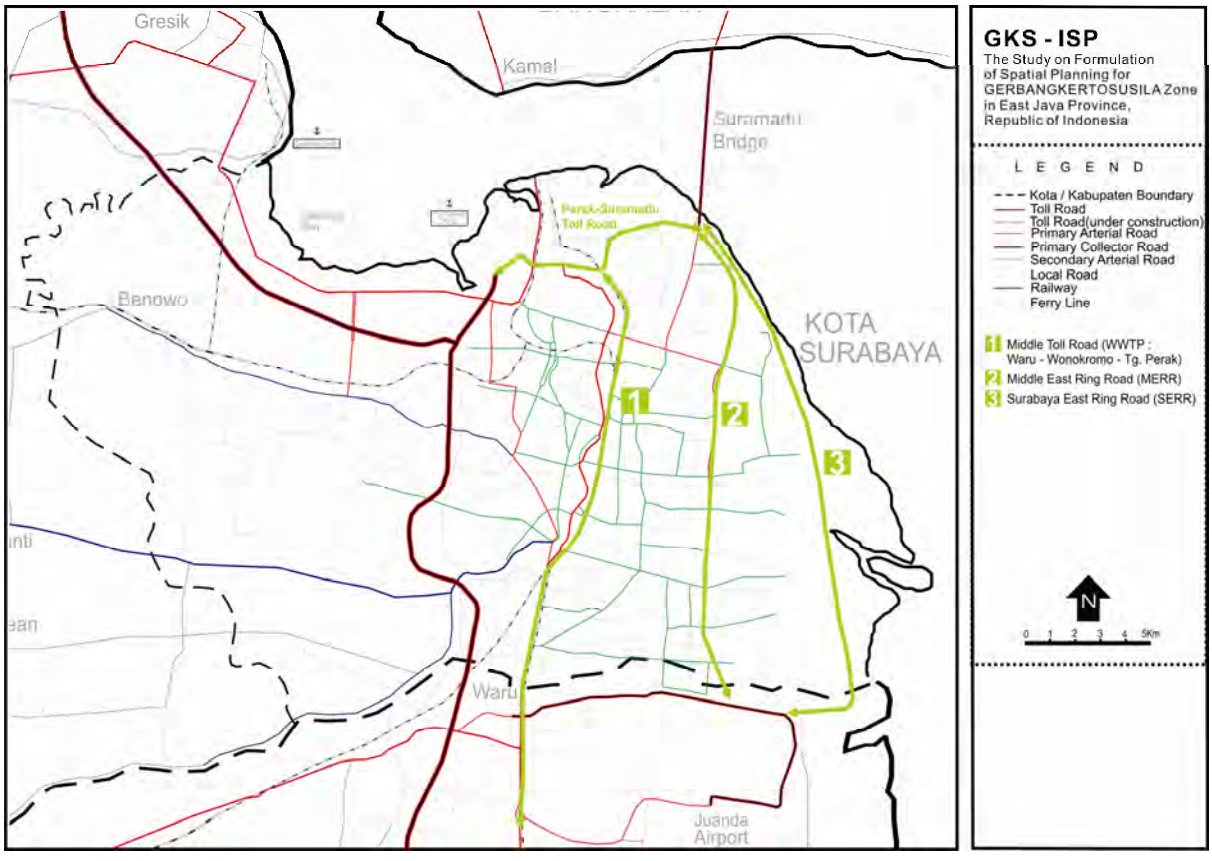
8.2 Comparison of Planned Toll Roads in Surabaya

In the expressway-intensive case, comparative assessments were further conducted on corridors with toll developments due to future traffic demands, especially the three parallel north-south toll roads (Figure 8.2.1), which will connect the envisioned Perak–Suramadu toll road. Three alternatives were assessed:

- Alternative 1: MERR toll road (corridor 8a);
- Alternative 2: Surabaya East Ring toll Road (SERR) (corridor 8b), which is located on Outer East Ring Road (OERR); and
- Alternative 3: Waru – Wonokoromo – Tg. Perak (WWTP) toll road (corridor 5c).

Costs and future demands were analyzed to calculate the B/C ratio as well as the financial internal rate of return (FIRR) of each toll road for each case in which only one, or combination of the above toll roads, would be constructed. The results, which was also based on the distance-proportional toll tariff of Rp.1,000/km, is presented in Table 8.2.1. Even though considerable traffic volume was expected in each case, as shown in Table 8.2.2, the WWTP toll road and the MERR toll road were not viable due to the high construction costs of their elevated structures. From a viability point of view, the Study Team recommends the SERR toll road as the most viable alternative with a B/C ratio of over 1.0 and a decent FIRR.



Source: JICA Study Team

Figure 8.2.1 Planned Alternative Toll Roads in Surabaya

Table 8.2.1 Project Viability of Planned Toll Roads (Year 2030)

Case	Alt. No.	Toll Road	Cost (bil. Rp.)	FIRR (&B/C Ratio) of Toll Road			Remark
				WWTP	SERR	MERR	
A	**3**	**SERR Toll Road**	**1,386**	-	**11.0% (1.51)**	-	**At grade**
B	2	MERR Toll Road	4,551	-	-	n/a (0.42)	Elevated
C	1	WWTP Toll Road	5,177 (or more)	2.0% (0.68)	-	-	Elevated
D	1+3	SERR+WWTP	6,563	-0.6% (0.52)	5.2% (0.90)	-	Combination of two toll roads
E	1+2	MERR+WWTP	9,728	-0.7% (0.51)	-	n/a (0.25)	Combination of two toll roads
F	1+2+3	SERR+MERR+WWTP	11,114	-0.8% (0.51)	n/a (0.33)	n/a (0.21)	Combination of three toll roads

Source: JICA Study Team
Notes: Based on toll tariff of Rp.1,000 / km
WWTP: Waru – Wonokoromo – Tg. Perak
MERR: Middle East Ring Road
SERR: Surabaya East Ring toll Road

On the other hand, traffic demand on the major north-south roads was forecasted from the analysis of the effects of the traffic volume reduction due to the toll road(s). Demand forecasts on corridors 5c, 8b, and 8a, for the years 2015, 2020, and 2030 are presented in Table 8.2.2. In cases that has the WWTP constructed (i.e. cases C, D, E, F), considerable traffic volume reduction, or alleviation of traffic congestion, are expected to happen compared with the "do-nothing" case (i.e. case G) where none of the above three toll roads would be constructed. In quantitative figures, the WWTP would reduce around 32,000 pcu/day (from 249,000 to 217,000 pcu/day) on the major non-toll arterial roads by 2030. Among others, a reduction of around 25,000 pcu/day (from 136,000 to 111,000 pcu/day) is expected on Jl. A. Yani, which runs parallel to the WWTP. On the other hand, a relatively small traffic volume reduction (i.e. 6,000 pcu/day) is expected on MERR, which means that the MERR toll road will not benefit from a traffic volume reduction scheme. For this reason, it was dropped from the alternatives.

Table 8.2.2 Demand Forecast of Existing and Planned Toll Roads

Year 2030		Traffic Volume (PCU/day)							Total (PCU/day)		Total
Case	Toll Road Combination	Toll Sur-Gem	A Yani (5c)	WWTP	MERR (8b)	Toll MERR	OERR (8a)	SERR	Toll Road	Arterial Road	(PCU/day)
A	SERR	174,377	130,190	-	51,987	-	56,009	48,594	222,971	238,186	461,157
B	MERR	173,094	126,312	-	49,772	54,061	55,592	-	227,155	231,676	458,831
C	WWTP	161,265	111,338	58,133	50,444	-	55,621	-	219,398	217,403	436,801
D	SERR, WWTP	160,141	110,759	45,063	50,091	-	54,063	29,153	234,356	214,913	449,269
E	MERR, WWTP	159,237	110,246	44,263	50,680	32,026	53,620	-	235,526	214,546	450,072
F	SERR, MERR, WWTP	159,283	110,333	43,976	49,551	27,053	53,345	10,617	240,929	213,229	454,158
G	None of the above	200,375	136,170	-	55,501	-	57,564	-	200,375	249,235	449,610

Year 2020		Traffic Volume (PCU/day)							Total (PCU/day)		Total
Case	Toll Road Combination	Toll Sur-Gem	A Yani (5c)	WWTP	MERR (8b)	Toll MERR	OERR (8a)	SERR	Toll Road	Arterial Road	(PCU/day)
A	SERR	142,063	91,986	-	44,729	-	54,212	7,690	149,753	190,927	340,680
B	MERR	142,109	92,095	-	43,838	8,028	53,891	-	150,137	189,824	339,961
C	WWTP	136,360	90,596	11,928	44,416	-	50,757	-	148,288	185,769	334,057
D	SERR, WWTP	133,088	90,153	10,802	43,871	-	52,046	6,665	150,555	186,070	336,625
E	MERR, WWTP	133,638	90,319	10,686	42,930	6,574	51,762	-	150,898	185,011	335,909
F	SERR, MERR, WWTP	133,281	90,287	10,597	42,600	5,038	51,548	3,817	152,733	184,435	337,168
G	None of the above	146,863	92,515	-	44,156	-	53,595	-	146,863	190,266	337,129

Year 2015		Traffic Volume (PCU/day)							Total (PCU/day)		Total
Case	Toll Road Combination	Toll Sur-Gem	A Yani (5c)	WWTP	MERR (8b)	Toll MERR	OERR (8a)	SERR	Toll Road	Arterial Road	(PCU/day)
A	SERR	100,950	90,766	-	38,657	-	50,228	2,746	103,696	179,651	283,347
B	MERR	100,602	90,727	-	44,172	2,808	49,751	-	103,410	184,650	288,060
C	WWTP	97,931	89,057	5,127	38,528	-	49,115	-	103,058	176,700	279,758
D	SERR, WWTP	97,362	88,957	4,854	38,500	-	49,815	2,247	104,463	177,272	281,735
E	MERR, WWTP	97,308	89,049	4,768	43,509	2,125	49,399	-	104,202	181,957	286,159
F	SERR, MERR, WWTP	97,239	89,050	4,761	43,439	1,860	49,633	1,319	105,178	182,122	287,300
G	None of the above	102,214	90,853	-	38,528	-	49,418	-	102,214	178,799	281,013

Source: JICA Study Team
Note: Shaded cells indicate non-toll roads.

Table 8.2.3 Revised Traffic Demands with Toll Road Diversion Schemes

2030	A. Yani (5c)				MERR (8b)				OERR (8a)				WWTP			SERR		
Case	Capacity	V/C	Cap Volume	Potential Traffic for WWTP	Capacity	V/C	Cap Volume	Potential Traffic for WWTP	Capacity	V/C	Cap Volume	Potential Traffic for SERR	Original Volume	Additional Potential Volume	Total Volume	Original Volume	Additional Potential Volume	Total Volume
A		0.8	80,800	-		0.8	44,800	-		0.8	44,800	11,209	-	-	-	48,594	11,209	59,803
B		0.8	80,800	-		0.8	-	-		0.8	44,800	10,792	-	-	-	-	-	-
C		0.8	80,800	30,538		0.8	44,800	5,644		0.8	44,800	10,821	58,133	36,182	94,315	-	-	-
D	101,000	0.8	80,800	29,959	56,000	0.8	-	-	56,000	0.8	44,800	9,263	45,063	29,959	75,022	29,153	9,263	38,416
E		0.8	80,800	29,446		0.8	44,800	5,880		0.8	44,800	8,820	44,263	35,326	79,589	-	-	-
F		0.8	80,800	29,533		0.8	-	-		0.8	44,800	8,545	43,976	29,533	73,509	10,617	8,545	19,162
G		1.62	136,170	-		0.99	55,501	-		1.03	57,564	-	-	-	-	-	-	-

2020	A. Yani (5c)				MERR (8b)				OERR (8a)				WWTP			SERR		
Case	Capacity	V/C	Cap Volume	Potential Traffic for WWTP	Capacity	V/C	Cap Volume	Potential Traffic for WWTP	Capacity	V/C	Cap Volume	Potential Traffic for SERR	Original Volume	Additional Potential Volume	Total Volume	Original Volume	Additional Potential Volume	Total Volume
A		0.8	80,800	-		0.8	0	-		0.8	44,800	9,412	-	-	-	7,690	9,412	17,102
B		0.8	80,800	-		0.8	0	-		0.8	44,800	9,091	-	-	-	-	-	-
C		0.8	80,800	27,681		0.8	0	0		0.8	44,800	5,957	11,928	27,681	39,609	-	-	-
D	101,000	0.8	80,800	27,401	56,000	0.8	0	-	56,000	0.8	44,800	7,246	10,802	27,401	38,203	6,665	7,246	13,911
E		0.8	80,800	27,167		0.8	0	0		0.8	44,800	6,962	10,686	27,167	37,853	-	-	-
F		0.8	80,800	26,832		0.8	0	-		0.8	44,800	6,748	10,597	26,832	37,429	3,817	6,748	10,565
G		1.1	92,515	-		0.79	44,156	-		0.96	53,595	-	-	-	-	-	-	-

2015	A. Yani (5c)				MERR (8b)				OERR (8a)				WWTP			SERR		
Case	Capacity	V/C	Cap Volume	Potential Traffic for WWTP	Capacity	V/C	Cap Volume	Potential Traffic for WWTP	Capacity	V/C	Cap Volume	Potential Traffic for SERR	Original Volume	Additional Potential Volume	Total Volume	Original Volume	Additional Potential Volume	Total Volume
A		0.8	80,800	-		0.8	0	-		0.8	44,800	5,428	-	-	-	2,746	5,428	8,174
B		0.8	80,800	-		0.8	0	-		0.8	44,800	4,951	-	-	-	-	-	-
C		0.8	80,800	17,699		0.8	0	0		0.8	44,800	4,315	5,127	17,699	22,825	-	-	-
D	101,000	0.8	80,800	18,026	56,000	0.8	0	-	56,000	0.8	44,800	5,015	4,854	18,026	22,880	2,247	5,015	7,262
E		0.8	80,800	17,616		0.8	0	0		0.8	44,800	4,599	4,768	17,616	22,385	-	-	-
F		0.8	80,800	17,844		0.8	0	-		0.8	44,800	4,833	4,761	17,844	22,605	1,319	4,833	6,152
G		1.08	90,853	-		0.69	38,528	-		0.88	49,418	-	-	-	-	-	-	-

Source: JICA Study Team
Notes: Assumption the V/C ratio is maximum 0.8
Capacity of Frontage Roads on Jl. A. Yani = 17,000 PCU/day

Furthermore, demand forecast was revised again taking into account traffic diversions from the parallel non-toll arterial roads (i.e., Jl, A. Yani, MERR, OERR) to the remaining two alternative toll roads, i.e., the SERR and the WWTP. A 0.8 volume-capacity (V/C) ratio was applied to assume the "cap volume" on these non-toll arterial roads. In an equilibrium situation, these non-toll roads were nearly saturated, and the exceeding traffic were assumed to be diverted to the toll roads (i.e., from Jl. A. Yani and MERR to the WWTP, and from OERR to the SERR) which were considered as potential traffic to be added to the volume on the toll roads. While MERR will not be saturated up to 2020, some traffic diversion is expected and it is assumed as potential traffic to be added to the WWTP. The traffic volumes on the WWTP and the SERR were forecasted to be around 75,000 and 38,000 pcu/day, respectively, for 2030 (in Case D). Thus, construction of the WWTP could be supported from the traffic diversion point of view. In conclusion, both the SERR and the WWTP toll roads are included in the transportation action plan.

Nevertheless, it should be noted that high traffic volumes (23,000 pcu/day in Case D) is already expected on the WWTP even for 2015 (i.e., short term), as shown in Table 8.2.3, and that the development of the WWTP is classified as short term. This means that the alleviation of the current traffic congestion on Jl. A. Yani should urgently be solved. If construction of the WWTP is not implemented soon, the Study Team recommends the construction of continuous flyovers on Jl. A. Yani to help to increase traffic capacity and alleviate congestion by securing through traffic on the main road, as will be seen later.

