CHAPTER 28

FUTURE TRAFFIC DEMAND FORECAST FOR TDG

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FUTURE TRAFFIC DEMAND FORECAST OF TDG

28.1 ANALYSES OF TRAFFIC SURVEY RESULTS

This chapter describes the OD survey results. Other traffic survey results were discussed in Chapter 26.

28.1.1 Traffic Characteristics

(1) General

Roadside OD survey was conducted at six (6) stations. A number of samples and sample rate is shown in **Table 28.1-1**.

TABLE 28.1-1 ROADSIDE OD SURVEY STATION AND SAMPLE RATE

No.	Road Name	Location	No. of Sample	AADT	Sample Rate
1	Davao-Surigao Road	Tagum & Mawab Boundary	1090	3899	28.0%
2	Davao-Surigao Road	Davao City & Panabo Boundary	978	1096	8.9%
3	Davao-Bukidnon Road	Calinan & Marilog	743	2977	25.0%
4	Davao-Digos Road	Toril & Sta. Cruz	1045	6811	15.3%
5	Davao-General Santos Road	Malugon & Gen. Santos Boundary	1002	7244	13.8%
6	General Santos-Cotabato Road	Gen. Santos & Polomolok Boundary	1014	6956	14.6%
		Average	**982**	**6475**	**15.1%**

(2) Traffic Characteristics

Trip purpose is estimated through the OD data as illustrated in **Figure 28.1.1-1**. Of the total vehicle trips 63% were 'Business' trips, 28% were 'Private' trips.

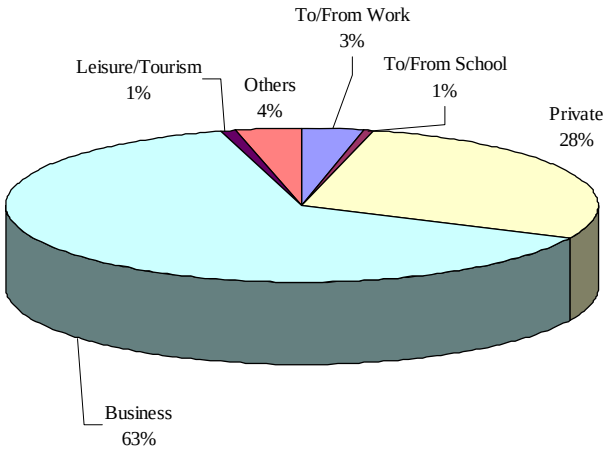


FIGURE 28.1.1-1 TRIP PURPOSE

(3) Average Number of Passengers by Vehicle Category

Vehicle OD is linked to passenger OD through the average number of passenger on board by type of vehicles as the vehicle occupancy rate. **Table 28.1.1-2** shows the average number of passenger on board by type of vehicles.

TABLE 28.1.1-2 AVERAGE NUMBER OF PASSENGERS BY VEHICLE CATEGORY AND BY ROAD

(Person/vehicle, including Driver)

Road Name	Location	Vehicle Type						
		Car / Van / Pup	Jeepney	Mini-Bus	Large-Bus	2-Axle Truck	3-Axle Truck	Truck Trailer
1. Davao-Surigao Road	Tagum & Mawab Boundary	4.9	19.8	32.2	37.6	2.6	4.1	2.3
2. Davao-Surigao Road	Davao City & Panabo Boundary	4.1	18.0	38.5	50.5	2.5	2.7	2.5
3. Davao-Bukidnon Road	Calinan & Marilog	3.9	18.3	28.5	50.1	2.7	2.8	2.7
4. Davao-Digos Road	Toril & Sta. Cruz	5.0	17.0	-	52.9	2.7	3.0	3.5
5. Davao-General Santos Road	Malugon & Gen Santos Boundary	5.0	20.8	24.9	41.1	4.5	2.5	3.3
6. General Santos-Cotabato Road	Gen Santos & Polomolok Boundary	5.7	17.6	36.3	49.9	2.9	2.7	2.4
Average		**5.1**	**18.4**	**32.2**	**46.6**	**3.2**	**2.9**	**2.8**

The survey results of 5.1 passengers for Car and 18.4 passenger for Jeepney, 44.8 passengers for Bus are used in this study (see **Table 28.1.1-3**).

TABLE 28.1.1-3 AVERAGE NUMBER OF PASSENGERS ON BOARD BY VEHICLE CATEGORY

Vehicle Category	Type of Vehicles	Average No. of Passengers (Person / veh.)
Passenger Car	Car/Taxi/Van	5.1
Jeepney	Jeepney	18.4
Bus	Mini-Bus, Large-Bus	44.8
Truck	2-Axle Truck, 3-Axle Truck, Truck-Trailer	2.9

(4) Traffic Type of Commodity

Three representative commodity items were selected in this study. They are Agri./ Fishery / Forestry Sectors, Mining/Construction Sectors, and Manufacturing Sectors. Other commodities not included in the first two categories are considered to include in the third. The results of total commodity volume by road are summarized in **Table 28.1.2-4**.

TABLE 28.1.1-4 TRAFFIC BY COMMODITY TYPE BY ROAD

(ton/day)

Station	Agri./ Fishery / Forestry	Mining/ Construction	Manufacturing	Total
1. Davao-Surigao Road	35,731.9	14,938.5	5,104.2	55,774.6
2. Davao-Surigao Road	35,354.8	16,054.2	11,138.3	62,547.3
3. Davao-Bukidnon Road	10,315.6	13,659.4	3,004.0	26,978.9
4. Davao-Digos Road	36,835.2	16,820.8	10,268.2	63,924.3
5. Davao-Gen Santos Road	8,810.6	4,209.8	2,398.7	15,419.1
6. Gen Santos-Cotabato Rd	17,665.6	4,886.7	8,779.6	31,331.9
Total	**144,713.7**	**70,569.3**	**40,693.0**	**255,976.0**
Share (%)	**56.5%**	**27.6%**	**15.9%**	**100%**

(5) Average Loading by Type of Truck

Vehicle OD is linked to commodity OD through the average weight loaded by type of truck. **Table 28.1.1-5** shows the average weight loaded by type of truck.

TABLE 28.1.1-5 AVERAGE LOADING BY TYPE OF TRUCK

(unit;kg)

	Agri./ Fishery / Forestry	Mining/ Construction	Manufacturing	Gross Average Loading*	Net Average Loading*
2-Axle Truck	3,529	6,249	1,973	3,731	2,396
3-Axle Truck	10,232	14,032	7,252	10,428	8,228
Truck-Trailer	16,548	19,158	11,636	16,008	10,977
Weighted Mean TRUCK	**7,146**	**9,290**	**4,026**	**6,831**	**5,081**

* Empty trucks are excluded.
** Empty trucks are included.

The average loaded volume by 2-Axle truck is 2.3 tons, 8.2 tons for 3-alxle truck and 10.9 for truck-trailer as shown in **Table 28.1.1-5**. The weighted mean of the survey result of 5.0 tons for truck is used in this study.

28.1.2 Present OD Table

(1) Procedure of Estimating the Present OD Tables

(a) The maximum entropy method was applied to obtain the OD tables of aggregated 4 vehicle types. For the application of the maximum entropy method, it is necessary to utilize the traffic volumes by type of vehicle crossing the zones of the network.

(b) The traffic volumes crossing zone border were obtained from the traffic counting survey results and supplemented by DPWH survey records.

(c) Under the process described above, the maximum entropy method was applied and the OD tables by vehicle category (Car, Jeepney, Bus and Truck) were produced. All Vehicle OD, Passenger car (including Jeepney and Bus) OD and Truck OD (large zone) are shown in **Tables 28.1.2-1**, **28.1.2-2** and **28.1.2-3**.

(d) The average vehicle passenger occupancy rates and loading rates by commodity category obtained from the roadside interview survey were then applied to each OD pair by vehicle classification, and the passengers and commodity for the OD pairs were obtained.

(e) Passenger OD of large zoning is shown in **Table 28.1.2-4** and total commodity trips in **Table 28.1.2-5**.

(f) For the examination of the accuracy of OD tables, the established All vehicle OD was assigned on the present road network. **Figure 28.1.2-1** shows the traffic volumes which resulted through traffic assignment procedure of the OD tables in the road network. The differences between surveyed traffic volumes and assigned volumes are presented in **Figures 28.1.2-2**. The assigned volumes in this manner show good consistency to the observed traffic.

(2) OD Tables and Traffic Flow

The concluded OD trips are presented in tables and the corresponding traffic flow is shown in figures. All of OD tables were obtained on small zoning base, and aggregated to large zoning base. Traffic zoning system is shown in **Table 28.2.1-1**. ODs trips presented in the report are those of All vehicles, Passenger Car, Truck and each of them is assigned graphically on the road network as traffic flow.

TABLE 28.1.2-1 ALL VEHICLES OD (LARGE ZONES)

(Vehicle)

	DAVAO CITY (Central)	DAVAO CITY (North	DAVAO CITY (Westl)	DAVAO CITY (Northwest)	CITY OF TAGUM (Capital)	CITY OF DIGOS, SANTA CRUZ	SANTA MARIA, MALALAG	ALABEL	GENERAL SANTOS CITY	Outside of Study Area	Total
DAVAO CITY (Central)	229,064	15,347	8,776	524	2,989	1,029	21	8	2,941	2,956	263,655
DAVAO CITY (North	15,121	43,978	1,563	89	838	275	0	9	619	691	63,183
DAVAO CITY (Westl)	9,067	1,634	481	515	348	146	0	0	243	354	12,788
DAVAO CITY (Northwest)	645	157	578	29	17	12	0	0	38	54	1,530
CITY OF TAGUM (Capital)	2,557	1,273	183	43	702	145	0	0	425	806	6,134
CITY OF DIGOS, SANTA CRUZ	1,204	247	192	2	306	760	0	0	852	2,937	6,500
SANTA MARIA, MALALAG	26	16	16	0	0	0	0	0	40	0	98
ALABEL	5	0	0	0	0	0	96	39	655	27	822
GENERAL SANTOS CITY	2,926	533	379	38	375	816	43	483	42,209	1,988	49,790
Outside of Study Area	3,296	865	347	140	962	4,190	0	32	2,076	644	12,552
Total	263,911	64,050	12,515	1,380	6,537	7,373	160	571	50,098	10,457	417,052

TABLE 28.1.2-2 PASSENGER CAR (INCLUDING JEEPNEY AND BUS) OD (LARGE ZONES)

(Vehicle)

	DAVAO CITY (Central)	DAVAO CITY (North	DAVAO CITY (Westl)	DAVAO CITY (Northwest)	CITY OF TAGUM (Capital)	CITY OF DIGOS, SANTA CRUZ	SANTA MARIA, MALALAG	ALABEL	GENERAL SANTOS CITY	Outside of Study Area	Total
DAVAO CITY (Central)	206,923	14,258	7,051	512	2,451	997	11	8	2,444	2,339	236,994
DAVAO CITY (North	13,942	35,994	1,045	84	368	252	0	0	452	414	52,551
DAVAO CITY (Westl)	7,012	1,028	303	387	197	111	0	0	142	174	9,354
DAVAO CITY (Northwest)	611	80	450	19	13	2	0	0	30	54	1,259
CITY OF TAGUM (Capital)	2,187	545	150	39	511	120	0	0	234	507	4,293
CITY OF DIGOS, SANTA CRUZ	1,170	237	169	2	281	568	0	0	678	2,363	5,468
SANTA MARIA, MALALAG	26	16	16	0	0	0	0	0	40	0	98
ALABEL	0	0	0	0	0	0	96	0	509	12	617
GENERAL SANTOS CITY	2,292	394	324	34	171	760	18	348	37,349	1,456	43,146
Outside of Study Area	2,830	375	301	121	526	3,513	0	0	1,481	512	9,659
Total	236,993	52,927	9,809	1,198	4,518	6,323	125	356	43,359	7,831	363,439

TABLE 28.1.2-3 TRUCK OD (LARGE ZONES)

(Vehicle)

	DAVAO CITY (Central)	DAVAO CITY (North	DAVAO CITY (Westl)	DAVAO CITY (Northwest)	CITY OF TAGUM (Capital)	CITY OF DIGOS, SANTA CRUZ	SANTA MARIA, MALALAG	ALABEL	GENERAL SANTOS CITY	Outside of Study Area	Total
DAVAO CITY (Central)	22,141	1,089	1,725	12	538	32	10	0	497	617	26,661
DAVAO CITY (North	1,179	7,984	518	5	470	23	0	9	167	277	10,632
DAVAO CITY (Westl)	2,055	606	178	128	151	35	0	0	101	180	3,434
DAVAO CITY (Northwest)	34	77	128	10	4	10	0	0	8	0	271
CITY OF TAGUM (Capital)	370	728	33	4	191	25	0	0	191	299	1,841
CITY OF DIGOS, SANTA CRUZ	34	10	23	0	25	192	0	0	174	574	1,032
SANTA MARIA, MALALAG	0	0	0	0	0	0	0	0	0	0	0
ALABEL	5	0	0	0	0	0	0	39	146	15	205
GENERAL SANTOS CITY	634	139	55	4	204	56	25	135	4,860	532	6,644
Outside of Study Area	466	490	46	19	436	677	0	32	595	132	2,893
Total	26,918	11,123	2,706	182	2,019	1,050	35	215	6,739	2,626	53,613

