

## ***Part III. Master Plan***

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## **Chapter 12 Preparatory Works for Master Plan Formulation**

### **12.1 Network Planning Approach**

#### **12.1.1 Definitions of Transport Network**

For the transport network planning purpose, the following terms were defined.

1) Present Network

Transport network as of March 2008, including road and highway, railways (Mtero, LRT, tramway and others) and ferry/sea-bus route.

2) Base Network

Base network is the present network added with committed projects of which implementation was already decided. The committed projects consist of projects under construction, bidding and design after approval. The base network is used as the basis of planning and its component projects are not evaluated in this Study.

3) Maximum Network

Maximum network is a network with new projects added to the base network. There are three groups of new projects: one is a group of projects planned by IMM but not approved yet, second is the projects planned or proposed by organizations other than IMM, such as KGM, DLH and IMM's transport-related affiliate organizations, and the third group is projects planned in this Study. A new project can be added at any time of the planning stage. Component projects of the maximum network will be examined and evaluated from traffic, economic, financial or environmental point of view. Several alternative networks will be derived from the maximum network.

4) Master Plan Network

Through repetitive analyses on the maximum network and alternative networks, the master plan network will be elaborated.

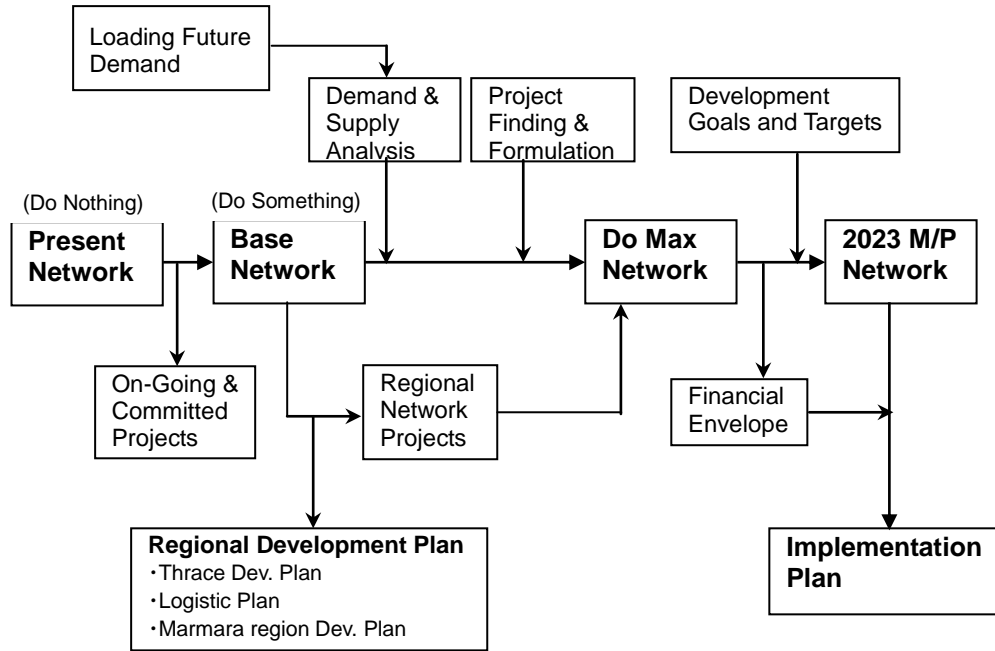
#### **12.1.2 Network Planning Process**

Network planning was conducted according to the process shown in Figure 12.1.1. Firstly, the base network was composed by reviewing existing projects and confirming their stages for implementation. Secondly, all the non-approved projects and other planned or proposed projects were added. After making analysis on demand/ capacity gaps, new projects were created to fill the gaps and improve the network configuration to form the maximum network. In addition, road and railway network was planned for the suburban areas expected to be newly urbanized in the future. Thus, the maximum network was formulated which is presented in Chapter 13 and Chapter 14.

In the next step, the maximum network will be tested to the future demand. Especially, large-scale projects will be evaluated by with and without comparison or by comparison of alternatives developed by their combination. All the component projects of the maximum network will be evaluated and prioritized. Finally, the Master Plan network will be composed, considering the financial constraints.

In case the Master Plan Network can hardly cope with future demand, some TDM measures will be studied on their applicability and efficiency in demand reduction. In the

last step of the Study, Implementation Plan of the Master Plan will be prepared, covering investment schedule, executing agency and implementation schemes.



Source : Study Team

**Figure 12.1.1 Network Planning Process**

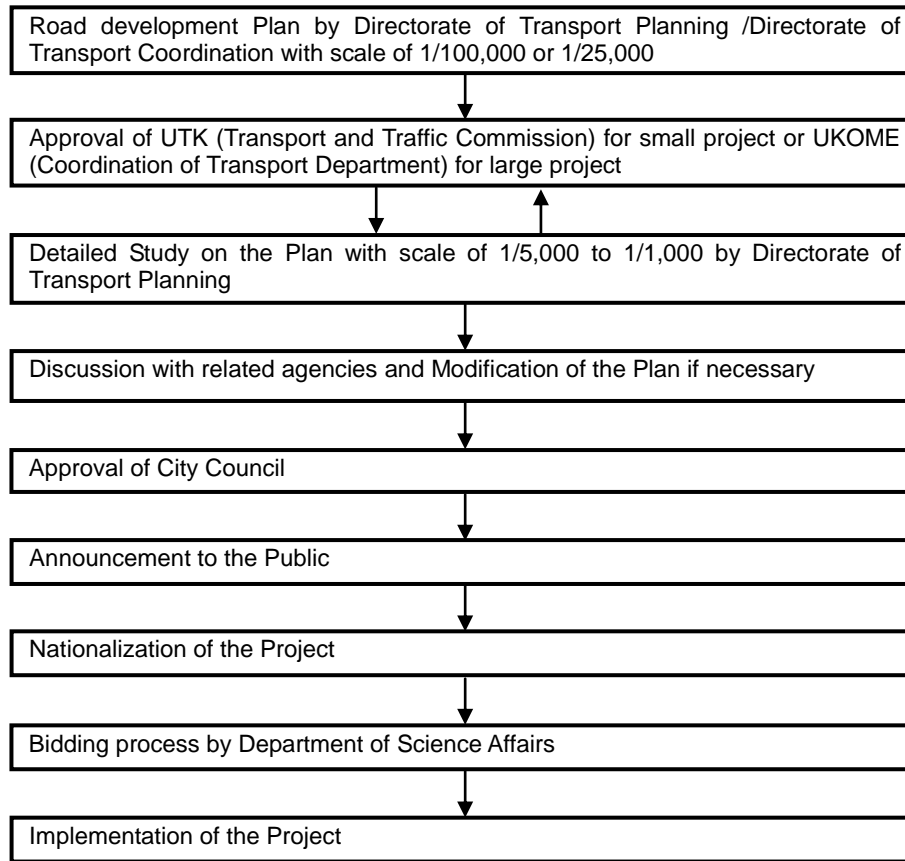
## 12.2 Base Network

### 12.2.1 Base Network of Road

The Municipality of Istanbul has steadily developed the road network in Istanbul during the past decades. Those efforts are still ongoing at present and there are many projects at various stages. They are classified as follows:

- A type: Under Construction
- B type: Tendering Stage
- C type: Detailed Design completed
- D type: Designing (D/D) Stage

The road project of IMM is generally carried out through the steps shown in Figure 12.2.1. At first, road projects are mainly planned by the Directorate of Transport Planning of the IMM. If they are approved by UTK (Transport and Traffic Commission) or UKOME (Transport Coordination Center) in the municipality, The Directorate of Transport Planning will proceed to more detailed study at the scale of 1/5,000 or 1/1,000. The detailed study results are sometimes discussed again and approved in UTK or UKOME. The plan is submitted to the City Council and will be approved unless any problem is anticipated. The plan will be announced to the public and proceed to the bidding process. From the bidding to the actual implementation, the Department of Science Affairs is responsible for the project.



Source : Directorate of the Transport Planning of IMM

**Figure 12.2.1 Procedure of the Road Project Implementation for Municipality Roads**

According to the Directorate of the Transport Planning of IMM, the road and intersection projects are as shown in Table 12.2.1. Projects are generally approved by city council based on the above procedure. Table 12.2.1 shows the development stage of each project as of June 2008. The approval is usually given based on the above mentioned procedure, however, there are some projects already approved in spite of the fact that the development stage is still at under design. According to IMM, there are special project cases where the approval is given in advance.

**Table 12.2.1 Road and Intersection Projects of IMM**

Stage	Project List		Approved Projects	
	Road	Intersection	Road	Intersection
Under Construction	18	39	18	39
Tendering Process	9	14	9	14
Design Completed	43	21	42	13
Design on-going	43	39	23	2
Under Study	32	9	0	5
Total	145	122	92	73

Source : Directorate of the Transport Planning of IMM

Most of the road projects are of small-scale with only a few km in length. Among them, relatively large-scale prominent projects are as follows:

1) Kagithane - Piyalepasa - Dolmabance (Inonu Stadium) Tunnel Project (A09) (C26)

This is composed of two tunnel construction projects linking Imrabor St. at the south-west part of Kagithane district with Dormabance St. running along the Bosphorus via Piyalepasa St., which is an arterial of the new CBD area in the N – S direction.

There is no main road crossing the central area in this east-west direction, therefore it is expected to contribute to the traffic dispersal of the congested area. This is already under construction as a 4-lane road.

2) Cendere-Ayazaga-Buyukdere Street project (C06)

This is a new connection road between Saryer District and TEM highway at Hasdal as well as Sisli Ayazaga District. It is expected to alleviate traffic concentration to the parallel road, Buyukdere St., which is the main arterial connecting the central area with the northern part. This project is still at the stage of D/D completed according to the project list, and has been approved by the city council already.

3) New road project in Basaksehir 4th Stage between Old Edirne Road and TEM highway (C17)

This project is to construct a new access road to Basaksehir area, a big residential development area in Kucukcekmece district from TEM highway in the south and Old Edirne Road in the north. The project road length is 7.6km with 4 lanes.

It contains many bridges and junctions. Some junctions are planned for future needs. It is also still at the stage of design completed, and has been approved already.

4) Widening of D-100 Highway between Kucukyali - Kartal (C27)

This is a widening project of D100 highway for the section from Kucukyali to Kartal of 8.8 km in length. This freeway is a main axis in Istanbul together with TEM highway. It aims to cope with the expanding traffic growth in the Asian region by widening from 4 lanes at present to 6 lanes. The widening of D-100 is planned to be extended from Kartal to Cayirova near Gebze in the next stage (D01). This project has been approved already and is at the tendering stage at present.

5) Gaziosmanpasa County Bogazkoy Town road and related infrastructure project (A14)

This is a widening project of Old Edirne Road and its extension from 2 lanes to 6 lanes in Gaziomanpasa district. This is the most important arterial in this district and connecting with TEM highway at the southern end. The project length is 9.8km.

It aims to cope with the traffic demand growth in accordance with the rapidly expanding residential development. This project has been approved already and is now under tendering process.

6) Avcilar - Firuzkoy Tahtakale Road Project (C04)

This project is a new road construction between Avcilar and TEM highway along the west area of Kucukcekmece Lake. The surrounding area is partly residential, but the density is still low. In the Istanbul Master plan of 1/25,000, the area is to be developed as a big fair area including convention or exhibition facilities or cultural facilities and some residential area. The project is still at the design stage as a 4-lane road, and already approved by the city council.

## 7) Bahcekoy-Kilyos Road project in Sariyer (D03)

This road is the further extension of the Cendere –Ayazaga-Buyudere project (C06) stated above. The project is to widen from 2 lanes to 4 lanes (partly 6 lanes). The purpose of the road is to develop the tourism at the northern coastal area of the Black Sea. This is still at a design stage but already approved.

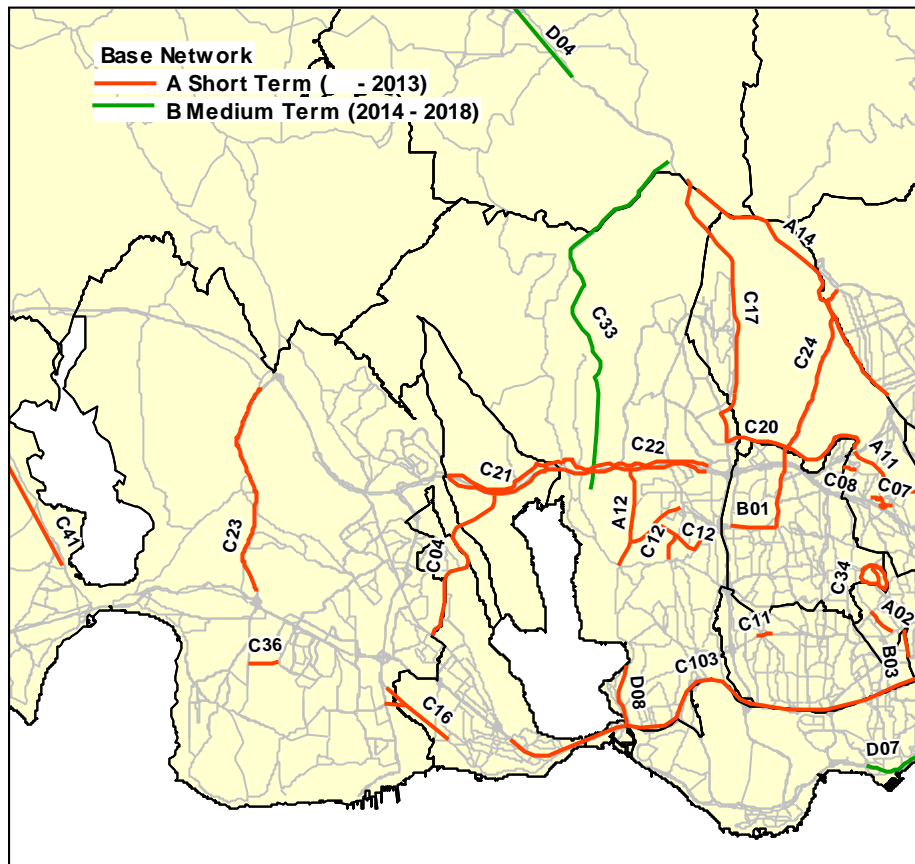
## 8) Road construction project between Istasyon Street - Kayabasi road in Kucukcekmece (C33)

This road is a new 4-lane road construction project of about 13 km in length between the Halkali Station road and Mehmet Akif road in Gaziomanpasa. This road aims to improve the accessibility of newly developed residential area of Kucukcekmece district and contribute to enhance mobility of freight traffic from the custom area to TEM highway by constructing an interchange. This road is also at the design stage but already approved.

In addition to the IMM proposed projects mentioned above, the road tunnel construction project crossing the Bosphorus was added to the base network. This project is promoted by DLH and already under bidding stage.

Figure 12.2.2 and represent the location of the approved road projects in European side and Asian side respectively. Table 12.2.2 is the list of projects in the base network.

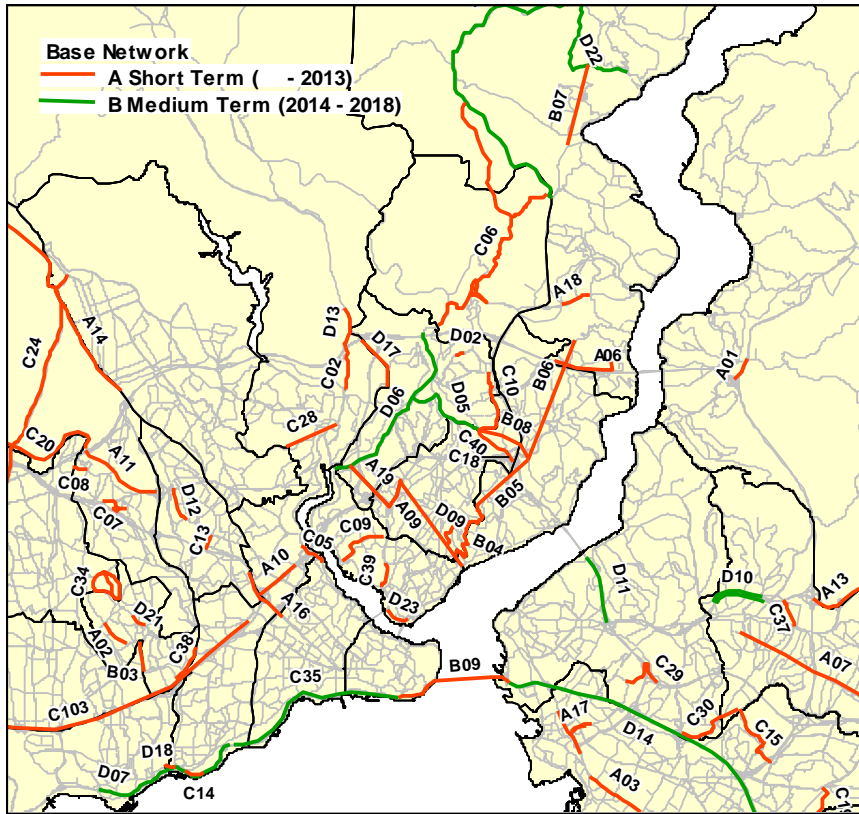
## (1) Central Area of European Side



Source : Elaborated by Study Team based on IMM/KGM Information

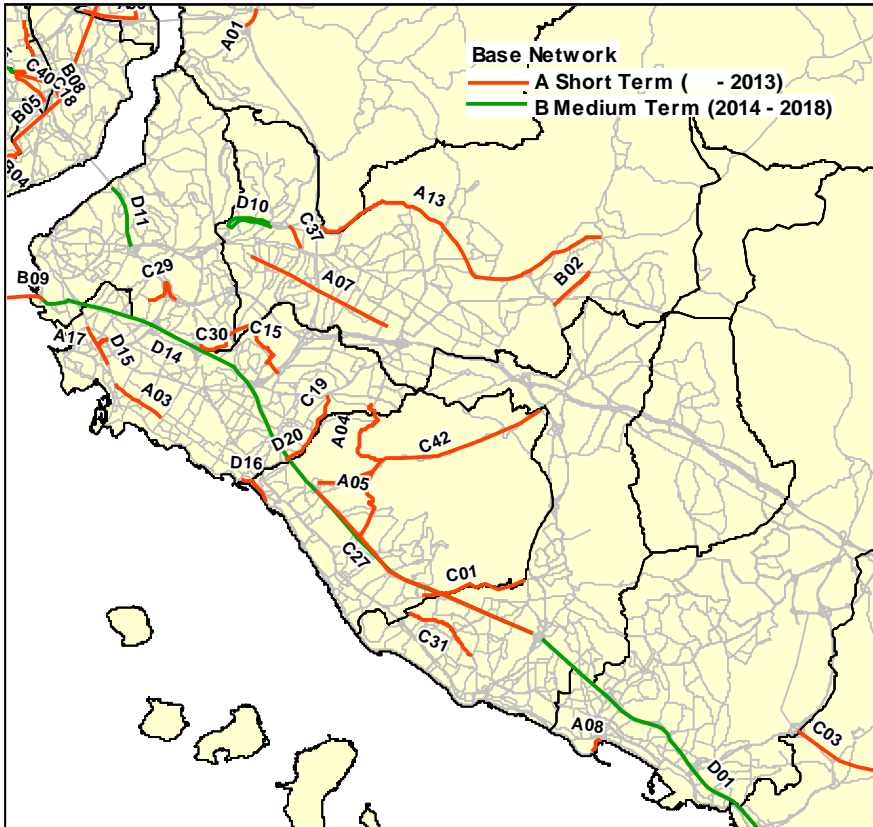
**Figure 12.2.2 Road Projects of Base Network**

**(2) Central Part of Study Area**



Source : *ibid.*

**(3) Asian Side**



Source : *ibid.*

**Figure 12.2.2 Road Projects of Base Network (Cont'd)**

**Table 12.2.2 Road Projects in Base Network**

No	New Code	Road Project Name	Project type	No. of Lane	Length (m)	Current Condition
1	A01	Kavacik Square - Mihrabat St. TEM Linkage Road Intersection construction	Rehab.	4→4	732	U.Constr.
2	A02	Gungoren Abdi ipekci st.road and Common infrastructure addition construction	Rehab.	4→4	951	U.Constr.
3	A03	(Kartal Cinar St.) Kadikoy between Kiziltoprak-Goztepe Park Bagdat Street Infrastructure and Road organization construction	Rehab.	4→3	1,916	U.Constr.
4	A04	Basibuyuk B.Bakkalkoy Road and Common infrastructure construction	Widening	2→4	5,000	U.Constr.
5	A05	Başbüyük Süreyyapaşa Road and Common infrastructure construction	Widening	2→4	2,000	U.Constr.
6	A06	Balta Limani - TEM B.Dere Linkage Road construction	Wg/New	2→4	2,839	U.Constr.
7	A07	Umraniye Hatboyu st.Road and Common infrastructure construction	New	0→4	5,160	U.Constr.
8	A08	Pendik IDO Dock completion of missings, linkage roads and underground autopark construction	New	0→4	510	U.Constr.
9	A09	Piyalepasa - Dolmabahce (Inonu Stadium) Tunnel	New	0→4	1,407	U.Constr.
10	A10	Edirnekapi D-100 Road Widening Project	Widening	6→12	1,320	U.Constr.
11	A11	Istek - Giykoop To Esenler Karaosmanoglu Ave. Road Widening And Rehabilitation Project	New	0→4	2,617	U.Constr.
12	A12	Kucukcekmece Halkali Residence area connection road	Widening	0→4	5,250	U.Constr.
13	A13	Sile Highway Umraniye Junction Connection Road rehabilitation project	Widening	4→6	11,534	U.Constr.
14	A14	Gaziosmanpasa County Bogazkoy Town road and related infrastructure project	Widening	2→6	9,824	U.Constr.
15	A15	Istinye acclivity-TEM side road- in between Baltalimanı road project	New	0→4	3,755	U.Constr.
16	A16	Vatan street improvement (TEM linking road) ( Anit Cemetery – Sagmalcilar subway station) project	Widening	6→6	1,739	U.Constr.
17	A17	Kadikoy Kurbalidere street altitude reducing project	Improve	3→3	734	U.Constr.
18	A18	Istinye Park Front Intersection and Road project	Widening	2→6	3,755	U.Constr.
19	A19	Kagithane - Piyalepasa Tunnel Project	Widening	0→4	2,500	D/DCompl
20	B01	Bagcilar CBD Region, Halkali Street road	Widening	2→4	1,547	Tendering
21	B02	Widwning project of Sumer ve Uysal Streets Road in Sarigazi Demokrasi	Widening	2→4	3761	Tendering
22	B03	Cavusbasi M.Akif Ersoy St.and Linkage road construction	Widening	4→6	926	Tendering
23	B04	Dolmabahce - Fulya Tunnel	New	0→4	1,135	Tendering
24	B05	Fulya - Levazim Sitesi Tunnel	New	0→4	2,375	Tendering
25	B06	Levazim Sitesi - Akatlar Tunnel	New	0→4	1,550	Tendering
26	B07	Sariyer Merkez -Cayirbasi Tunnel	New	0→4	2,,040	Tendering
27	B08	Zinciridere - Levazim Tunnel	New	0→4	660	Tendering
28	B09	Bosporus Road Tunnel Crossing	New	0→4	5500	Tendering
29	C01	Kartal, A2 Canakkale intersection- in between Tugay road linking road	Widening	4→4	448	D/DCompl
30	C02	Eyup –Fevzi Cakmak street - TEM linking road project	Widening	2→4	1,322	D/DCompl
31	C03	Tuzla, Sifa street - Aydintepe road -in between Sabiha Gokcen airport road	Wg/New	2→4	5,713	D/DCompl
32	C04	Avcilar - Firuzkoy Tahtakale Road project	New	0→4	6,005	D/DCompl
33	C05	Eyup, Ayvansaray street – D100 linking roads, junction project	Rehab.	4→4	799	D/DCompl
34	C06	Cendere-Ayazaga-Buyukdere street project	Widening	2→4	12,550	D/DCompl
35	C07	Esenler, Atişalani street - in between TEM North side road (842.Street-769.Street-Koyici street) road, intersection project	New	0→4	1,205	D/DCompl
36	C08	Esenler, Kurudere street- in between Barboros street (559.Street) Road, intersection project	Widening	2→4	441	D/DCompl
37	C09	Beyoglu, Piyalepasa Boulevard - in between Haskoy street road, intersection implementation project	Widening	2→4	1,748	D/DCompl
38	C10	Kagithane, Sultan Selim street - İnonu street - Talatpasa street - Dere street linking road implementation project	Wg/New	2→4	1,588	D/DCompl
39	C11	Junction project in Bahcelievler, Yıldırım Beyazıt street - Atatürk street-Degirmenbahce street intersection	Widening	4→4	523	D/DCompl
40	C12	Road project in Kucukcekmece, between Sakarya street- Halkali Center (Ikitelli street)	Widening	4→4	913	D/DCompl
41	C13	Road project in Bayrampaşa, between Tuna street-Yahya Kemal street	Wg/New	2→4	533	D/DCompl
42	C14	Zeytinburnu, coast road curve arrangement	Improve	4→4	596	D/DCompl
43	C15	Road improvement project between Karamanciftlik street and 3004 street in Kadikoy,	Improve	4→4	2,318	D/DCompl
44	C16	Road project in Avcilar, between Petrol Office street. - Kumcular Haramidere road	Wg/New	2→4	3,366	D/DCompl
45	C17	New road project in Basaksehir, 4.Etape (Old Edirne road - TEM highway)	New	0→4	7,582	D/DCompl
46	C18	Road prject in Sisli, Zinciridere street - Buyukdere street linking Project	Wg/New	2→4	252	D/DCompl
47	C19	Road project in Kadikoy, (Bostanci Tunnel street - Kayisdagi street) linking	Rehab.	4→4	1,403	D/DCompl
48	C20	Road project (Istek-Giykoop. - Basaksehir 4.Etape)	New	0→4	7,118	D/DCompl



