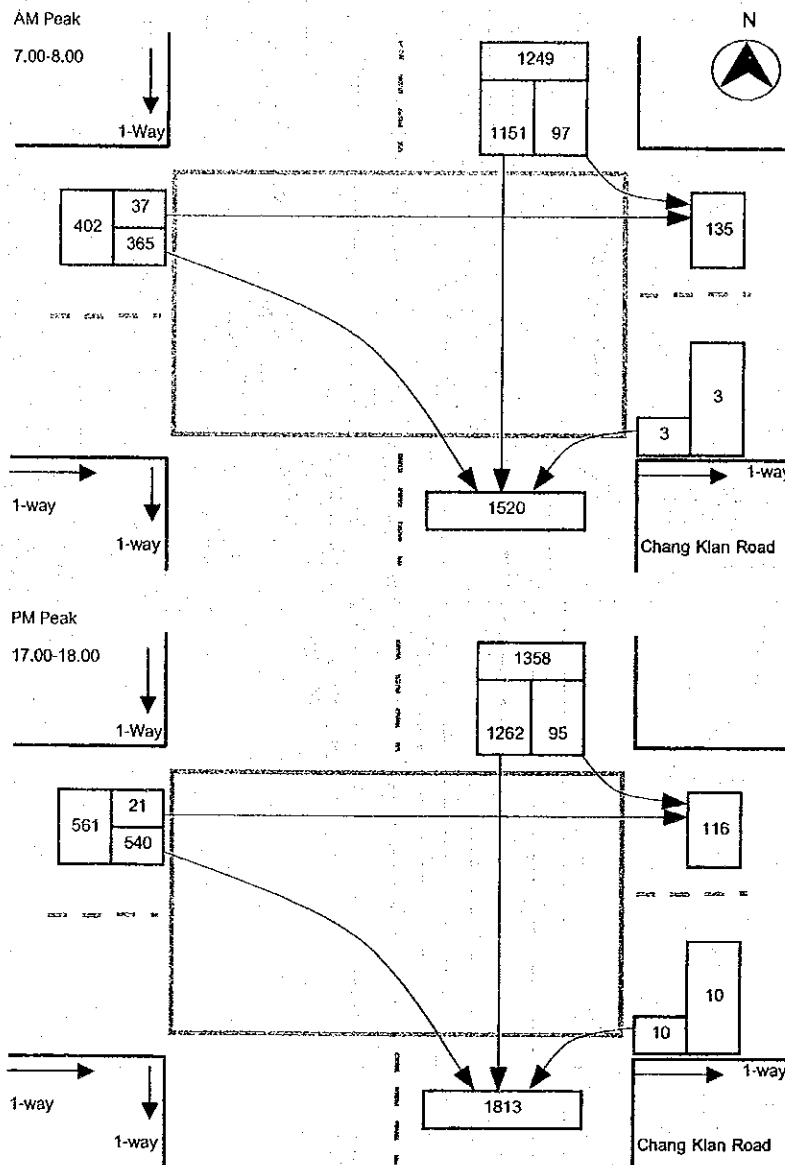
F-76

0 2 4 8 Meter

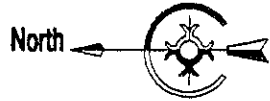
 THE STUDY ON IMPROVEMENT OF ROAD TRAFFIC ENVIRONMENT IN CHIANG MAI CITY		
Intersection No.19 Chang Klan Rd - Loi kroh Rd		
Designed by: Date: September 30 2001	Drawn by: Christom Date:	Checked by: Date:
File Name:		Drawing No.