8.3 Road Network Hierarchies

Taking the above road development corridors and assessments into account, the principal policy measures for road network development are described below, while the proposed future road functions are presented in Figure 8.3.1 (for GKS) and Figure 8.3.2 (for Surabaya):

- Formulation of road network through proper classes of roads so that the whole network will function efficiently and effectively. This includes completing the missing links, widening/upgrading existing roads, constructing flyovers at bottleneck intersections, physically separating through-traffic from local traffic by access control, etc;
- Increasing road capacities to fulfill traffic demands, especially in Central Surabaya, as well as minimizing the demand and capacity gap of the roads to the central area; and,
- Road development should aim not only to cope with the traffic congestion issues but also to lead to a desirable urban structure.

Road function definitions are presented in Table 8.3.1. In GKS road function implies that the primary and secondary road systems are the principal components of the road network. The primary road system was designed for inter-regional traffic and mainly serves traffic between urban centers. In effect, the primary system has relatively long distance trips. While no primary road was proposed for Corridor (3), the westward corridor, which runs from Surabaya to south of Kabupaten Gresik and south Kabupaten Lamongan, should be developed with partial access controls. As shown in Figure 8.3.1, primary arterial roads will connect with the national activity center (PKN: Pusat Kegiatan Nasional) (Table 8.3.2) and the regional activity center (PKW: Pusat Kegiatan Wilayah) (Table 8.3.3) through partial access control. On the other hand, primary collector roads will connect the PKW with the local activity centers (PKL: Pusat Kegiatan Lokal) (Table 8.3.4) with no access control.

Table 8.3.1 Definition of Road Functions

Road Function	Function	Through Traffic	Access Control
Primary Arterial	Linking PKN and PKN	Major	Partial Access Control
	Linking PKN and PKW		
	Linking PKN/PKW and International Sea Port and Airport		
Secondary Arterial	Connecting centers inside urban area	Partial	No Access Control
Primary Collector	Linking PKW and PKW	Partial	No Access Control
	Linking PKW and PKL		
Local Road	Linking PKL and PKL	Minor	No Access Control
	Others		

Source: National Regulation number 38 Year 2004
Remarks:
PKN : Pusat Kegiatan Nasional - National Activity Center
PKW : Pusat Kegiatan Wilayah - Regional Activity Center
PKL : Pusat Kegiatan Lokal - Local Activity Center

Table 8.3.2 List of PKN in Java

PKN	Remarks
Gerbangkertosusila, Bandung (Bandung Raya), Jakarta (Jabodetabek), Semarang (Kedungsepur). Yogyakarta	I/C/3 (Development Step I, Revitalization of existing cities)
Malang, Serang, Cilegon, Cirebon, Surakarta (Solo), Cilacap	I/C/1 (Development Step I, Development / function improvement)
Surabaya	Regional Center

Source: Government Regulation 26 Year 2008 and JICA Study Team

Table 8.3.3 List of PKW in East Java Province

PKW	Remarks
Pasuruan, Tuban, Kediri	I/C/1(Development Step I, Development / function improvement)
Probolinggo, Tulung Agung, Situbondo, Madiun, Jombang, Banyuwangi, Sampang, Sumenep	II/C/1 (Development Step II, Development / function improvement)
Sidoarjo, Gresik, Bangkalan	SMA Level Center
Mojokerto, Lamongan	GKS Kab. Center

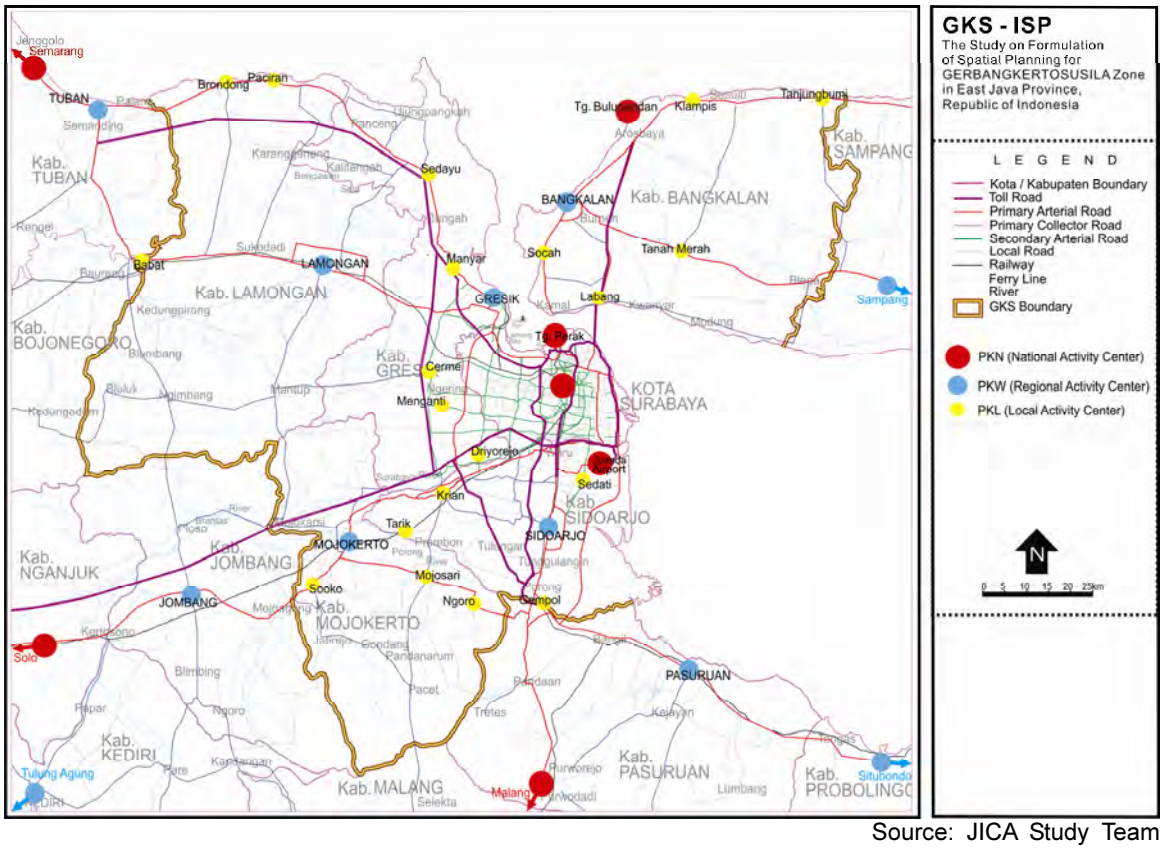
Source: Government Regulation 26 Year 2008 (Outside GKS) and JICA Study Team (Inside GKS)

Table 8.3.4 List of PKL in GKS Zone

PKL	Remarks
Paciran, Babat, Sedayu, Gempol, Tanah Merah, Klampis, Tg. Bumi	GKS Sub-Center
Menganti, Krian, Labang	SMA Sub-Center
Brondong, Manyar, Cerme, Driyorejo, Tarik, Sedati, Sooko, Mojosari, Ngoro, Socah	Other Kab. Sub-Center

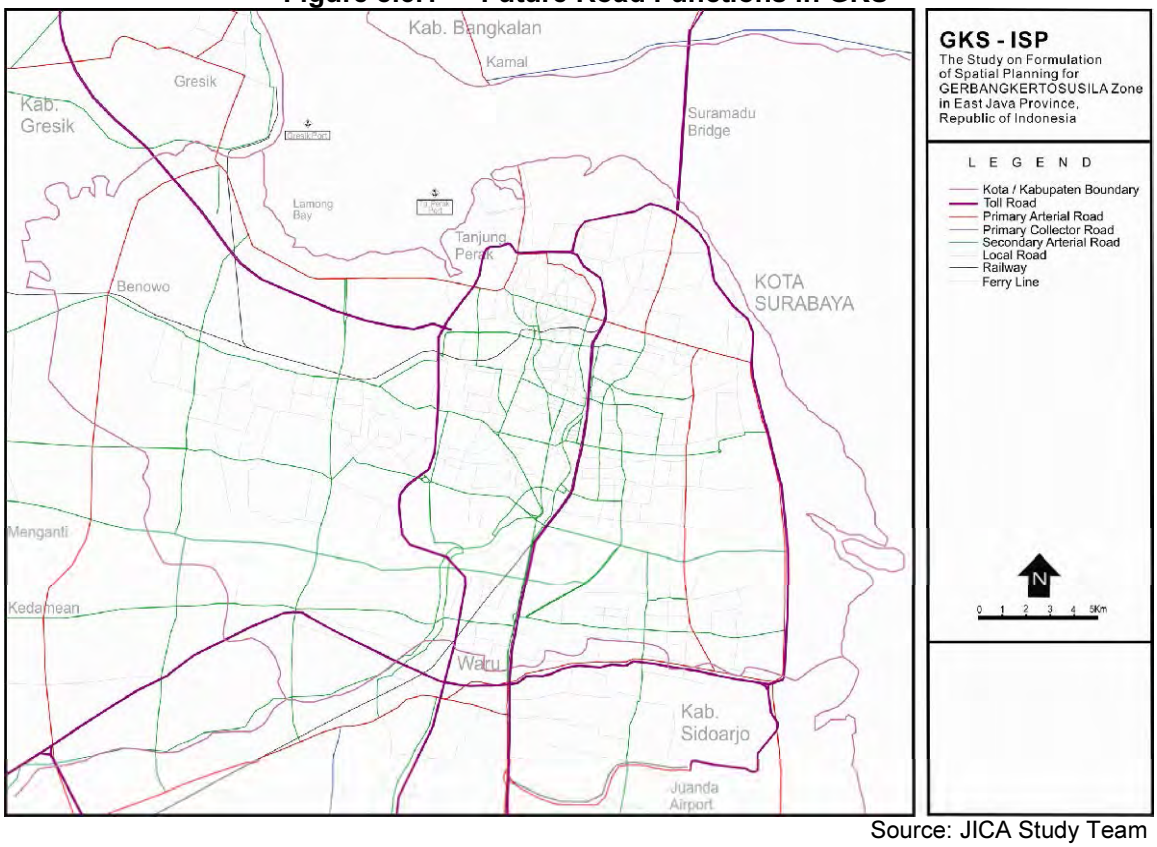
Source: JICA Study Team

The secondary road system will serve traffic mainly within the urban areas in SMA. Secondary arterial roads are designed usually with partial access control, while secondary collector roads have no access control. These two road systems should be smoothly integrated with each other. Some new secondary arterial roads in SMA still need to be added and developed in a north-south direction. For the east-west direction, while existing roads are mainly secondary arterial roads, some road sections should be widened and upgraded, while some missing links, or flyovers/underpasses, should be constructed. It should also be emphasized that both land acquisitions and environmental issues should be settled before actual implementation starts, because these were serious obstacles in the implementation of the Surabaya Urban Development Project (SUDP).