49	C21	Altinsehir To Bahcesehir Widening And Rehab. Project	Widening	4→8	7,600	D/DCompl
50	C22	Mahmutbey Altinsehir Servis Road Widening And Rehab. Project	Widening	4→8	8,600	D/DCompl
51	C23	Buyukcekmece - Tem Highway To D-100 Connection Road Widening And Rehab. Project.	Widening	4→8	7,700	D/DCompl
52	C24	Sultanciftligi to Mahmutbey Bridge connection road rehabilitation project	Widening	4→6	6,530	D/DCompl
53	C25	Additional Civil Work (Drainage etc.) for Metrobus Route between Topkapi - Kucukcekmece of D-100 Highway	CivilWork	12→12	10,892	D/DCompl
54	C27	Widening of D-100 Highway Between Kucukyali - Kartal	Widening	4→6	8,860	D/DCompl
55	C28	Eyup (Silahtaraga) - GOP cd. Tunnel	New	0→4	139	D/DCompl
56	C29	Uskudar, between Camlica Underpass- D-100 Land route (Hospital road) road, junction implementation project	New	0→3	1,788	D/DCompl
57	C30	Uskudar, between 3004 St.- D-100 branch road, junction project	Widening	2→4	2,098	D/DCompl
58	C31	Kartal, Saraylar st.- Koroglu st. - Tecerdag st. - Kortej st. Road rehabilitation project	Widening	2→2	2,755	D/DCompl
59	C32	Widening project between Buyukdere st.- Belediye st. (Dereboyu st.) in Kagithane	Widening	2→4	1,169	D/DCompl
60	C33	Road construction project between İstasyon street - Kayabasi in Kucukcekmece	New	0→4	12,777	D/DCompl
61	C34	Bagcilar Esenler street - Gungoren street - 6. street road rehabilitation project	Widening	2→4	3,345	D/DCompl
62	C35	Fatih Eminonu Kenndy street (between Aksakal street - 10.Yil street) road rehabilitation project	Rehab.	4→4	5,948	D/DCompl
63	C36	Beylikduzu Gurpinar road linkage road junction project	Widening	4→4	988	D/DCompl
64	C37	Dr. Fazil Kucuk street and Alemdag street linkage road project in Umraniye	Widening	2→4	885	D/DCompl
65	C38	Gungoren, Ali Riza Gurcan street road rehabilitation project	Rehab.	4→4	1,129	D/DCompl
66	C39	Beyoglu, Bulent Demir street road rehabilitation project	Rehab.	2→2	879	D/DCompl
67	C40	Sisli, Dereboyu st.- Zincirli dere road, junction project	Widening	2→4	933	D/DCompl
68	C41	Catarca-Mimar Sinan TEM Linkage project	Widening	2→4	9,431	D/DCompl
69	C42	Maltepe Buyukbakkalkoy-Yakacik Linkage project	Widening	4→6	4,384	D/DCompl
70	D01	Widening of D -100 between Kartal - Cayirova and surrounding road project	Widening	4→6	16,104	Designing
71	D02	Kagithane Sultan Selim st.- Barboros st linkage road project	New	0→4	328	Designing
72	D03	Bahcekoy-Kilyos road project in Sariyer	Widening	2→4	16,268	Designing
73	D04	Gaziosmanpasa, between Arnavutkoy - Karaburun road, junction project	Widening	2→3	21,904	Designing
74	D05	Kagithane, between Belediye st.- Cendere st. (Galata Deresi st.- Mithatpaşa st.) road, junction project	Widening	2→2	2,737	Designing
75	D06	Kagithane, Silahtaraga st.- TEM Sadabat Viaduct ( Cendere road) road, junction project	Widening	4→8	5,770	Designing
76	D07	Zeytinburnu Bakirkoy Kennedy street (between 10. Yil street - Fildami road) road rehabilitation project	Rehab.	4→4	4,813	Designing
77	D08	Kucukcekmece between Asik Veysel street - D-100 Highway road project	Widening	0→2	981	Designing
78	D09	Besiktas, between Kadirgalar street-Askerocagi street (Taskisla st.) road junction project	Widening	2→2	750	Designing
79	D10	Umraniye between Kucuksu Tantavi Tunnel TEM linkage road branch roads, road junction implementation project	New	0→4	3,157	Designing
80	D11	Road project between Bosphorus Bridge - Altunizade junction E-5 Highway	Improve	6→6	2,106	Designing
81	D12	Bayrampasa, 12.Street altitude reducing project	Improve	2→2	1,063	Designing
82	D13	Kagithane, between Hasdal TEM flyover bridge - Kemberburgaz st. ( Kemberburgaz road) road, junction project	New	2→4	1,252	Designing
83	D14	Between Harem - Kartal Junction D -100 North - South Branch roads and surroundings road, junction implementation project	Rehab.	3→3	20,827	Designing
84	D15	Kadikoy, in front of Fenerbahce Stadium Taskopru street - O1 road intersection road, junction implementation project	Widening	4→6	1,484	Designing
85	D16	Kadikoy, Coastal Road Bostanci junction and surrounding road, junction implementation project	Improve	6→6	1,193	Designing
86	D17	Kagithane - Hasdal Connection road rehabilitation project	Widening	2→4	1,670	Designing
87	D18	Cirpici Creek's linkage to Ayvalidere and construction of missings and İstasyon street and railway bridge transition construction (Zeytinburnu autopark)	Rehab.	4→4	301	Designing
88	D19	Bagcilar , Gunesli – TEM Linkage road project	Rehab.	4→4	1,770	Designing
89	D20	Linkage road project among Camasirci Deresi İnonu District, Findikli District and İcerenkoy District	Wg/New	2→4	1,460	Designing
90	D21	Junction project in Gungoren, Ataturk street - Kivircik Street - Cincin street intersection	Widening	4→4	500	Designing
91	D22	Road project between Sariyer – Bahcekoy – Mine linking road	Rehab.	2→2	3,985	Designing
92	D23	Beyoglu - Tersane st road costruction project	New	0→4	750	Designing

Source : *ibid.*

### 12.2.2 Base Network of Rail Transit

The Base Network consists of the existing railways, railways under construction, tender stage railways, railways under design stage and the ongoing projects that are listed in the IMM 2008 Investment Plan (2008—2010). The total length of railways in the Base Network is 320.9 km. Figure 12.2.3 shows the Base Network.



Source : *ibid.*

**Figure 12.2.3 Base Network (Railway)**

The Base Network Railways are defined by the use of single letter code as follows:

#### Project Code

E-xx :	Existing Railways
C-xx :	Projects Under Construction
T-xx :	Tender Stage Projects
D-xx :	Projects Under Designing Stage

#### 1) Projects under Construction

Presently, construction work for new lines and extension of the existing lines are underway. The total length of the projects under construction is 136.5km of which 72km is the section length of the Marmaray Project. The Marmaray project is expected to be completed in 2012, while the other construction projects are scheduled to be completed in 2009 or 2010.

- (1) **Extension of Taksim-4.Levent Metro (C-1&C-4):** The construction of the underground railway is underway for both sides of the existing metro, from Taksim to Yenikapi (C-1, 5.2km) and 4.Levent to Haciosman (C-4, 8.0km). The section of Taksim – Yenikapi will be an alternative route of Zeytinburnu - Kabatas Tramway (E-3) with higher speeds and more convenient access to Taksim Square. This section will connect the metro to the commuter railways of Marmaray Commuter at Yenikapi. In the section between Taksim and Sishene with length of 1.65 km, construction work has been completed except for E&M systems installation such as power supply, signal, and telecommunication.

The section of 4.Levent - Haciosman (C-4) connects Sariyer District to the center of

Istanbul, running through the new industrial area and Istanbul Technical University. Tunneling work for this section has been completed in February, 2008.

- (2) **Topkapi-Edirnekapi-Sultanciftligi Tramway (C-2):** Construction began in 2002 and the section between Sehitlik Station and Selam Station was completed and opened in September, 2007. Remaining section between Sehitlik and Topkapi is under construction and is expected to be completed in 2008. Passenger can transfer at either Ulubatli Station of Aksaray - Airport Light Metro (E-2) or Topkapi Station of Zeytinburnu - Kabatas Tramway (T-3) when the extension section is completed.
- (3) **Kadikoy-Kartal Metro (C-3):** This is a parallel route of the Marmaray Commuter. Both routes are connected at Ibrahimaga Station but Kadikoy-Kartal Metro will not go through the tunnel of the Marmaray Project. Total length of Kadikoy – Kartal Metro is 21.7 km with 16 stations. This route is expected to be in service between 2011 and 2013. The metro system is not the same as the existing Taksim-4. Levent Metro (E-1). Power supply system will be 1500V DC with overhead catenary (rigid catenary).
- (4) **Otogar - Bagcilar (Kirazli) Light Metro (C-5):** This is the extension of the branch line of Aksaray - Airport Light Metro (E-2) with a total length of 5.4km. Most section is underground. The construction started in 2005 and is expected to be completed in 2008. The location of Bagcilar Station is about 400m away from Bagcilar Station of Zeytinburnu - Bagcilar Tramway (E-4). The route runs through the high density residential area of Bagcilar District.
- (5) **Bagcilar - Ikitelli - Olimpiyat Koyu Metro (C-6):** This metro will be connected to Otogar – Bagcilar Light Metro (C-5) at Bagcilar Bati Kirazli 1 Station, providing mass transit access to the new industrial area in Gaziosmanpasa District. Total length of this line is 15.9 km with 11 underground stations. This metro is a different type from the existing Taksim - 4. Levent Metro (E-1). Power supply system will be 1500V DC with overhead catenary or rigid catenary. This line will extend to Bakirkoy station of Aksaray -Airport Light Metro (E-2).
- (6) **Marmaray Project (C-7):** The Marmaray Project consists of three components: Bosphorus crossing, commuter rail upgrading, and procurement of the rolling stocks. The total project cost is estimated as 3 billion USD.

The Bosphorus Crossing Project will connect European and Asian sides through a 1.4 km immersed tube tunnel under the Bosphorus Strait. The deepest point of the tunnel will be approximately 56 meters under the water surface level. This tube tunnel will be accessed by bored tunnels from Kazlicesme on the European side and Ayrilikcesme on the Asian side. New underground stations will be built by cut-and-cover method at Yenikapi, Sirkeci, and Uskudar, and other 37 at-grade stations along the line will be rebuilt or refurbished.

The project will upgrade the TCDD existing line as the commuter rail line. The existing two tracks will be fully upgraded to three tracks up to Halkali in European side and up to Gebze in Asian side. The entire upgraded and new railway system will be 76.3 km long of which 13.6 km are underground.

Bid for the procurement of rolling stock was done in February, 2008. New rolling stock purchased for this project is 440 vehicles in total; 280 in 2009, 40 in 2010, and 120 in 2011 with a total budget of approximately 750 million Euro.

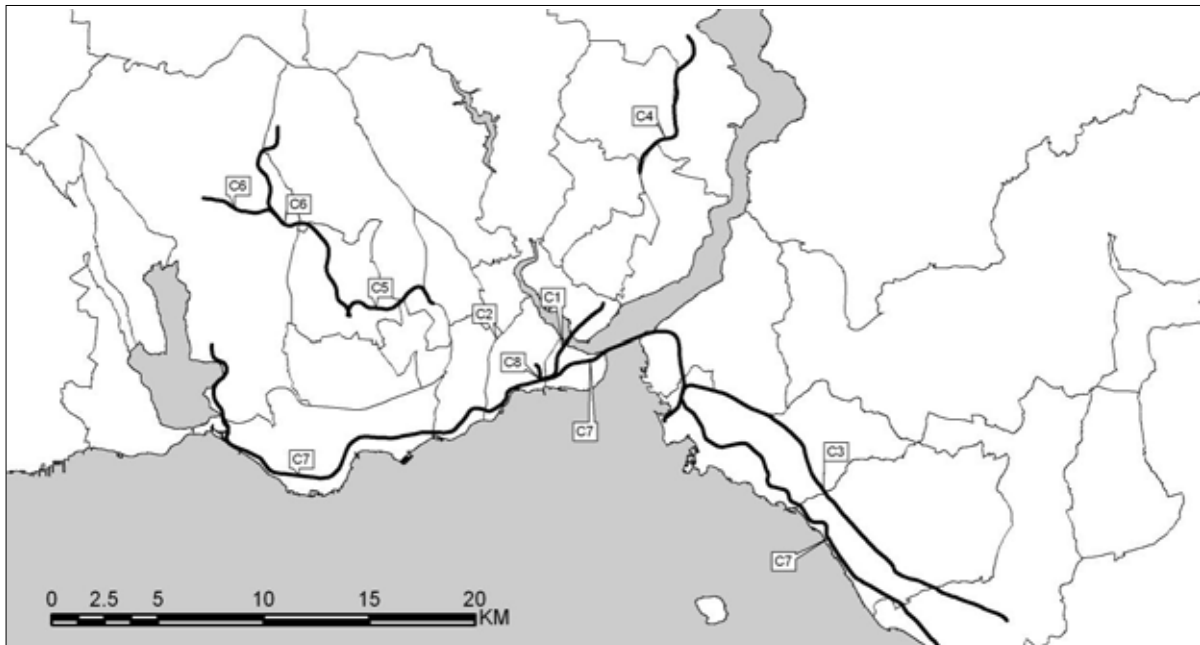
- (7) **Aksaray – Yenikapi (C-8):** This is the extension of Aksaray - Airport Light Metro (E-2) with a length of 700m, connecting the Light Metro to the commuter railway of Marmaray Project at Yenikapi Station. Extension route is expected to be in service by 2010.

**Table 12.2.3 Railway Systems under Construction**

Project Code	Project Section	Type	Length (km)	No. of Stations	Operation Year
C-1	Taksim - Yenikapi (Extension of Taksim - 4.Levent Metro:E-1)	Metro	5.2	4*	2010
C-2	Topkapi- Edirnekapi (Extension of Edirnekapi-Sultanciftligi Tramway:E-12)	Tram	3.1	2*	2008
C-3	Kadikoy-Kartal (New Line)	Metro	21.7	16	2011-2013
C-4	4. levent - Ayazaga – Haciosman (Extension of Taksim-4.Levent Metro:E-1)	Metro	8.0	5*	Mar-2009
C-5	Otogar – Bagcilar (Kirazli) (Extension of Aksaray-Airport Light Metro:E-2)	Light Metro	5.4	4*	Dec-2008
C-6	Bagcilar - Ikitelli Olimpiyat koyu (New line)	Metro	15.9	11	Dec-2008
C-7	Marmaray project	Suburban Railway	76.5	45	Mar-2012
C-8	Aksaray – Yenikapi (Extension of Aksaray – Airport Light Metro:E-2)	Light Metro	0.7	1*	2010
	Total		136.5		

Source : Study Team

\*: No. of stations excludes the exiting station.



Source: *ibid.*

**Figure 12.2.4 Location of Under Construction Projects**

2) Tender Stage Projects

There are two light metro projects which are under tender stage: Uskudar - Cekmekoy Light Metro (T-1) in the Asian side and Bakirkoy - Beylikduzu Light Metro (T-2) in the European side.

- (1) **Uskudar – Cekmekoy Light Metro (T-1):** This route runs east and west through high density residential areas of Uskudar District and Umraniye District in Asian side. The total length is 19km and it has 17 stations. The system will be a light metro with six cars for each train. The terminal station at Uskudar will connect this route to the commuter railway of the Marmaray Project.
- (2) **Bakirkoy - Beylikduzu Light Metro (T-2):** This route will connect the west area of Kucukcekmece Lake and Bakirkoy, running along the D100 and the north of Ataturk International Airport. The route will be connected to the existing Aksaray – Airport Light Metro (E-2) at Bakirkoy Station. The total length is 25km with 19 stations. The route is overlapped with the Metrobus route.

**Table 12.2.4 List of Tender Stage Projects**

Project Code	Route Name	TYPE	Length (km)	No. of Stations	Operation Year
T-1	Uskudar – Cekmekoy Light Metro	Light Metro	19.6	17	2012
T-2	Bakirkoy - Beylikduzu Light Metro	Light Metro	25.0	19	2012
	Total		44.6		

Source: *ibid.*



Source: *ibid.*

**Figure 12.2.5 Route of T-1 (Uskudar - Altunizade - Umr - Dudullu Light Metro)**



Source: ibid.

**Figure 12.2.6 Route of T-2 (Bakirkoy - Beylikduzu Light Metro)**

### 3) Projects under Design Stage

There are five railway lines (four metros and one tramway) under design stage, with a total length of 64.4km. In addition, Shishane – Kulaksiz – Cemal – Kamaci Guzergahi Monorail Project is listed in the IMM 2008 Investment Plan (2008-2010). Therefore, this monorail project is also included in this category.

- (1) **Bakirkoy-Bahcelievler-Bagcilar (D-1):** This is the southern extension of Bagcilar - Ikitelli Olimpiyat Koyo Metro (C-6) from Bagcilar to Bakirkoy port, running parallel to Zeytinburnu - Bagcilar Tramway (E-4) between Bagcilar and Bahcelievler. This route will be connected to another design-stage project of Yenikapi - Bakirkoy (D-3) at Bakirkoy, which is one of the transfer stations of Marmaray Commuter. The total length is 9km with 8 stations. This route and C-6 will form a north-south route between the industrial area of Ikitelli and the commercial and residential area in Bakirkoy District.
- (2) **Kabatas - Besiktas - Sisli - Giyimkent – Bagcilar (D-2):** This line goes along the expressway E-80 in Asian side, starting from Kabatas to a Bagcilar - Ikitelli Olimpiyat Koyo Metro (C-6) station in Bagcilar District. The total length is 24.5km with 19 stations. There are some transfer stations with other rail lines such as Kabatas with Zeytinburnu - Kabatas Tramway (E-3), Sisli with Taksim - 4.Levent Metro (E-1), Alibekoy with Halic Surround Tramway (D-4), Metris with Topkapi - Edirnekapi - Sultanciftligi Tramway (C-2), and Mahmutbey with C-6.
- (3) **Yenikapi – Bakirkoy (D-3):** This is a metro which connect Yenikapi and Bakirkoy through high density commercial and residential area between Zeytinburnu - Kabatas Tramway (E-3) and the commuter railway of the Marmaray Commuter. This route applies the same

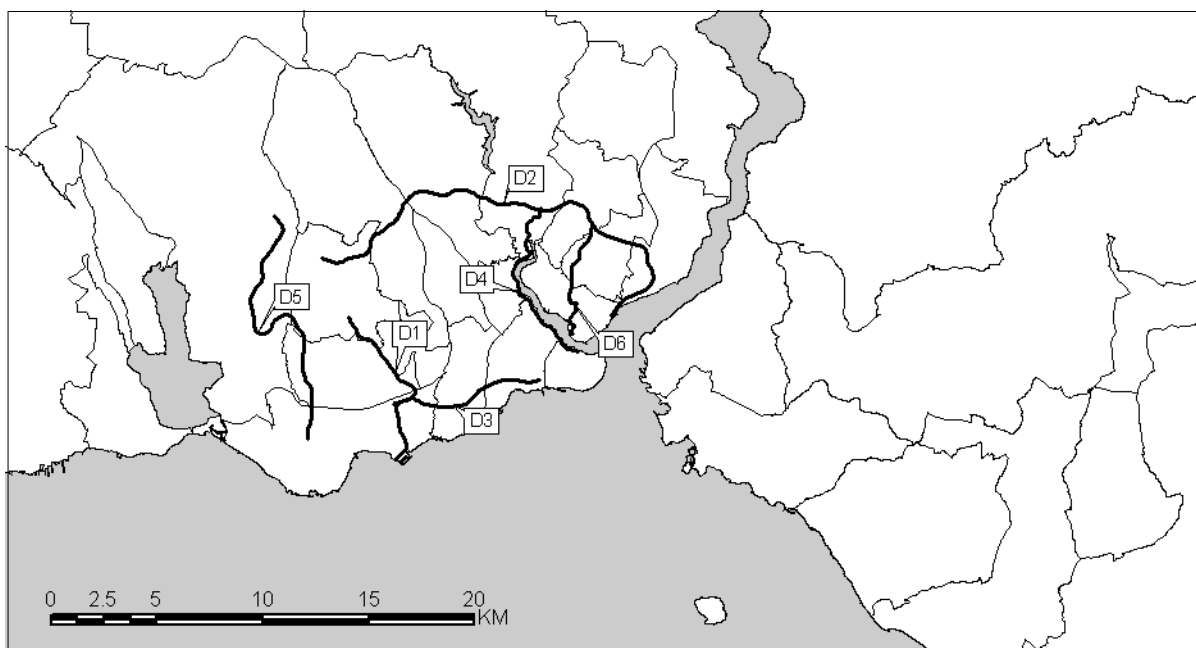
system as the existing Taksim - 4.Levent Metro (E-1), which will form a north-south rail corridor between Sariyer District and Bakirkoy District.

- (4) **Halic Surround Tramway (D-4):** Halic surround (Golden Horn) is planned as a culture valley. This route runs along Golden Horn connecting educational institutions.
- (5) **Yesilkoy - Ataturk Airport – Ikitelli (D-5):** This route will connect the industrial area of Ikitelli and Ataturk Airport north to south. The alignment of the route is on the east side of Basin Expressway in the southern section, while it is on the west side in the northern section.
- (6) **Shishane – Kulaksiz – Cemal – Kamaci Guzergahi Monorail (D-6):** This is the loop line of monorail in the Beyoglu area and will be connected with Sishane Station of Taksim - 4.Levent Metro (E-1). The route is still under study and not finalized yet. Expected route length will be 5.8km.

**Table 12.2.5 List of Under Design Stage Projects**

Project Code	Route Name	TYPE	Length (km)	No. of Stations	Operation Year
D-1	Bakirkoy - Bahcelievler Bagacilar (Extension of C-6 Line to the South)	Metro	9	9	2012
D-2	Kabatas - Besiktas - Sisli - Giyimkent - Bagcilar	Metro	24.5	20	2012
D-3	Yanikapi - Bakirkoy (Extension of E-1 Line to the West)	Metro	7	7	2012
D-4	Halic Surround Tramway	Tramway	9.6	13	-
D-5	Yesilkoy - Ataturk Airport - Ikitelli Metro	Metro	14.3	10	-
D-6	Shishane - Kulaksiz - Cemal Kamaci Guzergahi Monorail	Monorail	5.8	10	2010
	Total		70.2		

Source: *ibid.*



Source : *ibid.*

**Figure 12.2.7 Location of Projects under Design Stage**

## 12.3 Modal Shift by Network Development

### 12.3.1 OD Matrix by Mode

The approach for demand forecast in this study adopts basically “the four step method” as stated in Chapter 11, where future modal share is affected by the network conditions. In other words, future OD matrix can be forecast only after a future network is given.

As the first step, future OD matrix was forecast assuming no change on the present network. This is called “Do nothing” OD. The second OD matrix was made assuming all the railway projects including even premature ones in an idea stage, but not including any road projects. This OD matrix is called “Maximum Railway” OD matrix. The last OD matrix was forecast assuming the maximum network, that is, present network plus all the road and railway projects. This is called “Do maximum” OD matrix.

In this section, some comparative analyses were made on the above-mentioned four OD matrices. Total number of trips of the present OD matrix is about 365 million trips, while Do nothing OD in 2023 has 645 million trips, 1.8 times of the present. Their compositions by trip purpose are as shown in Table 12.3.1.

**Table 12.3.1 Trip Composition by Purpose in 2006 and 2023**

(Percent)

Case	Year	HBW	HBS	HBO	NHB	Total
Present	2006	60.2	8.0	19.6	12.3	100.0
Do Nothing	2023	35.1	24.4	30.6	9.9	100.0
Max. Railway	2023	46.7	19.4	27.6	6.3	100.0
Do Maximum	2023	31.5	32.1	29.1	7.3	100.0

Source: Study Team

### 12.3.2 Trip Length Distribution

Table 12.3.2 shows the average trip length by mode. As the urbanized areas will expand in the future, the average trip length tends to become longer in general. In 2023, average trip length will be 1.4 to 1.6 times of the present.

It is noted that passenger car and service vehicle passenger in the Maximum railway OD shows shorter length than present, while public transport makes its average length double of the present. This suggests that longer trips will shift to railway due to heavier traffic and more serious congestion on roads.

Figure 12.3.1 shows distribution of trip length by mode. The Do maximum OD shows the lengthening of car trips due to improvement of road network.