Peak Flow in PCU Junction No. J19 Intersecting Streets.....Chang Klan Road - Loi Kroh Road

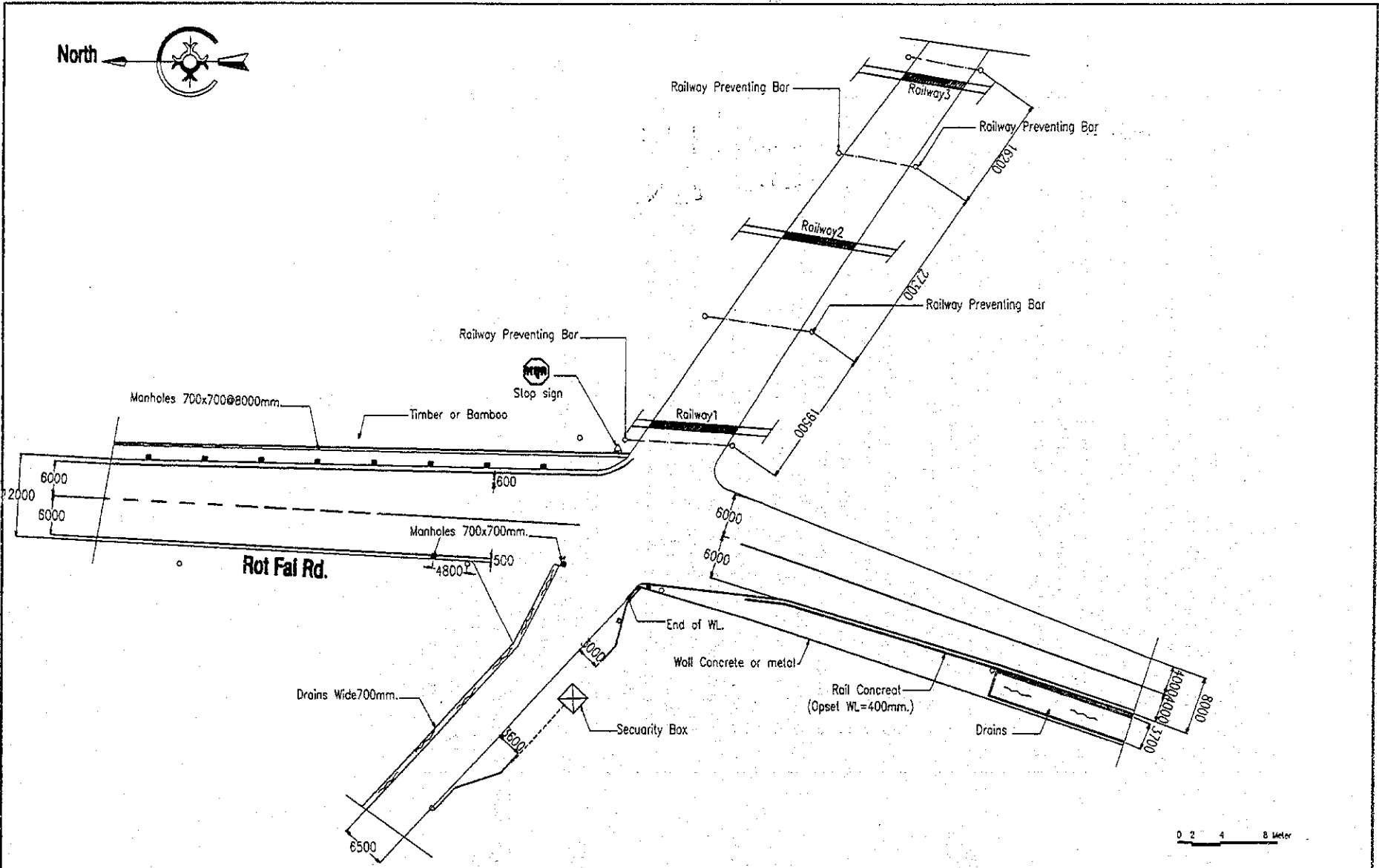
Peak Periods	from North approach				from East approach				from South approach				from West approach				Total inbound
	To South	To East	To West	Total From North	To West	To South	To North	Total From East	To North	To West	To East	Total From South	To East	To North	To South	Total From West	
AM: 7.00-8.00	1151	97	-	1249	-	3	-	3	-	-	-	-	37	-	365	402	1655
PM: 17.00-18.00	1262	95	-	1358	-	10	-	10	-	-	-	-	21	-	540	561	1829