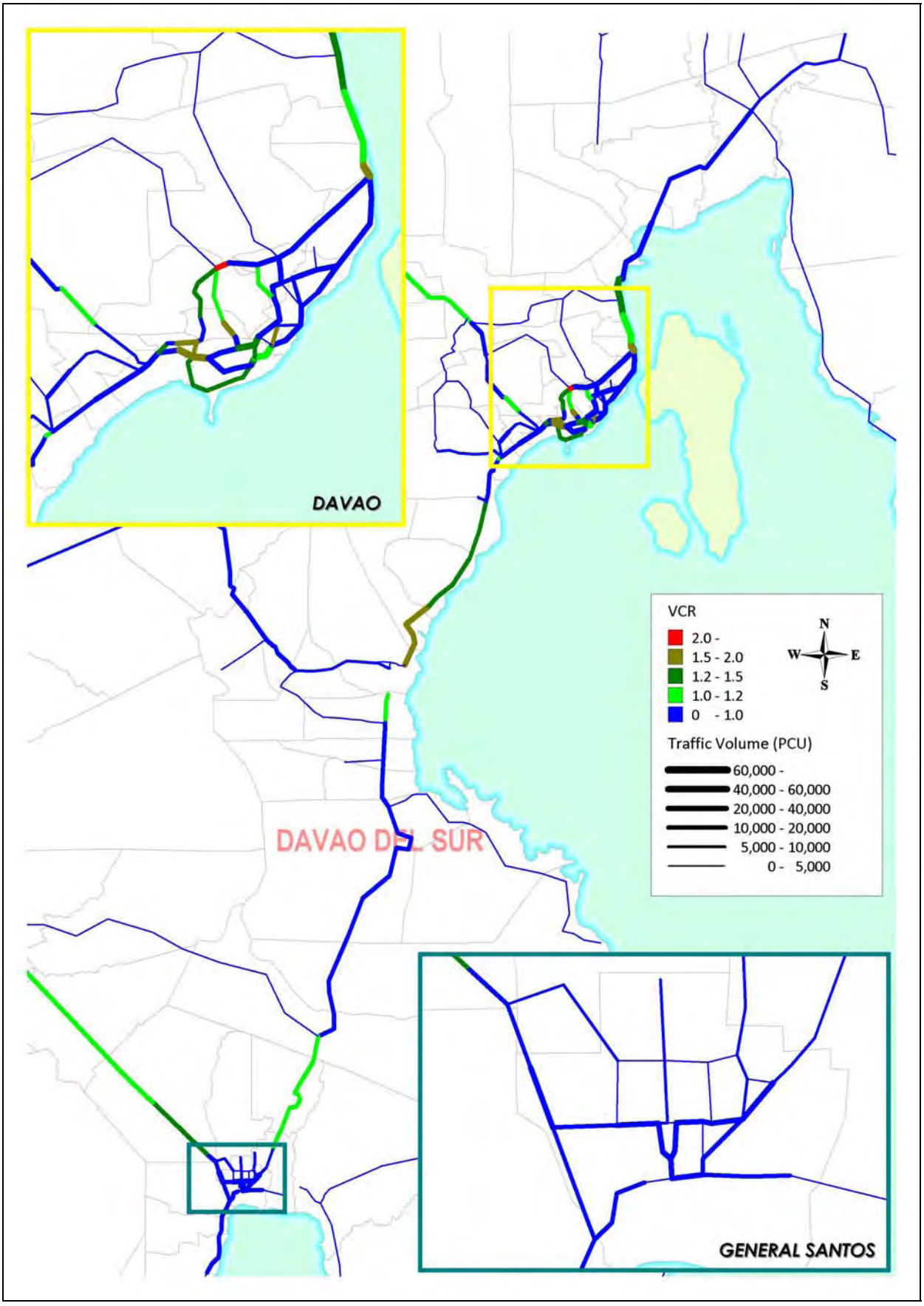


FIGURE 28.1.2-1 PRESENT TRAFFIC FLOW

TABLE 28.1.2-4 PASSENGER OD (LARGE ZONES)

(Person)

	DAVAO CITY (Central)	DAVAO CITY (North	DAVAO CITY (Westl)	DAVAO CITY (Northwest)	CITY OF TAGUM (Capital)	CITY OF DIGOS, SANTA CRUZ	SANTA MARIA, MALALAG	ALABEL	GENERAL SANTOS CITY	Outside of Study Area	Total
DAVAO CITY (Central)	2,119,039	154,905	76,882	5,957	39,103	12,974	493	41	37,072	44,179	2,490,642
DAVAO CITY (North	152,095	406,828	6,154	694	3,326	1,950	0	0	4,876	4,762	580,685
DAVAO CITY (Westl)	76,884	5,535	2,596	4,328	1,736	819	0	0	1,070	1,896	94,864
DAVAO CITY (Northwest)	6,560	727	6,046	97	133	10	0	0	193	1,400	15,166
CITY OF TAGUM (Capital)	36,415	3,524	925	265	5,843	1,342	0	0	1,752	7,955	58,020
CITY OF DIGOS, SANTA CRUZ	16,111	2,020	1,261	10	2,204	5,581	0	0	13,836	21,282	62,304
SANTA MARIA, MALALAG	530	82	82	0	0	0	0	0	204	0	897
ALABEL	0	0	0	0	0	0	490	0	5,083	61	5,634
GENERAL SANTOS CITY	32,833	3,680	4,002	200	2,173	13,599	92	2,546	383,566	33,534	476,224
Outside of Study Area	60,096	3,518	1,575	750	4,978	36,603	0	0	33,247	3,595	144,362
Total	2,500,561	580,818	99,522	12,301	59,495	72,878	1,074	2,587	480,898	118,663	3,928,799

TABLE 28.1.2-5 COMMODITY OD (LARGE ZONES)

(Tons)

	DAVAO CITY (Central)	DAVAO CITY (North	DAVAO CITY (Westl)	DAVAO CITY (Northwest)	CITY OF TAGUM (Capital)	CITY OF DIGOS, SANTA CRUZ	SANTA MARIA, MALALAG	ALABEL	GENERAL SANTOS CITY	Outside of Study Area	Total
DAVAO CITY (Central)	168,272	8,276	13,110	91	4,089	243	76	0	3,777	4,689	202,624
DAVAO CITY (North	8,960	60,678	3,937	38	3,572	175	0	68	1,269	2,105	80,803
DAVAO CITY (Westl)	15,618	4,606	1,353	973	1,148	266	0	0	768	1,368	26,098
DAVAO CITY (Northwest)	258	585	973	76	30	76	0	0	61	0	2,060
CITY OF TAGUM (Capital)	2,812	5,533	251	30	1,452	190	0	0	1,452	2,272	13,992
CITY OF DIGOS, SANTA CRUZ	258	76	175	0	190	1,459	0	0	1,322	4,362	7,843
SANTA MARIA, MALALAG	0	0	0	0	0	0	0	0	0	0	0
ALABEL	38	0	0	0	0	0	0	296	1,110	114	1,558
GENERAL SANTOS CITY	4,818	1,056	418	30	1,550	426	190	1,026	36,936	4,043	50,494
Outside of Study Area	3,542	3,724	350	144	3,314	5,145	0	243	4,522	1,003	21,987
Total	204,577	84,535	20,566	1,383	15,344	7,980	266	1,634	51,216	19,958	407,459

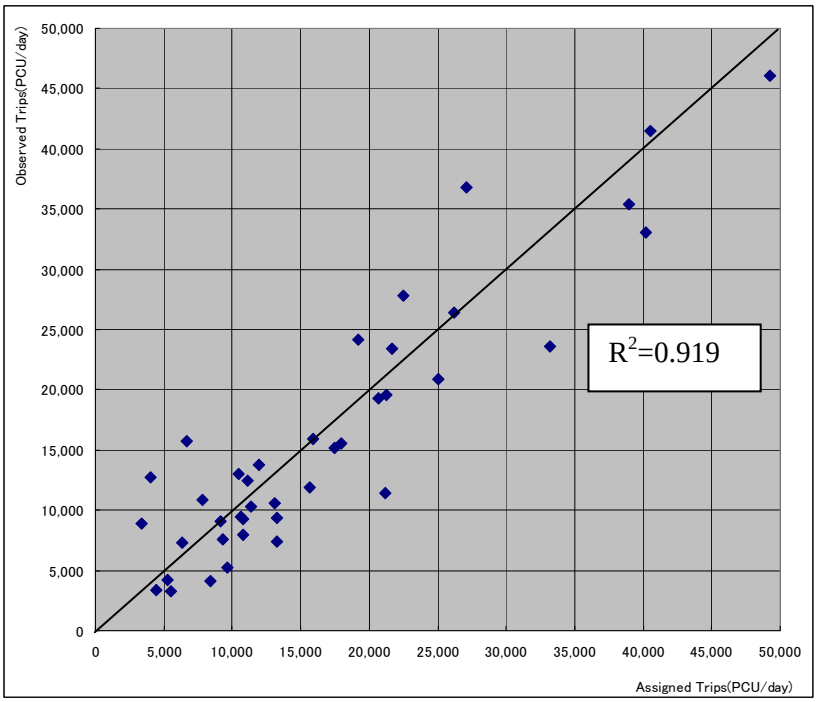


FIGURE 28.1.2-2 ASSIGNED AND OBSERVED TRIPS

28.1.3 Desire Line

Desire line of all vehicles, Passenger Car, Public Transport (Jeepney and Bus) and Truck are illustrated in **Figure 28.1.3-1.**

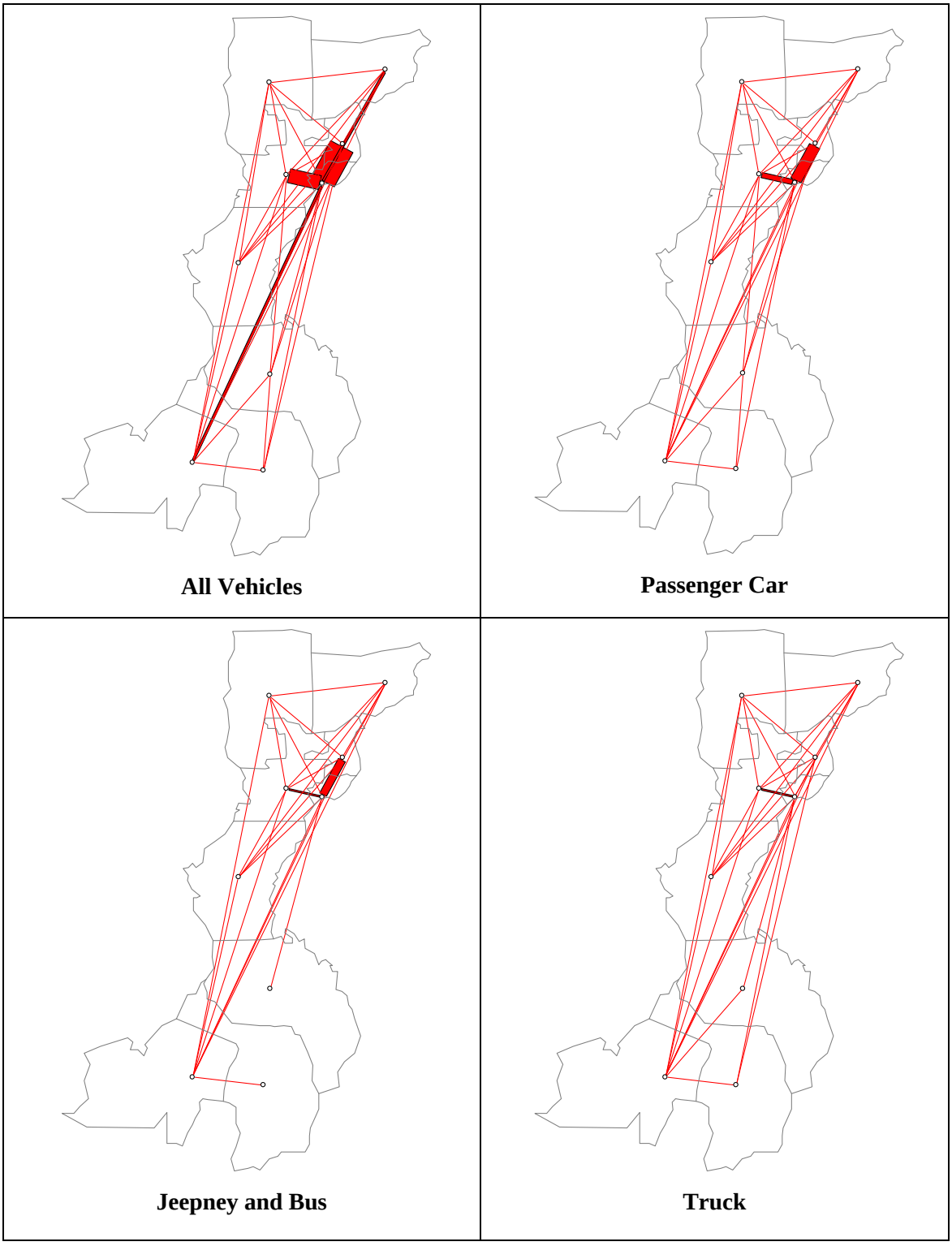


FIGURE 28.1.3-1 DESIRE LINE (YEAR 2009)

28.2 TRAFFIC DEMAND FORECAST

28.2.1 Development Of Demand Model

(1) Basic Idea of Model Development

Basic idea for the model development is as same as applied in Section 22.2.

- The forecast of future traffic demand is done by applying the conventional four-step methodology; namely: trip generation and attraction model, trip distribution model, modal split model, and traffic assignment model.
- However, modal split model is not applied because it is not necessary to consider transferring between modes.
- Trip generation and attraction model, and trip distribution model should be developed for vehicle trips corresponding to the type of vehicle: passenger car, jeepney, bus and truck. Therefore, four different OD matrices will be separately estimated for the future.
- The target year of future traffic demand forecast is the year of 2030, and the forecast at 2020 is also carried out.

The model development and forecasting procedure are shown in **Figure 28.2.1-1**.