**Table 12.3.2 Trip Length Distribution by Mode**

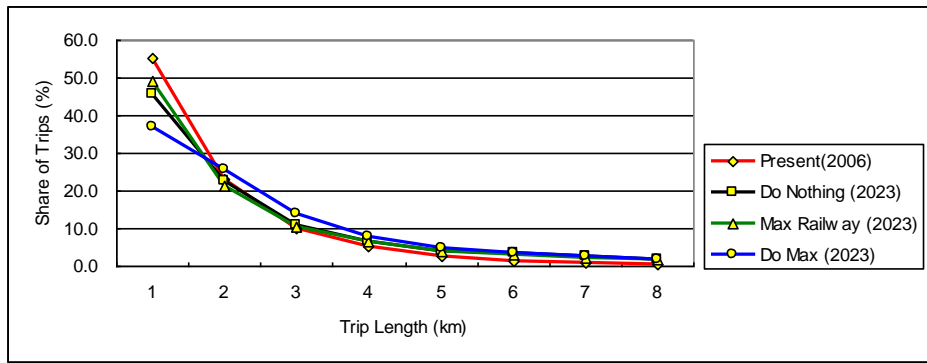
(Kilometer/ Trip)

Case	Year	Passenger Car	Service Vehicle	Public Transport	All Mode Without Walk
Present	2006	10.1	11.8	10.5	10.6
Do Nothing	2023	13.3	19.6	14.2	15.1
Max Railway		9.1	9.5	19.1	14.2
Do Maximum		16.5	15.9	16.0	16.3

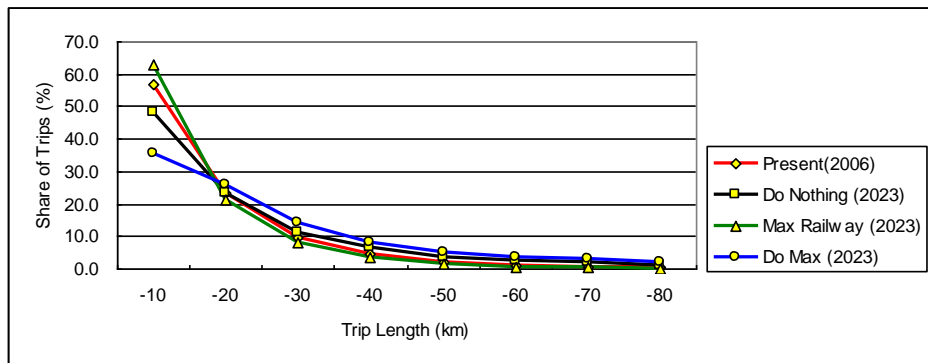
Source: Study Team



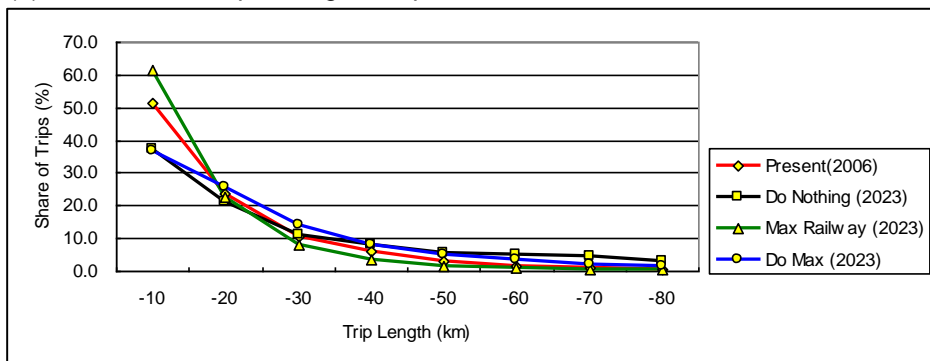
(1) All Mode excluding Walk Trip



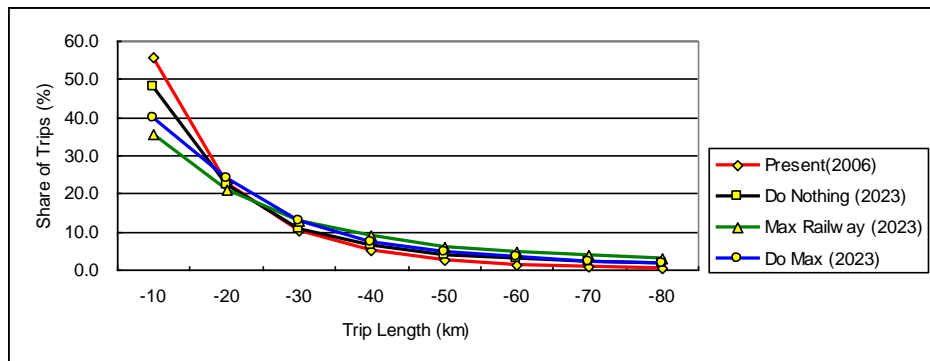
(2) Passenger Car Trip



(3) Service Vehicle passengers Trip



(4) Public Transport Passengers Trip



Source: Study Team

**Figure 12.3.1 Trip Length Distribution by Mode**

### 12.3.3 Modal Shift

Improvement of a mode will attract transportation demand to the mode. Table 13.3.3 compares the modal shares of three future OD matrices. The table means a comparison of three assumptions stated at the definition of three OD matrices.

Do nothing OD shows a similar pattern of modal share to the present. Considering a significant increase of passenger cars in the future, the almost same share of car passengers shows implicitly a strong suppression of demand by road congestion. If a railway network is developed without road improvement, a significant modal share will occur from service vehicle use to public transport use and road traffic would become less. Consequently, car user will increase for that.

If road projects are implemented to the maximum extent, the share of passenger car will rise up to almost 60%. Thus, almost a half of passenger car users were shifted to public transport use in case of Do nothing assumption.

**Table 13.3 3 Modal Share by Alternative OD Matrices**

Case	Year	Passenger Car	Service Vehicle	(Percent)	
				public Transport	Total
Present	2006	32.8	23.8	43.4	100.0
Do Nothing	2023	31.8	26.4	41.9	100.0
Max. Railway	2023	37.3	6.3	56.4	100.0
Do Maximum	2023	59.5	16.1	24.3	100.0

Source: Study Team

### 12.3.4 Average Congestion Rate

Figure 11.1.7 shows the OD traffic forecast for 2023 as assigned onto the base network. Although not as severe as the "Do Nothing" case shown elsewhere, the congestion level of over 1.5 is found on many links in the network.

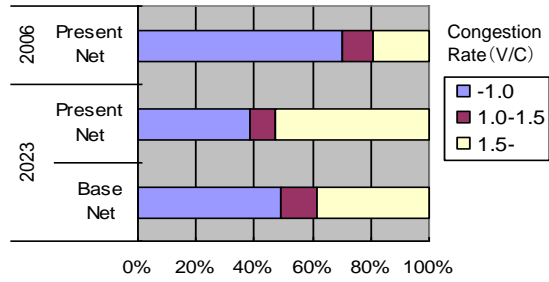
The average congestion ratio (or the average V/C ratio of all the network links, weighted by the link distances) is 0.47 for the present metropolitan network as a whole and 0.75 for the CBD. The same ratio estimated for 2023 is 0.79 for the entire base network and 0.81 for the CBD. The average congestion level of the entire base network will be just as high as that of the present CBD.(Table 12.3.4)

The traffic volume (in person kilometers) on the links with congestion of 1.5 or more makes up 20% of the total on the present network. The same share forecast for the base network in 2023 is nearly 40%. This clearly shows that the base network will not be able to cope with the expected growth of demand. The network is in need of investment larger than the committed projects.

**Table 12.3.4 Average Congestion Ratio**

Year	Network	Metrop. Area	CBD*
2006	Present	0.47	0.75
2023	Present	0.93	1.00
	Base	0.79	0.81

\*The area surrounded by TEM, Basin Expressway and Kozyayag Anadolu Expressway.



**Figure 12.3.2 Percentage Composition of Traffic Volume by Level of Link Congestion**

In the same way, Table 12.3.5 shows the road extension and traffic volume in terms of passenger-km by congestion rate.

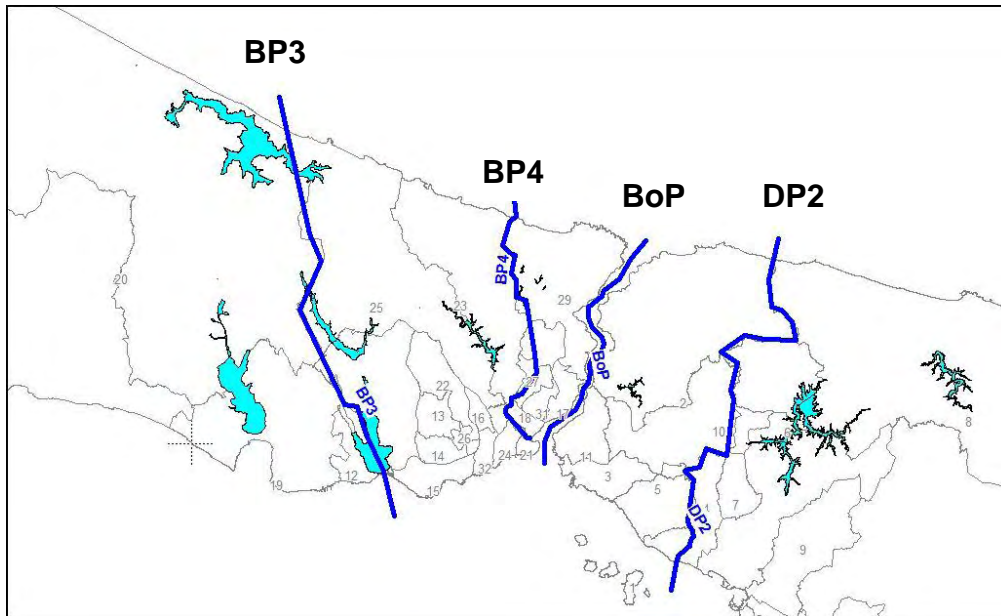
**Table 12.3.5 Congested Distance and Passengers in Congestion (Percentage)**

Indicator	Case	Year	Congestion Rate (Volume/Capacity)				Total
			-1.0	1.0-1.2	1.2-1.5	1.5-	
Road Length	Do Nothing	2006	95.3	2.1	1.3	1.3	100.0
	Do Nothing	2023	81.6	4.9	4.6	8.9	100.0
	Max Railway	2023	77.9	10.1	6.0	6.0	100.0
	Do Maximum	2023	88.4	5.8	3.5	2.3	100.0
Passenger -Km	Do Nothing	2006	82.2	6.1	6.0	5.7	100.0
	Do Nothing	2023	44.1	7.4	9.9	38.6	100.0
	Max Railway	2023	51.5	14.8	11.9	21.8	100.0
	Do Maximum	2023	73.3	9.5	7.5	9.7	100.0

Source: Study Team

## 12.4 Demand/ Capacity Gaps

The Base Network was assessed by comparing 2023 demand with transport capacity at four screen lines. Screen lines were drawn north to south on the district boundaries as shown in Figure 12.3.1. By doing this, volume of trips crossing the screen lines can be estimated by integrating traffic zones, instead of loading OD volumes on the network.



Source : *ibid.*

**Figure 12.4.1 Screen Lines for Demand/ Capacity Analysis**

Figure 12.3.2 illustrates the demand in 2005 and 2023 in comparison with capacities on screen lines of the present and the base network, respectively.

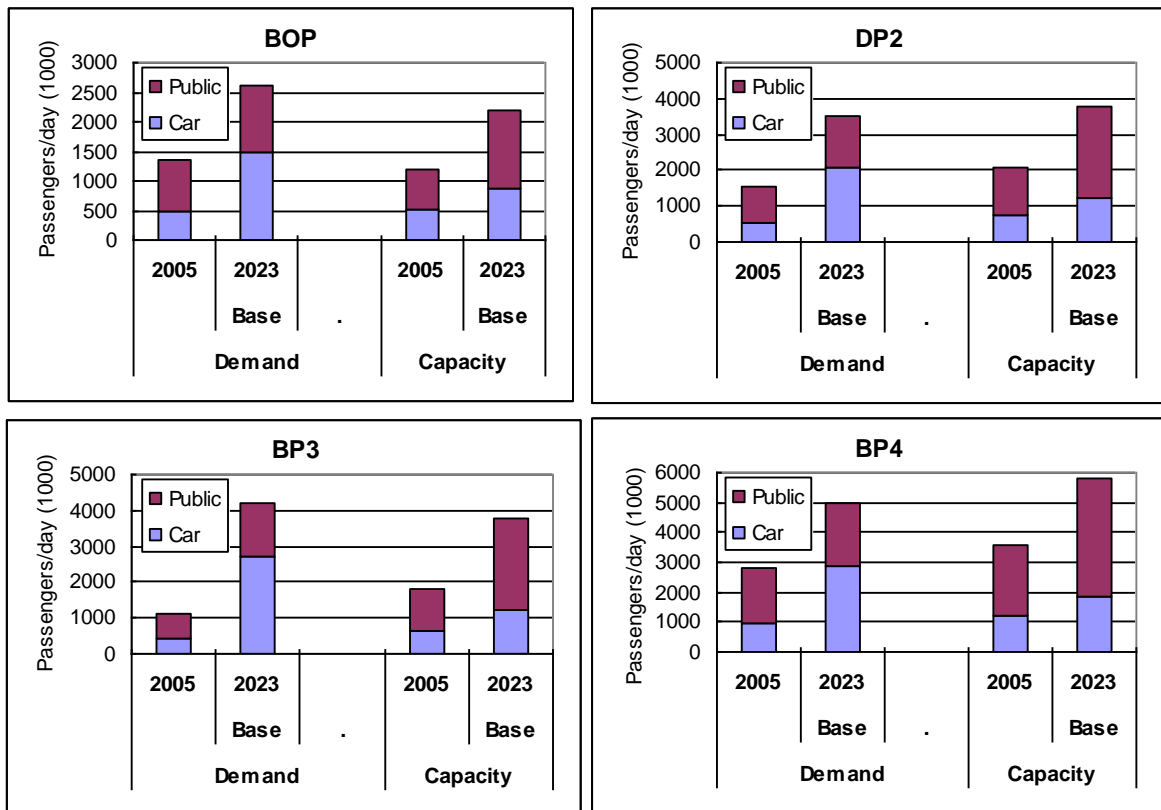
Several conditions were assumed to estimate the capacity of road and railway in terms of number of passengers:

- Average occupancy of a passenger car was assumed at 1.57, a service bus at 10.0 and a bus at 30.4.
- Composition of road traffic was assumed for car at 70%, service at 5% and bus at 25% in terms of pcu.
- Average capacity of rail transit was assumed at 35,000 passengers/ hour/ direction for HRT, at 20,000 for LRT and at 8,000 for tram.
- Peak hour ratio was assumed at 12.15%.

In case of the Bosphorus screen line, current daily demand of about 250,000 passengers for marine transport was added to the present and future capacity as well as to demand. In addition, no induced demand is considered for the demand crossing the Bosphorus, in other word, the dummy variable X was assumed to be one half of the present value at 0.5 in the future.

Except the screen line BP4, capacity of the Base Network almost meets the future demand. If observing the demand by mode, however, capacity for car passengers is much less than

the demand, while capacity for public transport passengers has a surplus over the demand. This suggests that strong TDM measures would be needed unless any other projects are implemented.



Source : *ibid.*

**Figure 12.4.2 Demand/ Capacity Gaps of Present and Base Network in 2005/ 2023**

## 12.5 Possible Investment in Istanbul Transport Sector

The IMM's annual budget in 2007 allotted YTL 2280 million to the transport sector. The amount corresponds to 1.8% of the gross regional domestic product of IMM in the same year. In case of large cities in the world, generally, investment in the transport sector falls in the range of 1.0 to 3.0% of their GRDP. In some boom cities, however, the ratio exceeds 4.0% or even 5.0%.

Istanbul is now in the cradle of development of urban railway network and has started extensive construction works. Therefore, the ratio of transport investment to the GRDP will be maintained in a high level. Assuming the ratio at 1.8 – 3.0%, possible investment amount was estimated as shown in Table 12.5.1. Roughly speaking, an amount of TRL 70 – 80 billion is regarded as the possible investment in the period of 2009 – 2023, inclusive of expenditure for maintenance. The amount also includes investment by the Central government and the private sector.

**Table 12.5.1 Possible Investment in Istanbul Transport Sector**

(Million YTL, at 2005 current prices)

Investment per GRDP	1.8%	2.5%	3.0%
2005	1901+α	1901+α	1901+α
2006	-	-	-
2007	2280+α	2280+α	2280+α
2008	2,246	3,120	3,744
2009	2,363	3,282	3,938
2010	2,486	3,453	4,143
2011	2,615	3,632	4,359
2012	2,751	3,821	4,585
2013	2,894	4,020	4,824
2014	3,045	4,229	5,074
2015	3,203	4,449	5,338
2016	3,370	4,680	5,616
2017	3,545	4,923	5,908
2018	3,729	5,179	6,215
2019	3,923	5,449	6,538
2020	4,127	5,732	6,878
2021	4,342	6,030	7,236
2022	4,567	6,344	7,612
2023	4,805	6,673	8,008
2024	5,055	7,021	8,425
2025	5,318	7,386	8,863
Possible Investment Total, 2009-2023	51,765	71,895	86,274

Source : *ibid.*

Note: GRDP growth assumption – 5.2% per year

Actual IMM investment figures in 2005 & 2007 despite of unknown state transport investments in Istanbul

Reference indicators from other JICA transport M/P experiences regarding transport investment per GRDP – 2.6% for Manila, Philippines, 2.5% for Hochiminh City, Vietnam

## 12.6 Preparatory Works for Project Evaluation

### 12.6.1 Transport Economy and Related Matters

#### 1) Transport Activity in Metropolitan Economy

The economy of Istanbul is strong in the field of trade, banking and financial institutions, and business and personal services, since the shares of those economic activities are over 35% in Turkey. The transport and communication sector accounts for 12-13% in the Istanbul economy and has a share of 21-23% in the nationwide transportation and communication sector which is almost equivalent to that of Istanbul's GRDP in the national total.

**Table 12.6.1 Istanbul's GRDP by Sector, Composition and Share in Nation, in 1995 and 2004**

(National = 100)

Sector	GDP by Sector (\$ Million)		Composition in Istanbul Economy (%)		Share (%)	
	1995	2004	1995	2004	1995	2004
Agriculture	0.4	0.4	1.4	0.5	1.8	1.0
Industry	8.8	20.1	30.1	26.3	26.2	25.0
Construction	1.2	2.1	4.1	2.8	16.3	18.0
Trade	7.5	23.6	25.7	30.9	28.7	35.5
Transportation & Communication	3.7	9.8	12.7	12.8	22.9	21.0
Financial Institutions	2.2	7.3	7.5	9.6	40.4	45.0
Ownership of Dwelling	1.3	4.4	4.5	5.8	30.9	32.0
Business and Personal Services	1.9	4.6	6.5	6.0	39.3	41.0
Bank Service Charges	2.2	4.1	7.5	5.3	48.8	50.0
<b>Total</b>	<b>29.2</b>	<b>76.4</b>	<b>100.0</b>	<b>100.0</b>	<b>21.9</b>	<b>24.0</b>

Source: Turkey Statistics Institute, 2005

## 2) Trade and Sea Freight

Istanbul is a trade hub in the Turkish economy. In the country's external trade, Istanbul historically kept its share at some 40% in export and at around 40% in import.

It is observed that trading value jumped up in Turkey, particularly in Istanbul between 2004 and 2005. Although we have not obtained any explainable information to this sharp increase from \$67.4 million in 2004 to \$111.8 million in 2005 or by 1.66 times, conventional sea trade with port operation may not absorb such a change.

Major ports in Istanbul are Ambarli, Haydarpaşa, and Silivri and so on. As for container transport, Istanbul ports handled 1.1 million TEU in 2005. Due to physical constraint of Haydarpaşa Port, its metropolitan gateway function has been transferring to Ambarli Port.

**Table 12.6.2 Historical Trading Amounts in Turkey and Istanbul, between 1995 and 2005**

(\$ Billion)

Year	Turkey		Istanbul		Istanbul's Share (%)	
	Export	Import	Export	Import	Export	Import
1995	21.6	35.7	10.3	13.7	47.6	38.5
1996	23.2	43.6	10.8	17.1	46.2	39.3
1997	26.3	48.6	11.7	18.4	44.5	37.8
1998	27.0	45.9	12.1	18.5	44.7	40.3
1999	26.6	40.7	11.6	16.6	43.5	40.7
2000	27.8	54.5	13.6	22.6	48.9	41.5
2001	31.3	41.4	14.8	16.8	47.1	40.7
2002	36.1	51.6	16.7	21.5	46.3	41.6
2003	47.3	69.3	21.7	28.6	45.7	41.3
2004	63.2	97.5	27.1	40.3	43.3	41.5
2005	73.5	116.8	41.7	70.1	56.8	60.1

Source: Turkish Statistical Institute, 2006

## 3) Public Bus Operation and Finance

IETT bus fleet is composed of 2,824 buses. The average age of the fleet is 12. Fleet renewing speed is low. The number of old buses over 15 years that have already completed their economic life, is 1,279.

IETT uniquely owns a variety of buses in terms of capacity (normal, articulated since 1979, double-decker since 1993, etc.), engine type (diesel and natural gas), fuel emission level in conformity with EU standards and other minor designs for the disabled. IETT seems to show a strong interest in new bus technologies and services. Today, IETT's representative bus is of normal type (2,327 vehicles) with diesel engine (2,750 vehicles).

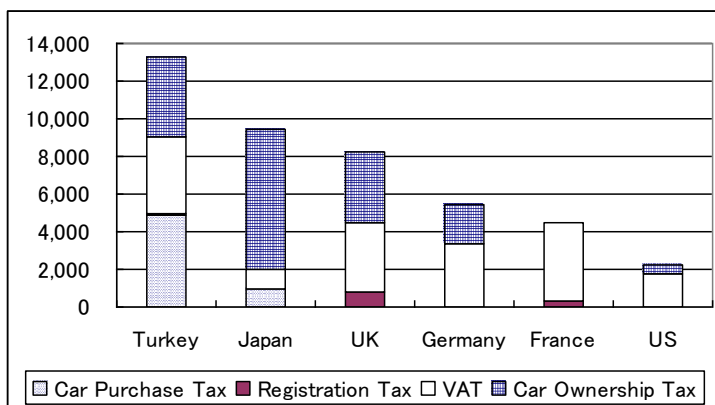
IETT buses work 16 - 18 hours a day and 2.5 drivers are assigned per bus. The daily average kilometrage of an IETT bus is 526,000 km and it consumes a total fuel of approximately 250 tons. By vehicle capacity, fleet is classified into 2 categories; high capacity (articulated bus for 150 passengers on the average) and normal capacity (normal bus for 100 passengers on the average).

According to the IETT Strategic Plan 2008-2012, IETT will procure 500 natural gas fueled buses and 50 hydrogen fueled buses, budgeting at YTL 354.9 million during the planning period. The plan clearly shows that IETT will shift its bus fleet from diesel to natural gas fueled buses. On the other hand, the role of hydrogen fueled bus in the future IETT fleet is still uncertain although the plan says that 50 buses will be experimentally introduced in 2012 or the final year of the plan.

4) Car Restriction Policy

Turkey holds a strict and comprehensive car restriction policy regarding car purchase, owning and usage. More precisely, excise tax on car (24% to 50% depending on engine size), VAT (18%) and registration fee (YTL 103) are required when purchasing a car while a car owner must also pay car ownership tax where the tariff is set by engine size and by vehicle age.

Compared with some other car affluent countries, Turkey charges extraordinary costs on car buyers and owners. For instance, the purchase and owning cost of a 1,500 cc car for 11 years in Turkey is YTL 13,249, considerably larger than Japan (YTL 9,418 equivalent) and UK (YTL 8,238 equivalent). Except for small countries and city states, there may be no other country like Turkey to make strong policy intervention on private car by economic means.



Source: Study Team

Note: The basis for comparison - (1) Engine: 1,500 cc, (2) Weight: 1.5 tons, (3) Price without Tax: TYL 18,000, (4) Service Period: 11 Years, (5) Exchange Rate: mid of February 2007

**Figure 12.6.1 Comparison of Car Purchase and Owning Costs between Turkey and Some Car Affluent Countries, 2007**



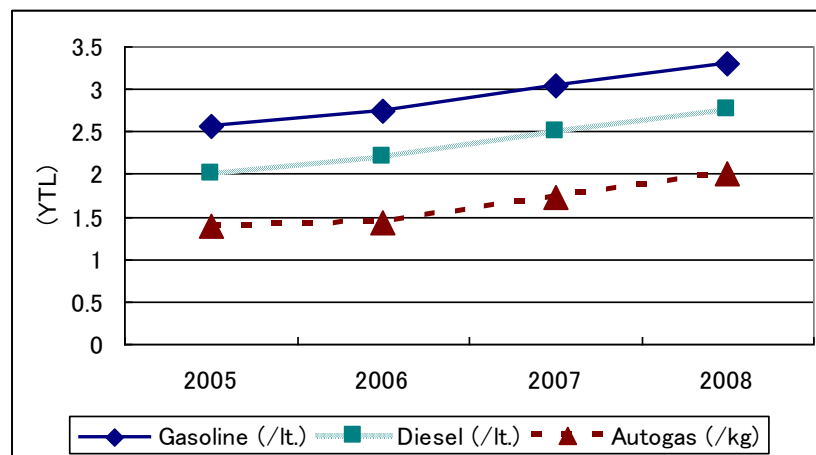
5) Fuel Pricing Policy

Fuel price in Turkey is also extremely high; gasoline (YTL 3.05), diesel (YTL 2.50), and Autogas or LPG for vehicle use (YTL 1.74) per liter. It is mainly attributed to excise tax on fuel, i.e., YTL 1.4845 per kg in 2007. The taxes such as excise tax and VAT account for over 60% in those fuel prices.