Code	J-20	Signalization	Not signalized
Name	Rot Fai Road and Sa Na Lung Road		
Physical conditions	<ol style="list-style-type: none"> <li>1. X type junction, where a collector road (Sa Na Lung Road) diagonally crosses another collector road (Roi Fat Road) and railroad.</li> <li>2. Roi Fat Road is 12 meter wide while width of Sa Na Lung Road is only 6.5 meter. No sidewalk is provided to all approaches.</li> <li>3. Northwest corner is cut to make left turn from Sa Na Lung easier. Covered ditch extends into junction..</li> <li>4. Junction is located very close to railroad crossing. East approach is only few meters long and downhill from railroad toward junction.</li> <li>5. Good pavement on three approaches but pavement at railroad crossing is deteriorated.</li> </ol>		
Traffic conditions	<ol style="list-style-type: none"> <li>1. Traffic volume is small. 14-hour traffic count is 15,000 PCU for total approach traffic. Roi Fat Road carries slightly more volume than Sa Na Lung Road.</li> <li>2. In spite of small traffic, queue of up to 100 meter develops when railroad crossing is closed for a long time.</li> <li>3. Chaotic situation occurs when railroad crossing opens after the long closure and waiting vehicles and motorcycles are discharged at one time.</li> <li>4. Because two roads are diagonally intersected, right turn from south approach, ratio of which is 20-28 %, is required to make a sharp turn.</li> <li>5. A Gate to the base is located close to the junction. Vehicles in and out of the gate go directly to the get cutting diagonally the junction.</li> </ol>		
Analysis	<ol style="list-style-type: none"> <li>1. Although frequency is not often, closure of railroad crossing disrupts the smooth operation of the junction and creates chaotic condition.</li> <li>2. The situation is compounded by the short and downhill east approach, diagonal crossing of two roads and high right turn ratio from the south approach.</li> <li>3. Good visibility on the east side of Rot Fai Road because of railway may cause speeding.</li> </ol>		
Improvements	<ol style="list-style-type: none"> <li>1. Application of pavement markings.</li> <li>2. Improvement of pavement and possibly widening of railroad crossing by State Railway of Thailand.</li> </ol>		
Cost (thousand Baht)	Geometric improvement and pavement marking:		123
	Signal installation/improvement:		
	Engineering services:		25
	Total project cost:		148 thousand Baht



F-79



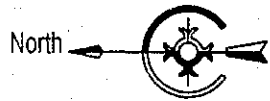
0 2 4 8 Meter

Sun na ung Rd.