Source: JICA Study Team

Figure 8.3.1 Future Road Functions in GKS

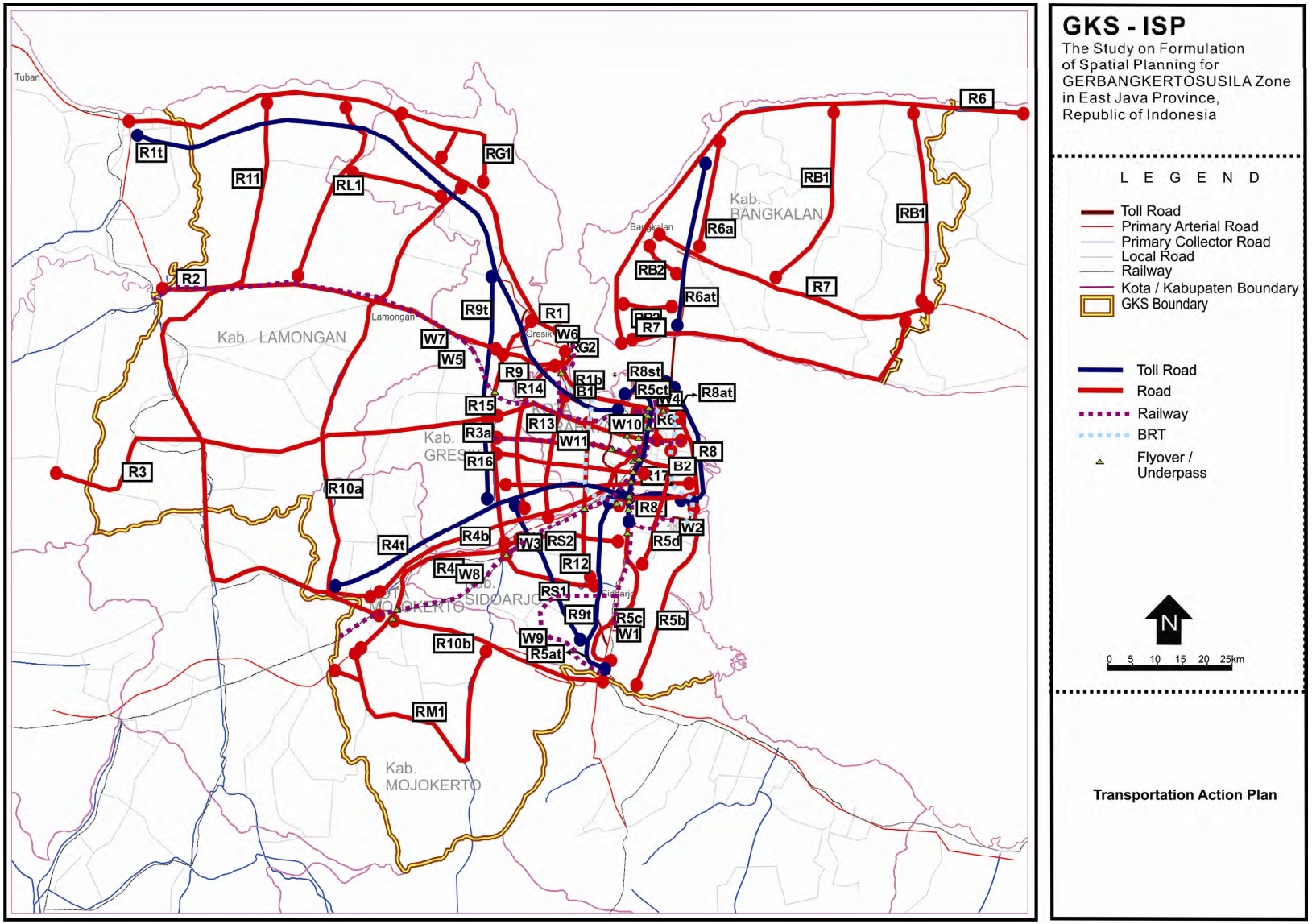


Source: JICA Study Team

Figure 8.3.2 Future Road Functions in Surabaya

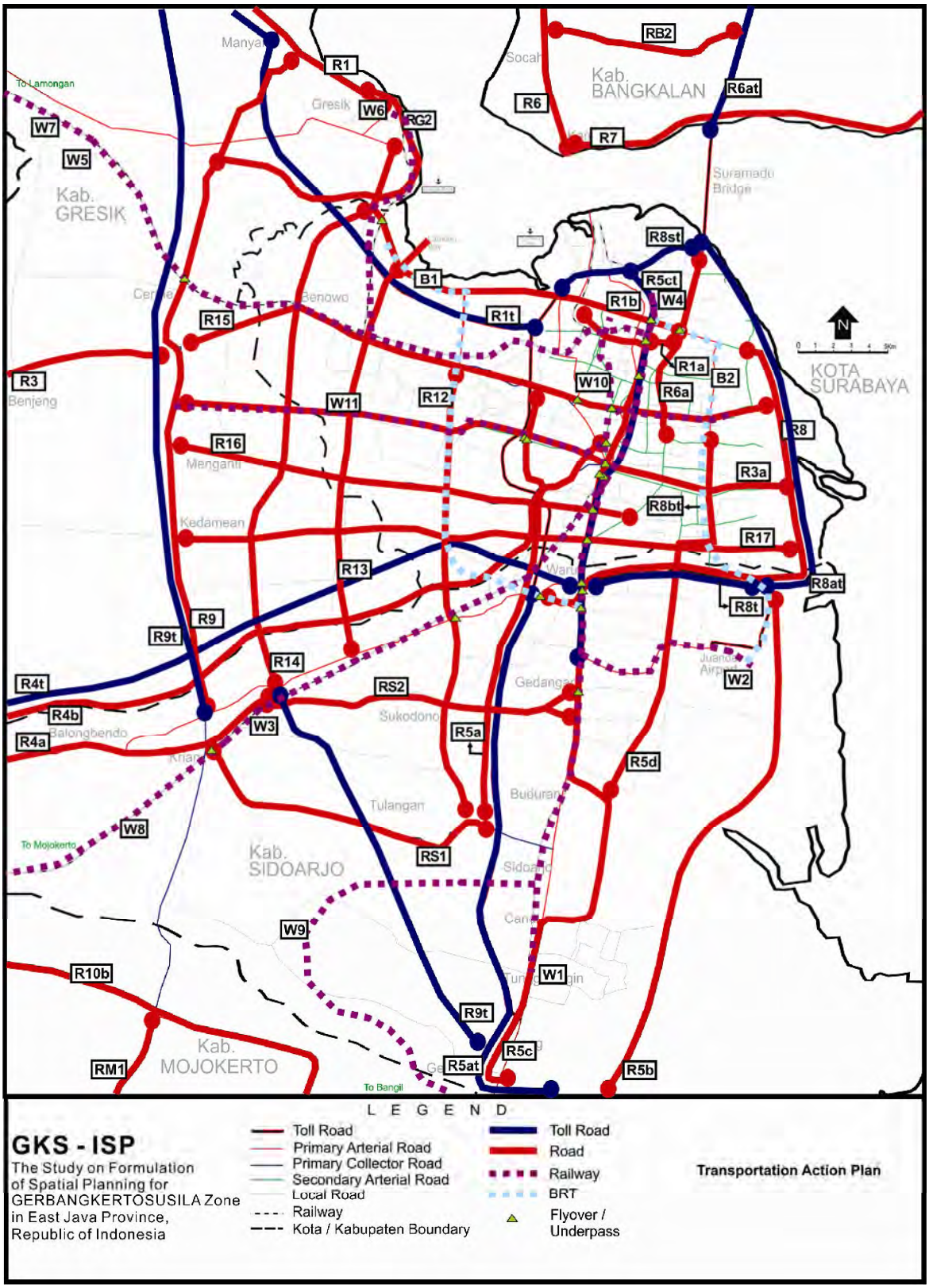
8.4 Road Development Projects

In the proposal for the road development projects, the Study Team followed not only the roads that were listed in the ARSDS-GKS master plan (1997) but also the latest road and flyover plans prioritized by each local government. The Study Team reviewed them in light of the above-mentioned corridor developments and road network hierarchies. The road development projects are shown in Figure 8.4.1 (i.e. for GKS) and Figure 8.4.2 (i.e. for SMA), and listed in Table 8.4.1. These projects were included in future road networks and tested in terms of future demand forecasts, to sort them into projects to be implemented in the short term (i.e. 2015, Figure 8.4.6), medium term (i.e. 2020, Figure 8.4.7), and long term (i.e. 2030, Figure 8.4.8). Actual road project components to be included in each road development project are presented in Figure 8.4.3 (for GKS) and Figure 8.4.4 (for SMA). Phased road project components are also presented in Figure 8.4.7 (for short term), Figure 8.4.9 (for medium term), and Figure 8.4.11 (for long term).



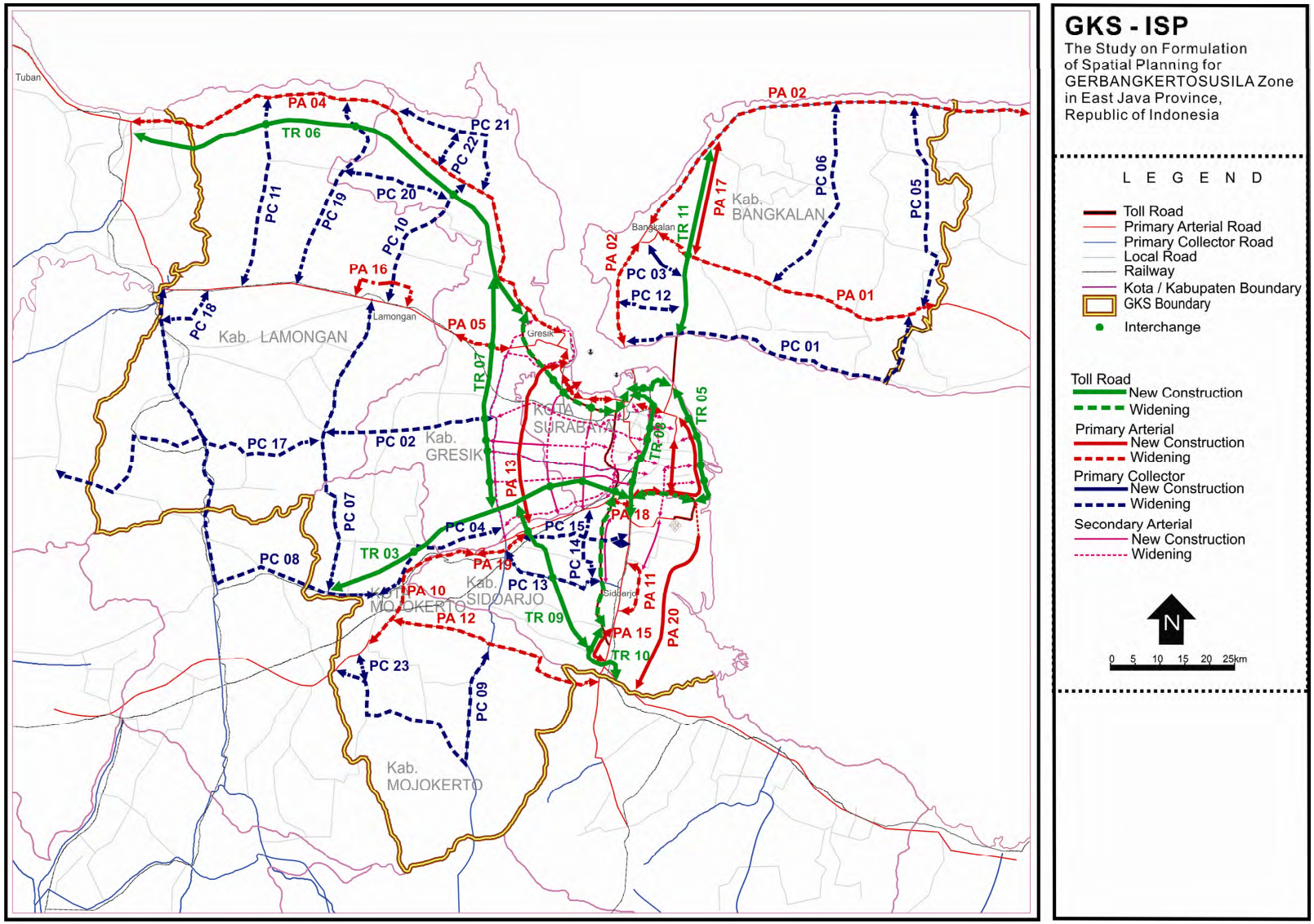
Source: JICA Study Team

Figure 8.4.1 Road Development Projects in GKS



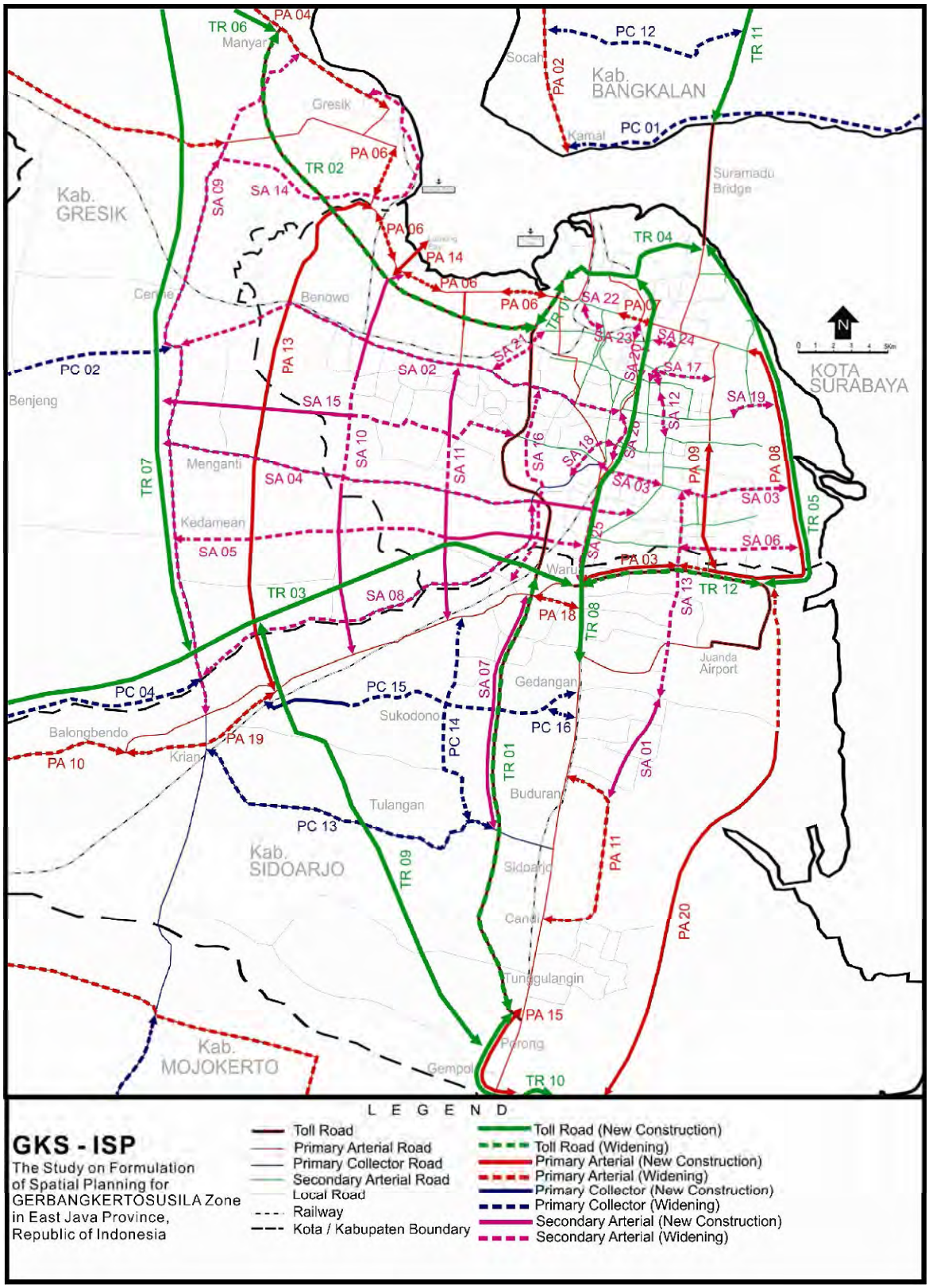
Source: JICA Study Team

Figure 8.4.2 Road Development Projects in SMA



Source: JICA Study Team

Figure 8.4.3 Road Project Components in GKS



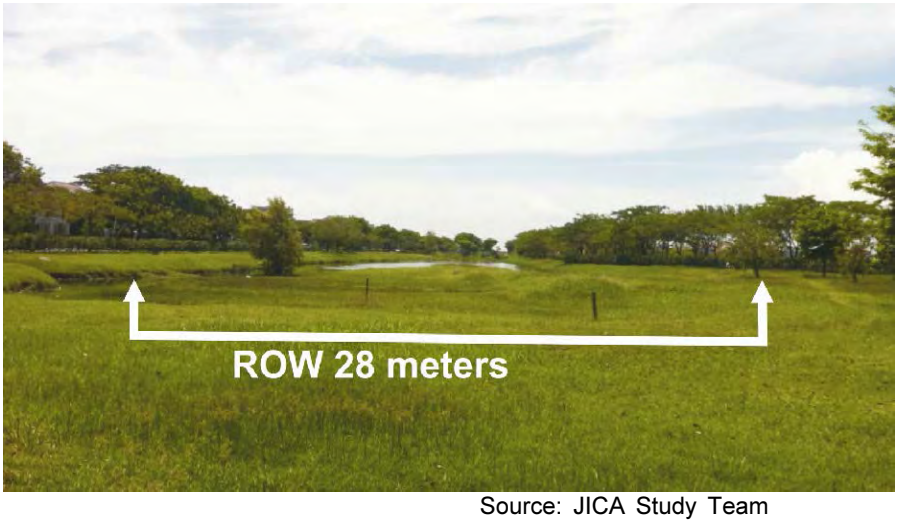
Source: JICA Study Team

Figure 8.4.4 Road Project Components in SMA

1) Short Term (2015)

For the short term, four prioritized east-west road projects were proposed together with the two road development projects along the north-south corridor. The following were the short term priorities: widening and improvement project on the existing Surabaya-Gempol and Surabaya-Gresik toll road sections, new toll road connecting Kabupaten Gresik up to Kabupaten Tuban (project R1t), new toll road connecting Kota Surabaya and Kabupaten Mojokerto (project R4t: Toll SUMO), and new development of Waru–Wonokoromo–Tg. Perak toll road (project R5ct: WWTP). The purpose of constructing the Gresik–Tuban toll road is to reduce the heavy freight traffic on the national road (project R2, which is also proposed to be improved in the short term) as well as to support the industrial and port development plans on the northern coast of Kabupaten Lamongan and Gresik.

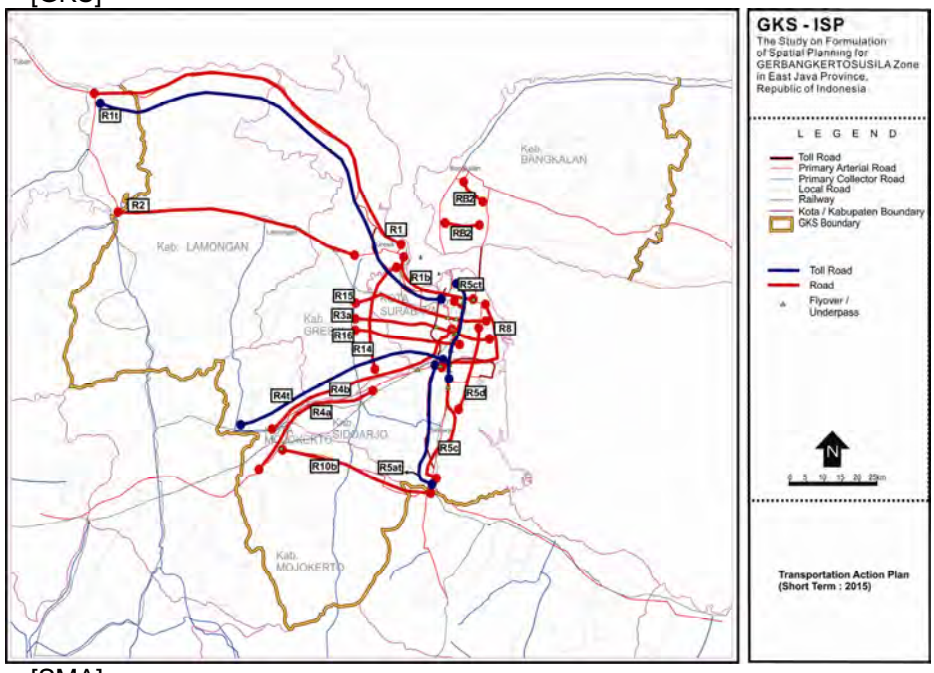
Primary collector road development (project RB1, RB2) will be applied in Kabupaten Bangkalan to improve the access road between the Suramadu Access Road and the road in Socah Industrial Estate and Bangkalan. These access roads were considered important for port development in Socah (Madura Seaport City). Primary arterial road developments will be applied to the following: the national road (Tuban–Babat–Lamongan–Gresik) including Lamongan Ring Road (project R2) to support the major oil and gas industrial development in Block Cepu and Kabupaten Bojonegoro; the road connecting Kabupaten Mojokerto to Kabupaten Pasuruan (project R10b); the road connecting Kabupaten Mojokerto to Kota Surabaya (project R4a); the road connecting Gresik and Driyorejo, or the Outer West Ring Road II, which bypasses Surabaya (project R14); and the arterial road on project R8, which connects Waru-Juanda as “frontage road” of the SERR (Surabaya East Ring Road). The importance of developing project R8, in the short term, is to secure right-of-way (ROW) for the SERR toll road (Figure 8.4.5), which will be constructed in the medium term (2020), thus avoiding future land acquisition complications.