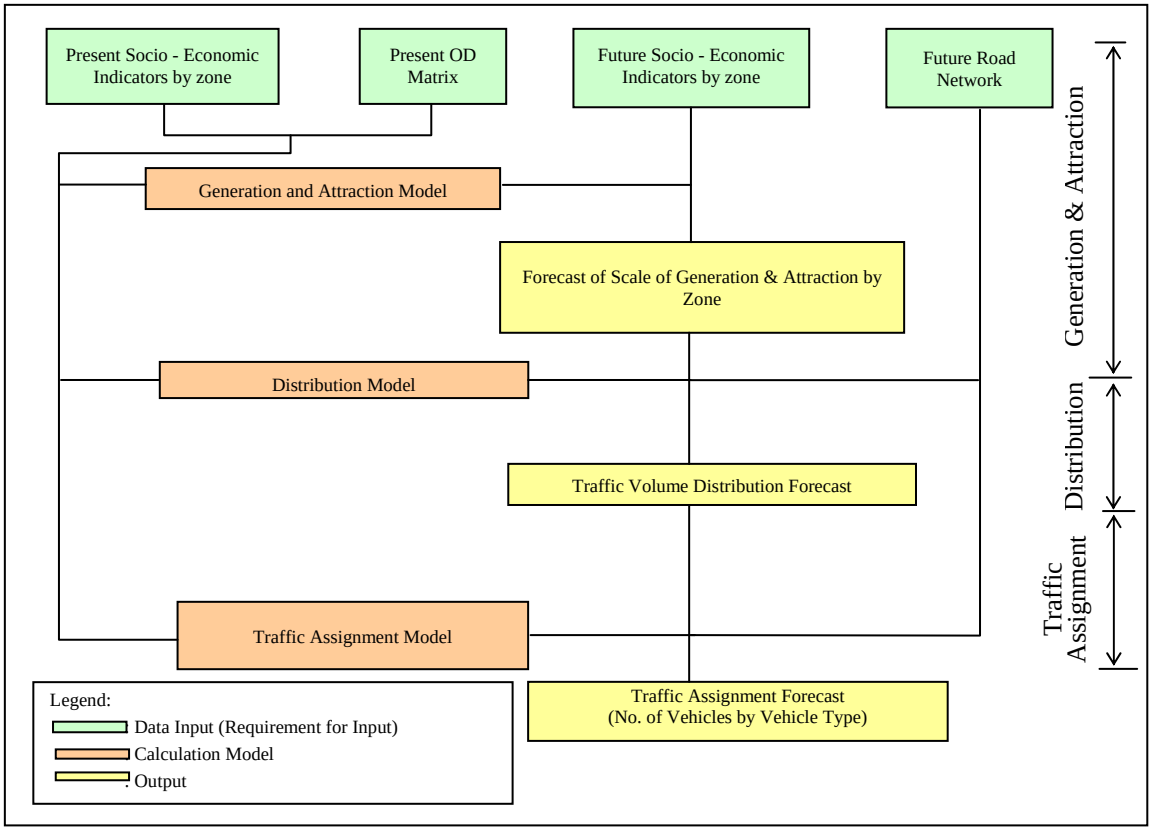


FIGURE 28.2.1-1 TRAFFIC DEMAND FORECAST PROCEDURE

(2) Zone System in the Study Area

The model predicts trips over the road network based on the attributes of traffic analysis zones (TAZ). Zonal Attributes used in trip generation including population and employment. A key component of the model development process was the development of zone system to cover the Study Area.

The study area is defined from zone 1 to 54 in traffic zoning system, and outside the study area is defined from zone 55 and 122. (See **Table 28.2-1** and **Figure 28.2-2**)

TABLE 28.2-1 (1) TRAFFIC ZONING SYSTEM (STUDY AREA)

Table Zoning System in Study Area

No.	Zone Code	District(Balangay)	City/Municipality	Province	Region
1	11101	POBLACION	DAVAO CITY	DAVAO DEL SUR	REGION 11
2	11102	TALOMO1(MA-A, MATINA PANGI)			
3	11103	TALOMO2(BUCANA, MATINA CROSSING, MATINA APLAYA)			
4	11104	TALOMO3(TALOMO)			
5	11105	TALOMO4(BAGO GALLERA, BALIOK, DUMOY)			
6	11106	TALOMO5(OTHERS)			
7	11107	AGDAO			
8	11108	BUHANGIN1(BUHANGIN)			
9	11109	BUHANGIN2(PAMPANGA)			
10	11110	BUHANGIN3(SASA)			
11	11111	BUHANGIN4(OTHERS)			
12	11112	BUNAWAN1(PANACAN)			
13	11113	BUNAWAN2(ILANG,MUDIANG)			
14	11114	BUNAWAN3(MAHAYAG, TIBUNGCO,GATUNGAN)			
15	11115	BUNAWAN4(BUNAWAN, SAN ISIDRO, LASANG)			
16	11116	PAQUIBATO			
17	11117	BAGUIO			
18	11118	CALINA			
19	11119	MARILOG			
20	11120	TORIL1(TORIL, LIZADA, DALIAO)			
21	11121	TORIL2(OTHERS)			
22	11122	TUGBOK			
23	11201		BANSALAN		
24	11202		CITY OF DIGOS		
25	11203		HAGONOY		
26	11204		KIBLAWAN		
27	11205		MAGSAYSAY		
28	11206		MALALAG		
29	11207		MALITA		
30	11208		MATANAO		
31	11209		PADADA		
32	11210	Zone-1(CORONON, SINORON, ZONE I(POB.),ZONE II(POB.), ZONE III(POB.), ZONE IV(POB.))	SANTA CRUZ		
33	11211	Zone-2(BATO, MATUTUNGAN, MELILIA, SALIDUCON, SIBULAN, TAGABULI, TIBOLO, TUBAN)			
34	11212	Zone-3(ASTORGA, DARONG, JOZE RIZAL)			
35	11213		SANTA MARIA		
36	11214		SULOP		
37	11301		CARMEN	DAVAO DEL NORTE	
38	11302	Zone-1(CAGANGOHAN, GREDU (POB.), J.P.LAUREL, NEW PANDAN (POB.), SALVACION, SAN FRANCISCO (POB.), SAN VICENTE, SANTO NINO (POB.), SAN PEDRO)	CITY OF PANABO, SAN ISDRO		
39	11303	Zone-2(A.O. FLOIRENDO, DATU ABDUL DADIA, DAPCO, LOWER PANAGA (ROXAS), MANAY, NANYO, NEW MALAGA(DALISAY), NEW MALITBOG, NEW VISAYAS, QUEZON, SINDATON, SOUTHERN DAVAO,TIBUNGOL)			
40	11304	Zone-3(BUENAVISTA, CACAO, CONSOLACION, KASILAK, KATIPUNAN, KATUALAN, KAUSWAGAN, KIOTOY, LITTLE PANAY, MABUNAO, MADUAO, SAN NICOLAS, SAN ROQUE, SANTA CRUZ, TAGPORE, UPPER LICANAN)			
41	11305		CITY OF TAGUM (Capital)		
42	11306		BRAULIO E. DUJALI		
43	12101	Zone-1(BULA, DADIANGAS EAST, DADIANGAS NORTH, DADIANGAS SOUTH, DADIANGAS WEST,LAGAO,SAN ISIDRO, CITY HEIGHTS)	GENERAL SANTOS CITY	SOUTH COTABATO	REGION 12
44	12102	Zone-2(TINAGACAN, UPPER LABAY, BATOMELONG, OLYMPOG)			
45	12103	Zone-3(CONEL, MABUHAY)			
46	12104	Zone-4(BALUAN, BUAYAN, KATANGAWAN, LIGAYA)			
47	12105	Zone-5(LABANGAI, SINAWAL, APOPONG)			
48	12106	Zone-6(SAN JOSE,CALUMPANG, FATIMA)			
49	12107	Zone-7(TAMBLER, SIGUEL)			
50	12201		POLOMOLOK		
51	12202		T'BOLI		
52	12301		ALABEL	SARANGANI	
53	12302		MALUNGON		
54	12303		MALAPATAN		

TABLE 28.2-1 (2) TRAFFIC ZONING SYSTEM (OUTSIDE THE STUDY AREA)

Table Zoning System in Study Area

No.	Zone Code	District(Balangay)	City/Municipality	Province	Region
55	11215		JOSE ABAD SANTOS	DAVAO DEL SUR	REGION 11
56	11216		DON MARCELINO		
57	11307		ASUNCION (SAUG)	DAVAO DEL NORTE	
58	11308		KAPALONG		
59	11309		NEW CORELLA		
60	11311		SANTO TOMAS		
61	11312		TALAINGOD		
62	11401		LAAK (SAN VICENTE)	COMPOSTELA VALLEY	
63	11402		MONTEVISTA		
64	11403		MONKAYO		
65	11404		MAWAB,NABUNTURAN (Capital)		
66	11405		COMPOSTELA		
67	11406		MARAGUSAN (SAN MARIANO) ,NEW BATAAN		
68	11407		MABINI (DOÑA ALICIA) ,MACO		
69	11408		PANTUKAN		
70	11501		CITY OF MATI ,TARRAGONA	DAVAO ORIENTAL	
71	11502		BANAYBANAY,LUPON		
72	11503		GOVERNOR GENEROSO,SAN ISIDRO		
73	11504		CARAGA,MANAY		
74	11505		BAGANGA,CATEEL, BOSTON		
75	12203		BANGA	SOUTH COTABATO	REGION 12
76	12204		CITY OF KORONADAL (Capital)		
77	12205		NORALA		
78	12206		SURALLAH		
79	12207		TAMPAKAN		
80	12208		TANTANGAN		
81	12209		TUPI		
82	12210		SANTO NIÑO		
83	12211		LAKE SEBU		
84	12301		LIBUNGAN, PIGKAWAYAN, ALEOSAN, MIDSAYAP, PIKIT, ALAMADA, BANISILAN, CARMEN	COTABATO (NORTH COTABATO)	
85	12302		KABACAN, MATALAM		
86	12303		M'LANG, TULUNAN		
87	12304		ANTIPAS, PRESIDENT ROXAS		
88	12305		KADAPAWAN CITY		
89	12306		MAKILALA		
90	12307		MAGPET		
91	12308		ARAKAN		
92	12404		MAITUM	SARANGANI	
93	12405		KIAMBA		
94	12406		MASSIM		
95	12407		GLAN		
96	12500			SULTAN KUDARAT	
97	13101		LA PAZ, LORETO, VERUELA	AGUSAN DEL SUR	REGION 13
98	13102		BUNAWAN, ROSARIO, SANTA JOSEFA, TRNTO		
99	13103		ESPERANZA, SAN LUIS, TALACOGON,		
100	13104		CITY OF BAYUGAN, PROSPERIDAD, SIBAGAT, SAN FRANCISCO		
101	13200			AGUSAN DEL NORTE	
102	13300			SURIGAO DEL NORTE	
103	13400			SURIGAO DEL SUR	
104	9100			ZANBOANGA DEL NOR	REGION 9
105	9200			ZAMBOANGA DEL SUR	
106	9300			ZAMBOANGA SIBUGAY	
107	10101		BAUNGON, LIBONA, TALAKAG	BUKIDNON	REGION 10
108	10102		IMPASUG-ONG, MALITBOG, MANOLO FORTICH, SUMILAO		
109	10103		MALAYBALAY CITY		
110	10104		LANTAPAN, VALENCIA		
111	10105		KALILANGAN, PANGANTUCAN		
112	10106		DON CARLOS, MARAMAG		
113	10107		KITAOTAO, QUEZON		
114	10108		CABANGLASAN, SAN FERNANDO		
115	10109		DAMULOG, DANGCAGAN, KADINGIAN, KIBAWE		
116	10200			LANAO DEL NORTE	
117	10300			MISAMIS OCCIDENTAL	
118	10400			MISAMIS ORIENTAL	
119	14100			COTABATO CITY	REGION 14 ARMM
120	14200			LANAO DEL SUR	
121	14300			MAGUINDANAO	
122	14400			SHARIFF KABUNSUAN	

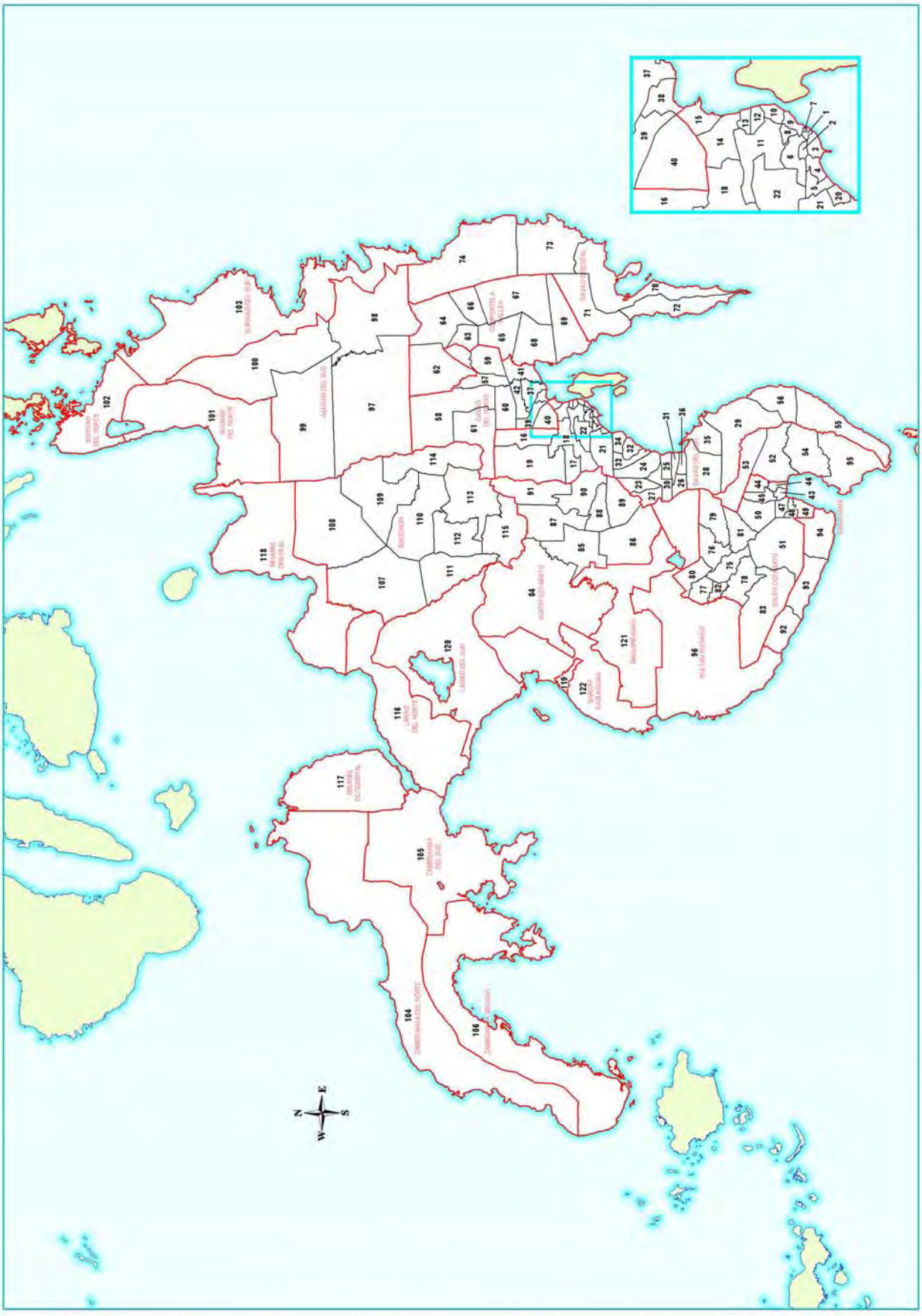


FIGURE 28.2-2 ZONING MAP (MINDANAO)

28.2.2 Model Description

(1) Trip Generation Model

Trip generation and attraction models are to estimate the number of trips generated from and attracted to each zone. The linear regression models are adapted in the Study. The model parameters are calibrated in **Table 28.2.2-1**.