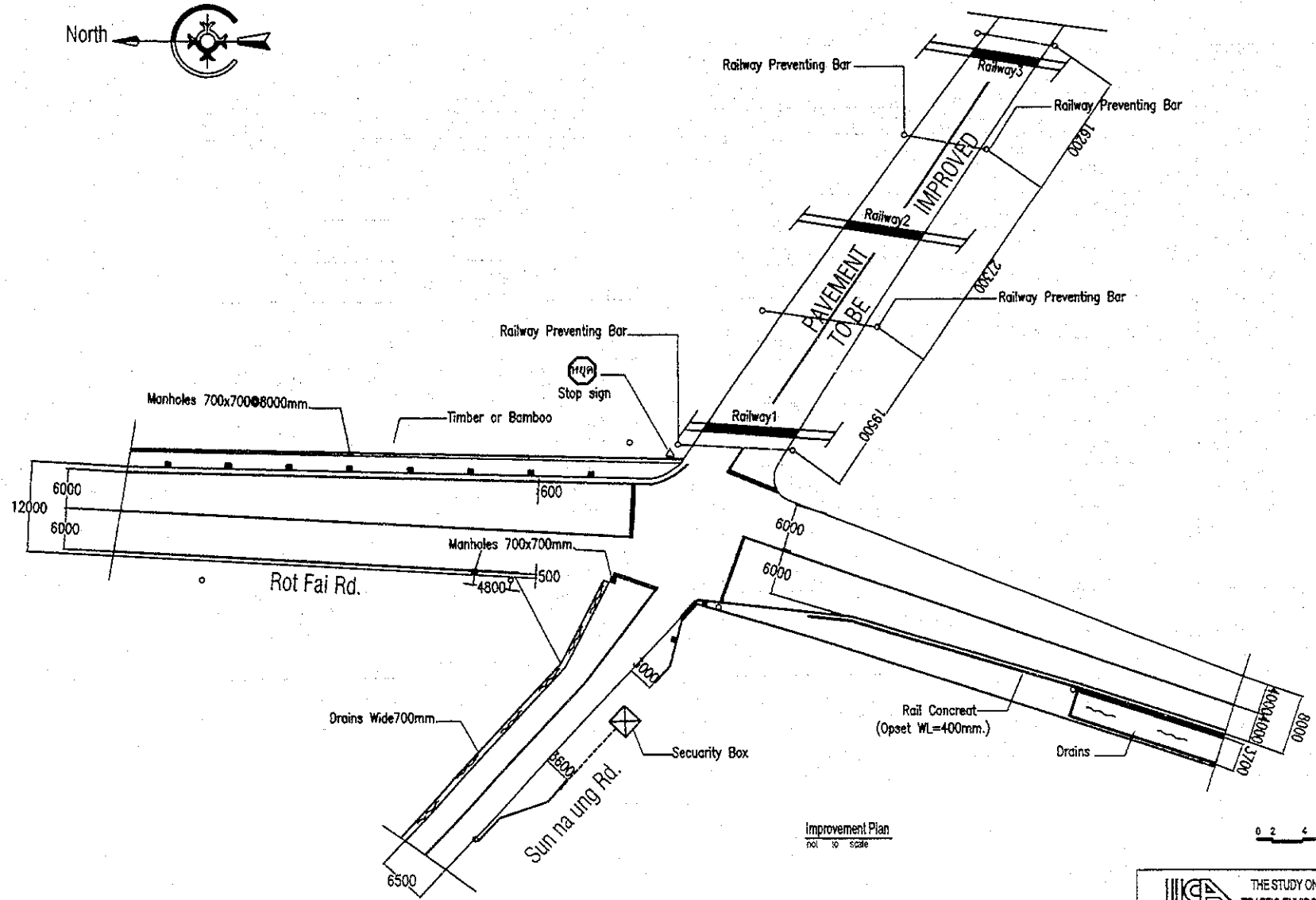
Rot Fai Rd.

Existing Plan  
not to scale

THE STUDY ON IMPROVEMENT OF ROAD TRAFFIC ENVIRONMENT IN CHANG MAI CITY		
Intersection No.22 Sun na ung Rd - Rot fai Rd		
Designed by: Date:	Drawn by: Jitaporn Date: September 17 2001	Checked by: Date:
File Name:	Drawing No.	