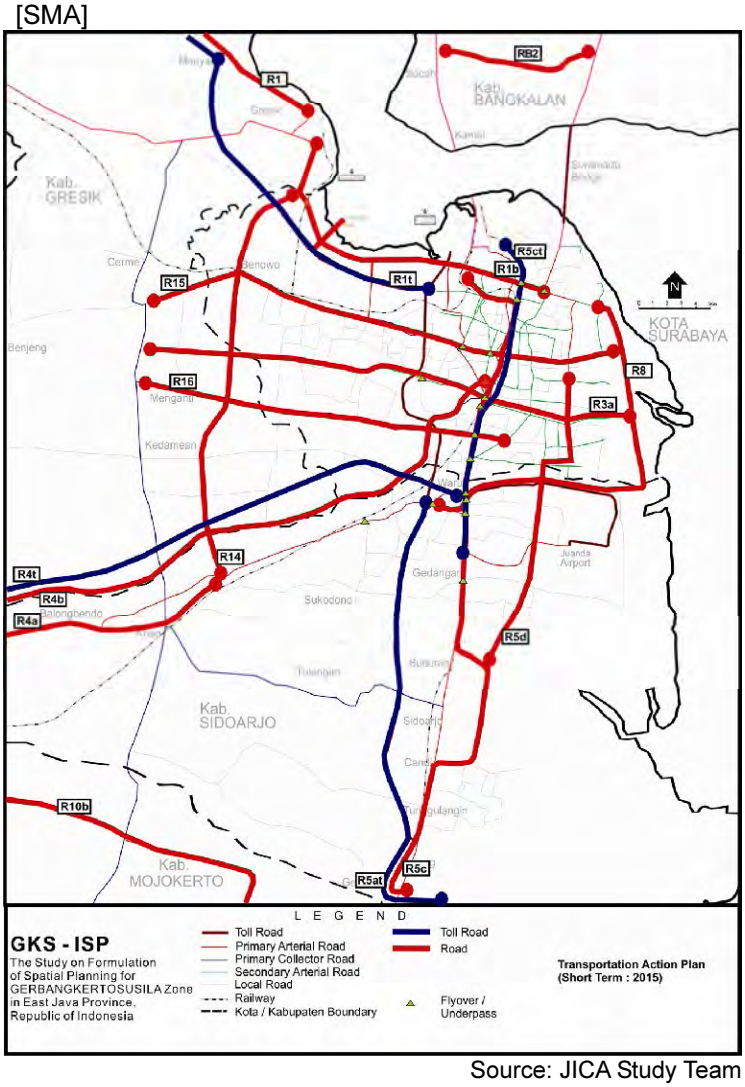
Source: JICA Study Team

Figure 8.4.5 Reserved ROW for the SERR (Laguna Indah Housing Complex)

[GKS]



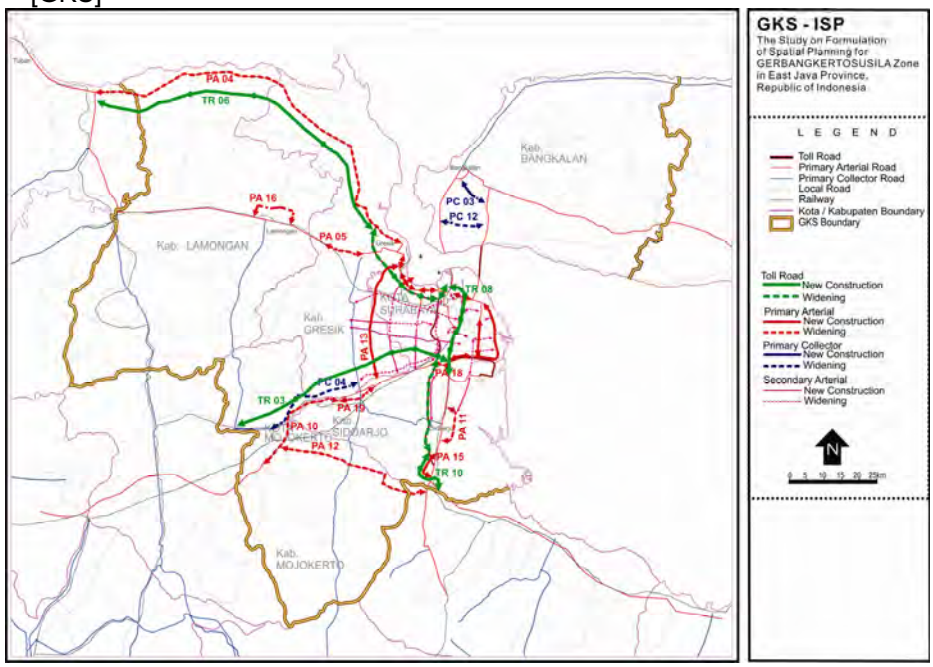
[SMA]



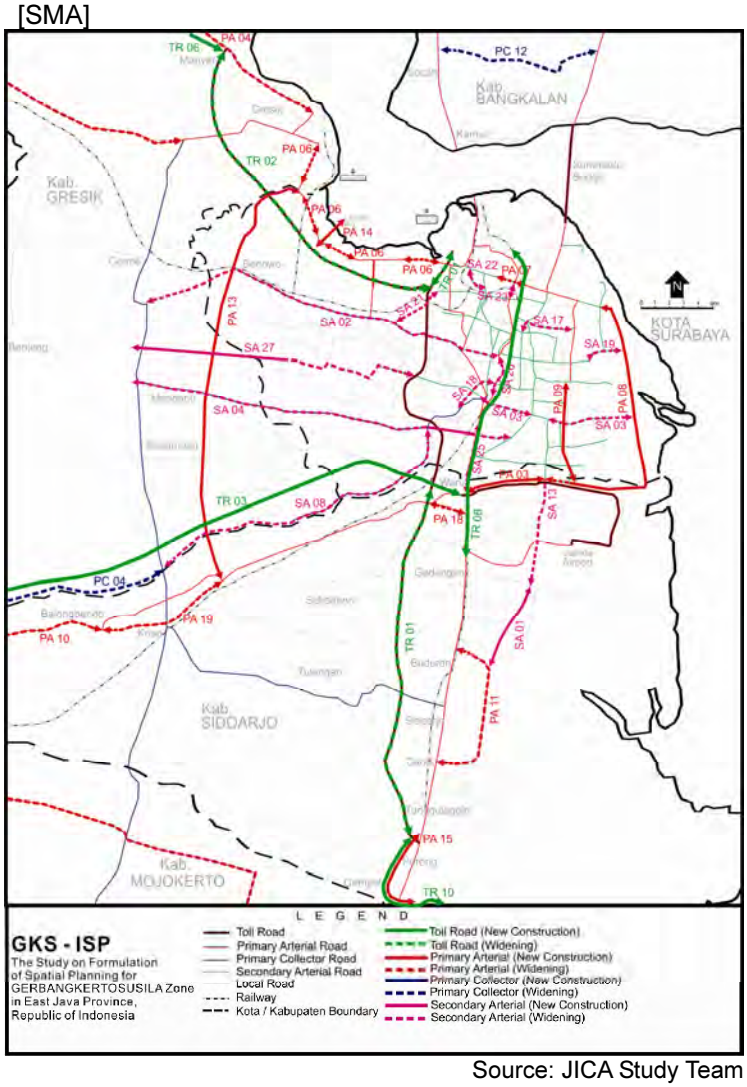
Source: JICA Study Team

Figure 8.4.6 Phased Road Development Projects (2015: Short Term)

[GKS]



[SMA]



Source: JICA Study Team

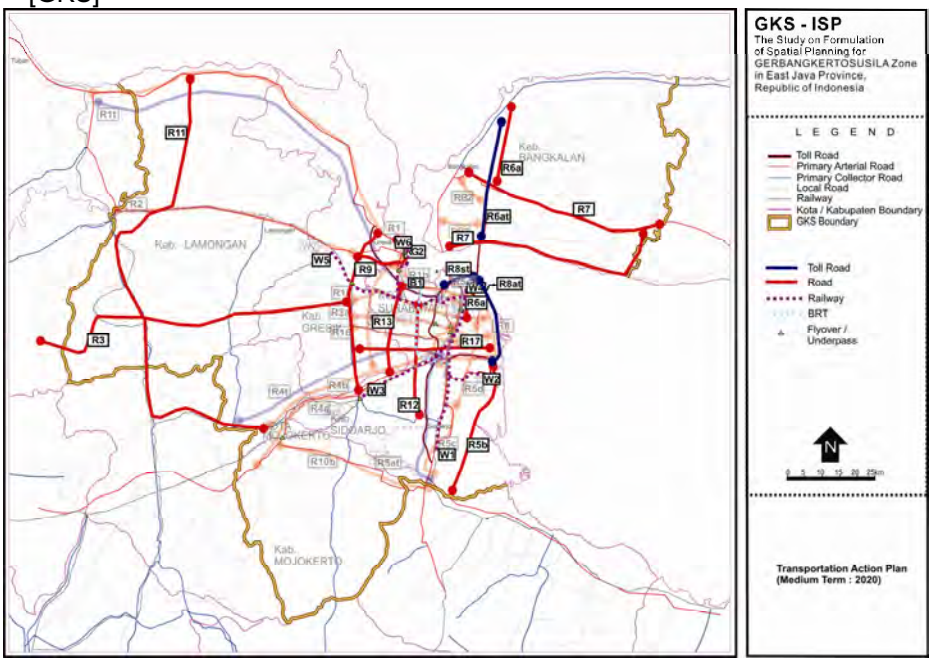
Figure 8.4.7 Phased Road Project Components (2015: Short Term)

2) Medium Term (2020)

Main road development projects for the medium term are: the toll road connecting Perak-Suramadu (project R8st), toll road connecting Suramadu Bridge to the planned Tg. Bulu Pandan (project R6at), new Surabaya East Ring Toll Road (Project R8at: SERR), and a new arterial road connecting Kota Surabaya and Kabupaten Pasuruan through Sidoarjo without passing through the center of Kabupaten Sidoarjo (project R5b). For freight road development in GKS, the Study Team proposed Road Project R11, which connects the industrial and port areas in northern Kabupaten Lamongan with both Kabupaten Jombang and Kabupaten Malang.

The road development project inside Kota Surabaya will be applied along the north-south and east-west corridors. Project R13 is also known as Outer West Ring Road I in Kota Surabaya. The road development along this corridor is designed to accommodate through traffic along the north-south corridor in West Surabaya and connect it to the Lamong Bay access road, which is planned to be constructed in the short term. Project RG2 is designed as a ring road of Kota Gresik, which is expected to have several industrial areas, as well as private and public ports.

[GKS]



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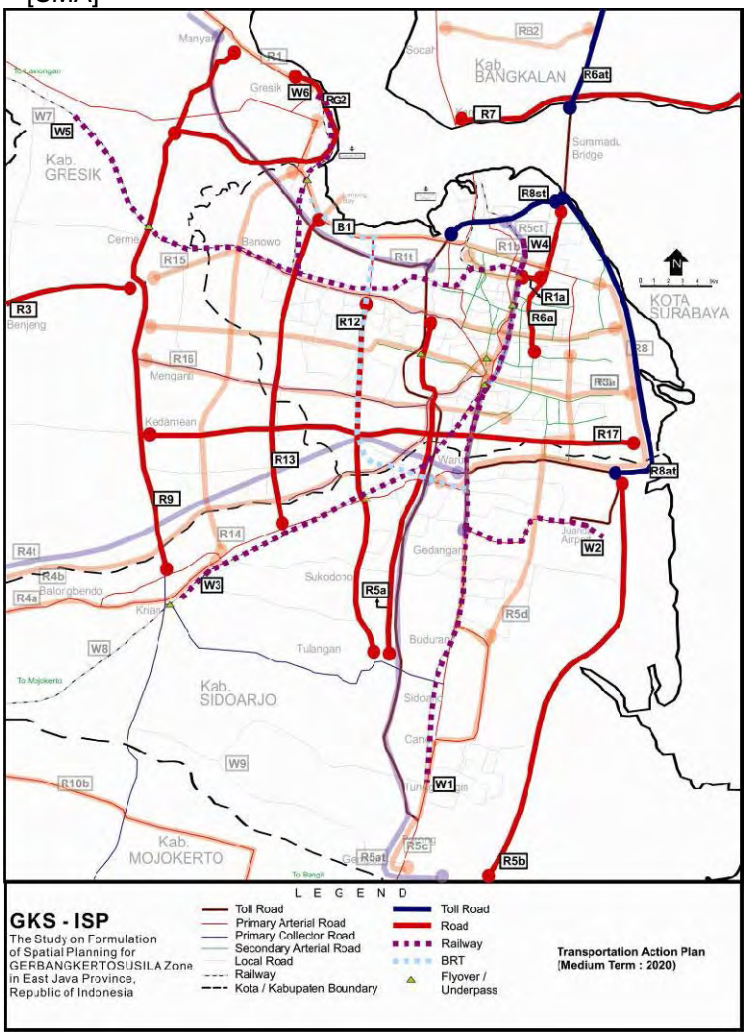
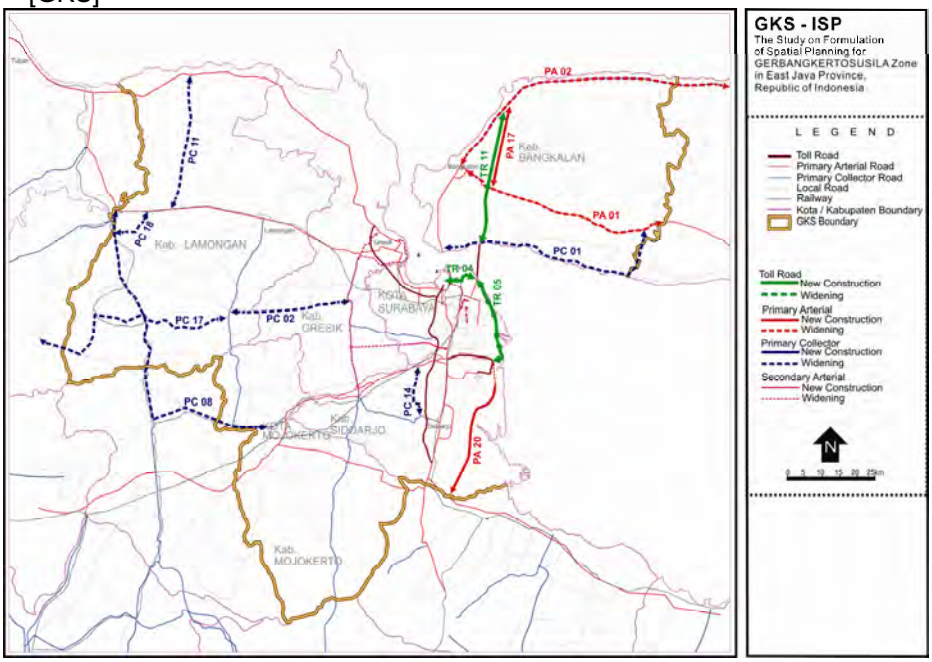