One international comparison survey on petrol price with tax<sup>1</sup> shows that Turkish petrol is the second highest in terms of tax ratio in price, i.e., 63.3%, next to UK (64.4%) in 2007. In terms of retail price, Turkish petrol is the most expensive among 29 sample countries.

High fuel price setting, combined with tax and recent soaring oil prices, resulted in very high fuel prices in Turkey, and it also effectively discouraged people and business entities to use vehicles on roads. According to one media analysis, the combined effect of excise tax increase (from YTL 1.4845 per kg in 2007 to YTL 1.5985 in 2008) and oil price hike has increased the retail prices by 8.4% for gasoline, 10.8% for diesel and 15.8% for Autogas in 2008.

Another phenomenon is for vehicle users to change fuel from prohibitive gasoline to cheaper diesel and Autogas. For example, diesel consumption exceeds gasoline in Turkey. The government encourages LPG use because of its safe, economical and competitive characteristics. LPG products are classified into bottled LPG, bulk LPG and Autogas. The Autogas consumption volume was 2,006,263 tons in 2007 which accounted for 57% of the all LPG consumption in Turkey. It is noteworthy that the Autogas share sharply increased from 44% in 2006. Under the very high price setting for gasoline nowadays, Autogas is also becoming popular among individuals and business entities.



Source: 2005 – 2008 figures from Consumer Prices Indices Database  
 Projection figures for 2008

**Figure 12.6.2 Recent Fuel Price Hike, Istanbul, 2005-2008**

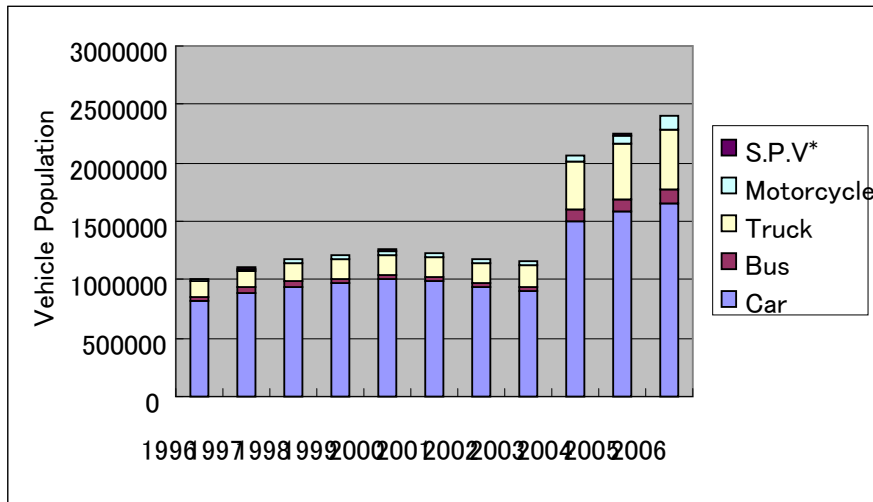
6) Vehicle Registration

The number of vehicles registered in Istanbul is 2,408 thousand at the end of 2006 except for road construction machinery vehicles, having a 22% share in Turkey or being equivalent to Istanbul's GRDP share in Turkey. In recent years, motorization in the

<sup>1</sup> Ministry of Economy, Trade and Industry, Japan, 2007

metropolitan society has been accelerating since 2004 although data inconsistency is found between 2003 and 2004 due to the change in data collection method.

Compared with the national vehicle inventory 2006, Istanbul has a larger share of passenger cars, i.e., 69% in Istanbul vs. 56% in Turkey, while it has a smaller share of motorcycle, at 5% in Istanbul vs. 17% in Turkey. There may be two main reasons: (1) is citizen in Istanbul more affordable to have passenger cars and (2) public transport services are more densely provided in Istanbul unlike the massive flow of motorcycle seen in other areas in the country.



Source: Turkish Statistical Institute  
 Note: \* Special Purpose Vehicle

**Figure 12.6.3 Vehicle Population in Istanbul, between 1996 and 2006**

## Chapter 13 Maximum Road Network

### 13.1 Evaluation of Base Network

In this section, the Base Network will be evaluated from the following viewpoints.

- Present Network Problems
- Urban Development Planning
- Traffic Demand vs Capacity

#### 13.1.1 Present Network Problems

As mentioned earlier, the following issues have been identified as the road network problems:

- Inadequacy of arterial/semi-arterial roads in densely built up areas
- Traffic congestion related to the Bosphorus crossing
- Lack of coordination between road network and other transport modes
- Inadequate development of network in the newly urbanized area

##### 1) Inadequacy of arterial/semi-arterial roads in densely built up areas

The typical areas related to the first issue above are the CBD area, Gungoren/Bagcilar/Bahcelievler area and Umranye/Uskudar area. In the CBD area, the road widening projects from Besikitas to Kagithane and several tunnel projects in the Northwest – Southeast direction and Northeast – Southwest direction are included in the Base Network. They will contribute to the traffic dispersal, and will be effective to mitigate the traffic congestion in the area. However, even after they are implemented, the arterial/semi-arterial roads may be still insufficient. The real problem is that there is not so much appropriate space for further road development. Accordingly modal shift to mass transit system should be pursued.

In the Gungoren/Bagcilar/Bahcelievler, area several road projects are included in the Base Network, however, they are mostly small-scale improvement projects, and thus the insufficiency of the arterials particularly in the West – East direction will remain even if all the projects in the Base Network are implemented.

Regarding the northern part of Umranye/Uskudar area, some arterial road projects are included in the Base Network such as the development of Hotboyu St or the connection road between Fazil Kucuk St and Alemag St. However, they are only short connections and not yet adequate for formulating the arterial network in the area.

##### 2) Traffic congestion related to the Bosphorus crossing

As for the second issue, it is closely related to the road network development in the CBD area and Umranye/Uskudar area mentioned above as the first issue. Together with the implementation of Marmaray project, the network formulation will contribute to the improvement in the traffic condition of the Bosphorus crossing.

##### 3) Lack of coordination between road network and other transport modes

The third issue is mainly treated by constructing transfer centers or intersection improvement projects. For instance, the intersection project at Aksaray, which is at the

designing stage but has been approved already, is including the development of pedestrian squares for the passengers of LRT and tramway. Therefore it is difficult to address this issue only from standpoint of road network. Coordination between modes will be studied carefully in the next stage of the present study.

#### 4) Traffic demand vs capacity

Regarding the fourth issue, many road projects in the newly developed residential area have been included in the Base Network; particularly those in Esenler, Kucukcekmece and the east part of Buyukcekmece are expected to provide better access to the newly populated areas.

### **13.1.2 Urban Development Planning**

According to the land use plan prepared by IMM, the urbanized area will be expanded to westward and eastward of Istanbul.

Particularly Silivri, Buyukcekmece on the European side and Pendik, Tuzla on the Asian side are to accommodate most portion of the population increase in the future.

In order to establish new sub-centers and create well designed new urban areas, transport network should be developed according to the travel demand.

The Base Network does not include road development projects in such areas, where the urbanization has not yet reached but is soon to be accelerated in the future. Only few connection roads for the existing settlements. In this sense, the Base Network does not yet meet the future urbanization, and many feeder roads should be planned in the present study.

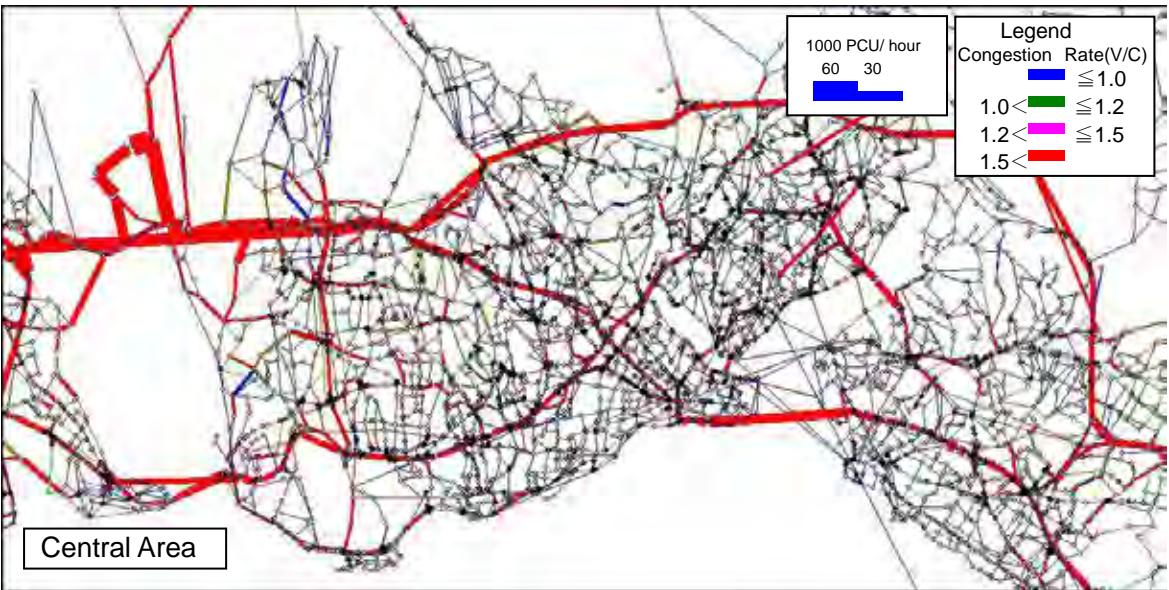
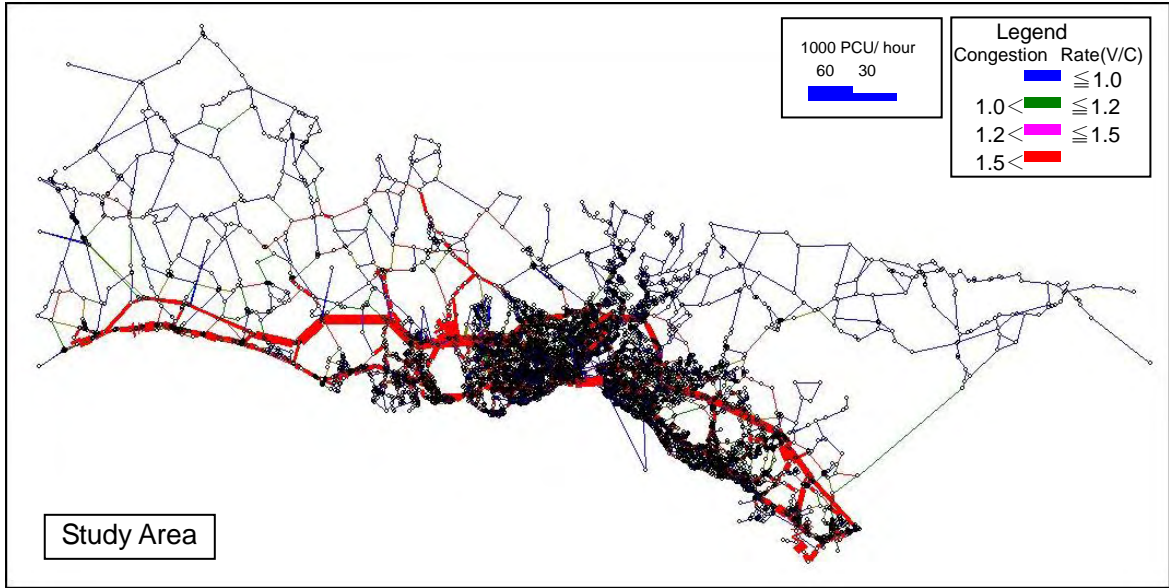
### **13.1.3 Traffic Demand vs Capacity**

In order to tackle the network problems mentioned above, various efforts have been undertaken by IMM and other government agencies. The Base Network defined in Chapter 11 of this report includes the Bosphorus tunnel promoted by DLH and a number of road projects planned and approved by IMM in addition to the existing roads.

Although the Base Network is not yet the master plan to be proposed by this study, its performance has been tested by traffic assignment to identify the deficiencies of the Base Network and the direction of the master planning. Figure 13.1.1 to Figure 13.1.4 present the results of the traffic assignment.

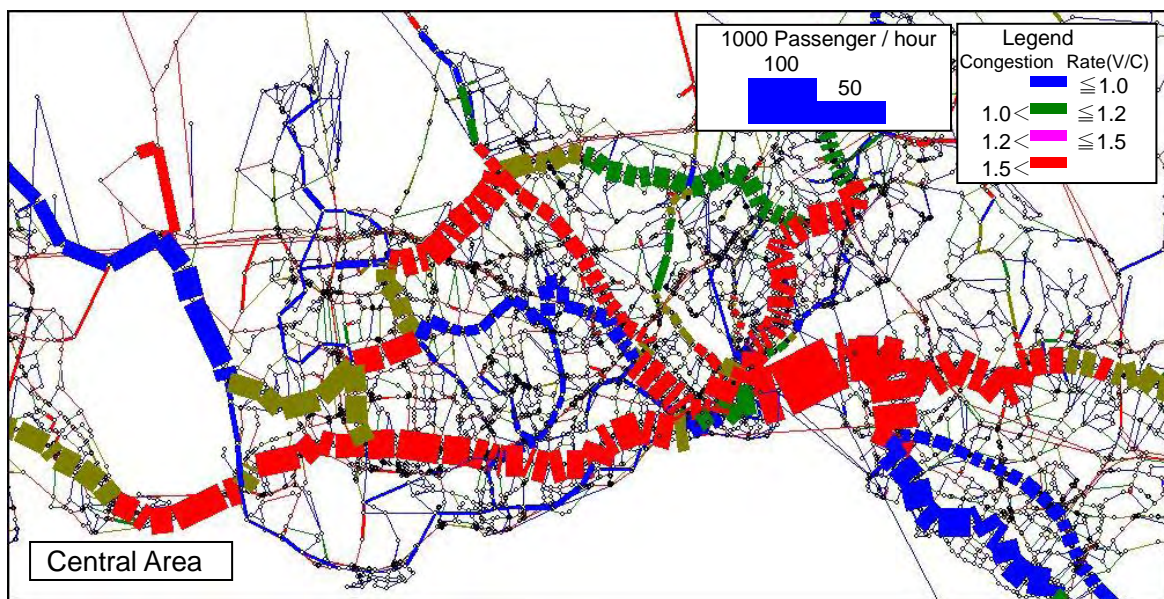
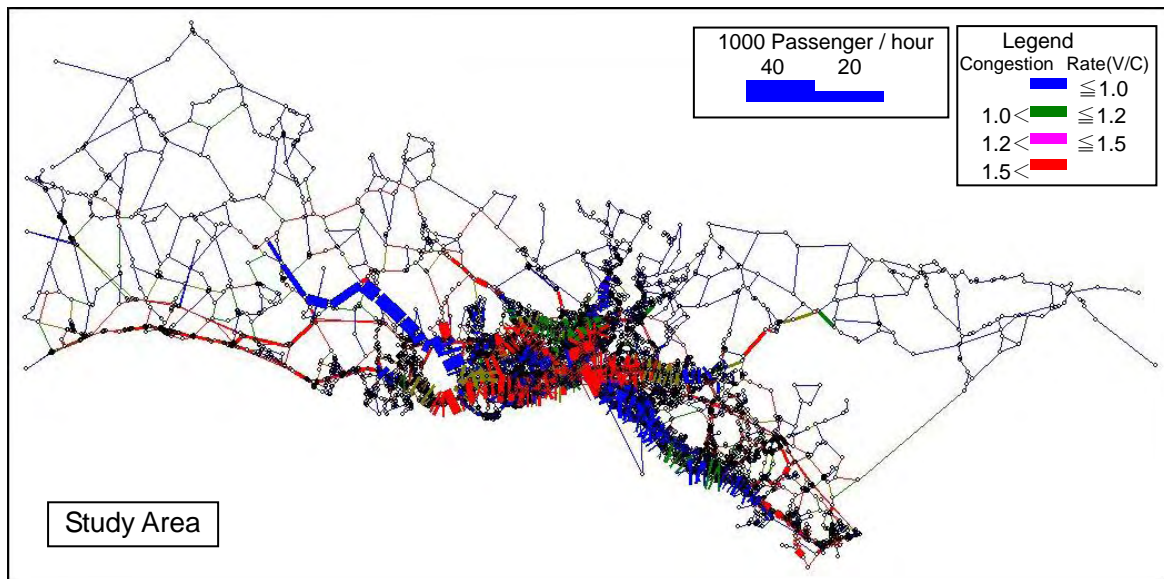
The following points are noted:

- A. The network will be saturated to a remarkable extent, showing that the Base Network is still insufficient to cope with the future traffic demand.
- B. The road network will be particularly congested for the motorways and the arterial roads on the European side. Proper countermeasures must be additionally incorporated in the master plan.
- C. Public transport network, mainly of railways, will also be overloaded in and near the central area on the both sides of the Bosphorus Strait. Additional railways should be proposed in the central area across the Bosphorus Strait.



Source : Study Team

**Figure 13.1.1 Peak-Hour Traffic Assignment Result of Car and Service Vehicle  
 (2023 Demand on the Base Network)**



Source : Study Team

**Figure 13.1.2 Peak-Hour Traffic Assignment Result of Public Transport  
(2023 Demand on the Base Network)**

## 13.2 Preparation of Maximum Network

Road network plan in this chapter focuses on the expansion of Base Network considering its insufficiency for each of the following areas/issues:

- Inter-regional highway network
- The network of the areas where serious deficiency is observed in the Base Network
- The network in the areas which will be newly developed as sub-centers.

### 13.2.1 Inter-regional Road

The central government has road tunnel construction plan and a motorway development plan crossing the Bosphorus.

The former was proposed by DLH (The Directorate of Railway, Airport and Harbor Construction of the Ministry of Transport) in order to alleviate the traffic congestion on the Bosphorus crossings. DLH has an intension to realize the project as a BOT (Build-Operate-Transfer) scheme, which is now at the tendering stage. The tender was postponed several times because of the uncertainties for the private sector of the surrounding conditions. It is reported that the successful bidder was finally selected through the tender in April 2008. This project is included in the Base Network, since it will soon proceed to the implementation stage.

In relation to the latter the nationwide motorway is planned and implemented by the Directorate of Highways of Ministry of Transport (KGM). The motorway development plan includes the Third Bosphorus Bridge Project, which is one of the most influential factors on the transport condition in Istanbul. According to KGM, there are six alternative routes: Corridor1 to Corridor5 and Northern Corridor as illustrated in Fig 13-2-1.

The Northern Corridor is the route passing through either forest or water reservoir area in the northern part of Istanbul. In the case of Corridor2, the construction of a metro line is planned in addition to the road development. The starting point of the new motorway is assumed at Kinali near Silivri on the west and the end point is assumed at Akyaz in the east, which is located at about 70km east of Gebze. The total road length will be about 250km.



Source: KGM

**Figure 13.2.1 Alternative Routes for the Motorway Development**

The best route has not been decided yet as of October 2008. However, from the viewpoints of consistency with the land use plan developed by IMM as well as effectiveness for improving the urban transport problems, the Corridor 2, located in between the existing two bridges, should be selected. In this case, metro line is also planned on the Third Bridge.

Since this project may have large impacts on the road network as well as the traffic flow, the Corridor 2 is included in the Maximum Network. If the Northern Corridor, Corridor 3, 4 or 5 is selected by KGM, Corridor 2 will be an additional proposal by the study team. However, if Corridor 1 is selected, Corridor 2 will be replaced with in the Maximum Network.

### 13.2.2 CBD area and Sariyer area

The CBD area (Beyoglu/Besiktas/Sisli area) is the most active business area, whereas the arterial and semi-arterial roads are not sufficiently developed as stated before. There are three arterial roads, Buyukdere St., Barbados St. and Piyalepasa Burvali, however all of them are running in parallel in the northeast – southwest direction with an average interval of 1 km. There are neither semi-arterial roads in between them, nor any arterial/semi-arterial roads in the transversal direction. Accordingly the traffic congestion is often observed during the peak hours.

In the Base Network, several roads are planned for implementation to cope with this situation; the tunnel projects of Piyalepasa – Dolmabahce and Kagithane – Piyalepasa in the northwest – southeast direction, the tunnel projects of Dolmabahce – Fulya, Fulya –



Levazim Siltesi, Levazam Siltesi – Akaltar, etc. in the northeast – southwest direction, and several road widening projects such as Sisli – Zincirlindere Road. These projects will contribute to the traffic dispersal and the segregation between through traffic and intra zonal traffic.

In addition to the Base Network, additional tunnel projects, Tophane – Haskoy and Tophane – Iplikci in the Beyoglu district are proposed in the CBD area by IMM. Furthermore, the Third Bosphorus Bridge is planned to be connected to the planned tunnels in Besikitas and the Cendere Road in Kagithane for the traffic from/to Uskudar and Umranye area as well as the traffic from the Silivri area.

It will contribute to strengthen the linkages between CBD and the sub-centers, Halkali/Ikiteli Media Express zone, Silivri in the west and Kartal and Tuzla attraction centers in the east.

With regard to the CBD area, further road development will not be necessary in addition to the above projects by the target year, since a rail - oriented transport system is planned to serve the CBD area.

As for the connection with Sariyer area from the CBD area, there are two roads, Buyukdere St. and the coastal road along the Bosphorus. As the latter is a narrow zigzag road, the former functions as the main road, and therefore is often congested. IMM is planning two tunnel projects, Derbent Hacıman tunnel and Almutlualti – Poligon Mah tunnel, which will directly connect CBD area with Keferkoy, the district center of Sariyer by linking with Sariyer Merkez – Cayirbasi tunnel. No other additional roads will be required at present.

Consequently only those projects proposed but not yet approved by IMM will be included in the Maximum Network.



Source : Study Team

**Figure 13.2.2 Maximum Network in the CBD and Sariyer**

### **13.2.3 Gungoren/Bagcilar/Bahcelievler Area**

This area is densely populated, however the road network has been irregularly developed since the residential development has progressed without appropriate city planning. There are several arterial roads in the north-south direction, however no arterial roads exist in the east-west direction. IMM has a tunnel connection project, which is planned from Eyup to Bahcelievler/Bagcilar area through Byrampasa and Gungoren districts to improve the accessibility to the CBD area.

Since the area is densely built up already, the connection roads accessible to the tunnel will be limited. In addition to the road projects planned by IMM, the following roads are proposed in order to improve the arterial road network in the area.

#### Construction of the missing link connecting Mimar Sinan St. and Posta St.(PF44)

Mimar Sinan St. has been developed from Media expressway to Bagcilar St. as a wide 4-lane road with a median strip. On the other hand Posta St./Eski Londra Asfalti road has been developed from Cincindere St to Dumlupinar St, which is the arterial road connecting TEM highway and D100 near Zeitinburnu.

The section between Bagcilar St and Cincindere St is not linked yet and is fully covered by a number of residences. By constructing a road tunnel of 1.5 km in this section, an arterial road in the east-west direction will be created and it will drastically improve the accessibility of the residents of the area to the Media Expressway or Topkapi and the CBD area.

#### Extension of Mehmet Akif Bulvari to Cobancesme interchange of D100(PF45)

Miramar Akif Bulvari has been developed in the north-south direction from TEM highway to around Mimar Sinan St, however, it has not been extended to D100. The missing section is also a built up area, therefore some difficulty is expected for the implementation. Construction of a tunnel will be required for the extension.

Once it is completed, it will be the main arterial in this area and highly contribute to the improvement of the accessibility to Bakirkoy sub-center as well as the coastal area from Gungoren/Bagcilar/Bahcelievler area.



Source : *ibid*,

**Figure 13.2.3 Maximum Network in Gungoren/Bagcilar/Bahcelievler**

#### 13.2.4 Avcilar/Buyukcekmece area (Area between two lakes)

In this area, the most important issue is the freight traffic related to the Ambarli port, which causes not only additional burden on the arterial roads but also adverse impacts on the urban environment.

At around Hadimkoy area, a logistic center is to be established according to the land use plan prepared by IMM. Therefore the transportation system between the port and the logistic center should be strengthened. There is a plan to construct a railway and transport all the cargo from the port by using trains. However, it seems to take a long time to establish the Ro-La system since a branch line from the port has to be constructed and the main rail line should be also improved and double tracked. In addition, the distance from the port to the logistic center is less than 20 km, which is more advantageous for road traffic in terms of transport time and cost required.

The Haramdere Kumcular road connecting the port with D100 is now under construction for its widening from 4 lanes to 6 lanes. The connecting road of Haramdere Kumcular road, i.e., the TEM Haramdere Baglanci road between D100 and TEM highway is often congested with the traffic from the port and the traffic from the surrounding residential areas.

KGM has proposed a new road construction from D100 to a junction near Hadimkoy of TEM highway. The route is to diverge from TEM Haramdere Baglanci road at Suyolu road and runs toward north in parallel with Dogan Arasi Bulvari, then crosses the TEM highway at near Ornek, merges into Hadimkoy Altinsehir road, and reaches the logistic center as well as Hadimkoy junction.