$Gi = ai * X1i + bi * X2i + ci * Di + C$
$Aj = aj * X1j + bj * X2j + cj * Dj + C$

Where,

Gi – Trip Generation in zone *i*
Aj – Trip Attraction in zone *j*
X1*i*, X2*j* – Attributes in zone *i, j*
D*i*, D*j* – Dummy Variables
a*i*, a*j*, b*i*, b*j* – Coefficients
C – Constant

TABLE 28.2.2-1 GENERATION/ATTRACTION MODELS

Model Type	Vehicle Type	Attributes		Dummy Variables	Constant	R^2 Multiple Correlation Coefficient
		Population	Employee			
Trip Generation	Passenger car	58.62	-	36058.57	-	0.821
	Jeepney	-	89.46	39143.26	267.80	0.936
	Bus	4.51	-	-	-	0.821
	Truck	-	9.29	11830.83	688.13	0.864
Trip Attraction	Passenger car	42.80	-	28899.37	-	0.820
	Jeepney	-	87.07	38973.05	301.55	0.934
	Bus	4.70	-	-	-	0.822
	Truck	-	8.09	11917.82	710.58	0.860

(2) Trip Distribution Model

A trip distribution model is to estimate the number of distributed trips by the combination of origin and destination (OD) zones, i.e., OD matrices, based on the trip generation and attraction by zone, which are described in the previous section.

The most widely used model for trip distribution is a Gravity model, which aims to estimate travel demand based on the relationship between trip generation, trip attraction, and impedance function between zones such as a travel distance. This analysis resulted in the following formulas as a trip distribution model.

$$Tij = K \cdot \frac{Gi^{\alpha} \cdot Aj^{\beta}}{Dij^{\gamma}}$$

Where,

Tij : inter zonal trip distribution from zone *i* to *j*
Gi : trip generation in zone *i*
Aj : trip attraction in zone *j*
Dij : travel length from zone *i* to *j*
K, α, β, γ: model parameters

TABLE 28.2.2-2 TRIP DISTRIBUTION MODEL

Vehicle Type	Parameter				R^2 Multiple Correlation Coefficient
	α	β	γ	*K*	
Passenger car	0.35902	0.36619	0.21173	0.19472	0.768
Jeepney	0.40495	0.81680	0.35649	0.14491	0.770
Bus	0.30648	0.35686	0.07980	1.38794	0.800
Truck	0.24915	0.26646	0.01489	0.65355	0.702

Calibration of the Gravity model is accomplished by developing adjustment factors. The adjustment factors can be determined by comparing model output and observed data. The model formula is shown as follows.

$$T_{ij} = P_i \cdot \frac{A_j K_{ij} D_{ij}}{\sum_n A_{in} K_{in} D_{in}}$$

Where, K_{ij} : Adjustment factor between existing and model value for the zone pair of *i* and *j*

The output of a distribution model is a set of elements that show the travel flow between each pair of zones. However, the row totals of distribution elements do not match with trip productions and the column totals of distribution elements do not match with trip attractions. Therefore, an iteration is done until satisfied that the row totals match trip productions and the column totals match trip attractions.

(3) Assignment Model

JICA STRADA, which was developed by JICA, is used for traffic assignment simulation. This system provides two major types of highway assignment model, namely, incremental assignment and user equilibrium assignment. For this Study, the incremental assignment is employed.

The incremental assignment divides the input OD matrix data into several increments and assigns each increment to the minimum route where the generalized cost is the least. Once the increments are assigned, link cost of each link is calculated and the minimum route is found again for the next increments.

28.2.3 Future Travel Demand Forecast

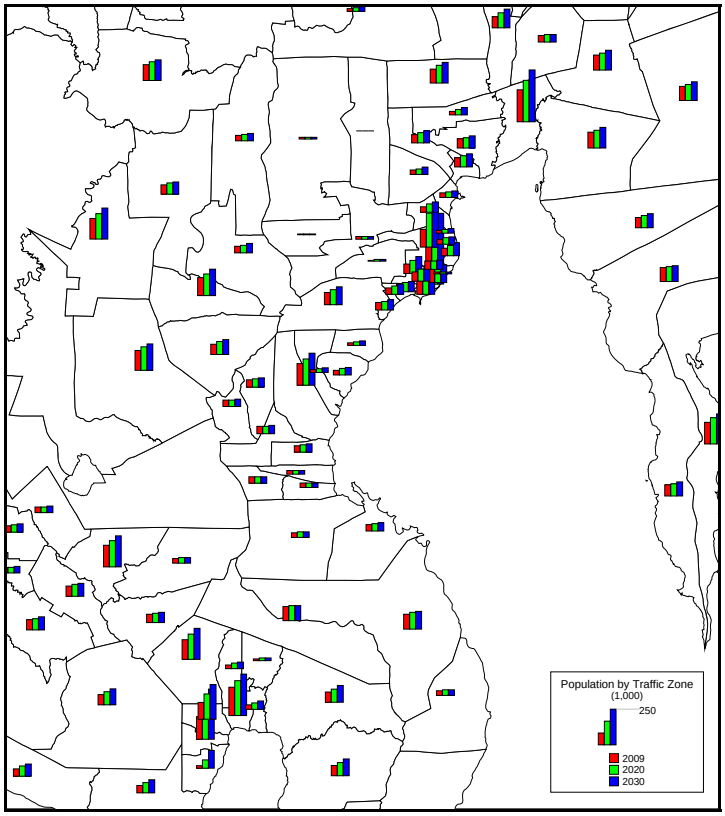
(1) Socio-economic Data for Demand Forecast

Based on the existing socio-economic data, the future value by traffic zone for the development of trip production and attraction model is prepared. **Table 28.2.3-1** summarizes the projected population and employment in the future by area only for Region XI. The total population of Region XI is 9.8 million in 2020 and 11.7 million in 2030, while the number of employees is 2.3 million in 2020 and 3.1 million in 2030.

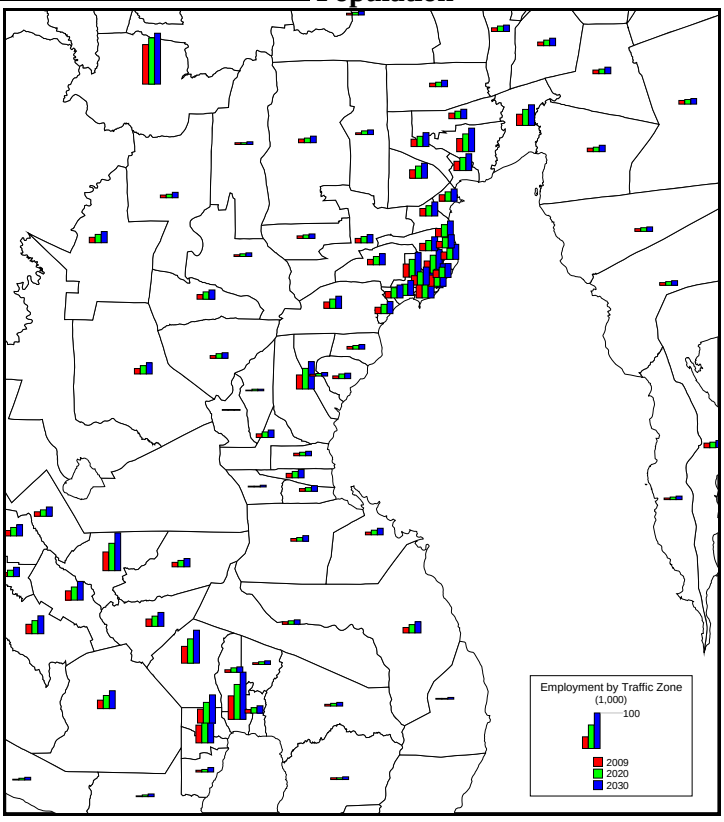
TABLE 28.2.3-1 SOCIO-ECONOMIC DATA FOR FUTURE DEMAND FORECAST

Region	Province	City/Municipality	Population Projection (thousands)			Employment Projection (thousands)		
			2009	2020	2030	2009	2020	2030
Region XI	DAVAO DEL SUR	DAVAO CITY	1,430.3	1,820.5	2,132.9	501.9	714.2	955.1
		BANSALAN	55.0	59.0	62.7	3.3	4.6	6.2
		CITY OF DIGOS (Capital)	151.4	186.9	223.9	40.4	57.5	76.9
		HAGONOY	47.5	52.2	56.5	7.2	10.2	13.6
		KIBLAWAN	43.6	46.3	48.7	2.6	3.7	5.0
		MAGSAYSAY	45.5	48.4	50.9	2.0	2.8	3.7
		MALALAG	35.8	38.8	41.4	7.8	11.1	14.9
		MALITA	107.9	117.9	127.0	16.3	23.2	31.0
		MATANAO	50.7	55.3	59.6	11.7	16.7	22.3
		PADADA	25.4	27.2	28.7	13.0	18.5	24.8
		SANTA CRUZ	78.8	95.4	113.1	21.5	30.6	40.9
		SANTA MARIA	49.2	53.6	57.7	9.1	13.0	17.4
		SULOP	29.6	32.4	35.0	7.8	11.1	14.9
		CARMEN	63.5	74.8	86.4	36.5	50.9	67.1
		CITY OF PANABO	159.7	192.8	227.6	70.9	98.9	130.2
		CITY OF TAGUM (Capital)	226.2	290.0	359.6	31.2	43.4	57.2
		BRAULIO E. DUJALI	26.8	37.6	51.2	15.0	21.0	27.6
	SOUTH COTABATO	GENERAL SANTOS CITY	568.2	823.3	1,132.8	186.7	270.8	371.7
		POLOMOLOK	137.8	176.7	219.7	46.3	67.2	92.3
		T'BOLI	73.6	92.1	111.9	24.9	36.1	49.6
	SARANGANI	ALABEL (Capital)	75.4	95.2	116.6	5.1	7.2	9.8
		MALUNGON	97.0	102.4	107.7	6.8	9.6	13.1
		MALAPATAN	69.3	92.3	117.6	4.7	6.6	9.0
	DAVAO DEL SUR	JOSE ABAD SANTOS (TRINIDAD)	64.1	73.8	83.3	3.3	4.6	6.2
		DON MARCELINO	35.7	38.8	41.8	2.6	3.7	5.0
	DAVAO DEL NORTE	ASUNCION (SAUG)	80.0	104.5	132.8	10.7	15.0	19.7
		KAPALONG	62.4	65.9	69.3	14.0	19.5	25.7
		NEW CORELLA	47.0	51.4	55.6	11.8	16.5	21.7
		SANTO TOMAS	100.8	123.6	146.6	9.7	13.5	17.8
		TALAINGOD	20.5	25.7	31.0	6.4	9.0	11.8
	COMPOSTELA VALLEY	LAAK (SAN VICENTE)	68.8	80.8	92.9	6.5	9.0	11.6
		MONTEVISTA	35.9	40.1	44.2	3.4	4.8	6.1
		MONKAYO	92.8	103.5	114.4	8.8	12.3	15.8
		MAWAB	104.9	121.3	138.1	9.9	13.8	17.8
		COMPOSTELA	72.4	86.7	100.6	6.8	9.4	12.2
		MARAGUSAN (SAN MARIANO)	99.4	114.0	128.8	9.4	13.1	16.9
		MABINI (DOÑA ALICIA)	109.0	125.0	141.6	10.3	14.4	18.5
		PANTUKAN	72.0	85.5	98.7	6.8	9.4	12.1
	DAVAO ORIENTAL	CITY OF MATI (Capital)	151.7	181.9	213.2	12.0	16.5	21.9
		BANAYBANAY	97.4	106.3	115.1	7.8	10.8	14.3
		GOVERNOR GENEROSO	80.3	88.6	96.9	6.4	8.9	11.8
		BAGANGA	84.4	101.4	119.5	6.7	9.2	12.2
		BOSTON	84.5	90.3	95.8	6.8	9.4	12.5
	SOUTH COTABATO	BANGA	74.7	82.4	90.1	25.9	37.5	51.5
		CITY OF KORONADAL (Capital)	154.4	183.9	214.0	52.8	76.5	105.0
		NORALA	45.0	50.8	56.7	15.5	22.5	30.9
		SURALLAH	73.1	82.0	90.6	25.2	36.6	50.2
		TAMPAKAN	34.7	37.0	39.3	12.1	17.5	24.0
		TANTANGAN	36.8	42.4	48.0	12.6	18.3	25.1
		TUPI	59.1	66.6	74.3	20.4	29.5	40.6
		SANTO NIÑO	39.0	42.6	46.1	13.5	19.6	27.0
		LAKE SEBU	62.2	73.3	83.8	21.3	30.9	42.4
		ALAMADA	539.3	725.4	930.8	59.8	85.8	116.4
	NORTH COTABATO	KABACAN	145.9	180.0	216.8	16.4	23.6	32.0
		M`LANG	137.5	161.6	186.1	15.7	22.4	30.4
		PRESIDENT ROXAS	67.5	75.9	83.9	7.7	11.1	15.1
		CITY OF KIDAPAWAN	122.6	153.3	185.1	13.8	19.8	26.8
		MAKILALA	74.1	89.1	105.0	8.4	12.0	16.3
		MAGPET	45.7	54.8	63.8	5.2	7.4	10.1
		ARAKAN	40.0	47.1	54.2	4.5	6.5	8.8
	SARANGANI	MAITUM	37.6	41.1	44.5	2.6	3.7	5.1
		KIAMBA	55.6	70.1	84.8	3.8	5.3	7.3
		MAASIM	52.5	72.0	95.1	3.5	4.9	6.7
		GLAN	108.9	148.6	195.9	7.3	10.3	14.0
	SULTAN KUDARAT	BAGUMBAYAN	703.0	873.0	1,060.0	58.2	82.9	110.2
Total			**7,921.5**	**9,773.2**	**11,678.0**	**1,639.4**	**2,336.4**	**3,141.7**

Figure 28.2.3-1 describes the increase of population and employment by traffic zone. The height of bar chart indicates the total number of population at resident place and workers at working place by traffic zone. Colors indicate the value by year: red is in the year of 2009, green is 2020, and blue is 2030.