Source: JICA Study Team

Figure 8.4.8 Phased Road Development Projects (2020: Medium Term)

[GKS]



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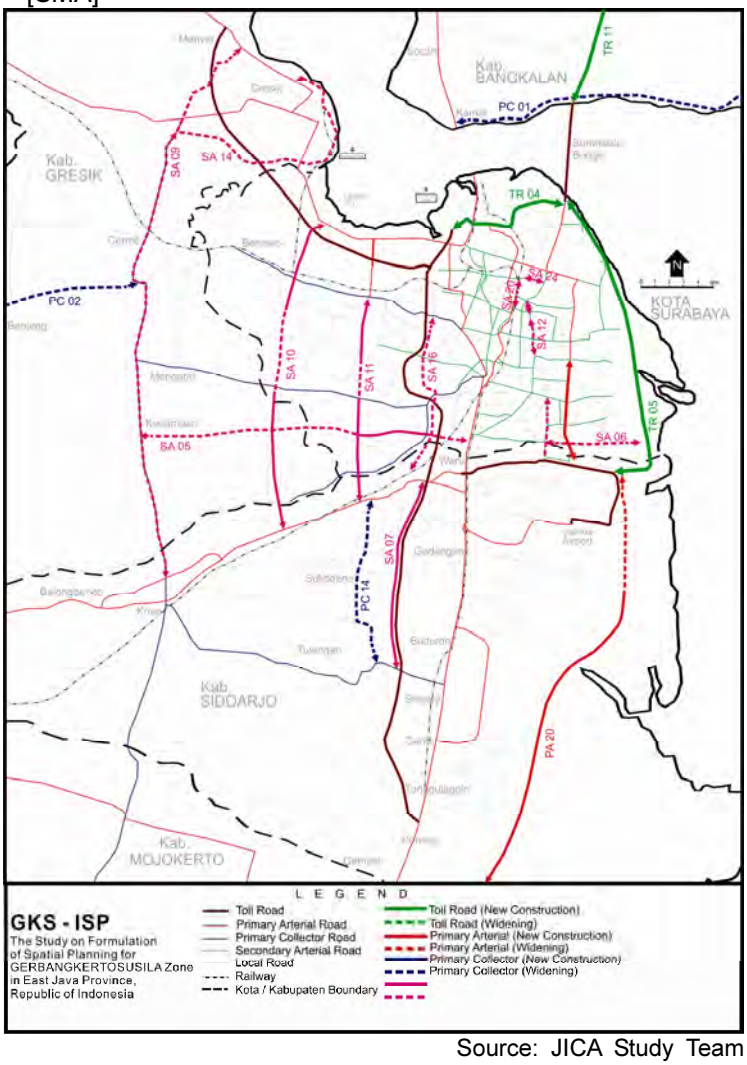


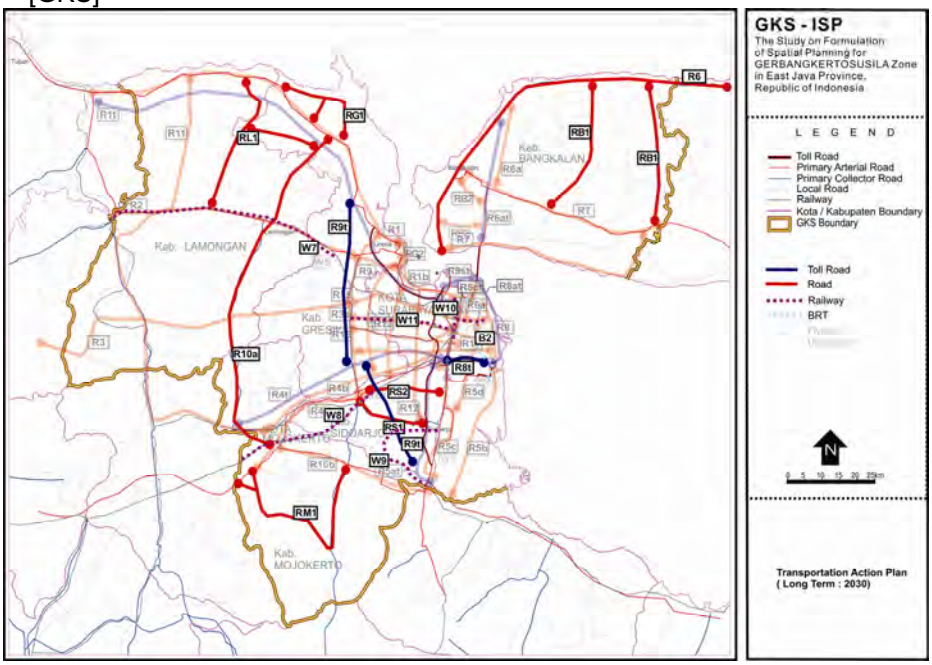
Source: JICA Study Team

Figure 8.4.9 Phased Road Project Components (2020: Medium Term)

3) Long Term (2020)

Road development projects for the long term include the Krian-Manyar, and the Krian-Gempol sections. The Manyar-Krian-Gempol toll road will not only accommodate traffic bypassing Kota Surabaya, but will also be an alternative detour to skirt around the Lapindo mud flow in Porong, Kabupaten Sidoarjo, which could spread further in the future. Arterial road development in Kabupaten Bangkalan (Project R6) is designed to be an access road from Kamal to Tg. Bumi via Socah and Kota Bangkalan. The purpose of developing this road is to provide a north and south access road for the Kabupaten Bangkalan coastal line, where several ports (Socah, Tg. Bulu Pandan and Tg. Bumi) and industrial areas (Socah, Klampis and Suramadu Footage Area) are planned. Primrary collector development projects are: a road connecting Kecamatan Sedayu (Kabupaten Gresik) and Kota Mojokerto via Kota Lamongan (Project R10a), a road in Kabupaten Mojokerto (Project RM1) to create the "tourism route" that connects Mojosari, Pacet, and Trowulan with several historical and religious sites, as well as several others in North Gresik (Project RG1), Kabupaten Bangkalan (Project RB1), Kabupaten Lamongan (Project RL1) and Kabupaten Sidoarjo (Project RS1 and RS2). The second airport development that is planned in Kabupaten Lamongan, in the long term, will also be supported by the road development in Kabupaten Lamongan (Project RL1), as well as the primary arterial road development (Project R2), and the commuter railway development (Project W7).

[GKS]



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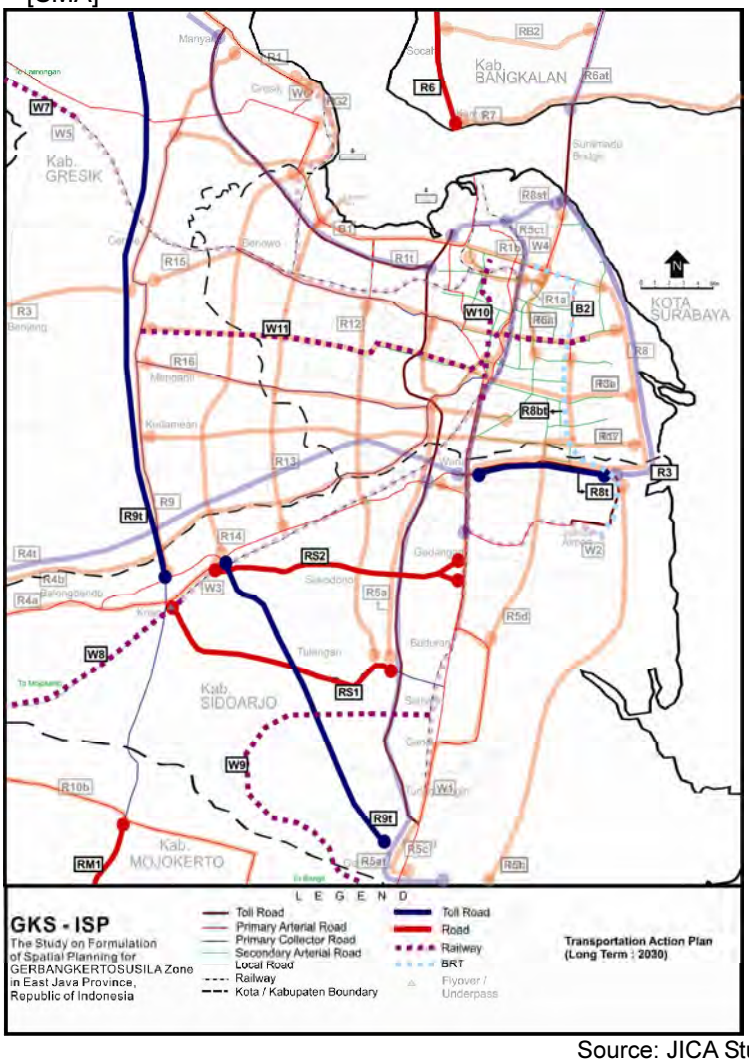
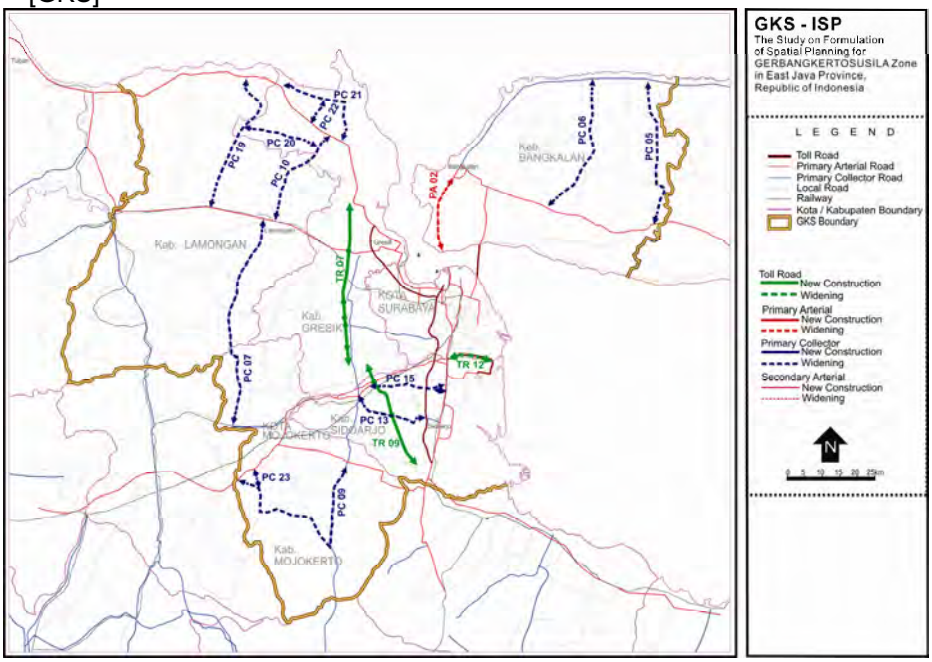


Source: JICA Study Team

Figure 8.4.10 Phased Road Development Projects (2030: long term)

[GKS]



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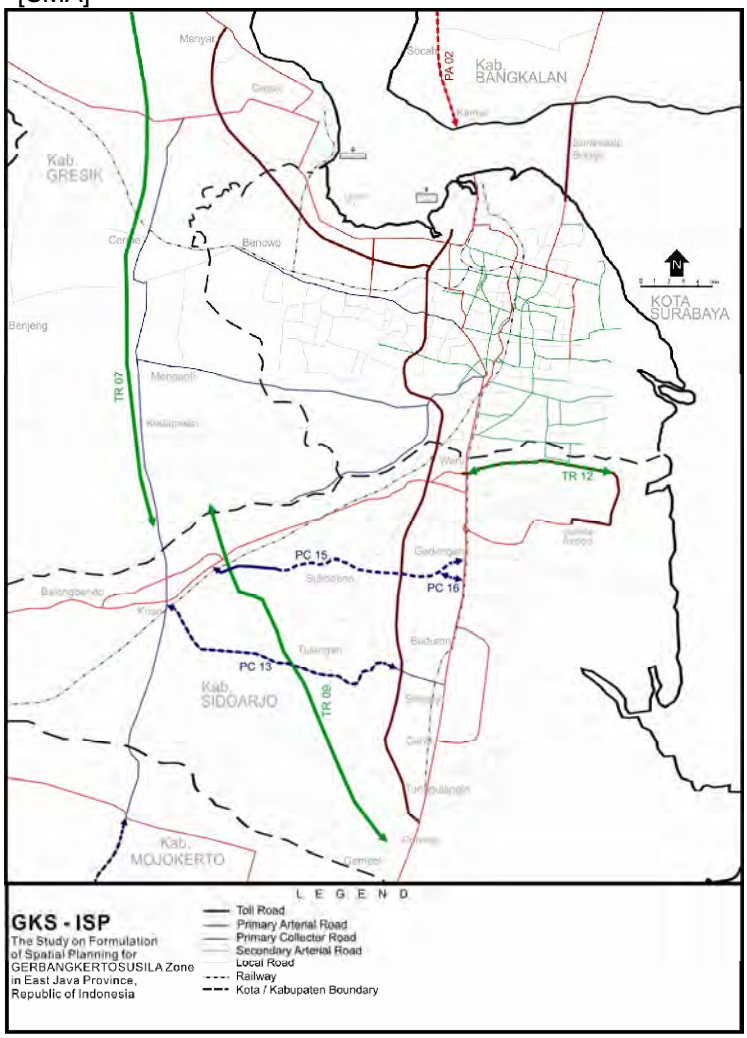


Source: JICA Study Team

Figure 8.4.11 Phased Road Project Components (2030: long term)

Table 8.4.1 List of Road Development Projects

Project ID	Total Cost (mil. Rp)	Annual OM cost (mil. Rp)	Description
Short Term (Year 2015)			
1	847,696	11,646	This is an existing provincial road which functions as a primary arterial road passing through the northern coast of East Java where the industrial and port development is planned as a national policy. This road should be upgraded to a national road, to support the industrial development program.
1b	123,246	1,693	This road includes a national road connecting Surabaya (Jl. Gresik) and Gresik City on the northern coast of Surabaya. It needs to be widened from 2 to 4 lanes, and the work is ongoing. Existing Jl. Rajawali and Jl. Kenjeran roads serve as one of the main east-west corridors connecting "East Surabaya" and "West Surabaya" in the north of Surabaya. This road also goes through Margomulyo industrial and warehouse area, and the access road development is also planned for Lamong Bay port.
1t	2,382,145	49,091	This package includes development of Surabaya - Gresik toll road (widening from 4 to 6 lanes) and its extension with a total length of 80.6 kilometers. This road development will contribute to the northern coastal development of East Java as a national policy. It will also reduce the burden of existing truck traffic on Corridor 2 and will serve as an alternative freight transport route connecting Tuban with Surabaya and south of GKS.
2	259,644	3,567	This is an existing national road connecting Surabaya, Gresik, Lamongan and Babat and it currently serves as an important freight corridor as part of northern Java trunk road. Current road widening work from 2 to 4 lanes is under way. Ring roads are also planned to bypass the center of Lamongan and Babat.
3a	370,023	5,084	This road is one of the important east-west corridors to be developed through Jl. Adityawarman, Jl. Jagir Wonokromo and Jl. Wonorejo (Outer East Ring Road). The Study Team proposes a new flyover connecting Jl. Adityawarman and Jl. Jagir Wonokromo in order to facilitate through traffic. Though it is a secondary arterial road, it needs to be developed as a 6-lane road with sufficient width. The Study Team also proposes a new corridor of MRT (Mass Rail Transit) in the west of Surabaya.
4a	319,918	4,395	This is a national and primary arterial road connecting major sub-centers of Krian, Mojokerto, and Sooko and extending to Jombang. While Surabaya-Mojokerto Toll Road is planned parallel to this road, it is still expected to serve regional traffic as well as the industrial estate on Corridor 4, and It needs to be widened from 2 lanes into 4 lanes.
4b	487,568	6,698	This is a provincial road in Surabaya while it is a kabupaten road outside Surabaya. It is an alternative road for serving traffic between Surabaya and Mojokerto and thus it should be developed as a secondary arterial road. In Wringinanom, many factories have been plotted, generating truck traffic.
4t	1,463,410	30,157	This Surabaya – Mojokerto Toll Road is currently under construction (4 lanes). The total length is 33.8 kilometers with 8 lanes/2 ways in urban area and 6 lanes/2 ways in rural area as future widening. The toll road extension is planned toward Jombang and Kediri as part of Trans-Java Toll Road.
5c	371,097	5,098	This is an arterial road development along the of North-South corridor from Surabaya City up to Gempol sub-center detouring the Sidoarjo mud flow. In Surabaya, frontage roads are currently being constructed on both sides of this road, and continuous flyovers are planned for through traffic. Existing railway along this corridor is planned to be developed and elevated as commuter railway service (first stage), and at-grade railway crossings will be removed. The Sidoarjo Ring Road which bypasses the center of Sidoarjo is also planned, and a relocation and reconstruction of a primary arterial road detouring Sidoarjo mud flow is in progress.