A branch line of new motorway which is already included in the land use plan prepared by IMM, is planned to link with Hadimkoy junction, therefore the above proposed road is

easily accessible to the new motorway as well. The total length of the new road will be about 12km.

Since the proposed route has to pass the built up area, it is proposed to build a tunnel up to the merging point with Hadimkoy Altinsehir road in order to minimize the land acquisition problem as well as the adverse environmental impacts.

The road will be mainly used by freight vehicles between the port and logistic center as a truck route, therefore it will be effective to segregate the freight traffic related to port from the ordinary traffic related to the surrounding residential area.



Source : *ibid*,

**Figure 13.2.4 Maximum Network in Avcilar/Buyukcekmece area**

### 13.2.5 Western Marmara Sea

The western Marmara Sea is designated as the largest area to be urbanized in the land use plan by IMM. The population in the western area of the Buyucekmece Lake is planned to increase by as much as about 2 million until the year 2023, particularly the population growth in Silivri is 1.5 million. In order to realize the urbanization in this area, transportation network should be developed.

Table 13.2.1 shows the population density in the area at the western side of Buyukcekmece Lake. The population density in the area is expected to increase from 100 ~ 3,000 person/km<sup>2</sup> to 1,000 ~ 42,000 person/km<sup>2</sup>. Particularly the density in Silivri sub-center will be 8,000 ~ 10,000 person/km<sup>2</sup> in 2023.

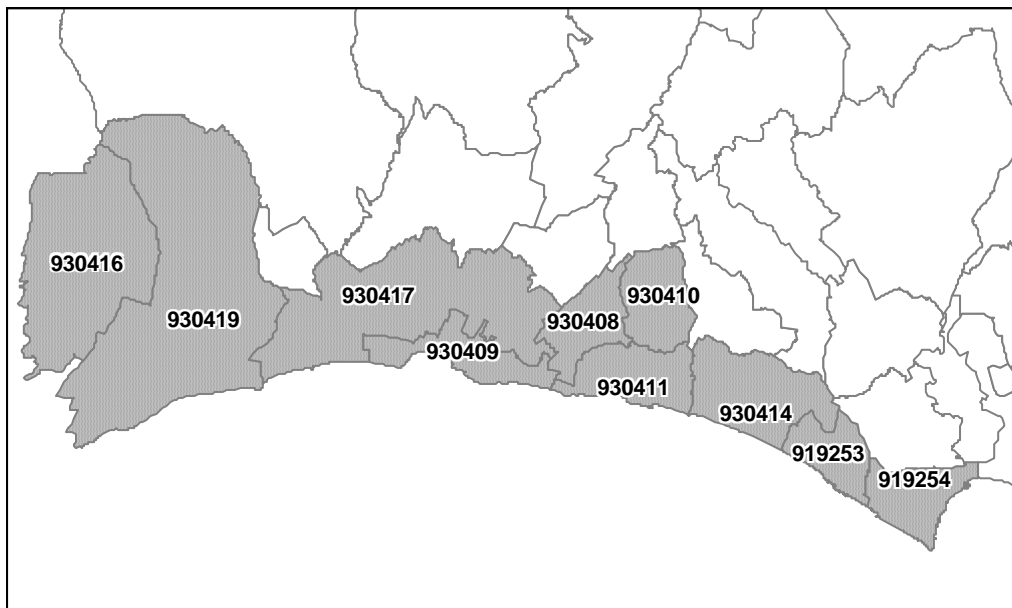
In the light of the common relationship between population density and road density, the road density of 15 to 20km/km<sup>2</sup> will be required in the urban area. Since the share of the arterial road is approximately 10%, the arterial road network should be developed to the level of 1.5 to 2 km/km<sup>2</sup>, which implies an average interval of arterial road at 1 to 1.3 km.

Taking into account of the land use at present as well as in the future and the topographic condition, the sub-center of Silivri is assumed to be developed at the north of the existing residential area in between TEM highway and D100.

**Table 13.2.1 Population Density and Road Density in the Western Coastal Area (Silivri, Buyukcekmece)**

Code	District	Year 2005			Year 2023		
		Population Density	Road Density		Population Density	Road Density	
			Arterial Road	All Road		Arterial Road	All Road
person/km <sup>2</sup>	Km/km <sup>2</sup>	Km/km <sup>2</sup>	person/km <sup>2</sup>	Km/km <sup>2</sup>	Km/km <sup>2</sup>		
919253	Buyukcekmece	779	0,8	8,1	1.354	1~3 (interval: 1-2 km)	10~20 (interval: 100-200 km)
919254	Buyukcekmece	3.071	0,1	9,6	5.340		
930408	Silivri	280	0,8	4,9	3.727		
930409	Silivri	3.133	1,3	10,9	41.639		
930410	Silivri	224	0,0	5,8	2.973		
930411	Silivri	567	0,6	12,5	7.541		
930414	Silivri	276	0,9	6,4	480		
930416	Silivri	97	0,0	1,7	1.296		
930417	Silivri	63	0,4	3,2	837		
930419	Silivri	114	0,3	2,8	1.520		

Source : Census Data



Source : Study Team

**Figure 13.2.5 Zone Map in the Western Marmara Coastal Area**

Between TEM highway and D100, two arterial roads are proposed in parallel to those motorways. These roads could be effectively used as the linkage from the newly urbanized sub-center in Silivri to the Buyukcekmece district, Hospital/research center planned at the neighboring zone, and fair area and IT industrial complex planned at the west side of Silivri. Arterial roads in the north-south direction, which connect the two arterials with the two motorways, are also proposed with 1 to 2 km interval.

In addition, several semi-arterial roads are proposed to formulate the skeleton of the road network in the new town.

The existing road between the new port at the western end of the coast and IT industrial

complex university campuses will be totally rebuilt including the improvement of alignment and widening as an arterial road.

Finally the motorway proposed by KGM is planned to join to the TEM highway at Kinali near Silivri area, then a connecting motorway is proposed to link D100, TEM highway and the new motorway as well as the proposed new airport. The road network plan in this area is shown in Figure 13.2.6.



Source : *ibid*,

**Figure 13.2.6 Maximum Network in Western Marmara Sea Coastal Area**

### 13.2.6 Umraniye/Uskudar Area

Umraniye/Uskudar area is also one of the built up areas where an appropriate city planning has not been applied. Therefore the road network has not been appropriately developed. Mainly due to the topographic condition, sometimes there is no direct connection among the sub-districts and the alignments of the main roads are not well designed. For instance, there is no arterial road between Umraniye and Uskudar except for the motorway connection road.

As additional projects to the Base Network, several road projects have been planned by IMM. The prominent projects are as follows;

- 1) Widening of Hatboyu St. (Coastal road linkage) in Umraniye

Hatboyu St. is a connection road between the Kandili St. at the coastal line of the Bosphorus and Umraniye district in Asian side. There is no main ring road in between the two freeway

ring roads of 6 to 7 km interval, therefore this project aims to improve the accessibility of the Umraniye district by widening the existing road from 2 lanes to 6 lanes and constructing a new short stretch for crossing the Sile Road. It will be directly linked with the eastern section of Hatboyu St. under construction at present.

- 2) Two Tunnel Projects connecting Umraniye to Uskudar (Beylerbeyi - Harem Tunnel and Beylerbeyi – Hekimbasi Tunnel)

These tunnel projects are planned to directly link Umraniye district and Uskudar district in parallel with the coastal line of the Bosphorus. One is the tunnel between Beylerbeyi St. located a little north of Bosphorus Bridge and Uskudar Harem Sahir St. on the Asian side. The other is between Beylerbeyi St and Bosna Bulvari located at the middle of TEM highway and D100. Currently there is no direct linkage among these areas because of the mountainous topography.

The motorway extension from the Third Bosphorus Bridge proposed by KGM is planned in this area. The main route is to intersect with TEM highway at around the district boundary between Umraniye and Beykoz. A branch line of the motorway is also planned to diverge at the east side of Bosna Bulvari, goes down southward and reach the Goztepe Interchange of D100.

In addition to the above projects, the following road projects are proposed as a part of Maximum Network in order to establish more effective network.

- 3) Construction of connection road between the tunnel project and TEM highway

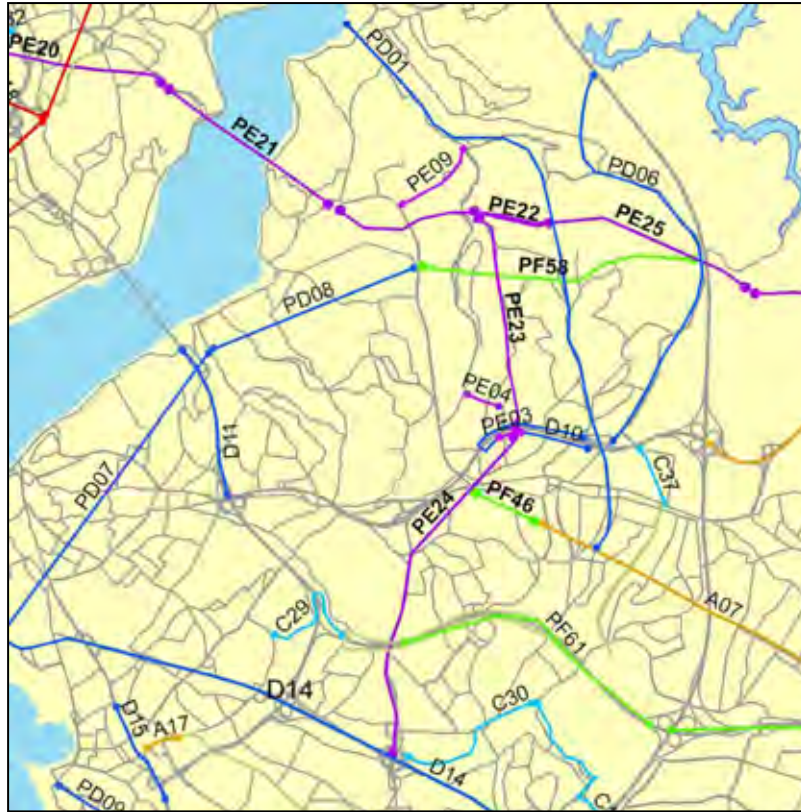
This connection road aims to improve the mobility of the residents in the eastern part of Umraniye and to realize a direct connection between TEM highway and Hydarpassa port area by linking the road tunnel stated above and the intersection of TEM highway and the proposed new motorway.

The proposed route of this project is a built up area, therefore the land acquisition may have some difficulties. In that case, it can be implemented by developing a tunnel partially .

- 4) Construction of the missing link between Bosna Bulvari and Hatboyu St

Bosna Bulvari is an arterial road running in parallel to D100 in between two motorways, however ends at Alemdag St, located near the motorway connection road. On the other hand, Hatboyu St has been developed as an arterial road accessible to TEM highway from Umraniye, however the development has been suspended at around Cengiz Topel road. The length of the missing link is about 800m.

By constructing the missing link, Bosna Bulvari and Hatboyu St will be connected and function as major arterial roads in this area. Since the area along the route is densely built up already, the project will be implemented by constructing a tunnel.



Source : *ibid*,

**Figure 13.2.7 Maximum Network in Umraniye / Uskudar area**

### 13.2.7 Tuzla New Development Area

In the northern part of Tuzla district, an attraction center is planned in the land use plan prepared by IMM. It is supposed to include logistic area, organized industrial zone and amusement park. In order to make it function as the sub-center, transport network should be developed in this area.

The motorway route is planned at about 5 km north of TEM highway in the area. Ataturk/Orhanli road, the connecting road between TEM highway and D100 is proposed to be widened and extended to the proposed motorway.

Several arterial roads should be newly developed in a grid pattern centering on the intersection between Ataturk/Orhanli road and Kurkoy-Orhantli road. In addition, it is proposed to rebuild the Ankara road and connect with Baglanti road as an arterial road so as to strengthen the linkage between the sub-centers, Kartal and Tuzla. It will also contribute to the accessibility improvement of the residents of Pendik and Tuzla, where high population growth is expected.





Source : *ibid*,

**Figure 13.2.8 Maximum Network in Tuzla New Development Area**

### 13.3 Projects Included in the Maximum Network

The projects added in the Maximum Network consist of those planned but not yet approved by IMM, the new motorway including the Third Bosphorus Bridge planned by KGM and the road projects newly proposed by the study team. The projects shown in the network are analyzed in terms of their necessity and validity etc. Therefore, the network alternatives are regarded as the maximum case of road development.

The project code is classified by progress stage as follows:

PC type: design completed

PD type: design stage

PE type: study stage

PF type: newly proposed by study team

The project location maps and project lists are shown in Figure 13.3.1 to 13.3.3 and Table 13.3.1.



Source : *ibid*,

**Figure 13.3.1 Network Alternatives (Maximum Network) (European Side 1)**



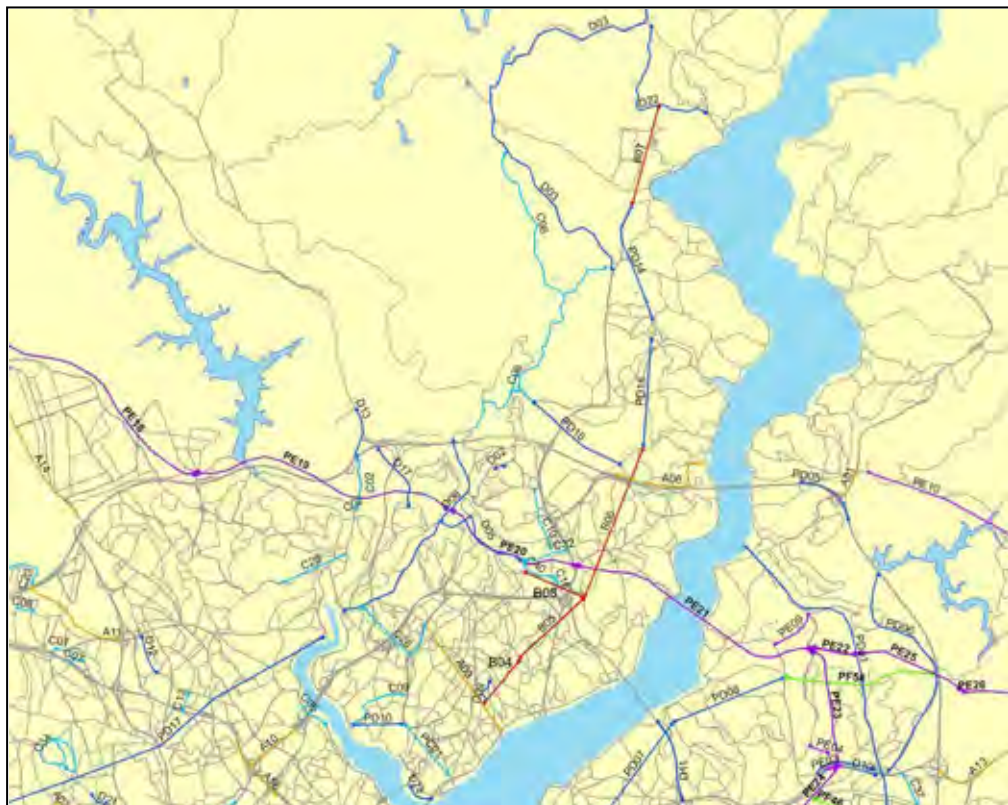
Source : *ibid*,

**Figure 13.3.2 Network Alternatives (Maximum Network) (European Side 2)**



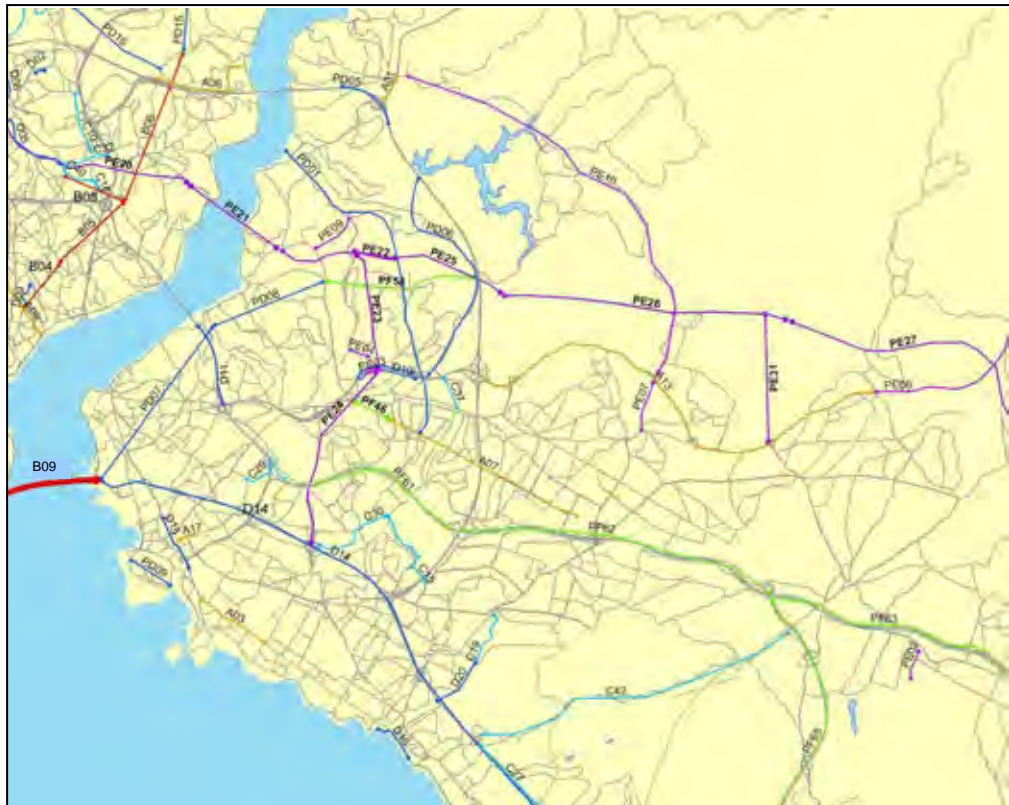
Source : *ibid*,

**Figure 13.3.3 Network Alternatives (Maximum Network) (European Side 3)**

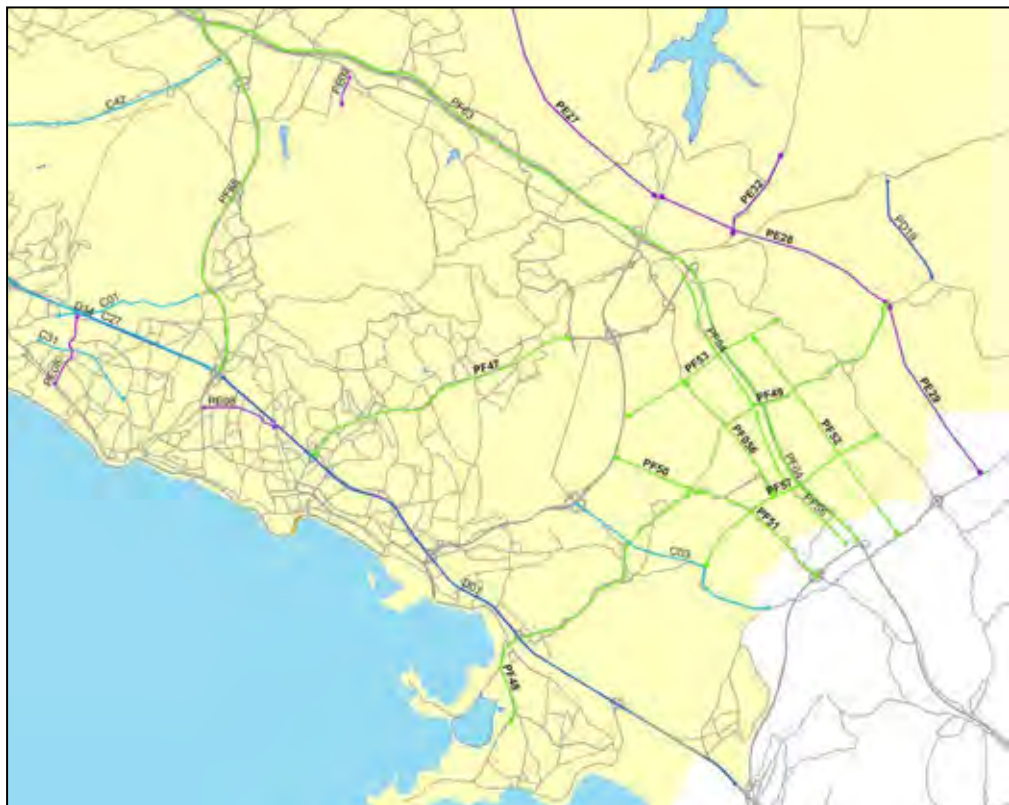


Source : *ibid*,

**Figure 13.3.4 Network Alternatives (Maximum Network) (Central Area)**



Source : *ibid*,  
**Figure 13.3.5 Network Alternatives (Maximum Network) (Asian Side 1)**



Source : *ibid*,  
**Figure 13.3.6 Network Alternatives (Maximum Network) (Asian Side 2)**

Table 13.3.1 Road Projects Added in Maximum Network

No.	New Code	Road Project Name	Project type	No of Lane	Length (m)	Current Conditon
1	PC01	Tophane - Iplikci Tunnel	New	0→4	1,275	D/D Compl
2	PD01	Widening of Hatboyu street (Coastal road Linkage) in Umraniye	New	0→4	8,526	Designing
3	PD02	Bakirkoy between D-100 Land Route (Incirli Junction) - Coastal Road (Atakoy Junction) underpass - flyover project	one way pair	4→3	10,278	Designing
4	PD03	Widening project between Kirac and Esenyurt construction road	Widening	2→4	1,808	Designing
5	PD04	Between Hadimkoy bridge- Yassioren road, road, junction project	Widening	2→4	7,920	Designing
6	PD05	Beykoz, Miharabat Street-TEM Highway Linkage project	Rehab.	8→8	1,660	Designing
7	PD06	Umraniye, between Kucuksu junction- İsfalt association (Kucuksu street) road rehabilitation project	New	0→2	6,009	Designing
8	PD07	Beylerbeyi - Harem Tunnel	New	0→4	4,320	Designing
9	PD08	Beylerbeyi - Hekimbasi Tnnel	New	0→4	3,600	Designing
10	PD09	Kadikoy - Moda Tunnel	New	0→4	920	Designing
11	PD10	Tophane - Haskoy Tunnel	New	0→4	470	Designing
12	PD11	Road Construction For W. Trade Center by Private Sector	New	0→6	3,900	Designing
13	PD12	Kucukcekmece D-100 Highway Cobancesme Junction - Olympics Road Linkage Road and Junction Project	Wg/New	0→6	16,800	Designing
14	PD13	Yakuplu Kumcular Servis Road Project	Widening	4→6	3,800	Designing
15	PD14	Derbent Haciosman Tunnel Project	New	0→4	2,500	Designing
16	PD15	Armutlualti - Poligon Mah. Tunnel Project	New	0→4	2,760	Designing
17	PD16	Armutlualti - Ayazaga Tunnel Project	New	0→4	3,000	Designing
18	PD17	Kuyumcu Kent - Otogar - Eyüp Tunnel Project	New	0→4	13,900	Designing
19	PD18	Road rehabilitation project between Bagcilar, Malazgirt underpass-Mehmet Akif avenue (8.St-1/3St-1/13 St-2/13 St)	Rehab.	4→4	1,368	Designing
20	PD19	Tuzla Formula-1 Road Network 6 numbered road project	New	0→4	2,740	Designing
21	PD20	Link Road between Malazgirt Rd and Mahmat Akif Bulbari	Wg/New	2→4	900	Designing
22	PE01	Road project in Bakirkoy (D-100 Highway Sefakoy junction - airport A-14 Apron linkage road)	New	0→2	874	Studying
23	PE02	Sultanbeyli Necip Fazil street - Kartal TEM linkage road project	Widening	2→4	804	Studying
24	PE03	Between Umraniye Mandira st - Bag st road project	New	0→2	401	Studying
25	PE04	New linkage road project between Umraniye Karadeniz street - Mandira street (continuous section of Hatboyu street)	New	2→4	541	Studying
26	PE05	Kartal Sehit Ahmet Yalcin St - Arkoz St - Cavusoglu St, Adnan Kahveci Viaduct Linkage road junction project	New	2→4	1,958	Studying
27	PE06	Umraniye, between Sile Road Yenidogan junction - Pasakoy junction road, junction implementation project	Widening	2→4	4,171	Studying
28	PE07	Re-organizing The existing road in Umraniye Cekmekoy Cavusbasi street according to the construction plan as 20m	Widening	2→4	1,278	Studying
29	PE08	Kartal between Tekel street - D-100 road, junction implementation project	New	0→4	1,917	Studying
30	PE09	Uskudar between Zubeyde Hanim Street - Hekimbasi Ciftlik street construction roads implementation projects	Widening	2→4	1,227	Studying
31	PE10	Beykoz , between Kavacik junction – Cekmekoy junction (Cavusbasi road) road, junction implementation project	Widening	2→3	10,891	Studying
32	PE11	Widening of D100 from Silivri to Kinali	Widening	4→6	7,700	Studying
33	PE12	Construction of New Motorway (Silivri - New Airport Connection Motorway)	New	0→6	15,600	Studying
34	PE13	Construction of New Motorway (New Airport Connection Motorway - Hadimkoy/Yassioren Rd)	New	0→6	17,600	Studying
35	PE14	Construction of New Motorway (Hadimkoy/Yassioren Rd - Junction of Hadimkoy Branch Motorway)	New	0→6	12,650	Studying
36	PE15	Construction of New Motorway (Hadimkoy Branch Motorway)	New	0→6	5,500	Studying
37	PE16	Construction of New Motorway (Junction of Hadimkoy Branch Motorway - Basaksehir4)	New	0→6	5,300	Studying
38	PE17	Construction of New Motorway (Basaksehir4 - Kayabasi)	New	0→6	8,100	Studying
39	PE18	Construction of New Motorway (Kayabasi - TEM Hekimsuyu Junction)	New	0→6	6,700	Studying
40	PE19	Construction of New Motorway (TEM Hekimsuyu Junction - Kagithane)	New	0→6	6,600	Studying
41	PE20	Construction of New Motorway (Kagithane - Third Bosphorus Bridge)	New	0→6	3,930	Studying
42	PE21	Construction of New Motorway (Third Bosphorus Bridge)	New	0→6	5,955	Studying
43	PE22	Construction of New Motorway (Third Bosphorus Bridge - Junction of New Kadikoy Motorway)	New	0→6	1,215	Studying
44	PE23	Construction of New Motorway (Junction of New Kadikoy Motorway - Junction with N-S TEM Linkage Highway)	New	0→6	3,000	Studying
45	PE24	Construction of New Motorway (Junction with N-S TEM Linkage Highway - Junction with D100)	New	0→6	4,800	Studying