Population



Employment

FIGURE 28.2.3-1 SOCIO-ECONOMIC DATA BY TRAFFIC ZONE

(2) Total Number of Generated Vehicle Trips

The first step of forecasting procedure is to estimate the number of total trip generated in the Study Area. The total number of vehicle trips can be estimated by applying the Growth Rate model discussed in the section 28.2.2. The yearly growth rate of population is used to estimate the number of vehicle trips for passenger car, jeepney, and bus, while the yearly growth rate of employment is for truck. As shown in **Table 28.2.3-2**, the total number of vehicle trips is estimated at 662.5 thousand in 2030.

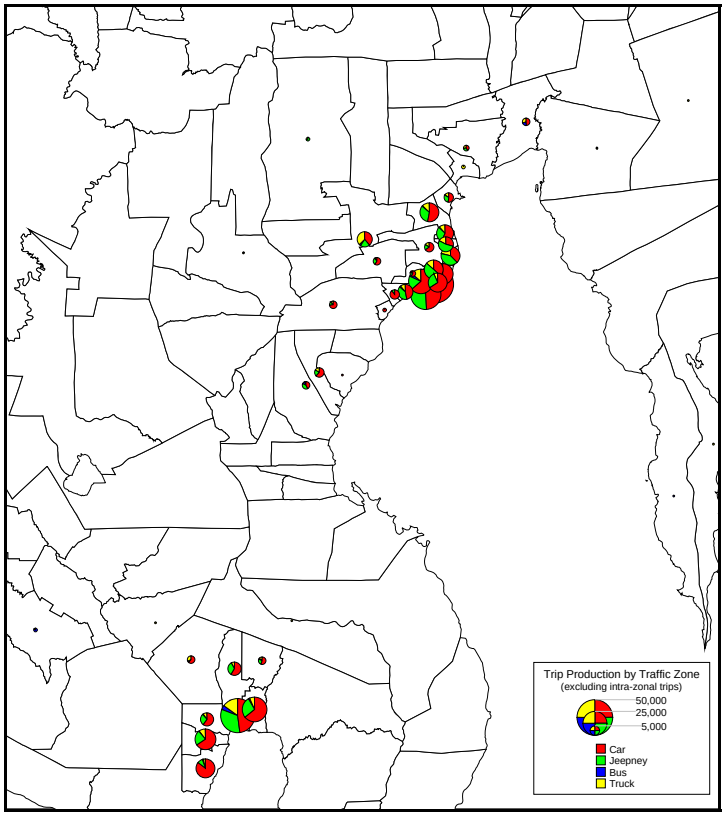
TABLE 28.2.3-2 TOTAL NUMBER OF VEHICLE TRIPS ESTIMATED

Year	Passenger Car	Jeepney	Bus	Truck	Total	Growth Rate	Population Growth Rate (%)	Employment Growth Rate (%)
2009	244,300	130,400	11,200	56,000	441,900	1.00		
2010	249,500	133,200	11,400	57,800	451,900	1.02	2.15	3.13
2015	274,600	146,600	12,500	69,600	503,300	1.14	1.93	3.78
2020	300,300	160,300	13,700	79,900	554,200	1.25	1.80	2.80
2025	325,500	173,800	14,900	97,900	609,100	1.38	1.63	3.50
2030	351,400	187,600	16,100	107,400	662,500	1.50	1.54	2.51
2030/2009	1.44	1.44	1.44	1.92	1.50		1.86	3.14

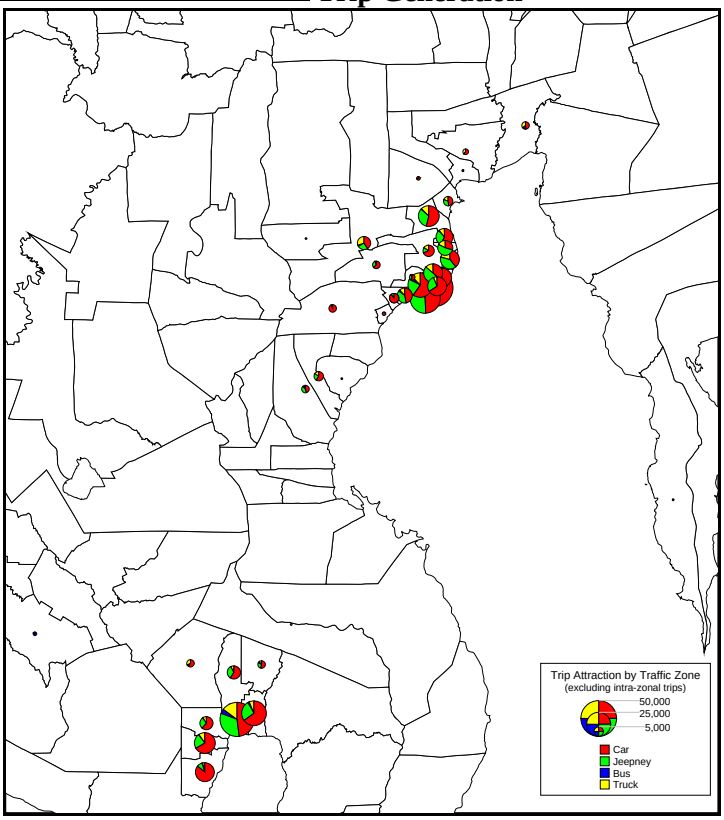
(3) Trip Generation by Traffic Zone

Next, the trip generation and attraction of each traffic zone are calculated by using the models described in the previous section, and the above total number of trip generation is distributed into each traffic zone in proportion with the model value for the trip generation and attraction.

Figures 28.2.3-2 and **28.2.3-3** illustrate the number of vehicle trip generation and attraction, but excluding intra-zonal trips, in the year of 2030. The size of pi indicates the number of trips and colors indicate by mode: red is passenger car, green jeepney, blue bus, and yellow truck.

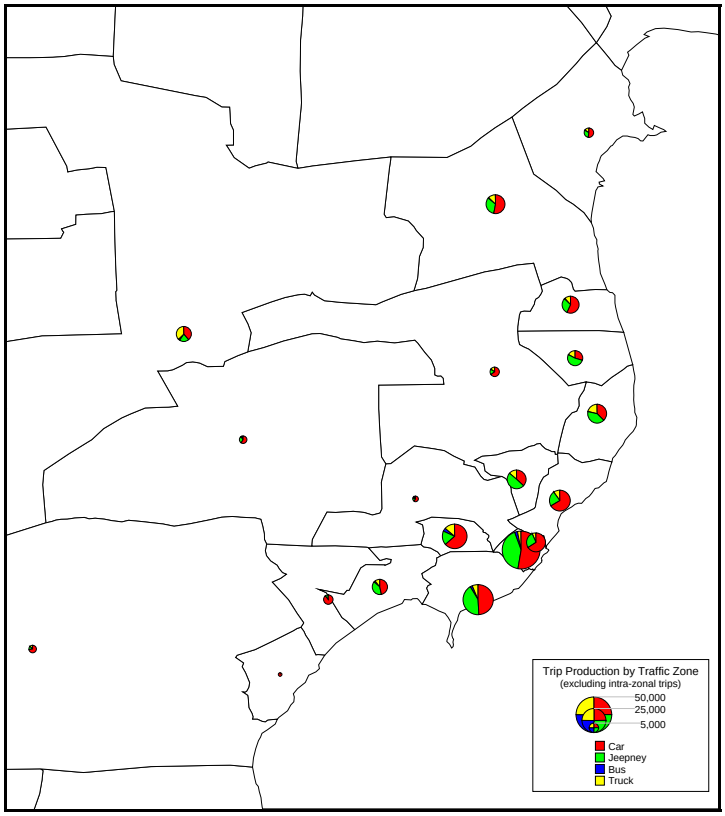


Trip Generation

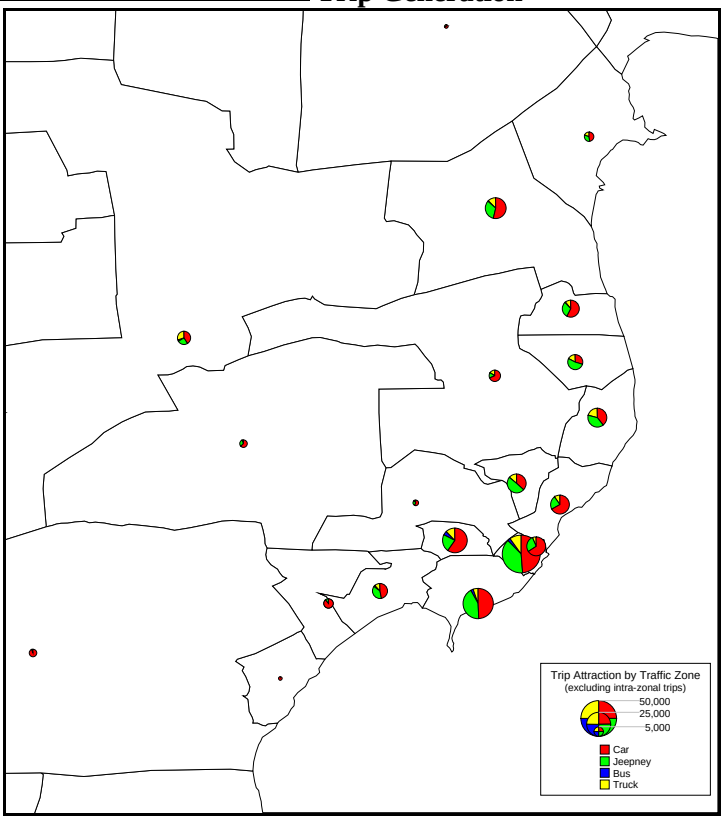


Trip Attraction

FIGURE 28.2.3-2 TRIP GENERATION AND ATTRACTION IN 2030 BY TRAFFIC ZONE



Trip Generation



Trip Attraction

FIGURE 28.2.3-3 TRIP GENERATION AND ATTRACTION IN 2030 BY TRAFFIC ZONE (DAVAO CITY)

28.3 "DO NOTHING" CASE TRAFFIC ASSIGNMENT

The following figures illustrate the result of traffic assignment in cases of "Do-Nothing" case. **Figures 28.3-1** shows the result of traffic assignment in the year of 2020 and **Figures 28.3-2** shows the result in the year 2030.