P-80



Improvement Plan  
not to scale



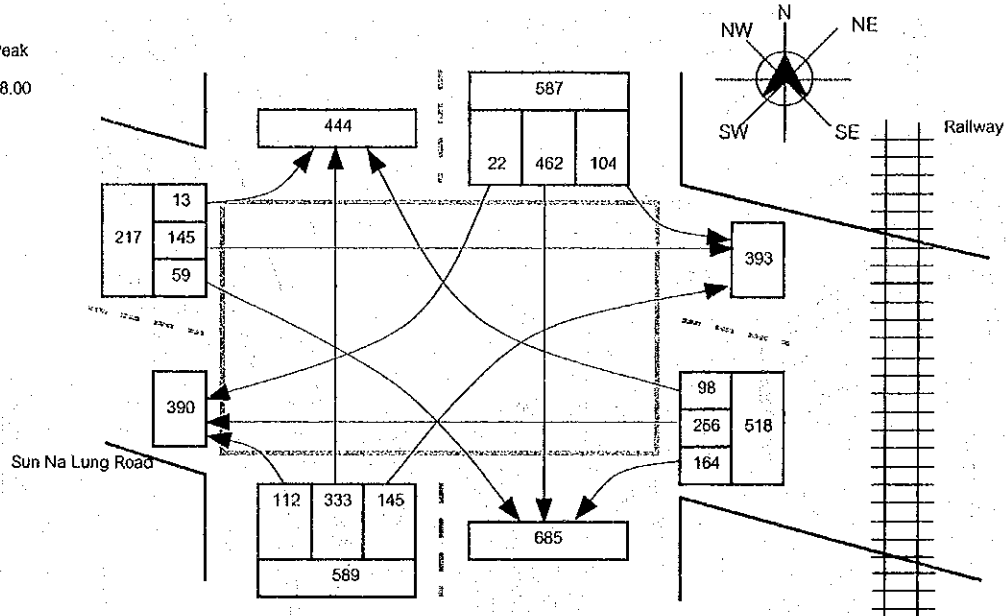
THE STUDY ON IMPROVEMENT OF ROAD TRAFFIC ENVIRONMENT IN CHIANG MAI CITY	
Intersection: No.20 Sun na lung Rd - Rot fai Rd	
Designed by:	Drawn by: Jituporn
Date:	Date: September 17 2001
File Name:	Checked by: Date: Drawing No.



Peak Flow in PCU Junction No. J20 Intersecting Streets.....Rot Fal Road - San Na Lung Road

Peak Periods	from North approach				from Southeast approach				from South approach				from Northwest approach				Total Inbound
	To South	To SE	To NW	Total From North	To NW	To South	To North	Total From SE	To North	To NW	To SE	Total From South	To SE	To North	To South	Total From NW	
	AM: 7.00-8.00	462	104	22	587	256	164	98	518	333	112	145	589	145	13	59	
PM: 17.00-18.00	327	138	11	475	102	100	86	288	250	60	112	422	253	33	73	359	1544