No.	New Code	Road Project Name	Project type	No of Lane	Length (m)	Current Condition
46	PE25	Construction of New Motorway (Junction of New Kadikoy Motorway - Junction with O2(N-S TEM))	New	0→6	3,900	Studying
47	PE26	Construction of New Motorway (Junction with O2(N-S TEM) - Cekmekoy)	New	0→6	7,000	Studying
48	PE27	Construction of New Motorway (Cekmekoy - Kurtkoy)	New	0→6	17,500	Studying
49	PE28	Construction of New Motorway (Kurtkoy - Otanli/Tepeoren Ataturk Rd)	New	0→6	6,000	Studying
50	PE29	Construction of New Motorway (Otanli/Tepeoren Ataturk Rd - Ciftlic Rd)	New	0→6	4,200	Studying
51	PE30	Construction of New Motorway (New Motorway - New Airport - D100 near Silivri)	New	0→6	13,500	Studying
52	PE31	Construction of Connection Road between New Motorway at Cekmekoy in Umranye	New	0→4	3,200	Studying
53	PE32	Widening of Connection Road to New Motorway at Kurtkoy in Pendik	Widening	2→4	2,400	Studying
54	PF01	New N-S Road No.1 for University-IT Center in Silivri	New	0→4	12,200	Proposed
55	PF02	Widening of N-S Road No.2 for University-IT Center in Silivri	Widening	2→6	20,800	Proposed
56	PF03	New N-S Road No.3 for University-IT Center in Silivri	New	0→4	16,000	Proposed
57	PF04	New E-W road at University in Silivri	New	0→4	3,500	Proposed
58	PF05	New E-W road No.1 at IT Center in Silivri	New	0→4	3,400	Proposed
59	PF06	New E-W road No.2 at IT Center in Silivri	New	0→4	4,100	Proposed
60	PF07	New E-W road No.3 at IT Center in Silivri	New	0→4	3,200	Proposed
61	PF08	New Road Connection No1 between Silivri and New Port	New	0→6	6,000	Proposed
62	PF09	New Road Connection No2 between Silivri and New Port	New	0→6	4,800	Proposed
63	PF10	New Connection Road No.1 in North residential area of New Port in Silivri	New	0→4	2,000	Proposed
64	PF11	New Connection Road No.2 in North residential area of New Port in Silivri	New	0→4	2,100	Proposed
65	PF12	New Connection Road No.3 (E-W) in North residential area of New Port in Silivri	New	0→4	3,800	Proposed
66	PF13	New N-S Road No.1 in New residential Area near New Port in Silivri	New	0→4	2,300	Proposed
67	PF14	New N-S Road No.2 in New residential Area near New Port in Silivri	New	0→4	3,100	Proposed
68	PF15	New Connection Road No1 in New Residential Area near New Port in Silivri	New	0→4	1,900	Proposed
69	PF16	New Connection Road No2 in New Residential Area near New Port in Silivri	New	0→4	3,100	Proposed
70	PF17	New Connection Road No3 in New Residential Area near New Port in Silivri	New	0→4	2,700	Proposed
71	PF18	New E-W Road No.1 in Silivri Sub-Center	New	0→4	10,300	Proposed
72	PF19	New E-W Road No.2 in Silivri Sub-Center	New	0→6	4,300	Proposed
73	PF20	New N-S Road in Hospital/Healthcare Zone in Silivri	New	0→4	2,300	Proposed
74	PF21	New N-S Road at West side of Silivri Sub-Center	New	0→4	4,900	Proposed
75	PF22	New N-S Central Road of Silivri Sub-Center	New	0→4	4,500	Proposed
76	PF23	New N-S Road at East side of Silivri Sub-Center	New	0→4	7,500	Proposed
77	PF24	New N-S Road Connection between TEM and D100 in Silivri	New	0→4	4,300	Proposed
78	PF25	TEM side road from PF21 to PF24	New	0→4	7,000	Proposed
79	PF26	New E-W Connection Road in Silivri Sub-Center at North	New	0→4	7,000	Proposed
80	PF27	New E-W Connection Road in Silivri Sub-Center at Center	New	0→4	3,700	Proposed
81	PF28	New E-W Connection Road in Silivri Sub-Center at South	New	0→4	8,600	Proposed
82	PF29	New N-S Road along the westside of New Airport in Silivri	New	0→4	8,600	Proposed
83	PF30	New N-S Road along the eastside of New Airport in Silivri	New	0→4	12,100	Proposed
84	PF31	Widening of N-S Road in Silivri	Widening	2→4	2,600	Proposed
85	PF32	New E-W Road No.1connecting to Silivri Sub-Center	New	0→4	11,800	Proposed
86	PF33	New E-W Road No.2connecting to Silivri Sub-Center	New	0→6	12,800	Proposed
87	PF34	TEM side road from PF24 to Connection Rd TEM-D100 at Selimpasa in Silivri	New	0→4	10,400	Proposed
88	PF35	New E-W Residential Road in Silivri	New	0→4	4,400	Proposed
89	PF36	New N-S Residential Road No.1 in Silivri	New	0→4	2,400	Proposed
90	PF37	New N-S Residential Road No.2 in Silivri	New	0→4	3,400	Proposed
91	PF38	New E-W Road No.1 between Silivri and Buyukcekmece	New	0→4	16,400	Proposed
92	PF39	New E-W Road No.2 between Silivri and Buyukcekmece	New	0→4	19,300	Proposed
93	PF40	New N-S Road between TEM and D100 in Silivri developed area	New	0→4	1,600	Proposed
94	PF41	New N-S Connection Road No.1 between PF38 and coastal area	New	0→4	1,400	Proposed
95	PF42	New N-S Connection Road No.2 between PF38 and coastal area	New	0→4	1,600	Proposed
96	PF43	New Truck Route for Ambarli Port - Logistic Center(tunnel for about half length)	New	0→4	12,000	Proposed
97	PF44	E-W Missing Linkage in Gungoren (tunnel)	New	0→4	1,100	Proposed
98	PF45	N-S Missing Link in Bahcelievler (tunnel)	New	0→4	2,400	Proposed
99	PF46	Connection Tunnel between Bosna Bulvari and Hatboyu St (tunnel)	New	0→4	1,000	Proposed

No.	New Code	Road Project Name	Project type	No of Lane	Length (m)	Current Condition
100	PF47	Re-Construction of Ankara Road between Pendik and Baglanti Road (incl. 2km new road)	Rehab./ New	4→4	7,100	Proposed
101	PF48	Widening of Ataturk Road(TEM - D100) in Tuzla	Widening	2→6	8,200	Proposed
102	PF49	Extension of Ataturk Road to New Motorway in Tuzla (Widening)	Widening	2→6	7,200	Proposed
103	PF50	E-W Access Road to New Logistic Center in Tuzla	New	0→4	2,000	Proposed
104	PF51	E-W Road from Logistic Center in Tuzla - Gebze	New	0→4	3,800	Proposed
105	PF52	New E-W road at Northern Tuzla Industrial Complex	New	0→4	5,100	Proposed
106	PF53	New N-S Road at Logistic Center and Industrial Complex in Tuzla	New	0→4	4,400	Proposed
107	PF54	TEM Side Road at Tuzla Industrial Complex(West Section)	New	0→4	3,800	Proposed
108	PF55	TEM Side Road at Tuzla Industrial Complex(East Section)	New	0→4	4,200	Proposed
109	PF56	New E-W Road st Logistic Center and Industrial Complex in Tuzla	New	0→4	3,500	Proposed
110	PF57	New N-S Road in Tuzla Industrial Complex	New	0→4	5,400	Proposed
111	PF58	Connection Road between New Motorway and Uskudar Tunnel (50% tunnel)	New	0→4	3,700	Proposed
112	PF59	New N-S Connection Road in Silivri Sub-Center at West	New	0→4	4,200	Proposed
113	PF60	New N-S Connection Road in Silivri Sub-Center at East	New	0→4	4,400	Proposed
114	PF61	Widening of TEM between New Motorway of Kadikoy Branch and O2 in Umraniye	Widening	6→10	4,300	Proposed
115	PF62	Widening of TEM between O2 and D100-TEM Baglanti Road in Umraniye	Widening	6→10	7,900	Proposed
116	PF63	Widening of TEM between D100-TEM Baglanti Road and Orhanli Baglanti Road in Sultanbeyli	Widening	6→10	13,400	Proposed
117	PF64	Widening of TEM in Tuzla	Widening	6→10	8,000	Proposed
118	PF65	Widening of D100-TEM connection road in Kartal	Widening	4→6	9,500	Proposed
119	PF66	Widening of E-W Road at Logistic Center in Tuzla	Widening	2→4	1,500	Proposed
120	PF67	Widening of Kennedy Street between Road Tunnel and Mustafa Kemal St. in Eminonu	Widening	5→6	1,500	Proposed
121	PF68	Widening/New Construction of Connection between TEM and New Motorway in Kucukcekmece (Altinsehir-Kayabasi Rd and Side Road of New Motorway)	Wg/New	2→4	5,900	Proposed
122	PF69	New N-S Riverside Road in Kucukcekmece	New	0→4	3,100	Proposed
123	PF70	Widening of Eski Istanbul Road between TEM and New Motorway in Kucukcekmece	Widening	2→4	6,200	Proposed
124	PF71	New E-W Linkage in Kucucekmece	New	0→4	4,000	Proposed
125	PF72	Bahcesehir - Hadimkoy Jct. Connection Road in Bahcesehir	New	0→4	5,300	Proposed
126	PF73	New E-W Linkage between Bahcesehir - Avcilar in Bahcesehir	New	0→4	5,800	Proposed
127	PF74	New E-W Local Street in Sirvli Sub-Center	New	0→6	3,600	Proposed

Source : Transportation Planning Dept., IMM

### 13.4 Preliminary Cost Estimation of the Project

To evaluate the priority and feasibility of the proposed projects the approximate cost are estimated. The cost of the project mainly consists of construction cost, and land acquisition / compensation cost.

#### 13.4.1 Construction Unit Cost

##### 1) Construction Unit Cost

The unit construction costs were established for the preliminary cost estimation of each project. The unit costs were examined based on the cost of the actual projects. The Study Team has obtained the following cost data:

- (i) Cost of the recently completed and on-going projects implemented by IMM.
- (ii) Standard construction unit cost issued by KGM including construction cost of roads categorized by pavement structure and lane numbers, tunnels, bridges and viaducts.
- (iii) Average construction cost provided by KGM including construction cost of motorway categorized by lane numbers, long span bridges and junctions.

From the above data, basic unit costs for road construction were established as shown in

Table 13.4.1.

**Table 13.4.1 Construction Unit Cost**

Construction Item	Unit Cost (US\$/meter/lane)
Road	650
Bridge	8,000
Tunnel	11,000
Trumpet Type Interchange	4,400,000
Clover Type Interchange	13,200,000

Source: Study Team

2) **Basic Conditions of the Construction Cost Estimate**

Approximate construction costs for each project are calculated under the following basic conditions and assumptions:

- (i) Lengths and additional lane numbers of the project routes are multiplied by the unit cost shown in Table 13.4.1.
- (ii) Total bridge length on each route is assumed to be 2% of the total length of the route.
- (iii) Costs of the engineering services are assumed to be 12% of the construction cost.

**13.4.2 Land Acquisition and Compensation Unit Cost**

1) **Land Price**

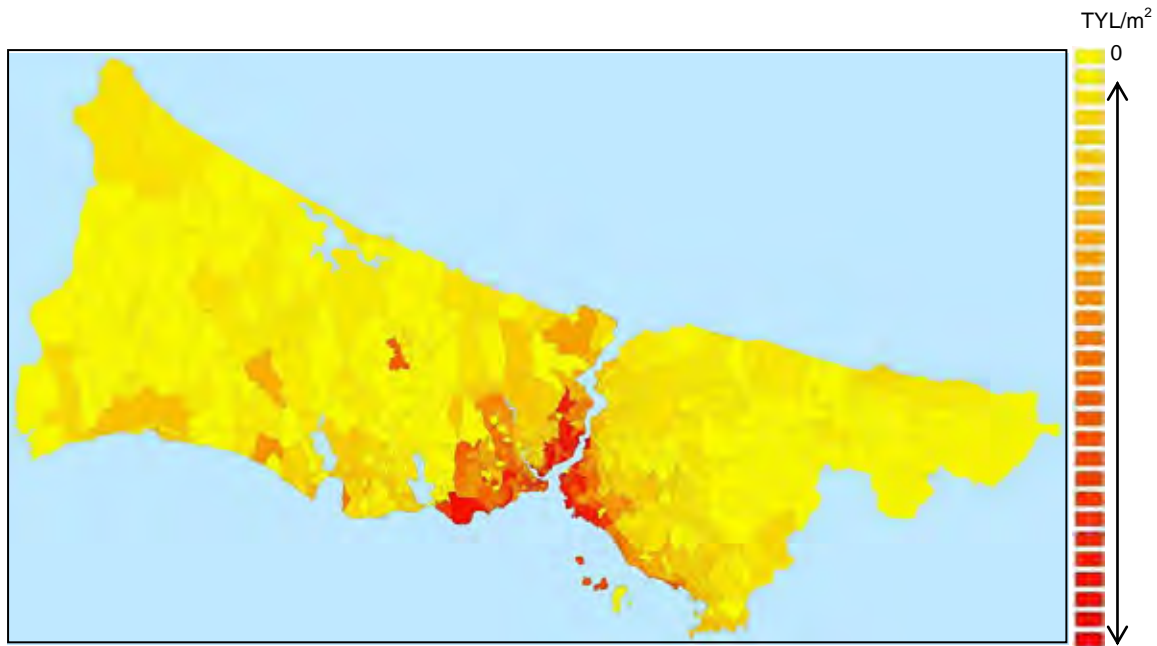
The land acquisition and compensation cost is an indispensable component of the total project cost, and they became higher than the construction cost in some of the projects.

To determine the unit land cost, following data were collected:

- (i) Government official land price list sorted by street issued by Ministry of Finance (2006 data).
- (ii) Government official land price list sorted by sub-division issued by Ministry of Finance (2006, 2002, 1992 data)
- (iii) The approximate land acquisition cost of 151 road infrastructure projects estimated by Land Acquisition Department of IMM prepared for their feasibility studies.

The following Figure 13.4.2 shows the distribution of the official land value for each subdivision. The data shows that the land value of developed area along the Bosphorus has reached 2,000 US\$/m<sup>2</sup>.





Source : *ibid*,

**Figure 13.4.1 Distribution of Official Land Value (2006)**

## 2) Process of the Determination of Land Nationalization by IMM

The actual land acquisition (nationalization) cost will be market value, which is usually two to five times higher than the government official land value. IMM determines the actual compensation cost necessary for the infrastructure construction with the following procedure:

- (i) Determine the area (parcel) and the buildings to be affected by the project.
- (ii) Check if those land and buildings are sold.
- (iii) Estimate the value of the land and the buildings to be affected. It will be done by a real estate specialist hired by IMM. In the evaluation, land use of the area, type of the structure on the land, facility of the building, direction of the building, age of the building, etc. are considered in detail to estimate the appropriate market value.
- (iv) Value of the buildings is evaluated by total floor space, facility, age, purpose, etc. based on the standard evaluation criteria.
- (v) Negotiate with the owner of the land and the building. If the property is for sale, the municipality will negotiate as a usual customer. If the property is not for sale, the price evaluated in above III) is offered.
- (vi) If the offered value is not acceptable for the owner of the property, the owner will appeal to the court for their decision.

## 3) Land Market Value

It is impossible to evaluate the accurate market value of the property without going through the above process because it is common that the land values vary block by block drastically depending on the land use and conditions of the structures on the land.

However, rough estimation of the unit land market price has been attempted by the Study

Team using limited data in order to estimate the cost for a large number of projects within a limited time schedule. Table 13.4.2 shows the average unit market land value for each district in comparison with official land value. This unit land value may be reconsidered and subdivided if further data are obtained.

**Table 13.4.2 Official Land Value and Market Land Value on Average (2006)**

District	(a)	(b)	(b) / (a)
	Official Value TYL/m <sup>2</sup>	Market Value TYL/m <sup>2</sup>	
Adalar	148	533	3.6
Avcilar	63	533	8.4
Bağcilar	249	412	1.7
Bahçelievler	232	540	2.3
Bakırköy	618	790	1.3
Bayrampasa	275	944	3.4
Besiktas	685	752	1.1
Beykoz	21	240	11.5
Beyoğlu	593	650	1.1
Buyukcekmece	63	370	5.9
Catalca	11	170	15.5
Eminonu	282	4000	14.2
Esenler	133	380	2.8
Eyup	112	480	4.3
Fatih	196	2000	10.2
Gaziosmanpasa	158	170	1.1
Güngören	157	623	4.0
Kadıköy	243	801	3.3
Kağıthane	69	700	10.1
Kartal	64	488	7.7
Kucukcekmece	-	367	-
Maltepe	96	658	6.8
Pendik	33	448	13.6
Sarıyer	66	752	11.5
Silivri	21	200	9.7
Sisli	604	650	1.1
Sultanbeyli	5	300	65.3
Tuzla	22	234	10.6
Ümraniye	20	430	21.8
Üsküdar	368	929	2.5
Zeytinburnu	443	1000	2.3

Source : *ibid*,

#### 4) Basic Conditions of Land Acquisition and Compensation Cost Estimate

Rough estimation of land acquisition and compensation cost for each project was made based on the following basic conditions and assumptions:

- (i) The average unit land market values shown in Table 13.4.2 were used for the cost estimation. However, some modifications of the unit values were made to evaluate the project in the district which has large area with both highly developed and undeveloped area.
- (ii) The required right of way width for new road construction was assumed to be the road width plus 10 meters.
- (iii) The required right of way width for road widening project was assumed to be additional lane width plus 5 meters.
- (iv) Land acquisition area for tunnel projects was assumed to be 4,000 m<sup>2</sup>.

It is noted that the construction law No. 18 prescribes that the government can acquire the

40% of parcels in maximum for free for the construction of infrastructure if the area is categorized as “unplanned” in the municipality’s land use plan. This rule shall be applied through the negotiation with the land owner. However, it is very difficult to consider this rule in the early stage of the project such as this master plan.

### 13.4.3 Result of Approximate Cost Estimate

The approximate cost estimate results are summarized in the following Table 13.4.3.

**Table 13.4.3 Approximate Cost Estimate Results**

Unit: Million US\$

Classification			Code	Cost		
				Construction +Engineering	Land Acquisition	Sub Total
Road	Base Net	Under Construction	A	188.0	0.0	188.0
		Tender Stage	B	539.7	0.0	539.7
		DD Completed	C	297.6	649.5	947.1
		Design Stage	D	430.8	851.2	1,282.0
		Subtotal		1,456.0	1,500.7	2,956.8
	Maximum Net	Design Stage	PD	249.2	446.9	696.1
		Study Stage	PE	2,084.1	1,044.2	3,128.3
		Proposed (New)	PF	1,330.0	1,566.7	2,896.8
		Subtotal		3,663.3	3,057.9	6,721.2
	Road Total				5,119.3	4,558.6
Tunnel	Base Net	Under Construction	A	463.5	0.0	463.5
		Tender Stage	B	403.5	0.0	403.5
		DD Completed	C	0.0	0.0	0.0
		Design Stage	D	0.0	0.0	0.0
		Subtotal		867.0	0.0	867.0
	Maximum Net	Study Completed	PD	1,067.7	21.3	1,088.9
		Study Stage	PE	762.9	352.0	1,114.9
		Proposed (New)	PF	661.5	40.9	702.5
		Subtotal		2,492.1	414.2	2,906.4
Tunnel Total				3,359.1	414.2	3,773.4
Road +Tunnel	Base Net	Under Construction	A	651.5	0.0	651.5
		Tender Stage	B	943.2	0.0	943.2
		DD Completed	C	297.6	649.5	947.1
		Design Stage	D	430.8	851.2	1,282.0
		Subtotal		2,323.1	1,500.7	3,823.8
	Maximum Net	Design Stage	PD	1,316.8	468.2	1,785.1
		Study Stage	PE	2,847.0	1,396.2	4,243.2
		Proposed (New)	PF	1,991.6	1,607.7	3,599.2
		Subtotal		6,155.4	3,472.1	9,627.5
	Road+Tunnel Total				8,478.5	4,972.8
Interchange/ Junction	Base Net			743.3	129.9	873.3
	Maximum Net			427.6	460.8	888.3
	Interchange/Junction Total			1,170.9	590.7	1,761.6
Grand Total				9,221.8	5,102.8	15,212.9

Source: *ibid.*

### 13.4.4 Road Projects to be evaluated

In order to determine the project priority, some road projects have been grouped as a package project since, those projects are closely related each other, and are expected to function efficiently as a network only if they are implemented at the same time.

As for the other road projects planned by IMM, 38 projects in total, they are assumed as an independent project, then will be evaluated independently.

As a result, 54 road projects/package projects are identified in this study. These projects to be evaluated including the package projects are shown in Table 13.4.4.