Project ID	Total Cost (mil. Rp)	Annual OM cost (mil. Rp)	Description
Short Term (Year 2015)			
5ct	5,177,000	50,700	This toll road is a national initiative toll road to alleviate traffic congestion in Jl. A. Yani. It is an elevated toll road from Waru-Wonokromo-Tg. Perak (WWTP) along 19.75 kilometers.
5d	476,170	6,542	This road serves not only as an access road to the center of SIER (Surabaya Industrial Estate of Rungkut) but also as an alternative road connecting Surabaya and Sidoarjo as an extension of MERR (Middle East Ring Road), which is currently under construction. The Study Team proposes BRT (bus rapid transit) connecting Juanda Airport and Sidotopo by making use of the centermost lane of the MERR.
5at	625,908	12,899	Surabaya – Gempol toll road is the first toll road in East Java, completed in 1986, and originally with 4 lanes/2 ways with a length of 43.8 kilometers. Widening to 6 lanes/2 ways have been completed in the section of Dupak – Waru, and the rest of the section needs to be widened to 6 lanes. Relocation/reconstruction of a toll road detouring Sidoarjo mud flow is in progress.
8	645,074	8,862	This is a primary arterial road development to connect Suramadu bridge and Juanda Airport, serving as a ring road (Outer East Ring Road). ROW for a toll road (SERR: Surabaya East Ring Road) has been reserved in the center of the road. This road will also serve as the boundary for development control.
10b	160,525	2,205	This is an existing national and primary arterial road with 5.5 to 6.0 meters width. Since industrial estates such as the PIER(Pasuruan Industrial Estate Rembang) and Ngoro are being developed, direct connection between Mojokerto, Mojosari, and Gempol is necessary to support industrial activities.
14	1,497,682	20,576	This primary arterial road is planned by the central government as the main North-South Corridor. The Study Team calls this road Outer West Ring Road II (OWRR II) with a total length of 22.3 km. It will pass Surabaya and will also go partly through Kabupaten Gresik and Kabupaten Sidoarjo, serving as a major bypass for passenger/freight traffic.
15	347,102	4,769	This road functions as one of the major east – west secondary arterial roads to be developed to form a grid-like road network. Box culvert construction is currently ongoing to widen the road to 4 lanes. Flyovers have been planned on Jl. Pasar Kembang and Jl. Pandegiling. The planned commuter railway development of Surabaya-Sumari-Lamongan is along this road, and the Study Team also proposes a new corridor of MRT (Kertajaya – ITS) along this road (east of Surabaya).
16	634,769	8,721	Jl. Menganti and its extension to Jl. Margorejo function as one of the major east – west secondary arterial roads to be developed. The missing link between Jl. A. Yani and Jl. Mastrip needs to be developed as a 4-lane road.
B2	335,533	4,610	These primary collector roads are planned to connect the Suramadu Bridge footage area with new Socah industrial estate and port (Kabupaten sub-center).
Total for Short Term	16,524,508	237,313	
Medium Term (Year 2020)			
1a	13,278	182	Jl. Kapas Krampung needs to be widened to 4 lanes to cater for east-west traffic and the traffic to/from Suramadu bridge. A flyover may be constructed to avoid at-grade railway crossing.
3	950,797	13,062	This is a primary collector road which connects Mantup (south of Kabupaten Lamongan) and Cerme (south of Kabupaten Gresik) as an extension of road project R15.. This road is planned to support the agricultural area in Kecamatan Ngimbang, Kabupaten Lamongan to Kabupaten Gresik and Surabaya.

Project ID	Total Cost (mil. Rp)	Annual OM cost (mil. Rp)	Description
Medium Term (Year 2020)			
5a	406,862	5,590	A secondary arterial road is planned to support the development in Kabupaten Sidoarjo as a SMA Level Center, connecting it to Surabaya. It will be developed as a frontage road of Surabaya-Gempol Toll Road in Kabupaten Sidoarjo, and in Surabaya the continuing roads of Jl. Jambangan, Jl. Karah Agung, Jl. Abdul Wahab Siamin, and Jl. Simogunung will also be widened to 4 lanes. A flyover is also planned on Jl. Mayjend. Sungkono.
5b	1,067,846	14,670	This primary arterial road is planned as "East Ring Road" of Kabupaten Sidoarjo, with a function to limit the development on the east side of the road. It will also serve as part of the future freight road network preventing trucks from passing through the Sidoarjo center.
6a	207,230	2,847	This primary arterial road is planned to be developed to support the Madura Island traffic connecting sub-centers of Klampis and Tanah Merah in Kabupaten Bangkalan. Development of this frontage road of a toll road to the planned Tg. Bulu Pandan port is conditional on the development of the port, and industrial and housing development in the Suramadu footage area (Labang).
6at	931,329	19,193	This toll road development connecting Suramadu Bridge and the planned Tg. Bulu Pandan Port is necessary to accommodate mostly heavy loaded traffic. Development of this toll road is conditional on the development of the port.
7	1,298,333	17,837	These primary arterial road and primary collector road (on the south coast) are planned to be developed to cater for the Madura Island traffic connecting Bangkalan City (SMA Level Center), sub-center of Tanah Merah, Kecamatan Blega, and toward Kabupaten Sampang, supporting the development along this corridor.
8st	1,976,685	24,944	The toll road development is planned to connect Tg. Perak and Suramadu Bridge and the planned SERR to form part of a toll ring road. Main objective for this development is to divert heavy loaded traffic which goes through the city center to this toll road.
8at	1,083,586	12,135	This is a toll road development to connect Suramadu Bridge and Juanda Airport, constructed on a primary arterial ring road (Outer East Ring Road). It is called SERR (Surabaya East Ring Road), and ROW for SERR has been reserved in the center of Outer East Ring Road. This road will serve not only as one of the major truck routes to connect the ports but also as the boundary for development control.
9	308,823	4,243	In the south of Kabupaten Gresik, many housing development projects have been planned. This road is planned to support these development. This road is currently used by many heavy loaded vehicles. The existing function of this road is a narrow kabupaten road but is planned as a secondary arterial road with 4 lanes. This road is planned to be developed as a frontage road of a toll road planned in the long term (Project R9).
11	1,209,383	16,615	This primary collector road will connect Tuban area and Pasuruan-Malang area through Mojokerto from a viewpoint of GKS Plus. Road length between Babat and Mantup is approximately 28.0 kilometers. The section of Pucuk - Brondong is a narrow kabupaten road (4.5 meter width) same as in the above Babat – Mantup section. It is necessary to widen the road width and strengthen the pavement to support the development in the northern coastal zone in East Java. The current road length is 28.2 kilometers. In GKS, this north-south long road is planned to be developed to connect both GKS sub-centers of Paciran and Babat in Kabupaten Lamongan up to Kabupaten Mojokerto. There are industrial area plotted in Paciran and agricultural area in the south of Kabupaten Lamongan.

Project ID	Total Cost (mil. Rp)	Annual OM cost (mil. Rp)	Description
Medium Term (Year 2020)			
12	452,505	6,217	This road is called Middle West Ring Road (MWRR) and it has partly been implemented and financed by Japan or executed by private investor. The section that has not been realized yet should be constructed to give full play of its function. Total road length is 15.7 kilometers with 4 lanes. On this road, a BRT line connecting Tambak Oso Wilangun Bus Terminal and Waru railway station is also proposed.
13	697,899	9,588	This road is called Outer West Ring Road I by the Study team. This road is planned to be developed to connect the northwest and the south of Surabaya (industrial area on Jl. Mastrip), forming a grid pattern road network. At the north tip of this road in Surabaya, there is an access road to connect the new port in Lamong Bay with a length of 1.2 km. The planned road width is 14 meters with 4 lanes.
17	631,981	8,682	This road functions as one of the major east – west secondary arterial roads to be developed to form a grid pattern road network. This road will support development in the south of Kabupaten Gresik, West of Surabaya, and Driyorejo. This road will connect Toll Road (Project R9t), to Surabaya at Kedamean and will go through Jl. Sumur Welut and Jl. Gayung Kebonsari. A flyover is planned on Jl. A. Yani.
G2	428,493	5,887	This secondary arterial road is planned as a ring road for Gresik City (SMA Level Center). This ring road is planned and partly completed by Kabupaten Gresik. The function of this road is bypassing the traffic through Gresik City and to support the new port development at Gresik point and Kali Lamong. A Truck cargo terminal is planned at the existing Bunder Bus Terminal along this ring road. Some section of the existing road is very narrow and it needs to be widened to at least 4-lane standard. Total road length is 26.5 kilometers.
Total for Medium Term:	11,968,435	165,090	
Long Term (Year 2030)			
6	678,252	9,318	This primary arterial road is functioned to accommodate the traffic along the north coastal line inside Kabupaten Bangkalan. Along this road, there are some port developments in Socah (Kabupaten Sub-Center), Tg. Bulu Pandan (GKS Sub-Center) and Tg. Bumi (GKS Sub-Center). Main development along this package is to support the industrial activities.
8t	702,161	8,886	This toll road will mainly serve traffic in the east of Surabaya, connecting Juanda Airport, SERR, and Outer East Ring Road with existing Surabaya-Gempol Toll Road and Surabaya-Mojokerto Toll Road. It is planned to be widened from 4 to 6 lanes. This package is also supported by a frontage road that will have been planned in previous term of development.
9t	2,034,983	41,936	This is a north-south toll road development which is planned between north Gresik, Krian, and Gempol connecting Surabaya - Gresik Toll Road and Surabaya - Mojokerto Toll Road (which will have been constructed by the long term) and Surabaya – Gempol Toll Road. This toll road will also support the new port development in the north of Kabupaten Gresik and Lamongan, residential development in Driyorejo/Krian, industrial estate in Wringinanom, industrial recycle park in the south of Kabupaten Gresik, and industrial areas in Kabupaten Pasuruan and Kabupaten Malang. It will also serve as one of the alternative detouring routes avoiding the Lapindo mud flow in Porong, Kabupaten Sidoarjo.

Project ID	Total Cost (mil. Rp)	Annual OM cost (mil. Rp)	Description
Long Term (Year 2030)			
10a	742,229	10,197	This is an existing provincial road which functions as a primary collector road. The road is very narrow, sometimes less than 4.0 meters. Since this road connects GKS Sub-Center of Sedayu and GKS Kabupaten centers of Lamongan and Mojokerto, it is necessary to be widened by future traffic demand. Road length is 65 kilometers.
B1	909,827	12,500	These roads are planned to accommodate the north-south traffic between the two primary arterial roads in Kabupaten Bangkalan.
G1	462,001	6,347	These primary collector roads are planned to connect the new Sedayu-Gresik industrial estate and private port (GKS sub-center) with the primary arterial road and toll road connecting Tuban and Surabaya. These roads are also planned to support the development of agricultural area in the north of Kabupaten Gresik.
L1	569,090	7,818	This is a narrow kabupaten road (3.5 to 4.0 meter width) to connect Lamongan and Sedayu on the north coast. These roads need to be widened and upgraded to primary collector road to support the industrial and agricultural development planned in this area. These roads may also serve as an access road to a second airport planned in GKS.
M1	571,935	7,858	These are currently primary collector roads supporting the tourism sites in Kabupaten Mojokerto, especially in Kecamatan Trowulan and Kecamatan Pacet. These roads are also used as transport route of construction materials in this area. Thus, road widening and betterment of the pavement is necessary to support the development in the region.
S1	181,258	2,490	This road is planned as a primary collector road connecting Krian and Sidoarjo. It will also improve the accessibility of agricultural development in western Kabupaten Sidoarjo.
S2	316,862	4,353	This road is planned to support the new town development in Kecamatan Sukodono. It will also serve as an alternative access road connecting Krian and Sidoarjo.
Total for Long Term:	7,168,598	111,704	

8.5 Flyover and Underpass Projects

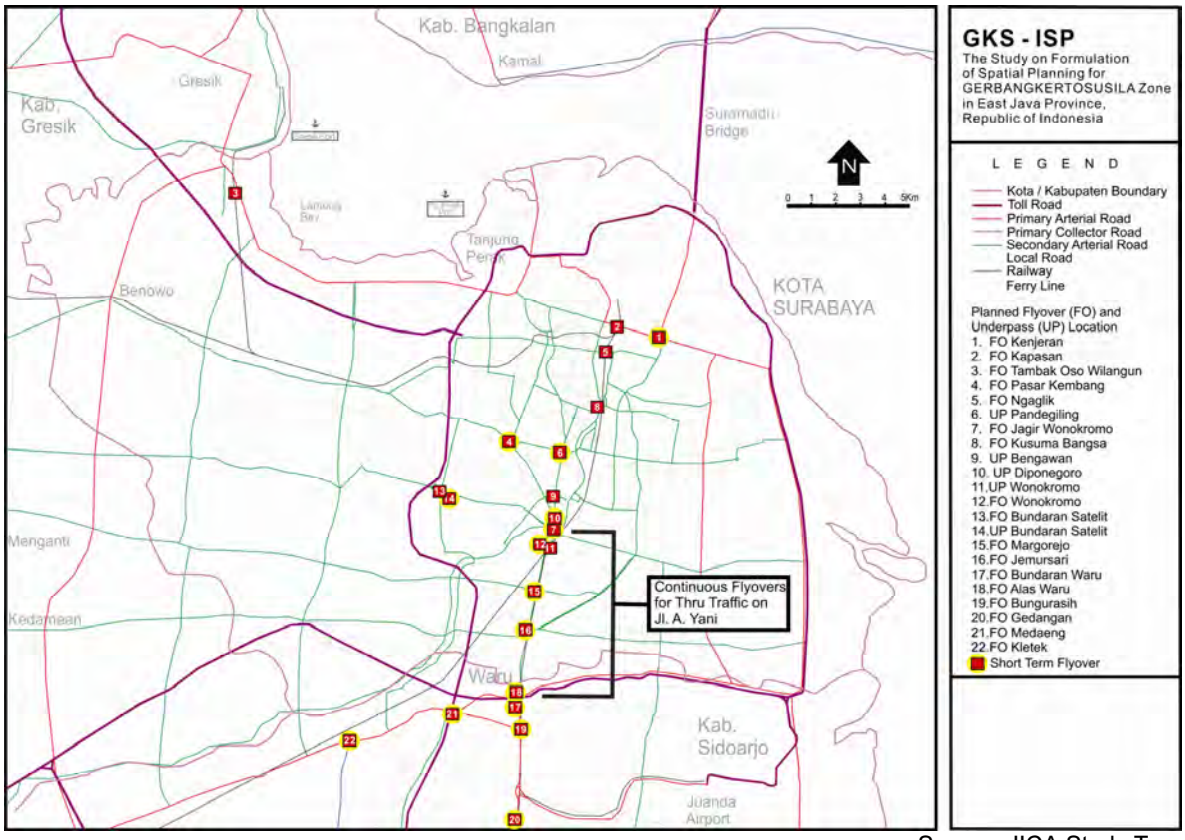
The Study Team has recommended the construction of flyovers and underpasses as an effective countermeasure in solving congestion in major intersections and railway crossings, especially in urban areas. The candidate flyover and underpass projects are listed in Table 8.2.3, and their locations are shown in Figure 8.5.1 (i.e. for Surabaya) and Figure 8.5.2 (i.e. for GKS). These projects will require coordination between relevant agencies because, while some flyovers are to be constructed over the existing railway, there are also plans to elevate some of the railway tracks, as proposed in the public transport development.