AM Peak  
7.00-8.00



PM Peak  
17.00-18.00

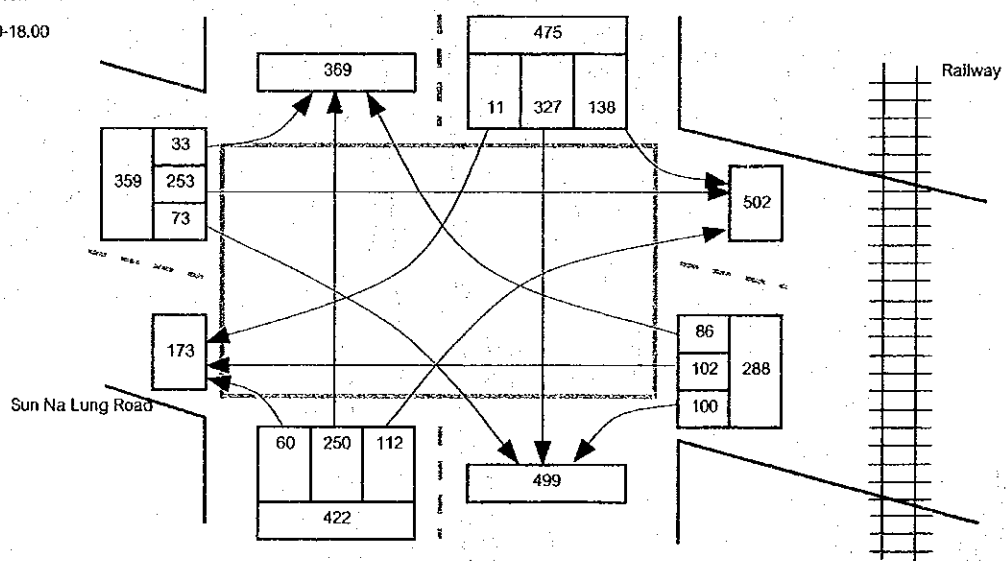


Table F-1 Breakdown of Project Cost

Intersection	J01	J02	J03	J04	J05	J06	J07	J08	J09	J10
	Baht		Baht	Baht	Baht	Baht	Baht	Baht	Baht	Baht
	x1000		x1000	x1000	x1000	x1000	x1000	x1000	x1000	x1000
<b>1. Geometric Improvement</b>										
Earthwork	63,896					2,514				
Pavement	510,608					7,431				
Median, sidewalk and island	491,635					77,283				
Pavment markings	390,265		149,153	139,647	231,816	206,335	280,496	272,745	83,168	221,416
Traffic safety device	0		0	22,033	0	9,681	0	18,695	0	0
Relocation	13,576					0				
Sub-total	1,469,980		149,153	161,680	231,816	303,244	280,496	291,440	83,168	221,416
<b>2. Signal and Flasher</b>										
Signal controller/flasher	36,400		241,800		518,700	478,400	518,700	518,700		518,700
Detector	0		0		174,200	133,900	309,400	525,200		174,200
Lantern and pole	748,800		650,000		782,600	504,400	1,020,500	1,268,800		1,132,300
Wiring	228,800		332,800		378,300	240,500	388,700	657,800		399,100
Test & adjustment	0		0		140,400	140,400	140,400	140,400		140,400
Timing parameter	49,400		0		42,900	49,400	49,400	49,400		42,900
Sub-total	1,063,400		1,224,600	0	2,037,100	1,547,000	2,427,100	3,160,300	0	2,407,600
<b>3. Engineering services</b>										
	506,676		274,751	32,336	453,783	370,049	541,519	690,348	16,634	525,803
<b>Total Project Cost</b>	<b>3,040,056</b>		<b>1,648,504</b>	<b>194,016</b>	<b>2,722,699</b>	<b>2,220,293</b>	<b>3,249,115</b>	<b>4,142,088</b>	<b>99,802</b>	<b>3,154,819</b>

Source: This Study

**Table F-1 Breakdown of Project Cost Continued**

Intersection	J11	J12	J13	J14	J15	J16	J17	J18	J19	J20
	Baht	Baht	Baht	Baht	Baht	Baht	Baht	Baht	Baht	Baht
	x1000	x1000	x1000	x1000	x1000	x1000	x1000	x1000	x1000	x1000
<b>1. Geometric Improvement</b>										
Earthwork		8,475		2,275	9,559	794		343,874		
Pavement		92,478		0	0	0		3,271,709		
Median, sidewalk and island		229,107		70,426	93,902	383,582		105,159		
Pavment markings	230,647	266,395	333,190	189,983	202,794	190,413	194,045	454,770	176,670	123,360
Traffic safety device		3,227	0	0	3,227	0	0	0	0	0
Relocation		0		0	0	0		8,902		
Sub-total	230,647	599,682	333,190	262,684	309,482	574,789	194,045	4,184,414	176,670	123,360
<b>2. Signal and Flasher</b>										
Signal controller/flasher	518,700	0	20,800	14,300	14,300	20,800	0	0	418,600	
Detector	174,200	0	0	0	0	0	0	0	122,200	
Lantern and pole	1,232,400	102,700	664,300	765,700	683,800	765,700	0	0	828,100	
Wiring	501,800	0	79,300	26,000	27,300	52,000	0	0	295,100	
Test & adjustment	140,400	0	0	0	0	0	0	0	140,400	
Timing parameter	49,400	49,400	49,400	49,400	49,400	49,400	49,400	49,400	0	
Sub-total	2,616,900	152,100	813,800	855,400	774,800	887,900	49,400	49,400	1,804,400	0
<b>3. Engineering services</b>										
	569,509	150,356	229,398	223,617	216,856	292,538	48,689	846,763	396,214	24,672
<b>Total Project Cost</b>	<b>3,417,056</b>	<b>902,138</b>	<b>1,376,388</b>	<b>1,341,701</b>	<b>1,301,138</b>	<b>1,755,227</b>	<b>292,134</b>	<b>5,080,577</b>	<b>2,377,284</b>	<b>148,032</b>

Source: This Study