**Table 13.4.4 Road Projects to be Evaluated**

No	Project name	Project Code						Construction Cost (US\$ Mil.)
RD001	Tophane - Iplikci Tunnel	PC01					62.8	
RD002	Widening of Hatboyu street (Coastal road Linkage) in Umraniye	PD01					195.2	
RD003	Bakirkoy between D-100 Land Route (Incirli Junction) - Coastal Road (Atakoy Junction) underpass - flyover project	PD02					118.3	
RD004	Widening project between Kirac and Esenyurt construction road	PD03					9.4	
RD005	Between Hadimkoy bridge- Yassioren road, road, junction project	PD04					28.6	
RD006	Beykoz, Mihrabat St.-TEM Highway Linkage project	PD05					12.3	
RD007	Umraniye, between Kucuksu junction- Isfalt association ( Kucuksu street) road rehabilitation project	PD06					50.6	
RD008	Beylerbeyi - Harem Tunnel	PD07					210.0	
RD009	Beylerbeyi - Hekimbasi Tunnel	PD08					175.8	
RD010	Kadikoy - Moda Tunnel	PD09					48.4	
RD011	Tophane - Haskoy Tunnel	PD10					24.9	
RD012	Road Construction For W. Trade Center by Private Sector	PD11					40.3	
RD013	Kucukcekmece D-100 Highway Cobancesme Junction - Olympics Road Linkage Road and Junction Project	PD12					291.8	
RD014	Yakuplu Kumcular Servis Road Project	PD13					24.5	
RD015	Derbent Haciosman Tunnel Project	PD14					61.9	
RD016	Armutlualti - Poligon Mah. Tunnel Project	PD15					68.1	
RD017	Armutlualti - Ayazaga Tunnel Project	PD16					73.5	
RD018	Kuyumcu Kent - Otogar - Eyup Tunnel Project	PD17					332.8	
RD019	Road rehabilitation project between Bagcilar, Malazgirt underpass-Mehmet Akif avenue (8.St-1/3St-1/13 St-2/13 St)	PD18					8.8	
RD020	Tuzla Formula-1 Road Network 6 numbered road project	PD19					25.0	
RD021	Link Road between Malazgirt Rd and Mahmat Akif Bulbari	PD20					4.3	
RD022	Road project in Bakirkoy,(D-100 Highway Sefakoy junction - airport A-14 Apron linkage road)	PE01					9.7	
RD023	Sultanbeyli Necip Fazıl st. - Kartal TEM linkage road project	PE02					4.1	
RD024	Between Umraniye Mandira St - Bag st road project	PE03					4.5	
RD025	New linkage road project between Umraniye Karadeniz street - Mandira St. (continuous section of Hatboyu St.)	PE04					4.5	
RD026	Kartal Sehith Ahmet Yalcin St - Arkoz St - Cavusoglu St, Adnan Kahveci Viaduct Linkage road junction project	PE05					12.7	
RD027	Umraniye, between Sile Road Yenidogan junction - Pasakoy junction road, junction implementation project	PE06					19.3	
RD028	Re-organizing The existing road in Umraniye Cekmekoy Cavusbasi St. according to the construction plan as 20m	PE07					7.5	
RD029	Kartal between Tekel St. - D-100 road, junction implementation project	PE08					25.0	

No	Project name	Project Code						Construction Cost (US\$ Mil.)
RD030	Uskudar between Zubeyde Hanım St. - Hekimbasi Ciftlik St. construction roads implementation projects	PE09						13.8
RD031	Beykoz , between Kavacık junction – Çekmekoy junction (Cavusbasi road) road, junction implementation project	PE10						31.6
RD032	West Buyukcekmece Road Network Package	PF38	PF39	PF40	PF41	PF42		495.6
RD033	East Silivri Road network Package	PF29	PF30	PF31	PF32	PF33	PF34	842.0
		PF35	PF36	PF37				
RD034	Silivri Center Road network Package	PF18	PF19	PF20	PF21	PF22	PF23	827.2
		PF24	PF25	PF26	PF27	PF28	PF59	
		PF60	PF74					
RD035	West Silivri (Port Area and University Area) Road Network Package	PF8	PF9	PF13	PF14	PF15	PF16	844.6
		PF17						
		PF1	PF2	PF3	PF4	PF5	PF6	
		PF7	PF10	PF11	PF12			
RD037	Tuzla Center Road Network Package	PF48	PF49	PF50	PF51	PF52	PF53	477.7
		PF54	PF55	PF56	PF57	PF58		
RD038	New Motorway west section Package	PE11	PE12	PE13	PE14	PE30		965.4
RD039	New Motorway Kucukcekmece section Package	PE15	PE16	PE17	PE18			547.7
RD040	New Motorway Kagithane section Package	PE19	PE20					520.5
RD041	New Bosphorus Crossing	PE21						843.0
RD042	New Motorway Kadikoy Branch Package	PE22	PE23	PE24				332.5
RD043	New Motorway Uskudar-Umraniye Package	PE25	PE26	PE31				360.0
RD044	New Motorway Umraniye-Tuzla Package	PE27	PE28	PE29	PE31	PE32		683.5
RD045	Widening of TEM Highway (Umraniye-Tuzla) Package	PF61	PF62	PF63	PF64			490.4
RD046	Widening of Connection road (TEM-D100) in Kartal	PF65						112.0
RD047	Kucukcekmece Road Network Package	PF68	PF69	PF70				135.8
RD048	Bahcesehir Road Network Package in Avcilar	PF71	PF72	PF73				202.7
RD049	New Truck Route for Ambarli Port - Logistic Center (tunnel for about half length)	PF43						358.9
RD050	E-W Missing Linkage in Gungoren (tunnel)	PF44						57.4
RD051	N-S Missing Link in Bahcelievler (tunnel)	PF45						121.4
RD052	Connection Tunnel between Bosna Bulvari and Hatboyu St (tunnel)	PF46						52.4
RD053	Re-Construction of Ankara Road between Pendik and Baglanti Road (incl. 2km new road)	PF47						63.0
RD054	Connection Road between New Motorway and Uskudar Tunnel (50% tunnel)	PF58						123.9
RD055	Widening of Kennedy St. between Road Tunnel and Mustafa Kemal St. in Eminonu	PF67						38.2

Source: *ibid.*

## Chapter 14 Maximum Railway Network

### 14.1 Evaluation of Base Network

The Base Network consists of the existing, under construction, tender stage, and design stage projects with a total length of 312.2 km as show in the figure below.



Source: Study Team

**Figure 14.1.1 Railway Base Network**

#### 1) Network Density in the Central Area

The world experience shows that high railway density in the central area attracts passenger movement between the central area and the suburban area to the railway network. The railway share in urban transport is high in Tokyo, London, Paris, and New York because of its high density of railway network in the central area. From this point of view, railway network density of the Base Network in the business zones such as Taksim, Sisli and Levent is not high enough to promote railway transportation. It is necessary to formulate a high density railway network in the center area to promote the use of railway.

#### 2) Coordination with Land Use Plan

The Base Network covers densely populated area and high demand corridor. On the other hand, the Base Network does not include railway system in Silivri along seaside where a large scale development will be needed in the land use plan. In addition, some newly populated areas still do not have railway access in the Base Network. For example, railway system in the new development area in the north of Kucukcekmece Lake is not included. There is no railway access along O-4 in Sultanbeyli District because this area is planned as low-density area where new urban development is restricted in the land use master plan.

#### 3) Bosphorus Crossing

The Marmaray Project will provide a double track railway with a capacity of 75,000 passengers per hour per direction to connect European side and Asian side. However, demand forecast shows that the capacity of the Marmaray Commuter will not be enough to cope with public transport demand in Bosphorus crossing. Since the Marmaray

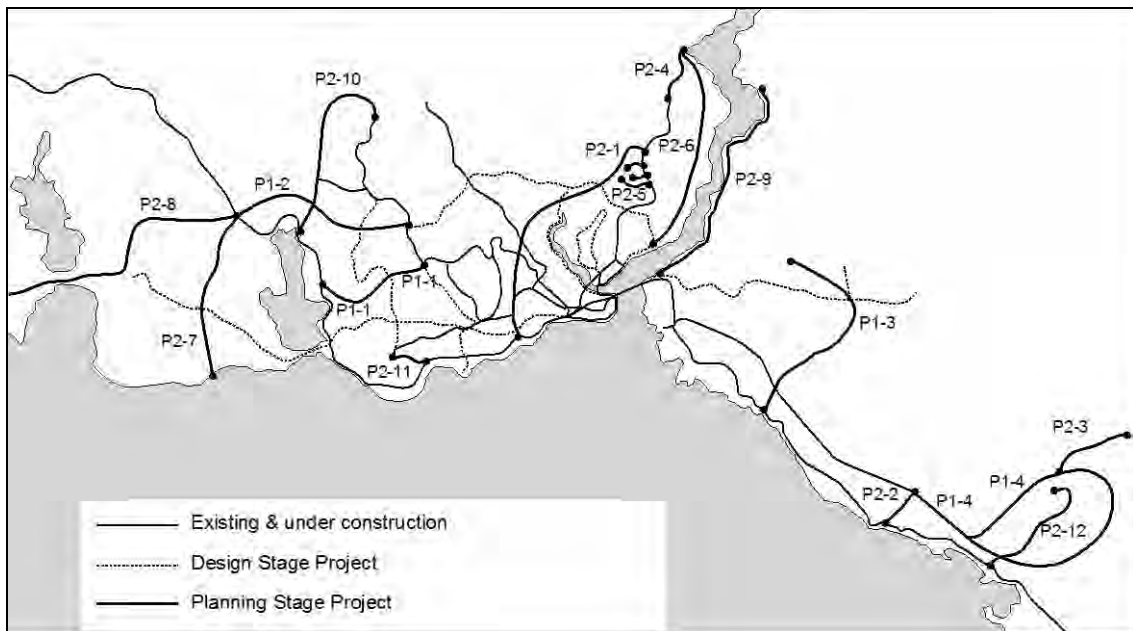
Commuter uses the existing TCDD line, transfer with the Metro is needed to connect the business area around Levent and Asian side.

## 14.2 Network Alternatives

### 14.2.1 Planning Stage Projects

To establish the railway network for the master plan, the latest plan (as of 2007) was adopted as the starting point of the analysis. The latest plan consists of the Base Network and the planning stage projects. The planning stage projects of a total length of 168.8 km consist of the first stage (51.6 km) and the second stage (117.2 km). The first stage projects consist of 4 lines and the second stage projects consist of 10 lines. The project code shall be defined P1 for first stage and P2 for second stage.

In addition to these projects, airport access rails for Ataturk Airport and Sabiha Gokcen Airport are planned as a part of the Marmaray Project.



Source: *ibid.*

**Figure 14.2.1 Planning Stage Railway Projects**

1) P1-1: Bagcilar–Halkali Light Metro (7.5 km)

This is the extension of Otogar–Bagcilar (Kizali) Light Metro (C-5) which is under construction. This line connects Bargcilar (Kizali) and Halkali east and west, crossing Yesikoy - Ataturk Airport - Ikitelli Metro (D-5). High-density residential and commercial area in Kucukcekmece will be served by this line.

2) P1-2: Tekstilkent–Istoc–Olimpiyat Koyu–Bahcesehir (Ispartakule) Metro (16.7 km)

This is the extension of Kabatas - Besiktas - Sisli - Giyimkent - Bagcilar Metro (D-2), connecting Bagcilar - Ikitelli - Olimpiyat Koyu Metro (C-6) and TCDD. Residential area in Halkali in the south of TEM and commercial and residential area in the north of Kucukcekmece Lake will be served by this line. Since the route to the north of the lake runs through a hilly area with a deep valley, there will be ground level sections, elevated

sections, and underground sections.

3) P1-3: Umraniye–Bostanci Metro (14.0 km)

This line connects Uskudar - Cekmekoy Light Metro (T-1) and Bostanci Station, running north and south direction through Umraniye District where population density is high but railway service is absent over large area in the Base Network. Bostanci is the station of the Marmaray Commuter and Kadikoy - Kartal Metro (C-3).

This will be an underground railway. Since this line will not go through other lines, its system can be independent from others.

4) P1-4: Kartal–Pendik–Tuzla Metro (18.1 km)

This is the extension of Kadikoy - Kartal Metro (C-3), running around Sabiha Gokcen Airport with a loop shape without direct access to the airport terminal.

5) P2-1: Seyrantepe–Alibeykoy–Gop–Kazlicesme Metro (16.3 km)

This is a circular railway passing through Zeytinburnu District, Bayrampasa District, Gaziosmanpasa District, Eyup District, and Kagithane District. This will divert traffic from the heavily congested corridor of Eminonu–Beyoglu–Sisli–Besiktas.

This will be underground railway.

6) P2-2: Kartal Monorail (3.0 km)

This line is planned to connect Kadikoy - Kartal Metro (C-3) and the Marmaray Commuter between the two Kartal stations. The function of the line is not only to bridge two parallel railways, but also to provide modern transport system in Kartal area. The route is in Kartal High Level Center Special Project Area. It should be reviewed in accordance with the Special Project.

7) P2-3: Sabiha Gokcen Airport–Formula-1 Monorail (7.7 km)

This line provides mass transit access to Formula-1, having connection to Kartal – Pendik - Tuzla Metro (P1-4).

8) P2-4: Haciosman–Cayirbasi Metro (2.7 km)

This is the northern extension of Taksim - 4.Levent Metro (E-1), connecting Saryer to the center of Istanbul. The section between 4.Levent and Haciosman is under construction.

9) P2-5: 4.Levent–Gultepe, 4.Levent–Sanayi, 4.Levent–Celiktepe Monorail (total 8.7 km)

The route length of these lines is short at 1–2.5 km, which is usually not efficient for monorail operation. It is necessary to review the concept and the transport system around this area.

10) P2-6: Besiktas–Seriye Metro (14.5 km)

This line runs through Besiktas District, connecting Seriyer and the center of the city. Since the existing metro and its extension (Taksim–Cairbasi) might be over saturated, this line is expected to be a diversion route.

11) P2-7: Ispartakule–Ambarli–Yakuplu Suburban Railway (10.5 km)

This railway line runs along O-3 Highway in Buyukcekmece north and south between



Ispartakule Station and Ambarli Port, providing both passenger and freight transportation services. The major role of this line is to carry cargos between Ambarli Port and the logistics center in Hadimkoy using the existing line of TCDD between Ispartakule and Hadimkoy.

12) P2-8: Ispartakule–Kirac–Buyukucekmece–Silivri Suburban Railway (25.8 km)

This line connects the western development area in Silivri and the center of Istanbul, having a transfer point at Ispartakule station with Tekstil Kent – Istoc - Olimpiyat Koyu - Bahcesehir (Ispartakule) Metro (P1-2) line and TCDD main line. From Ispartakule station, this line goes through the industrial area in Kirac (Buyukucekmece) to west, the hillside along the O-3 Highway to south, and goes down the slope along D-100 Highway to the south of Buyukucekmece Lake. After that, this line runs along seaside up to Silivri.

13) P2-9: Uskudar–Beykoz Metro (15.0 km)

This line runs along seaside of the Bosphorus Strait on the Asian side between Uskudar and Beykoz District.

14) P2-10: Ikitelli–Olimpiyat Koyu–Altinsehir Metro (13.0 km)

This line is the extension of Bagcilar–Ikitelli–Olimpiyat Koyu Metro (C-6), providing railway access to the new development area around Basaksehir. The route makes a turn and connects to Altinsehir station of TCDD main line.

This line is important to promote new development to the north of Kucukcekmece Lake.

15) P2-11&P2-12: Airport Access of Marmaray Project

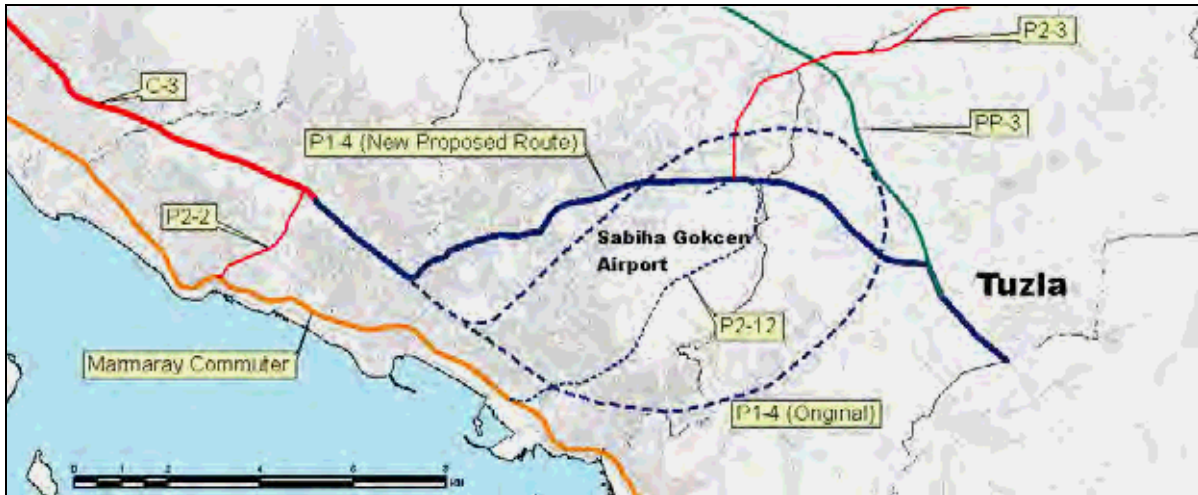
To connect the airport to Marmaray Project, railway lines for the access to Ataturk Airport (P2-11) and Sabiha Gokcen Airport (P2-12) are studied by DHL.

#### 14.2.2 Modification of the Planning Stage Projects

1) P1-4: Kartal –Pendik–Tuzla Metro and P2-12: Airport Access

P1-4 passes near Sabiha Gokcen Airport without any access to the airport terminal, while P2-12 has the access from Tersane station of Marmaray line running through the east of the airport.

The alignment of P1-4 should be revised so that the line can have the access to the airport and get more traffic demand from highly development areas. Instead of the loop line which goes through low development area, it is better to connect the industrial zone in Tuzla. The proposed new alignment is illustrated in the figure below.



Source: *ibid.*

**Figure 14.2.2 Proposed Alignment of P1-4**

2) P2-5: 4.Levent–Gultepe, 4.Levent–Sanayi, 4.Levent–Celiktepe Monorail

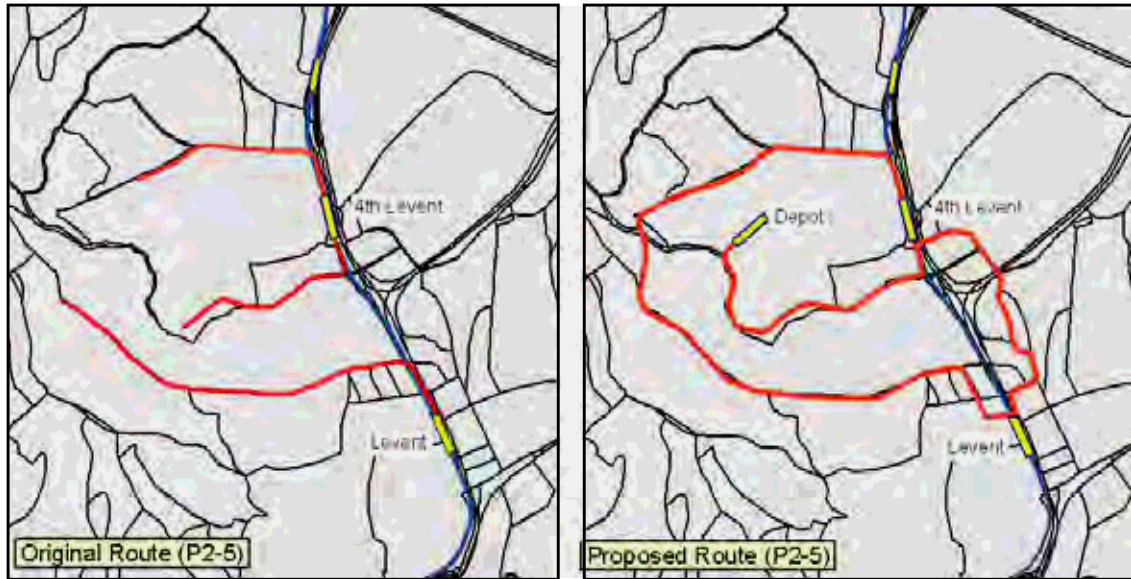
Operating three monorails in parallel for the short distance of 1–2.5km is not efficient. Although Istanbul has short-distance transportation systems such as teleferik and funicular, these systems are not suitable as the alternative of the three monorails due to the difference of the area condition. The system should satisfy the following conditions:

- The system can run in both flat and slope area (The slope is steep.).
- The width of the right-of-way of the available roads is narrow, and both sides of the roads are built-up area.
- Trip distance is short, and demand is not high.

Telefelik and funicular does not satisfy the first condition. There are some unique systems that satisfy the conditions. A new transport system—Skyrail (box below) operated in a Japanese city is one of the alternative systems. The Skyrail is similar to telefelik in Istanbul but the car of the Skyrail is suspended by a steel girder supported by piers. The passenger capacity is almost the same as telefelik. The Skyrail can be constructed along the three routes. However, the parallel operation of three systems in a small area is not feasible.

	<p><u>Skyrail (Seno Line)</u></p> <p>Rail Type: One box car suspended by steel girder                  Capacity: 2200 passengers /hour (both direction)                  Maximum Gradient: 27%                  Minimum Curvature: 50m                  Speed: 18km/h                  Traction: Cable, DC 440V                  Length: 1.3km with 3 stations (both ends included)                  Location: Hiroshima, Japan</p>
<p>Source: <a href="http://www.kobelco.co.jp">www.kobelco.co.jp</a> (Kobe Steel Group)</p>	

Instead of constructing and operating three separate lines, a loop line of a monorail system, which runs on the three routes, is proposed. Figure 14.2.3 shows the proposed route.



Source: *ibid.*

**Figure 14.2.3 Proposed Monorail Line**

Since the roads are narrow and the slope is steep, small types of monorails are suitable. The suspended monorail system operated in a Japanese city (box below) is one of the systems. The structure is slim because of its single track operation. The girder of the track is supported by piers which can be constructed along narrow roads.

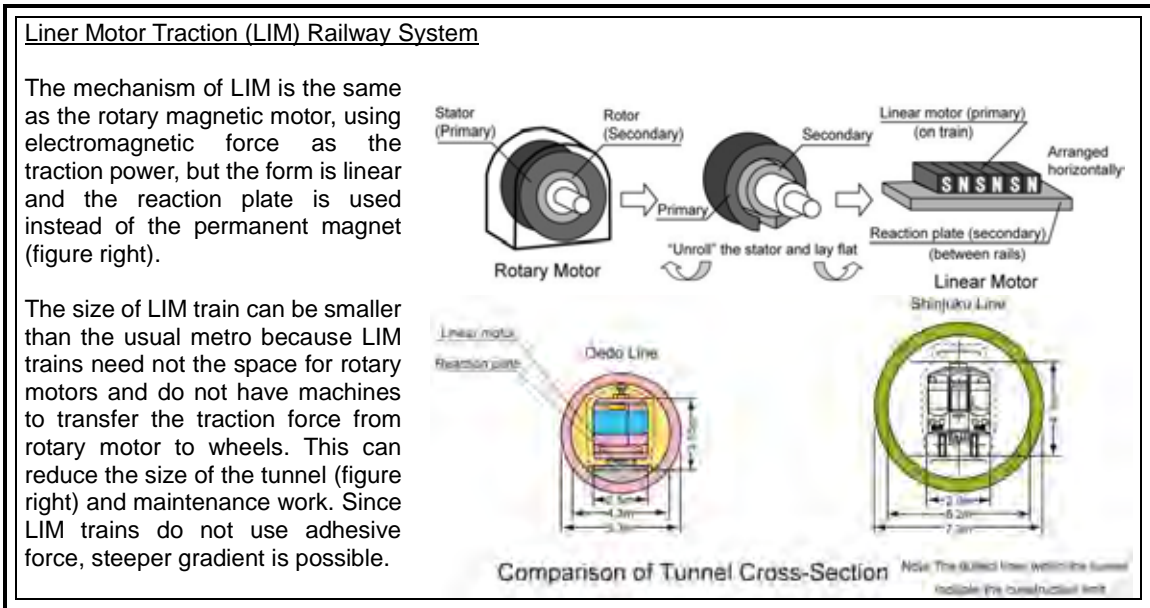
	<p><u>Suspended Monorail (Shonan Line)</u></p> <p>Rail Type: Suspended monorail, single track                  Train Composition: 3 cars per train                  Train Capacity: 220 per train (460 in full loading)                  Maximum Gradient: 7.4%                  Minimum Curvature: 100m (50m in stations)                  Traction: Cable, DC 1500V                  Length: 6.6 km with 8 stations (both ends included)</p>
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Source: [www.shonan-monorail.co.jp](http://www.shonan-monorail.co.jp)

3) P2-6: Besiktas–Seriye Metro

The line is proposed as a metro system. However, traffic demand is not expected to be high enough for a metro construction because the population along the route is estimated to be about only 222,000 in 2023, and the population density is relatively low along the route. In addition, this line goes through hilly area along the Bosphorus Strait, and it is difficult to find an adequate route that satisfies the standard specification of a metro system.

Instead of Metro system, it is recommended to introduce another type of transit system such as monorail, AGT, and linear motor traction (LIM) railway. The capacity of these systems is smaller than usual metro system, while the maximum gradient of these systems is about 6% while that of usual metro system is about 3.5%. Monorail and AGT need a surface space to accommodate the structure.



AGT System: Yurikamome (Tokyo)



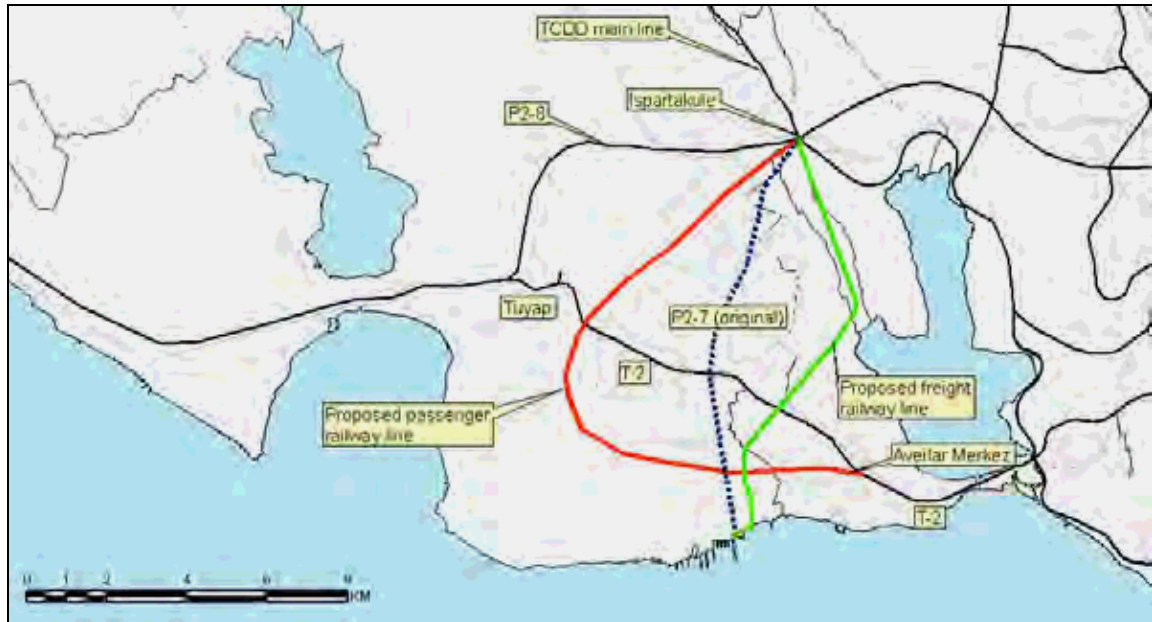
LIM Railway : Oedo Line (Tokyo)

4) P2-7: Ispartakule–Ambarlı–Yakuplu Suburban Railway

Since Buyukcekmece will be highly populated having a population of 1.6 million in 2023, this line should shift to western side to serve the middle of the urbanized area as a commuter rail. It is better to connect this line to Tekstilkent - Istoc - Olimpiyat Koyu - Bahcesehir (Ispartakule) Metro (P1-2) at Ispartakule station and to Avclar Merkez station of Bakirkoy - Beylikduzu Light Metro (T-2). The railway system should be the same type as P1-2 or T-2.