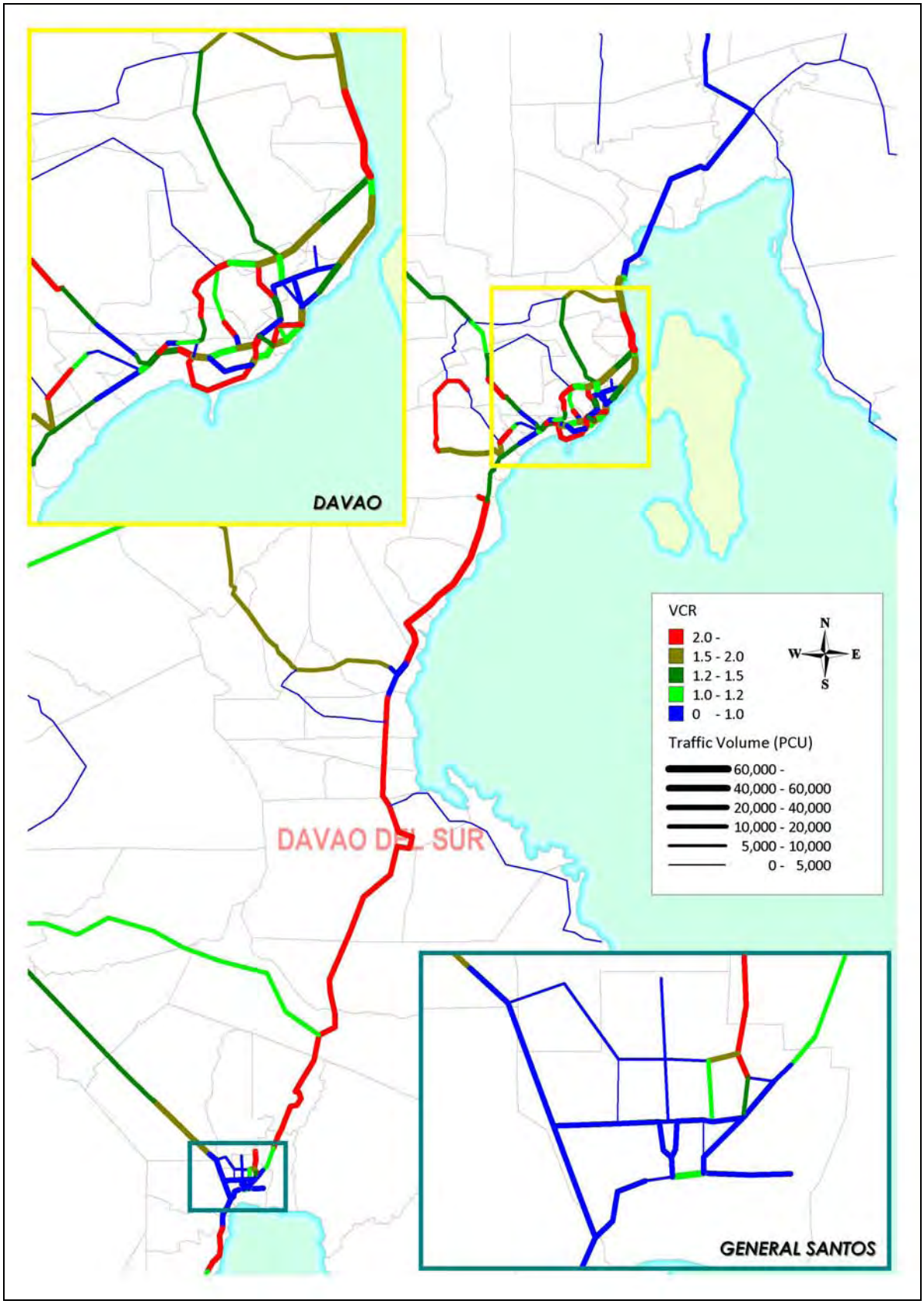


FIGURE 28.3-1 TRAFFIC ASSIGNMENT RESULT OF "DO-NOTHING" CASE IN 2020

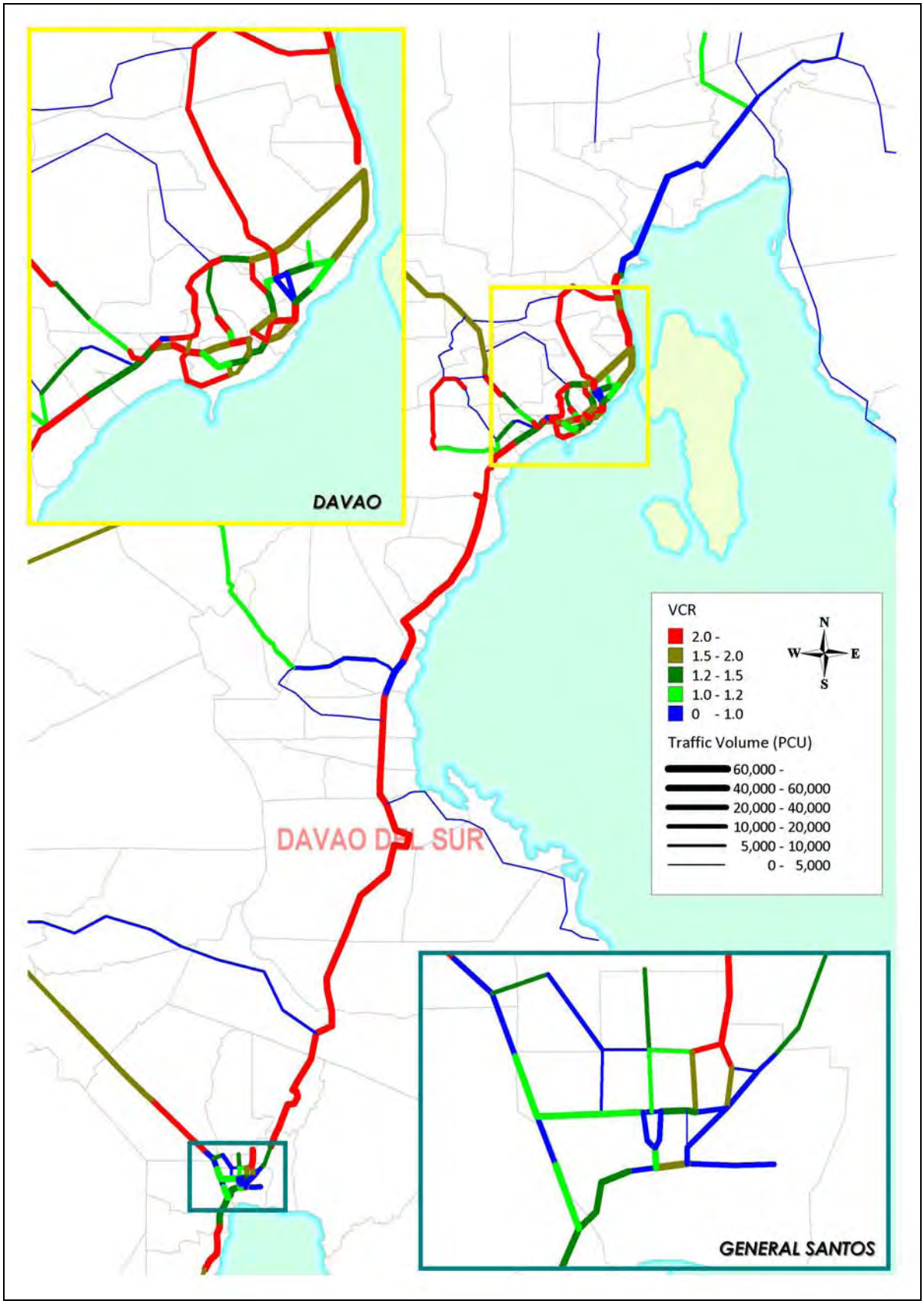


FIGURE 28.3-2 TRAFFIC ASSIGNMENT RESULT OF "DO-NOTHING" CASE IN 2030

CHAPTER 29

ENVIRONMENTAL AND SOCIAL CONSIDERATIONS FOR TDG

CHAPTER 29
ENVIRONMENTAL AND SOCIAL CONSIDERATIONS FOR TDG

29.1 NATURAL CONDITION AND URBAN DEVELOPMENT OF THE STUDY AREA

Natural conditions of the Study Area such as topography, geology, meteorology, watershed, flood prone areas and protected areas were presented in Section 25.1 of Chapter 25.

Urban development has been concentrated at narrow coastal plain areas, and it is now expanding towards the mountain sides. Road network development must be implemented under above natural conditions and urban development trends in due consideration of minimization of adverse impacts on environmental and social conditions.

29.2 HIGHWAY PLANNING TO MINIMIZE ADVERSE IMPACTS OF ENVIRONMENTAL AND SOCIAL CONDITIONS

The widening of the existing roads and construction of new roads were proposed in Chapter 30. The following considerations must be exercised;

(1) Widening of the Existing Roads

- Widening of existing roads should be planned within the existing road ROW. If necessary, the design standards may be relaxed to achieve these objectives.
- In many cases, a part of a house, shanties, fences are encroaching the existing road ROW, DPWH should properly consult with such owners and compensate at a reasonable price.
- In case new ROW acquisition is inevitable, consultation meetings with the affected people should be held to explain why land acquisition is needed and how the Government would compensate their properties, then the consent of the affected people should be obtained.

(2) New Road Construction

- Most proposed roads are planned in the rapidly urbanizing areas and topographically difficult locations.
- Alignment selection must be done carefully. Several alternative alignments should be studied to select an optimum alignment.
- In order to select an optimum alignment, all critical areas in terms of natural and social conditions must be identified. Latest satellite photos should be utilized to achieve these objectives. Alignments should be studied to avoid or not to hit the identified critical areas. An alignment that minimizes adverse environmental and social impacts should be selected as an optimum alignment.
- In order to minimize environmental and social impacts, appropriate design standards should be selected.
- Consultation meetings with the concerned people should be held from the stage of planning up to detailed design and construction stage. Constant dialogue with the concerned people should be made for the successful implementation of the project.
- For new road construction, DPWH needs to undertake detailed feasibility study including EIA study of which recommended TOR is shown in Annex 13.2.

CHAPTER 30

HSH DEVELOPMENT STRATEGY FOR TDG

CHAPTER 30
HSH DEVELOPMENT STRATEGY FOR TDG

30.1 IDENTIFIED ISSUES

Identified issues are as follows;

ARTERIAL ROAD NETWORK

- Simple road network except Davao City and Gen. Santos City urbanized areas.
- Arterial roads connecting Davao City with other major urban centers in Mindanao such as Gen. Santos, Cagayan de Oro City, Butuan City, Cotabato City have already been formed.
- There is no alternative road for those arterial roads, therefore, those arterial roads have to be strong.
- Due to topographical constraints, highly urbanized area of Davao City developed at the narrow coastal plain.
- Road network in highly urbanized area of Davao City is rather complex and no systematic network is formed.
- Roads in highly urbanized area of Davao City are all narrow, and mostly 4-lane roads. Further widening of these roads is practically very difficult due to roadside development.
- Roads in Gen. Santos City have mostly wide ROW, thus they can be converted to high standard roads.

TRAFFIC CONDITIONS

- Roads within the highly urbanized area of Davao City have traffic congestion problems and travel speed of most of the roads reduced to less than 20 km/hr.
- Arterial roads adjacent to the highly urbanized area of Davao City are also experiencing traffic congestion problems and travel speed is reduced to less than 20 km/hr.
- Gen. Santos City has less traffic problem and the roads in the city can be traveled at the travel speed of over 20 km/hr.

30.2 POLICY AND STRATEGY FOR DEVELOPMENT OF HSH

30.2.1 HSH Development Objectives

HSH development objectives are established as follows;

HSH DEVELOPMENT OBJECTIVES

- To decongest traffic on arterial roads of the Tagum-Davao-Gen. Santos corridor.
- To achieve strong linkage between Davao City and other major urban centers of Mindanao.
- To enhance agro-fishery industry.
- To recover international competitiveness of industries.
- To promote sound urban expansion of Davao City and Gen. Santos City.

30.2.2 HSH Development Strategy

HSH development strategies are established as follows;

DEVELOPMENT OBJECTIVES

- To decongest of traffic on arterial roads.
- To achieve strong linkage between Davao City and other major urban centers of Minadanao.
- To enhance agro-fishery industry.
- To recover international competitiveness of industries.
- To promote sound urban expansion of Davao City and Gen. Santos City.

DEVELOPMENT STRATEGY

- To promote transport facilities with higher service level.
- To connect Davao City with major urban centers with high standard transport facilities.
- To improve modal linkage.
- To provide transport facilities which guide sound urban expansion at Davao City and Gen. Santos City.

STRATEGY TO FORMULATE HSH NETWORK

- HSH network shall be formed with HSH-2, since formulation of HSH-1 is difficult due to the following reasons;
  - Traffic demand from outside to Davao City urbanized area is still low to require HSH-1.
  - In the highly urbanized area of Davao City, roads are too narrow to accommodate HSH-1.

30.3 INDICATION OF "DO-NOTHING" CASE TRAFFIC ASSIGNMENT

"Do-nothing" case traffic assignment (2030 traffic demand assigned to present road network) shows the traffic congestion road/sections as follows;

Inter-City Roads

- Davao - Digos Road
- Digos - General Santos Road
- Davao – Tagum Road

Roads within Davao City

- MacArthur Highway
- Quimpo Boulevard
- E. Quirino Avenue
- C.M. Recto Avenue – J.P. Laurel Avenue
- R. Castillo Avenue
- Davao City Diversion Road
- Ma-a Road
- D. Quinones Road
- Quezon Boulevard

30.4 PROPOSED HSH NETWORK

Based on the urban center distribution, regional/urban development strategies, distribution of economic zones and tourist attraction points, topographical constraints and traffic conditions, HSH network was proposed as shown in **Figure 30.4-1**. Major concepts are as follows;

Inter-City Transport Axes

- Davao-Tagum Transport Axis together with Davao-Tagum Parallel Transport Axis is formed as a HSH network
- Davao-Digos-General Santos Transport Axis together with Davao-General Santos Parallel Transport Axis is formed as a HSH network
- Davao-Cagayan De Oro Transport Axis is formed as a HSH network

Intra-City Transport Axes

Roads to be designated as HSH are as follows;

- Davao City Diversion Road
- Second Diversion Road to be formed
- MacArthur Highway – E. Quirino Avenue
- Quimpo Blvd.-Quezon Blvd.-Leon Garcia Avenue-R. Castillo Avenue
- C.M. Recto Avenue-J.P. Laurel Avenue
- Ma-a Road
- D. Quinones Road-Dacudao Avenue
- General Santos City Circumferential Road