If the construction of the WWTP is not implemented soon, a series of flyovers, or underpasses, are alternatively planned for the short term along Project R5c (Jl. A. Yani) to help to smooth traffic flow along the major north-south existing corridor.

Table 8.5.1 List of Flyover/Underpass Projects

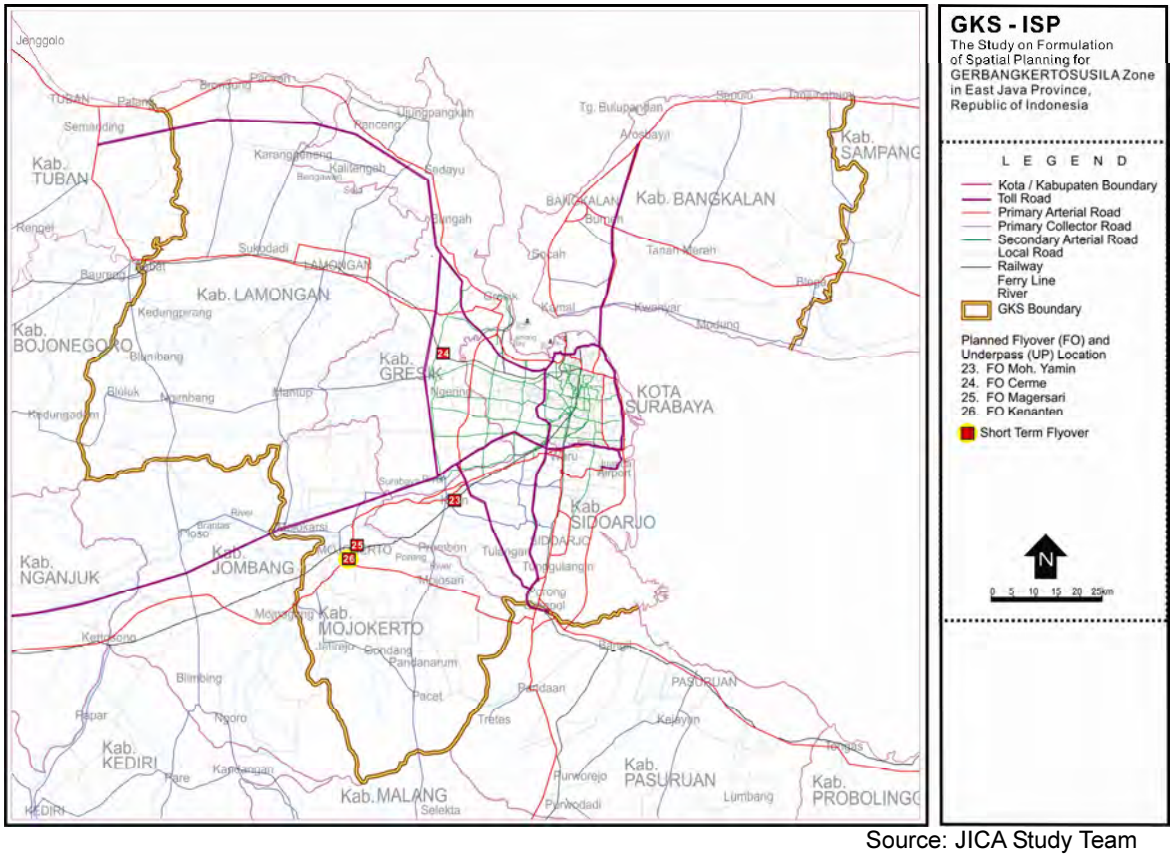
ID	FORM	CORRIDOR	FO / UP Name	Main Roads		Crossing Roads	Remarks	Traffic regulation	Number Of lanes	Related Road Projects	Dev. Term
1	FO	W-E	Kenjeran	Kenjeran		Putro Agung Wetan	To reduce traffic congestion of traffic to/from Suramadu Bridge	2 ways	4	R1b, R6a	Short
2	FO	E-W	Kapasan	Kapasan		Railway at grade	To reduce congestion of at-grade railway crossing (If freight line is to be elevated in the FS of railway development, FO will not be necessary.)	2 ways	4	R1b, W4	Medium
3	FO	E-W	Tambak Oso Wilangun	Tambak Oso Wilangun		Railway at grade	To reduce traffic congestion of at-grade railway crossing	2 ways	4	R1b, W6	Medium
4	FO	N-S	Pasar Kembang	Raya Diponegoro (starts from Kartini)	Pasar Kembang	Pandegiling - Banyu Urip	To reduce traffic congestion at continuous intersections of Jl. Kartini, Jl.Banyu Urip, an Jl. Pandegiling	2 ways	4	R15	Short
5	FO	E-W	Ngaglik	Ngaglik		Railway at grade and viaduct	To reduce congestion of at-grade railway crossing (If freight line is to be elevated in the FS of railway development, FO will not be necessary.)	1 way	2	R1a, W4	Medium
6	UP	W-E	Pandegiling	Pandegiling	Pandegiling	Urip Sumoharjo	To reduce traffic congestion at Pandegiling - Urip Sumoharjo Intersection	2 ways	2	R15, W10, W11	Short
7	FO	W-E	Jagir Wonokromo - Joyoboyo	Jagir Wonokromo	Joyoboyo	Jalan Stasiun Wonokromo, Wonokromo, and railway (at grade)	Crossing Jalan Stasiun Wonokromo and Wonokromo to get West - East corridor connected	2 ways	4	R3a, R5c, W4, W10	Short
8	FO	N-E	Kusuma Bangsa	Kusuma Bangsa	Prof. Dr. Moestopo	Gerbong and railway (at grade)	Reconstruction of the existing road bridge (due to higher clearance requirement for railway electrification) adding another FO to accommodate traffic from Kusuma Bangsa going to Prof. Dr. Moestopo	1 way (From north)	1	R5c, W4	Medium
9	UP	E-W	Bengawan	Bengawan		Jalan Raya Darmo	To get East-West Corridor directly connected	2 ways	2	R4b, W10, W11	Medium
10	UP	N-S	Diponegoro	Wonokromo	Diponegoro	Bottle neck	To reduce traffic congestion in the major intersection	1way	2	R5, W10	Short
11	UP	N-S	Wonokromo	Stasiun Wonokromo	A. Yani	Railway at grade	To reduce traffic congestion of at-grade railway crossing	2 ways	4	R5c, W4	Medium
12	FO	N-S	Wonokoromo or Mayangkara	A. Yani	Wonokromo	Jalan Stasiun Wonokromo	Duplicate of the existing FO for road widening	2 ways	2	R5c, W10	Short
13	FO	N-S	Bundaran Satelit	Dukuh Kupang Barat	Abdul Wahab Siamin	Raya Mayjend. Sungkono	To get Dukuh Kupang Barat and Abdul Wahab Siamin connected as N-S corridor	2 ways	4	R5a, R3a, W11	Medium
14	UP	E-N	Bundaran Satelit	Raya Mayjend. Sungkono	Raya Kupang Indah	-	To reduce traffic congestion entering Bundaran Satelit from Jl. Raya Mayjend. Sungkono (right turn movement)	1 way (From east)	1	R5a, R3a, W11	Short
		E-W			Raya Mayjend. H.R Mohammad	-	To reduce traffic congestion entering Bundaran Satelit from Jl. Raya Mayjend. Sungkono (straight movement)	1 way (From east)	1		
15	FO	N-S	Margorejo	A. Yani		Margorejo Indah	Crossing Margorejo Intersection to accommodate straight traffic along N-S corridor	2 ways	6	R16, R5c	Short
16	FO	N-S	Jemursari	A. Yani		Jemursari	Crossing Bundaran Jemursari to reduce congestion caused by heavy U turn traffic	2 ways	6	R5c, R17	Short
17	FO	N-S	Bundaran Waru	A. Yani		Bundaran Waru	To avoid traffic congestion at grade Bundaran Waru to accommodate straight traffic along N-S corridor	2 ways	6	R5c, R8	Short
18	FO	N-E	Alas Waru	A. Yani	Alas Waru	-	To increase accesibility to the entrance of Juanda toll Road	1 way (From North)	1	R5c	Short
19	FO	N-S	Bungurasih	Letjen S. Parman		Bungurasih T Section	Duplicate of existing FO to accommodate straight traffic along N-S corridor	2 ways	4	R5c, B1, R8	Short
20	FO	N-S	Gedangan	Gedangan Raya	Gedangan Raya	Kyai Haji Mukmin - Ketajen Raya	To reduce congestion at Gedangan Intersection to accommodate straight traffic along N-S corridor	2 ways	4	RS2, R5c	Short
21	FO	W-E	Medaeng	Let. Jend. Sutoyo	Let. Jend. Sutoyo	-	To improve the access of busses and MPU entering Purabaya terminal	1 way (From West)	1	R8, B1	Short
22	FO	N-S	Kletek	Raya Kletek	Sawagaling	Kletek Intersection	To improve access to/from PIA (Pasar Induk Agrobisnis)	2 ways	4	R12	Short
23	FO	N-S	Moh. Yamin	Raya Moh. Yamin	Kyai Mojo	Railway at grade	To reduce traffic congestion of at-grade railway crossing	2 ways	2	RS1, W8	Medium
24	FO	N-S	Cerme	Raya Cerme		Railway at grade	To reduce traffic congestion of at-grade railway crossing	2 ways	2	R9, W5	Medium
25	FO	N-S	Magersari	Mojokerto By Pass		Railway at grade	To reduce traffic congestion of at-grade railway crossing on primary arterial road (Mojokerto Bypass)	2 ways	2	R4a, W8	Medium
26	FO	N-S	Kenanten	Mojokerto By Pass		Railway at grade	To reduce traffic congestion of the major intersection of two national roads (Mojokerto Bypass)	2ways	2	R4a, R10b	Short

Source: JICA Study Team



Source: JICA Study Team

Figure 8.5.1 Flyover/Underpass Projects in Surabaya



Source: JICA Study Team

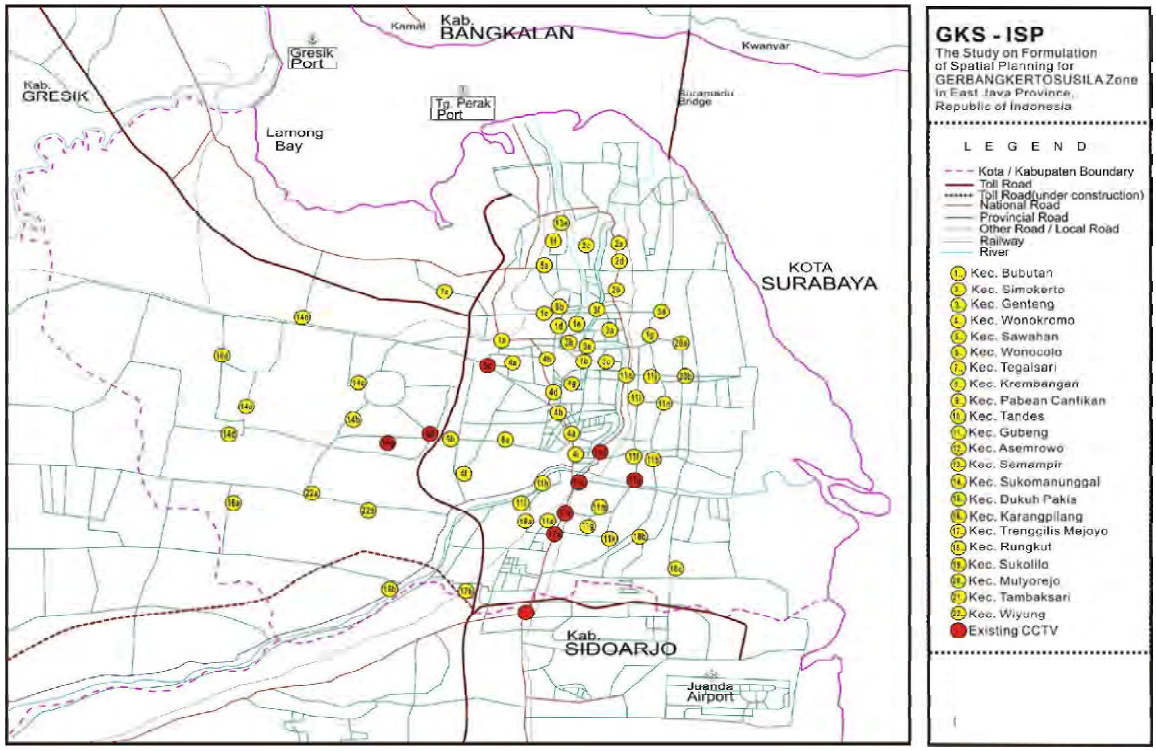
Figure 8.5.2 Flyover/Underpass Projects in GKS

TRAFFIC CONTROL AND MANAGEMENT

9. TRAFFIC CONTROL AND MANAGEMENT

9.1 Traffic Information System

Traffic congestion is becoming more serious in SMA due to the continuing rise in the number of automobiles and motorcycles. An essential element in traffic management is the identification of bottlenecks through such tools as the intelligent transport systems (ITS) technology, optimal traffic signal control, and the provision of traffic information. Traffic conditions in intersections can also be monitored through the ATCS project, currently under way in Surabaya, as shown in Figure 9.1.1. In addition to traffic monitoring, an efficient and inexpensive way of compiling data and disseminating traffic information is also necessary in SMA.



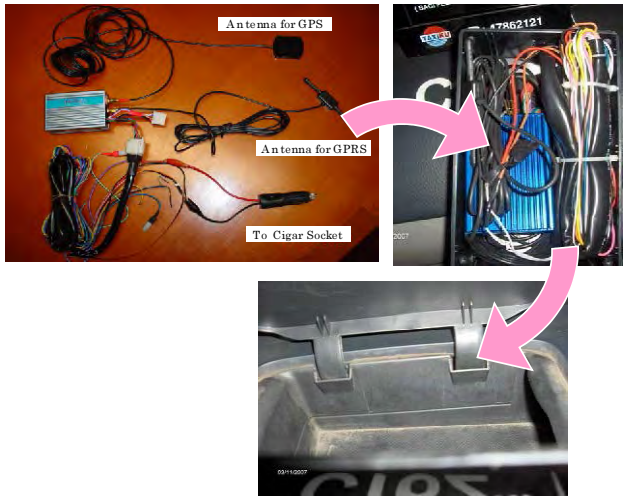
Source: Transportation Agency (Dinas Perhubungan), Kota Surabaya

Figure 9.1.1 Planned ATCS System in Surabaya

In the travel speed survey, average travel speed on each road section was measured by the obtained floating car data. 50 taxis were utilized in the survey, each equipped with a global positioning system (GPS) device (Figure 9.1.2), which automatically collected and measured data on vehicle location, speed, direction, and time information. The collected data were

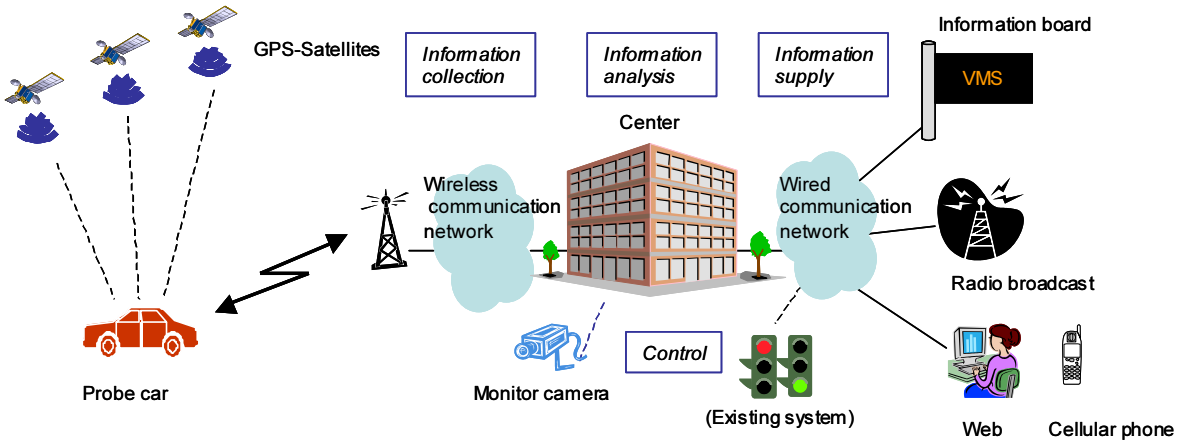
transmitted to the data center every 20 seconds via General Packet Radio Service, or GPRS. The data were collected over a period of one month for the road sections in which the 50 taxis were driven for every hour. Real time information of traffic speed will be available if enough number of such probe cars are to be utilized

The traffic information system as proposed by the Study Team will include probe cars, a central function, and basic information functions. Figure 9.1.3 illustrates the system outline. The in-vehicle unit installed in the "probe car" will have position detection and transmission capabilities to send the GPS data to the Center via wireless network. Taxis will function as probe cars. At present more than 2,000 taxis are operated in Surabaya. The Center will have data processing capabilities in order to make use of the incoming data, and compile data from multiple vehicles to gain a real-time understanding of traffic conditions.



Source: JICA Study Team

Figure 9.1.2 Example of In-Vehicle Unit



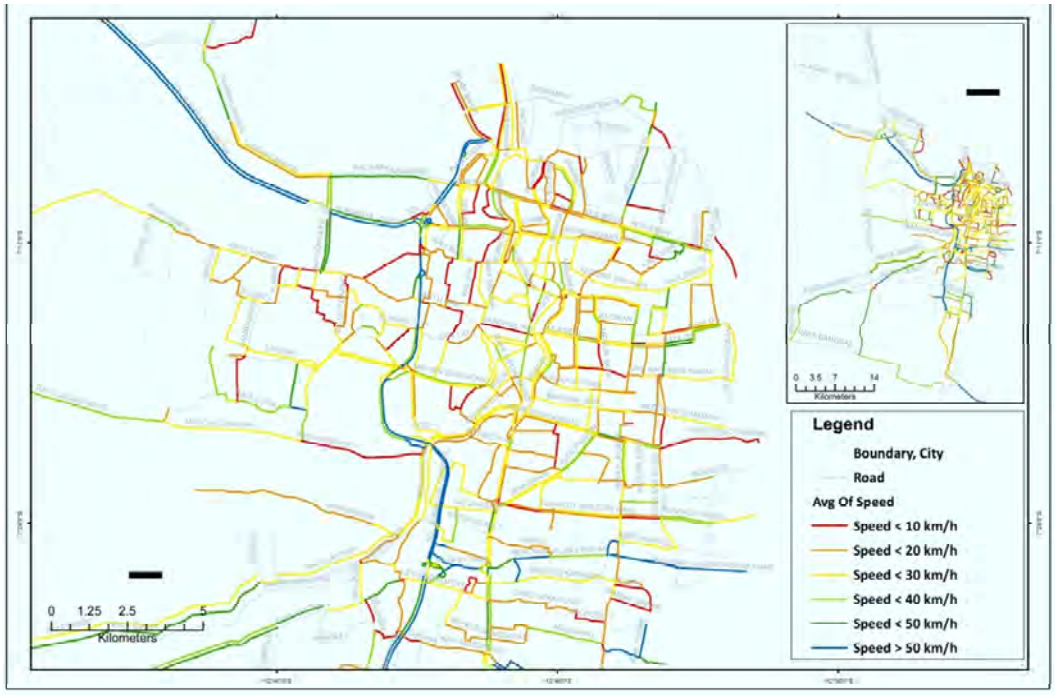
Source: Study on Development of Traffic Information System Aided by Probe Car on Arterial Road Network in Jakarta in the Republic of Indonesia" (JETRO, 2007)

Figure 9.1.3 Traffic Information System Aided by Probe Cars

Average travel time will be calculated for each road segment, after which the average travel speed for the road segment will be estimated. The results will be shown not only on the

variable message signboard (VMS) but also on a color-coded map (graphical information board) (Figure 9.1.4). Information on traffic congestion will also be disseminated via the internet to the general public, while specific information, such as traffic conditions in specific areas, will be provided on-demand for a certain fee for users through SMS, or other means.

The proposed traffic information system will eventually be integrated with the signal control server which will have an interface with existing ATCS to send and receive traffic data effectively for signal control. The signal control that is best suited to the traffic situation will be implemented through this form of dynamic information system.

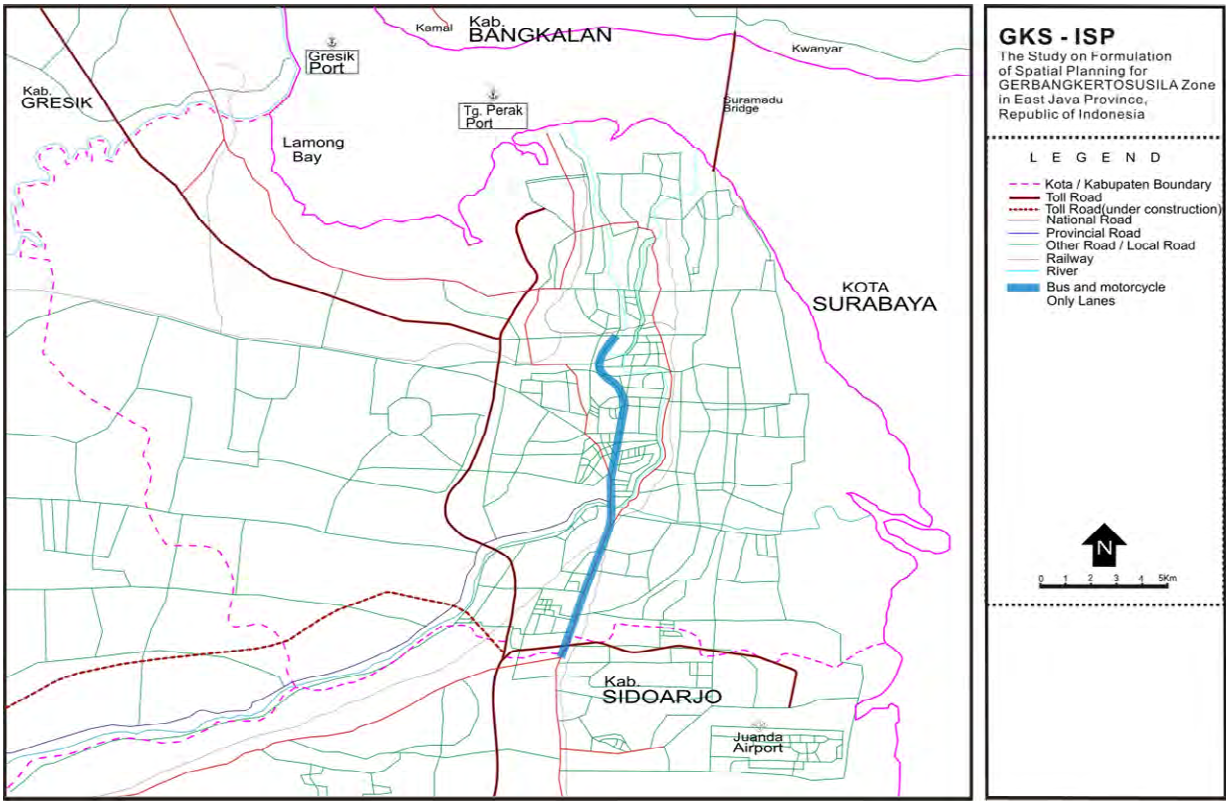


Source: JICA Study Team

Figure 9.1.4 Visual Display of Real-Time Traffic Information (Example)

9.2 Bus and Motorcycle Lanes

Usually in many metropolitan areas, road traffic demand overwhelmingly exceeds road capacities thus causing chronic traffic congestions, especially in CBDs. In the context of urban transportation, public transport is given priority over private vehicles to secure smoother travel for those who use public transport within the limited road space. From the viewpoint of safety and order the current policy of separating motorcycles and public transport from other private automobiles should be maintained. The policy will even be more effective if it is applied in more continuous road sections (Figure 9.2.1), which means considering extending target roads. It may also be necessary to add another lane for motorcycles and buses if motorcycles and buses make frequent stops, or if traffic is unbalanced, as shown in Figure 9.2.2.



Source: JICA Study Team

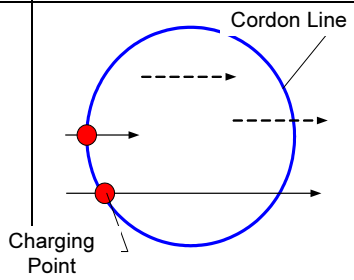
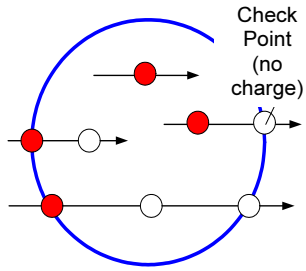
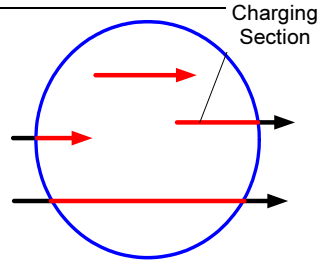
Figure 9.2.1 Current Location of Bus and Motorcycle Lanes

Source: Transportation Agency (Dinas Perhubungan), East Java Province

Figure 9.2.2 Unbalanced Traffic Situation on Bus/Motorcycle Lanes (Jl. A. Yani)

9.3 Electronic Road Pricing (ERP)

Road pricing refers to a measure that limit traffic volume through fees levied on vehicle users using roads located within the city center. It is one way of alleviating congestion and minimizing air pollution caused by excessive volumes of vehicles inside a CBD. Road pricing is currently being considered for implementation in Jakarta through an electronic road pricing (ERP) method. For more direct traffic demand management, the ERP should eventually be applied in Surabaya in the long term. For the long term, as well, the proposed public transport system should be implemented, to serve as a better alternative to private vehicle use. The following three charging methods shown in Figure 9.3.1 are the main road pricing schemes being used in various countries.

Charging Method	Concept Figure	Description
1. Cordon Pricing Eg: Oslo, Norway (1990), ERP in Singapore (1998)		Method where entering vehicles that cross over the cordon line that has been installed around the restricted area are charged a fee. In most cases payment is made every time one crosses over. When the cordoned area is large, it is difficult to accommodate internal traffic.
2. Area Pricing Eg: London(2003.2) ALS in Singapore (1975-98)		Method where in addition to entering vehicles that cross the cordon line, internal traffic within the cordoned area is also charged a fee. Most cases use a prepaid system.
3. Distance-Proportional Charging Eg: Charging heavy vehicles in Switzerland (2001)		Method where fee is charged according to the distance traveled within the restricted area. In Switzerland all large vehicles have an OBU installed, and the fee is calculated according to a vehicle's maximum load, emission characteristics, and distance traveled.

Note: trip that will be charged a fee
trip that will not be charged a fee

Figure 9.3.1 Main Charging Methods

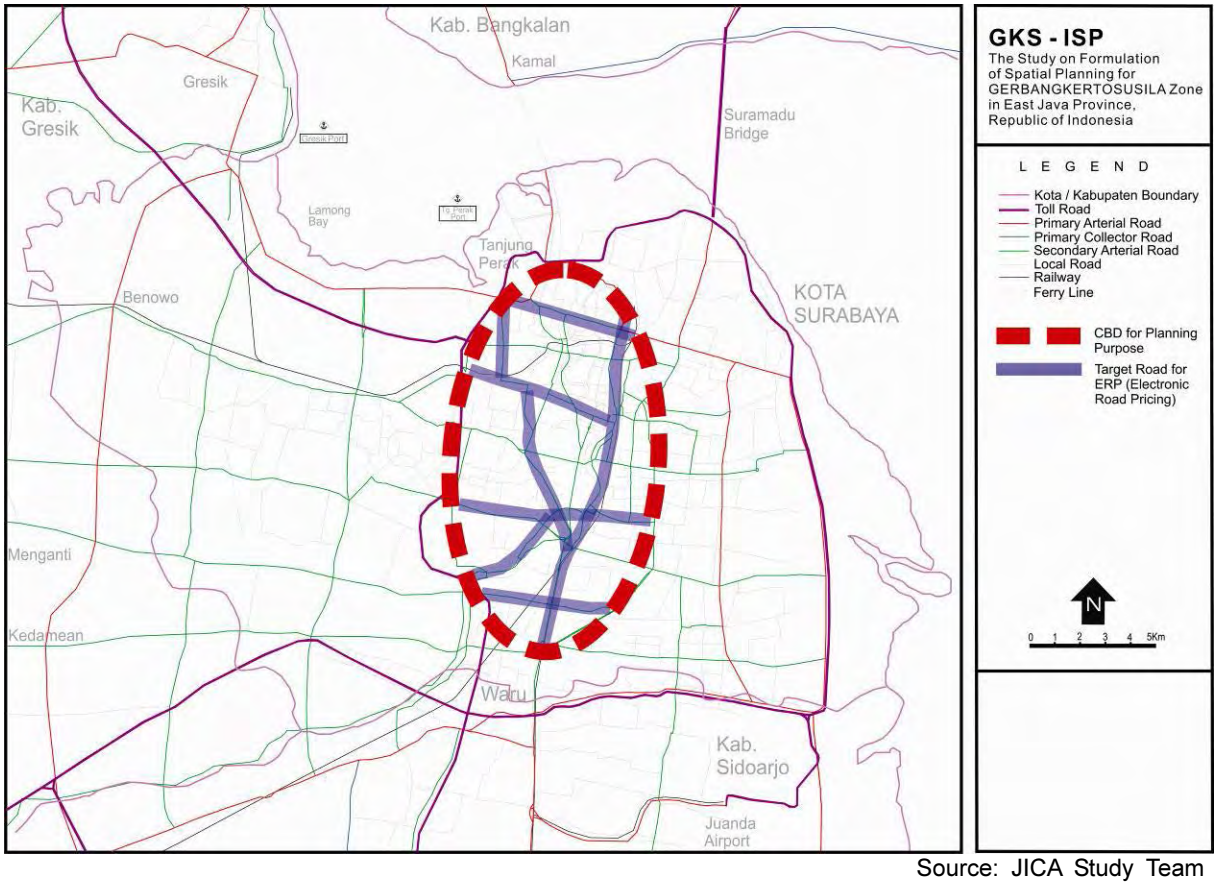
Based on the charging methods described above, the preferable pricing method for Surabaya may be considered as follows:

- Surabaya's road network is characterized by major trunk roads complemented by various small streets and private roads which could be used as bypass routes. Because it requires levying fees at cordon lines, the Cordon Pricing Method, will require the installation of

toll gates on small streets and lead to a tremendous number of gates. And since small streets often function as residential roads, imposing an area pricing on these streets may not be practical since it could restrict the flow of all cars.

- The charging method should have minimal social impacts and should be acceptable to citizens since regional differences may arise due to its effect on areas within and outside the road pricing area and also in terms of access to public transport systems proposed in this Study.

With all things considered, the most ideal charging method for Surabaya would be the "Area Pricing" method limited to major trunk roads. Vehicles traveling on the trunk roads within the CBD, as defined in the travel demand analysis in Section 6.2, will be charged a fee. Toll gates will be installed at certain intervals so that even vehicles traveling relatively short sectors will be charged. A sampling of the ERP targeted roads is presented in Figure 9.3.2. A further study will be necessary to discuss the necessity and technological contents of these approaches as well as to assess environmental, economical, and financial feasibilities.



Source: JICA Study Team

Figure 9.3.2 Example of Target ERP Roads in Surabaya