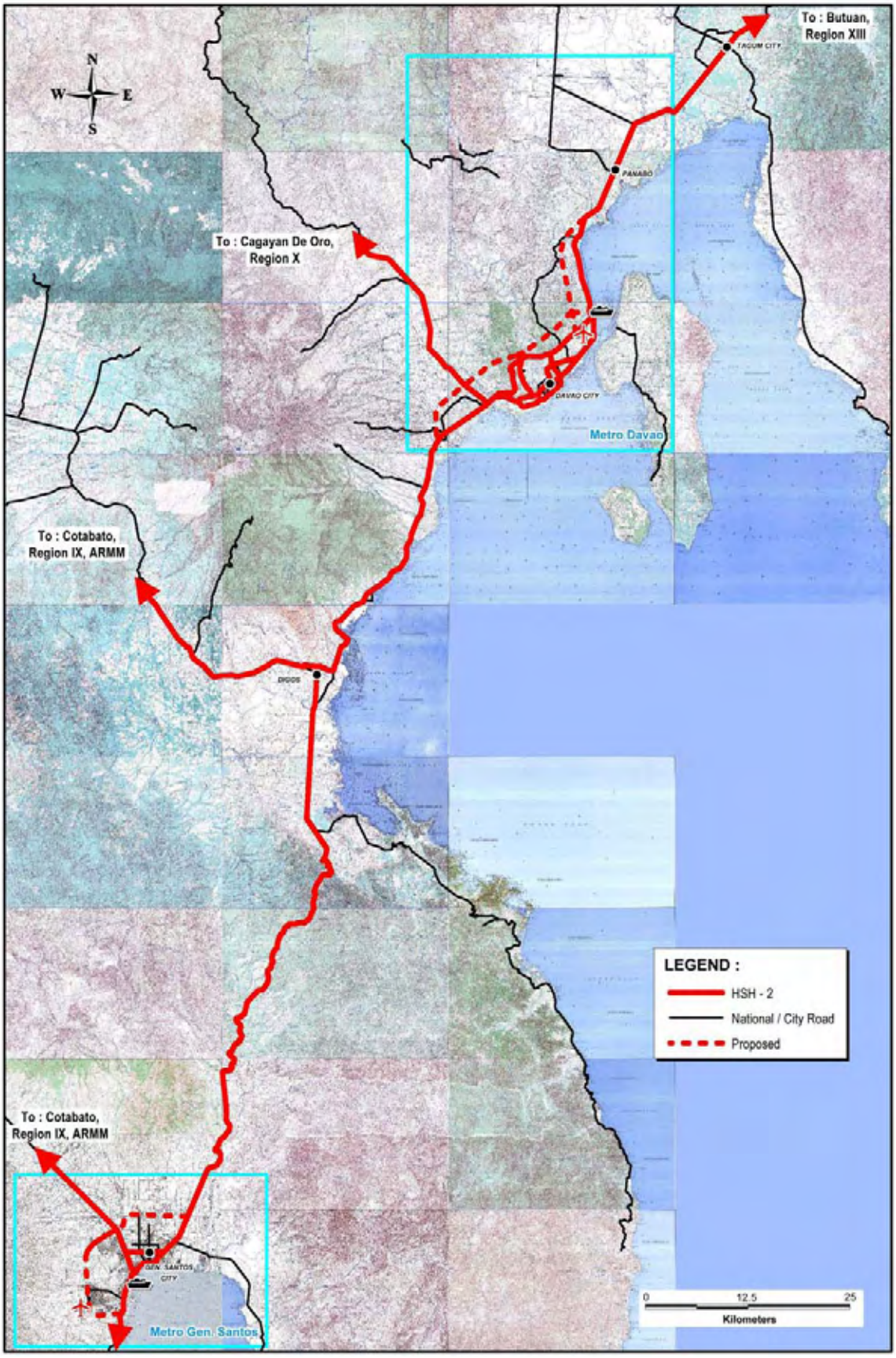


FIGURE 30.4-1 (1/3) PROPOSED HSH NETWORK: TAGUM-DAVAO-GEN. SANTOS CORRIDOR

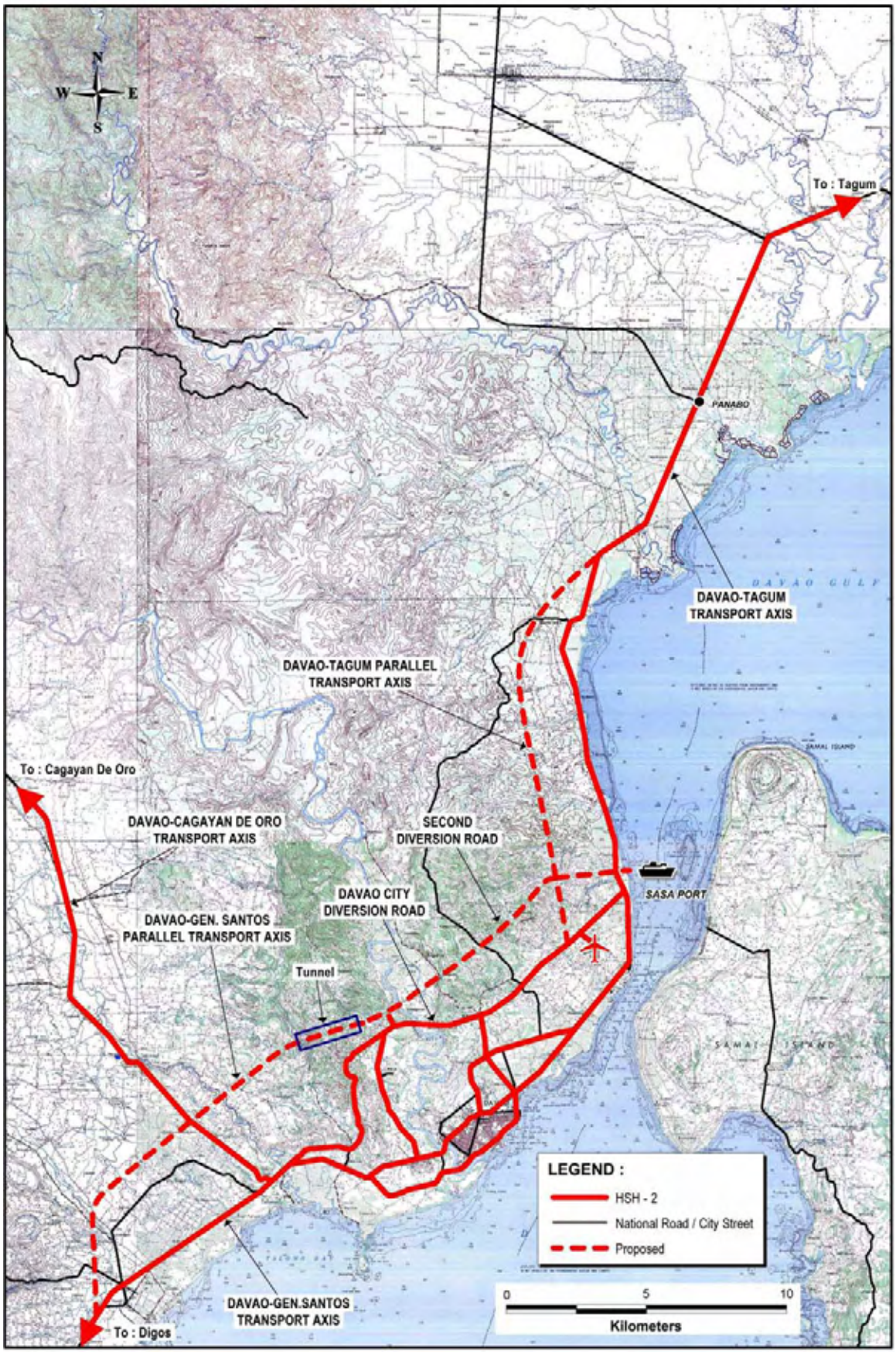


FIGURE 30.4-1 (2/3) PROPOSED HSH NETWORK: METRO DAVAO

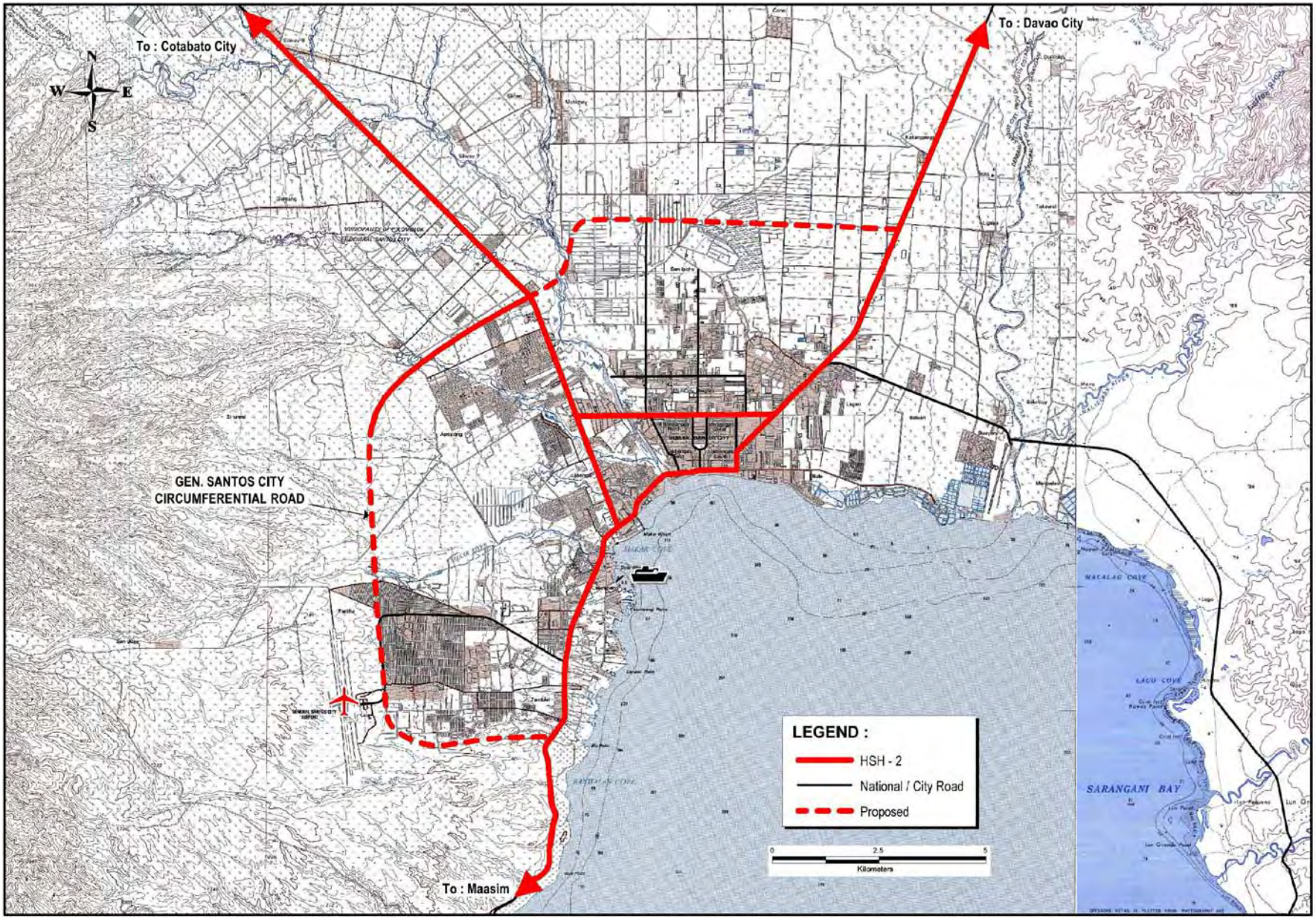


FIGURE 30.4-1 (3/3) PROPOSED HSH NETWORK: METRO GENERAL SANTOS

30.5 IDENTIFIED HSH PROJECTS

Identified HSH projects and their implementation targets are shown is **Table 30.5-1**, and graphically shown in **Figures 30.5-1** and **30.5-2**.

TABLE 30.5-1 IDENTIFIED HSH PROJECTS

Project Name		Implementation Target	
		By 2020	By 2030
Inter-City HSH	(1) Widening to 4-lane divided road for Davao-Tagum Road (At present, mostly un-divided 4-lane and some sections are still 2-lane)	• Convert to a 4-lane divided road	
	(2) Providing frontage roads for urban sections of Davao-Tagum Road (Panabo and Tagum urban sections		• Provide frontage roads to separate thru traffic from local traffic
	(3) Construction of Davao-Tagum Parallel Road including Sasa Port access road	• Construction of a 2-lane road	• Widening to a 4-lane road
	(4) Widening of Davao City Diversion Road from Sasa to Davao River Bridge	• Widening to a 6-lane road	
	(5) Construction of Davao-General Santos Parallel Road	• Construction of a 2-lane road	• Widening to a 4-lane road
	(6) Widening of Davao-General Santos Road between Davao and Digos	• Widening to a 4-lane road	
	(7) Widening of Davao-General Santos Road between Digos and General Santos		• Widening to a 4-lane road
Intra-City HSH	(8) Flyover construction for HSH within Davao City	• 4 Flyovers	• 3 Flyovers
	(9) Construction of Second Diversion Road		• Construction of a 4-lane road
	(10) Construction of General Santos City Circumferential Road	• Construction of a 2-lane road	• Widening to a 4-lane road

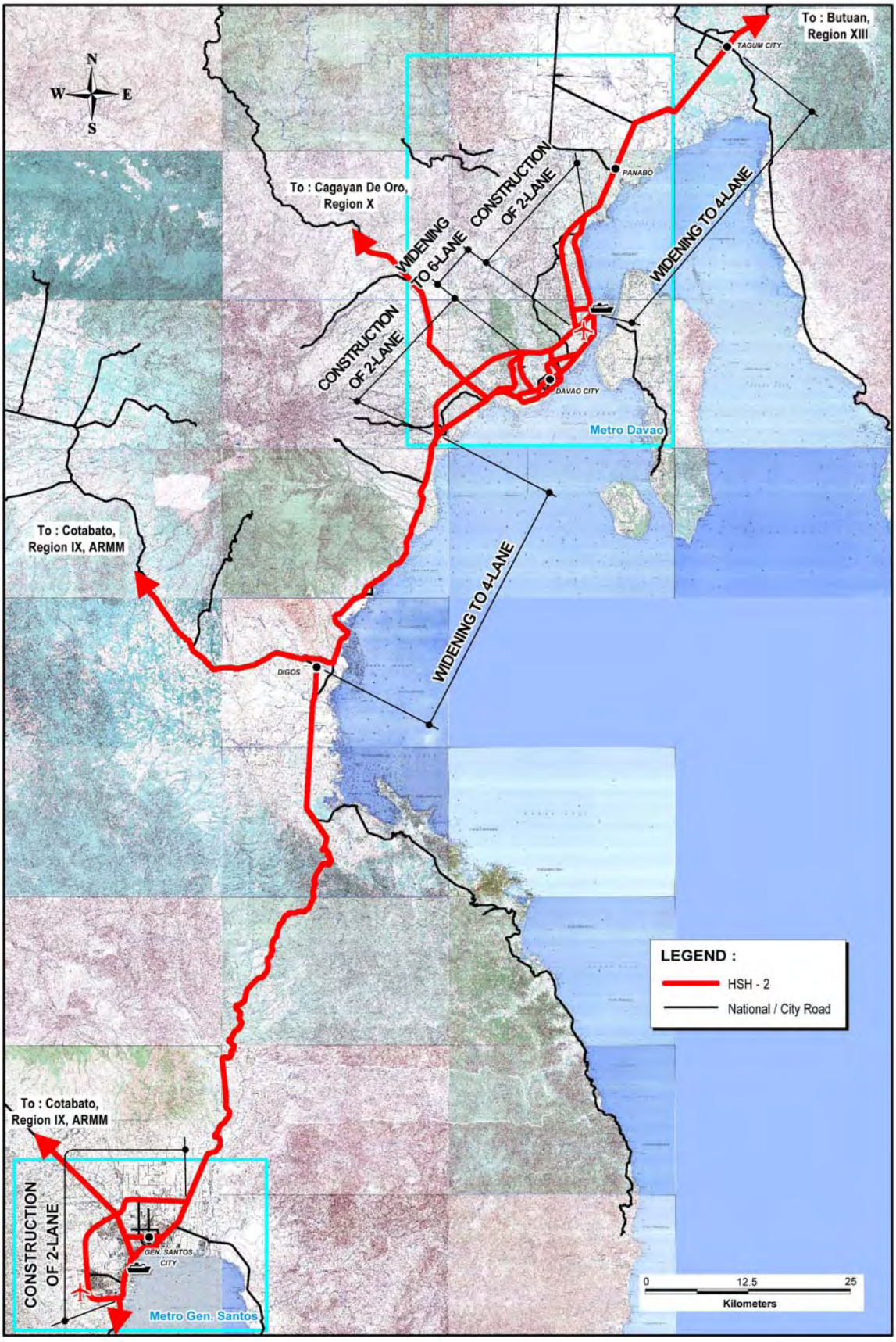


FIGURE 30.5-1 (1/3) PROPOSED 2020 HSH NETWORK: TAGUM-DAVAO-GENERAL SANTOS CORRIDOR

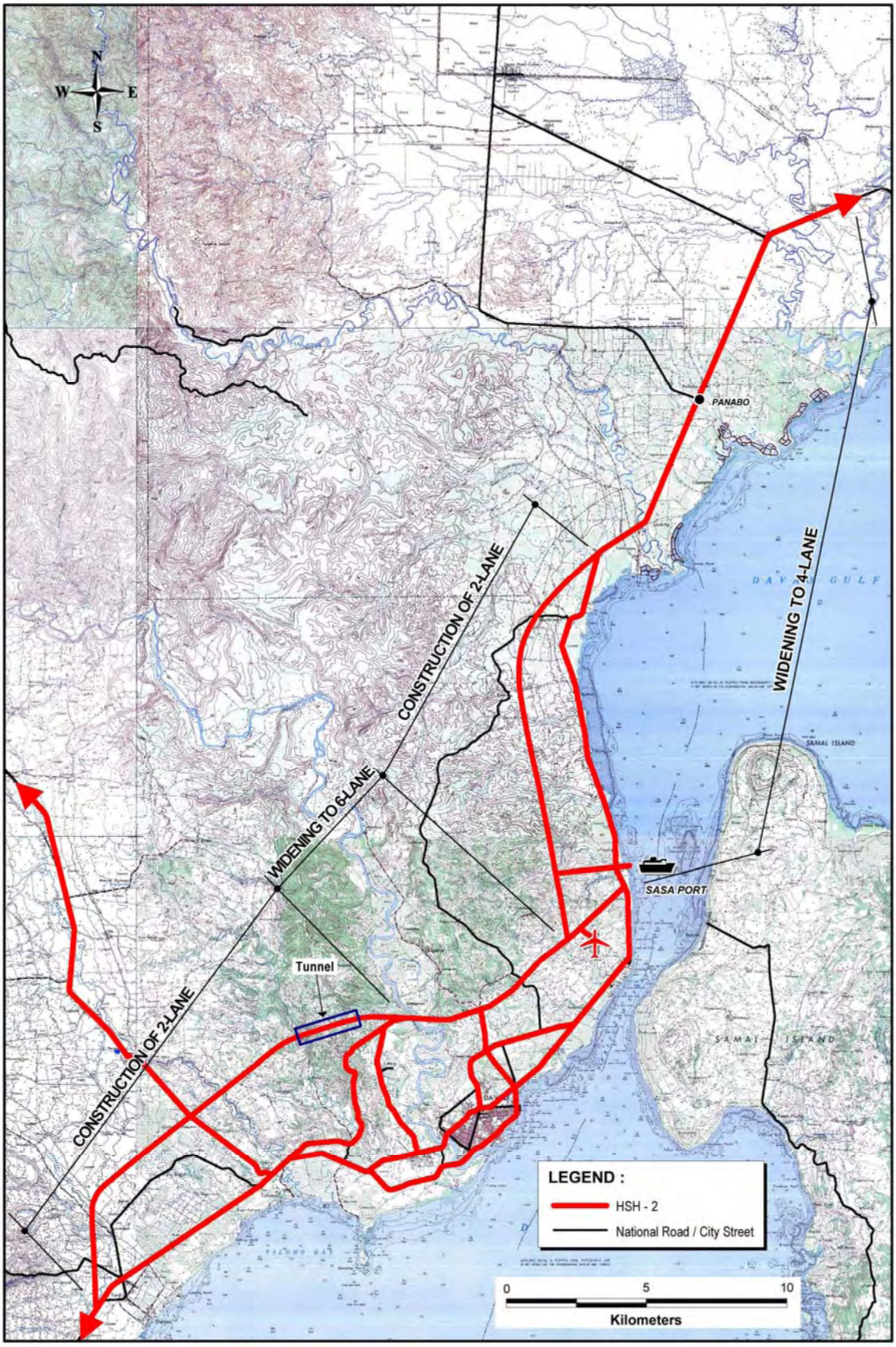


FIGURE 30.5-1 (2/3) PROPOSED 2020 HSH NETWORK: METRO DAVAO

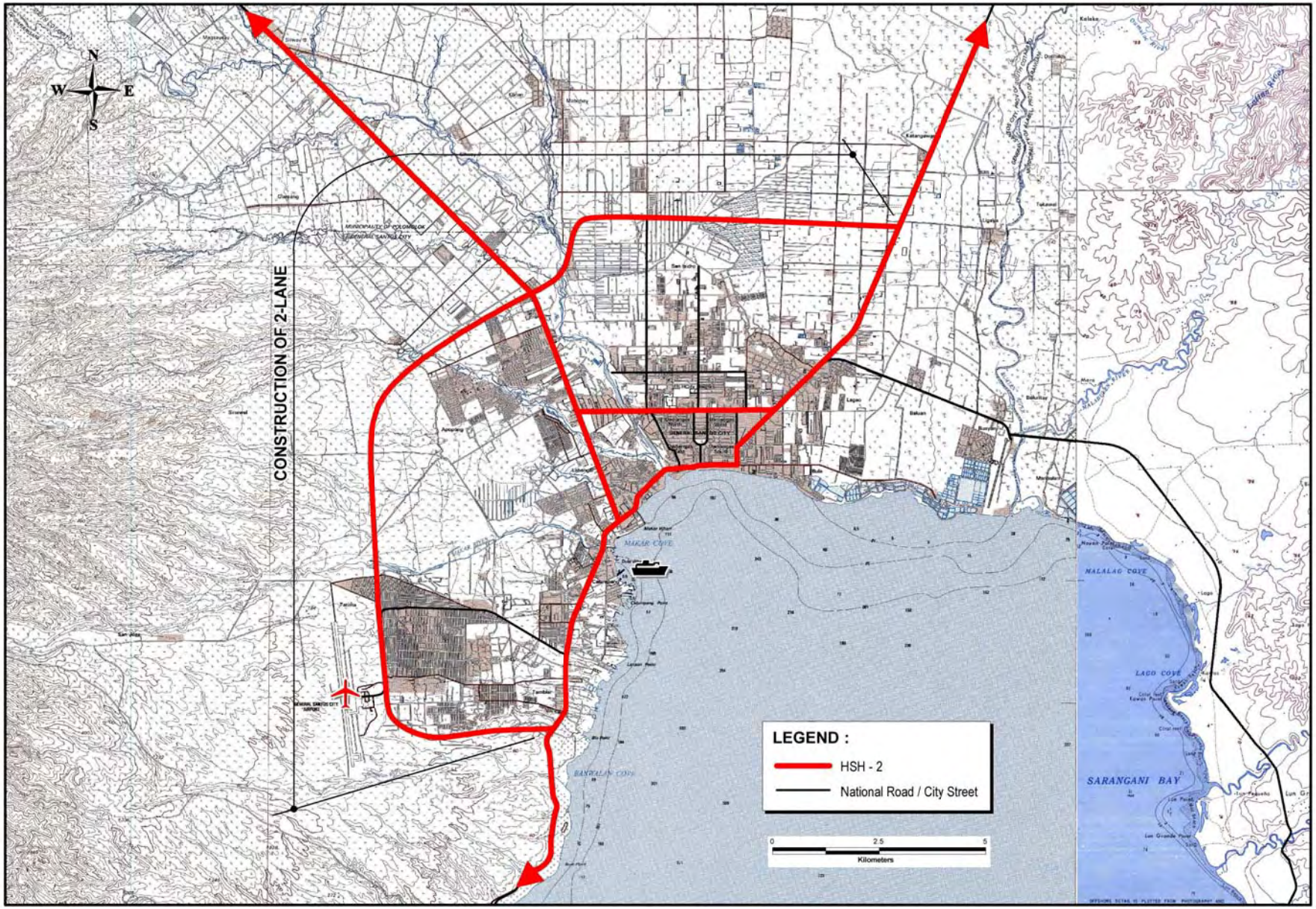


FIGURE 30.5-1 (3/3) PROPOSED 2020 HSH NETWORK: METRO GENERAL SANTOS

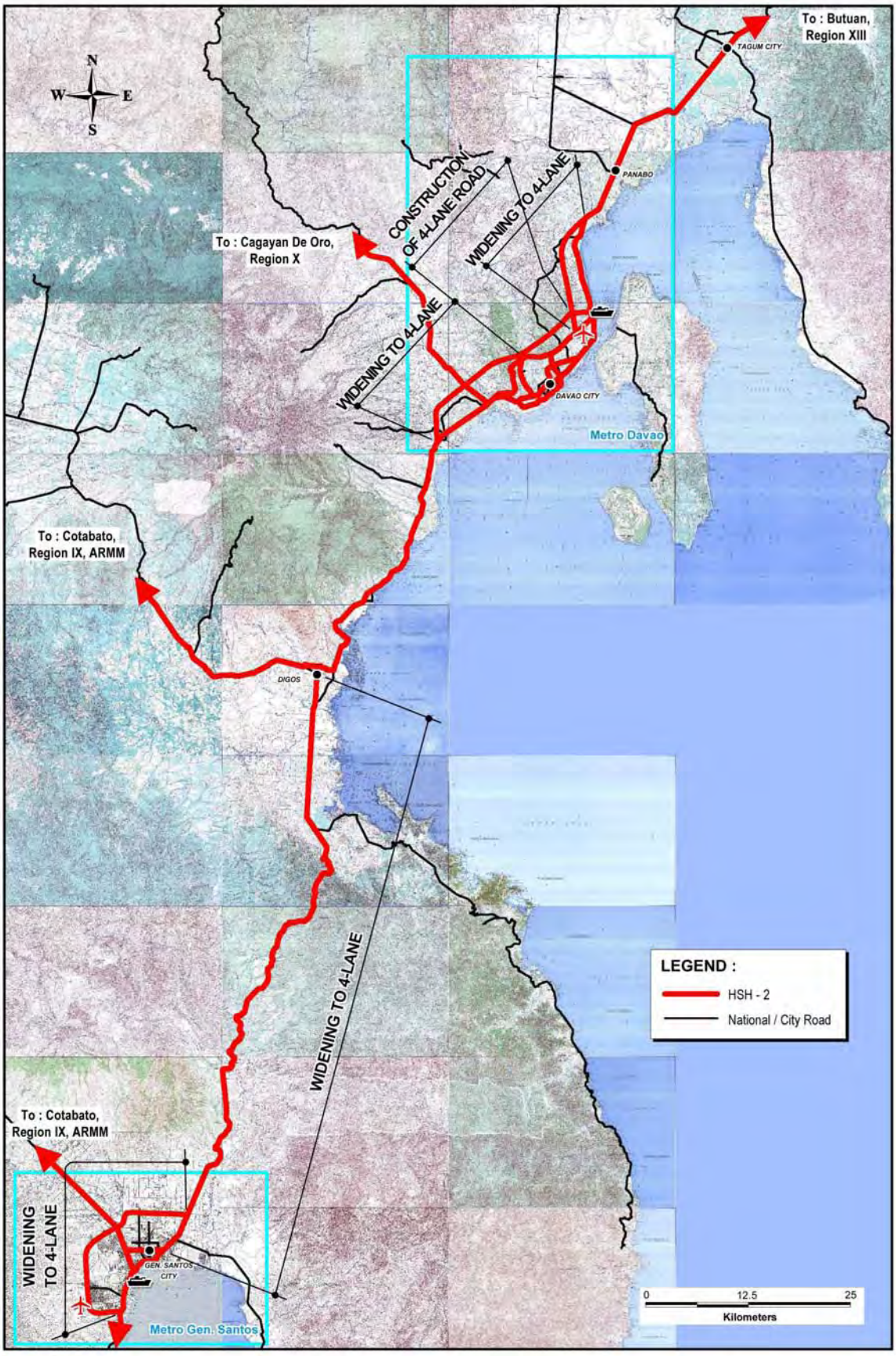


FIGURE 30.5-2 (1/3) PROPOSED 2030 HSH NETWORK: TAGUM-DAVAO-GENERAL SANTOS CORRIDOR