On the other hand, freight transport is also an important function of P2-7 in the original plan. IMP has a plan for a logistics system in which railway connection between Ambarlı Port and Hadimkoy is included. For this, the system is planned as the same as TCDD railway in the planning stage projects. It is better to realign this line to eastern side of the original line to go through less urbanized area. For freight transport, further studies will be necessary.

Figure 14.2.4 shows the proposed alignment of P2-7 as the commuter rail.



Source: *ibid.*

**Figure 14.2.4 Proposed P2-7 Line**

5) P2-8: Ispartakule– Kirac–Buyukucekmece–Silivri Suburban Railway

This line is very important to promote the development in Silivri.

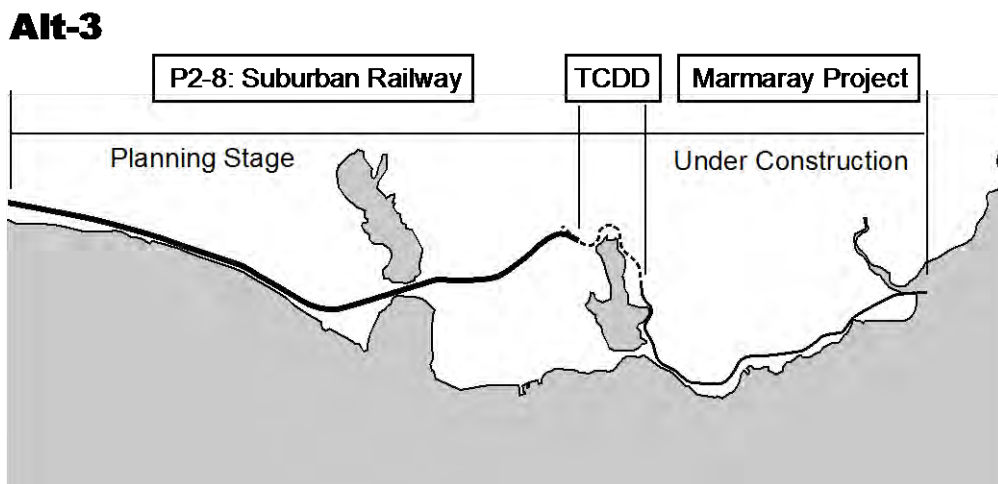
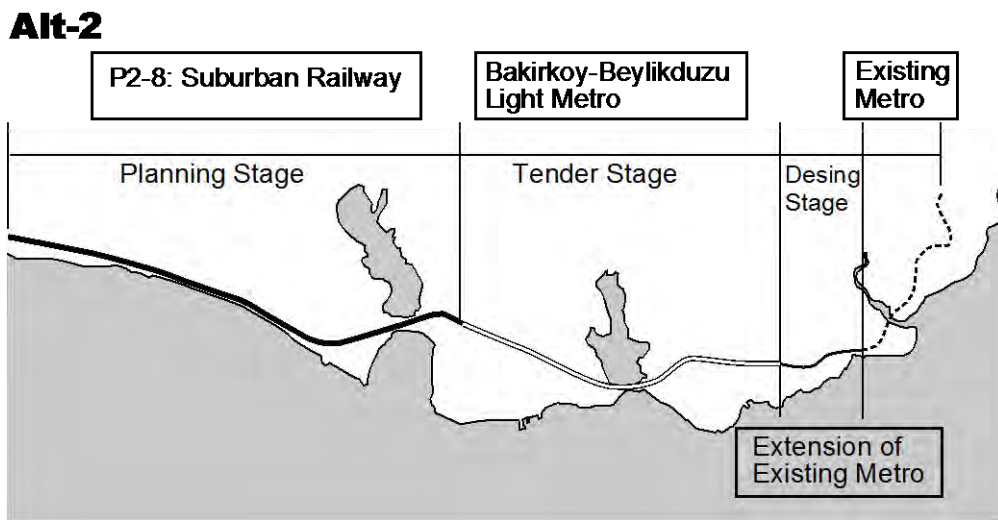
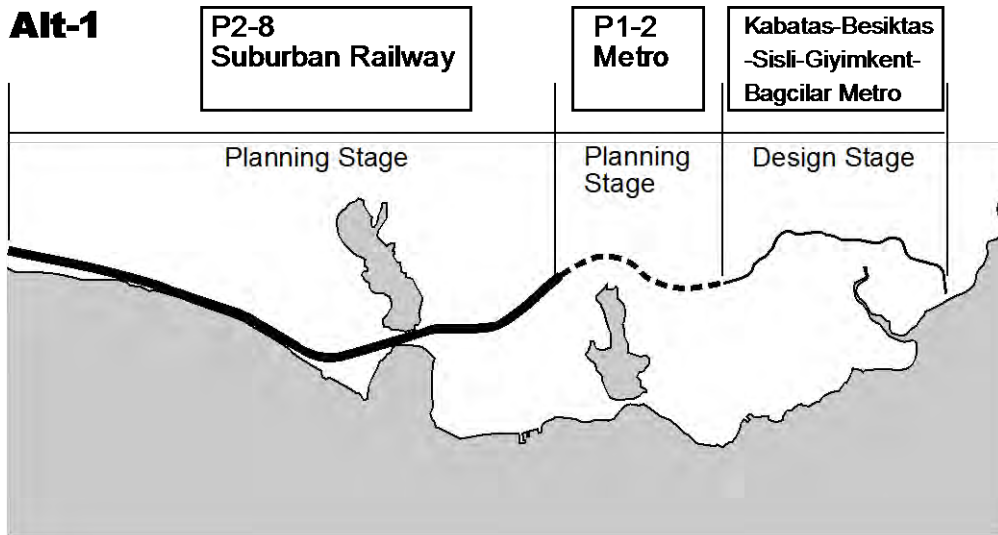
In the planning stage projects, the system of this line is proposed as a suburban railway (AC 25kV) connecting with Tekstilkent - Istoc - Olimpiyat Koyu - Bahcesehir (Ispartakule) Metro (P1-2) line and the existing TCDD main line at Ispartakule. However, it is better to use the same system as P1-2 (DC 1500V catenary) to enable through train operation with P1-2 and Kabatas – Besiktas – Sisli – Giyimkent – Bagcilar Metro (D-2) for the direction connection from Silivri to the center of the city as shown in Figure 14.2.5, Alt-1.

There is another alternative as shown in the Figure 14.2.5, Alt-2. In this case, Bakirkoy – Beylikduzu Light Metro (T-2) line should be extended westward from Tuyap station to P2-8 line. This route can connect the Silivri development area to the major corridor in the center of Istanbul.

The other alternative is to connect this line to TCDD line as shown in Figure 14.2.5, Alt-3. In this case, Silivri is directly connected to the Marmaray Commuter.

6) P2-9: Uskudar–Beykoz Metro

High traffic demand is not expected because the population in 2023 along the route is estimated to be only 103,000 and the population density is not so high compared to other central area. The system can be independent from other rail systems. Therefore, transit system of this line should be reviewed. The linear traction railway, AGT and monorail are the candidate railway system.



Source: *ibid*

Figure 14.2.5 Alternatives of P2-8 Connection

### 14.2.3 Bosphorus Rail Crossing

#### 1) Necessity of Mass Transit System for Bosphorus Crossing other than Marmaray Project

It is necessary to form an integrated and high density railway network to sift passengers from other transportation mode to railway. The Marmaray Project will significantly promote public transport because it will integrate railway networks in European and Asian sides that are currently separated. However, the demand analysis shows that the demand in public transport between European and Asian sides are far larger than the railway capacity of Marmaray Project. If buses are used by all the public transport demand that exceed the capacity, the 1st and 2nd Bosphorus Bridge will still suffer from serious traffic congestion.

The road tunnel project and the Metrobus project on the 1<sup>st</sup> Bosphorus Bridge will increase traffic capacity. Both projects have been already approved by the relevant authorities. In addition to these projects, another railway than Marmaray Project will be necessary for the following reasons:

- Since Marmaray Project runs on the TCDD line along seaside, railway connection between the business center in Sisri and Asian side is weak.
- Marmaray Project can carry approximately 75,000 passengers per hour per direction. However, more railway capacity will be needed to meet the traffic demand.
- Concentration of passenger demand on Yenikapi station will be too heavy.

#### 2) Tunnel and Bridge

Railway connection over the Bosphorus Strait is very difficult because the strait is wide (more than 1km) and deep (100-150m), and the both side of the strait are steep hilly area. There are two alternatives for the railway connection; under-sea tunnel and bridge.

Construction of an under-sea tunnel is very expensive and connectivity is not necessarily good because the approach from the ground to the tunnel becomes very long. The approach has the section deeper than 50m from the surface at a length of 5–7km without intermediate stations because a station in such deep place is unrealistic.

The construction of a railway bridge is more feasible. In this case, the bridge should be suspension type with more than 1,000m center span because construction of a pier at the center of the strait is impossible due to the depth of the strait and the ship traffic. The railway on the long span suspension bridge is already constructed in Japan and the operation and maintenance of the bridge and the track on the bridge is satisfactory.

Since a new Bosphorus Bridge for car traffic is proposed between the 1<sup>st</sup> and 2<sup>nd</sup> Bridge, it is proposed to construct a road & railway combined bridge for Bosphorus crossing. The railway system should be metro type so that the railway can be integrated to the metro network in Istanbul.

#### 3) Route of the New Railway on the Bridge


Since the proposed new bridge is located on the straight line between the western end of Umraniye - Bostanci Metro (P1-3) line and the eastern end of Seyrantepe - Alibeykoy - Gop - Kazlıcesme Metro (P2-1) line, it is natural to connect these line as a long railway line that go through major areas in European and Asian side. The connected line runs from Kazlıcesme station of the Marmaray Commuter in European side through Alibeykoy and

Seirantepe, crossing Bosphorus Strait, and runs from Umraniye to Bostanci station of the Marmaray Commuter in Asian side. Figures 14.2.6 illustrate the routes of the Bosphorus Crossing.

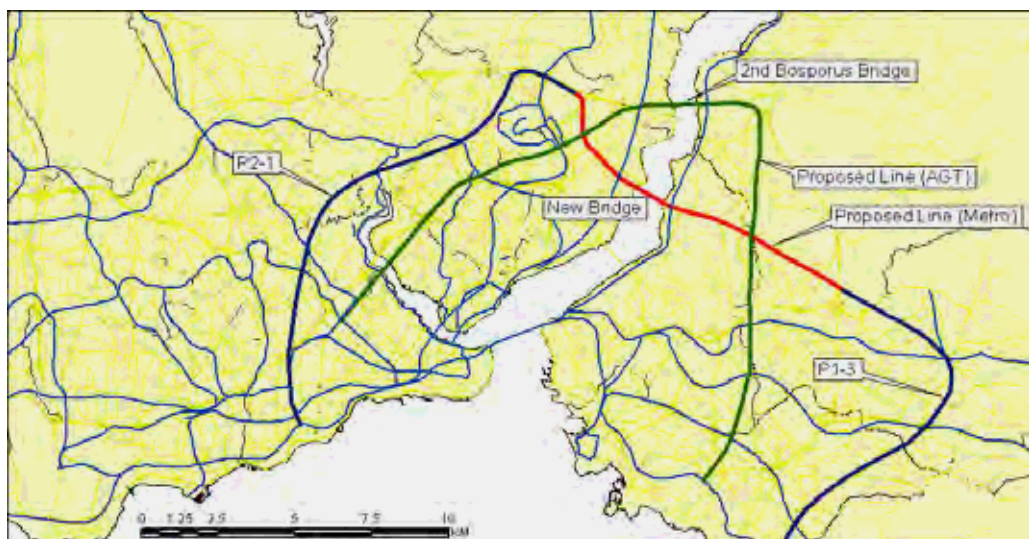
4) AGT on the 2nd Bosphorus Bridge

The 2nd Bosphorus Bridge is an 8-lane road bridge. Using the center lanes as the exclusive lanes for Metrobuses is one of the alternatives to connect European and Asian sides by a mass transit system and to promote public transport in Istanbul. Another alternative is to introduce Automated Guided Transit (AGT) system on the bridge.

AGT is a fully automated and grade-separated transit system equipped with rubber-tires. The vehicles of AGT are guided by horizontally installed guide wheels. Passenger capacity of AGT is higher than that of Metrobus.

Automated Guided Transit (AGT): Yurikamome Line	
Wheel: Rubber Tire	
Structure: 7.5m-width viaduct	
Bridge: 798m suspension bridge over Tokyo Bay (Rainbow Bridge)	
Route Length: 14.7km with 16 stations	
Operation: Full automatic operation	
Vehicle composition: 6 cars	
Car weight: 10.8 ton per car	
Capacity: 308–352 passengers per train	
Headway: minimum 3.5 minutes	
Power supply: 3 phase AC 600 V	
Source: <a href="http://www.yurikamome.co.jp">www.yurikamome.co.jp</a>	

In European side, it is proposed to use Motorway O-1 and O-2 for the AGT route, while the route goes north and south connecting Goztepe Station of TCDD, Geztepe Station of Kadikoy - Kartal Metro (C-3), Umranie Station of Uskudar - Cekmekoy Light Metro (T-1) and the 2nd Bosphorus Bridge in Asian side. Figures 14.2.6 illustrate the routes of the Bosphorus Crossing.



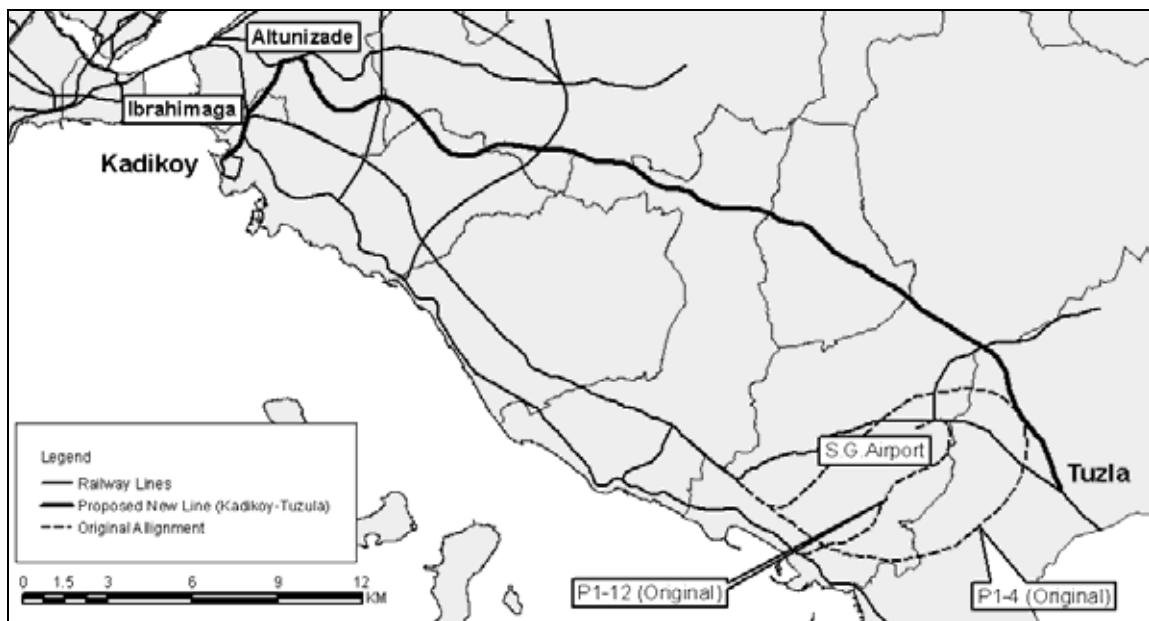
Source: *ibid.*

**Figure 14.2.6 Bosphorus Crossing**



#### 14.2.4 New Commuter Rail along Istanbul-Ankara Highway

In the present railway plan, railway service along Istanbul - Ankara Highway (O-4), where residential and industrial areas are developed, is insufficient. The area around the intersection of O-4 and FMS Kopusus Highway (O-2) is developed as an urban center, and the population density of the area is high. Although the proposed new railway on the new bridge would serve this area north and south, a new railway system of the radial direction (east and west) like Kadikoy - Kartal Metro (C-3) and Uskudar - Cekmekoy Light Metro (T-1) will be necessary to promote public transport. From this point of view, a new railway line is proposed along O-4 as shown in Figure 14.2.7. The west end should be Kadikoy station of C-3 and connected to the Marmaray Commuter at Ibrahimaga Station and to T-1 at Altunizade station while the east end should be connected to the revised P1-4: Kartal - Pendik - Tuzla Metro line in the north of Sabiha Gokcen Airport. The through train operation to Tuzula will be possible using P1-4 line.



Source: *ibid.*

**Figure 14.2.7 Track Alinement of Kadikoy- Tuzla Line**

#### 14.2.5 Railway Network in Newly Urbanized Area

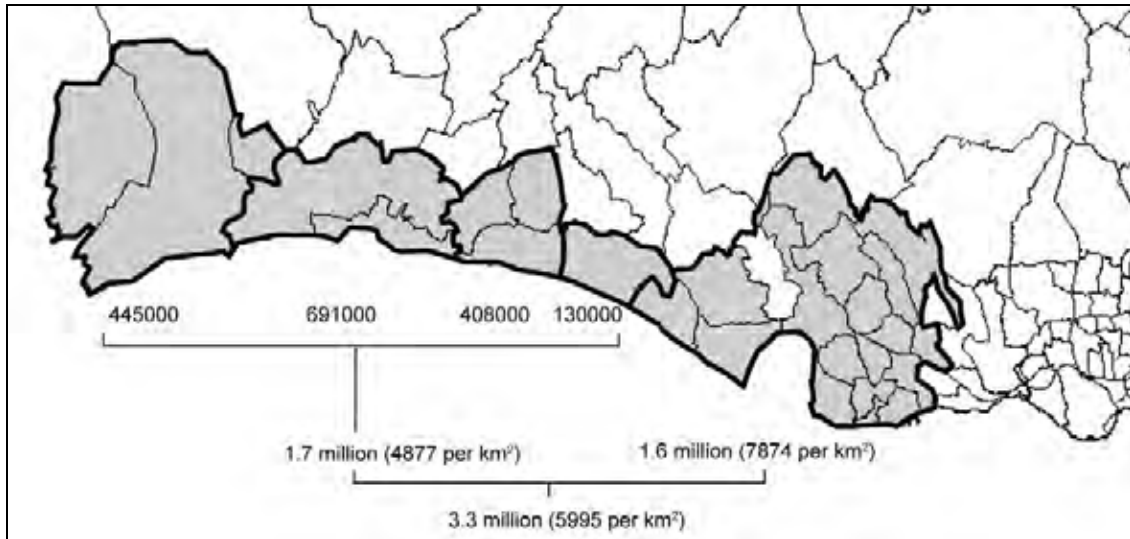
##### 1) Necessity of Railway System in Newly Urbanized Areas

Silivri District will have new urbanized area between TEM and D-100 for east-west direction with a population of approximately 1.7 million as shown in Figure 14.2.8.

The new development area spread over 30km along the seaside, ranging 50km to 80km distance from the center of Istanbul. Population density will be 4877 per square km in this area. Currently, the population in this area is only 123,000. It is necessary to introduce railway system for the newly urbanized area because:

- Population of 1.7million is large enough to introduce an urban rail system, or such a large city with a population of 1.7million should have an urban rail system. For example, Kobe (Japan) has 242km railway with a population of 1.5million.

- The new development area should be connected to the center of Istanbul by railway system to reduce traffic congestion of roads. In addition, providing railway system is inevitable to promote development in this area.
- Urban transport system inside the new development area is essential to attract new investment to this area.
- Long-distance railway system is necessary to connect Silivri to the center of Istanbul.



Source: *ibid.*

**Figure 14.2.8 Population Distribution in Silivri and Buyukcekmece in 2023**

## 2) Suburban railway system

Ispartakule - Kirac - Buyukcekmece - Silivri Suburban Railway (P2-8) should be extended to Gumsyaka. The access to the international airport should be provided by this line. This line runs along the central areas of new developments and goes through the new center of Silivri, passes the new international airport and reaches Gumsyaka. It is also proposed to extend this line to Tekirda along the seaside.

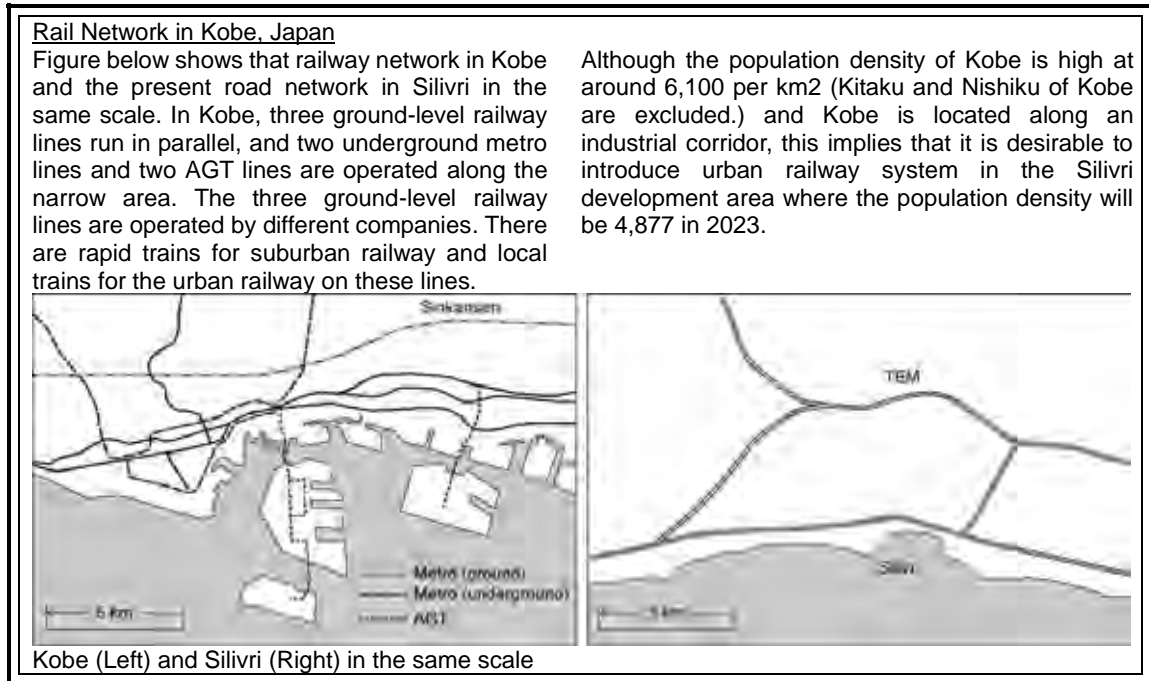
In the planning stage projects, no railway access for Special Project Area of Gumsyaka Logistics Center & Port, Degirmenkoy Technology Development Park, and Canta University is included. To provide a freight transport access, the new railway line that connects the existing main line of TCDD should pass outside the new development area in the northern side of Silivri.

A new suburban railway from Gumsyaka to the industrial zone in Tekirda is also proposed.

## 3) Urban Rail

As mentioned above, the population of the Silivri development area in 2023 will be 1.7 million and that of Buyukcekmece will be 1.6 million, forming a 3.3 million metropolitan area as a whole. Even though the suburban railway proposed above is constructed along this area, other urban rail services will be necessary to support urban activity in Silivri. Although the development area stretches east and west in the narrow area between TEM and D-100 along seaside at a width of 5–10km only, putting other railways is by no means

oversupply. In Asian side, the Marmaray Commuter, TCDD local lines, and Kadikoy–Kartal Metro (C-3) run through the narrow area along seaside.



Since Silivri is a hilly area in the narrow band between seaside and TEM, railway network development will be very expensive: railway lines from seaside to TEM need to go through steep slopes of high gradient and the length of the route would be very short for the efficient railway operation. Instead of constructing new lines for urban railway, it is proposed to construct the suburban railway as four-track railway line. In this case, the urban rail in Silivri will use two tracks with a station interval of 1–2km and rapid trains for the suburban operation will use the other two tracks with a station interval of about 5km.

#### 14.2.6 Extension of Marmaray project

The area along the TCDD main line from Halkali to the west is being developed as an industrial area and residential area, which will increase the traffic demand on the TCDD line. On the other hand, the existing single-track line will not be able to cope with the future demand. It is proposed to extend the Marmaray Project from Halkali to Hadimkoy by constructing a double-track railway line along the existing line.

#### 14.2.7 High Speed Train

Turkish State Railways (TCDD) has a high speed train network plan. Ankara–Istanbul and Ankara–Konya projects are underway. TCDD introduced new trains with a maximum speed of 250km from CAF (manufacture of high speed trains) of Spain. In European side, Istanbul–Kapikule (international border with Bulgaria) is proposed in the TCDD's high speed train network.

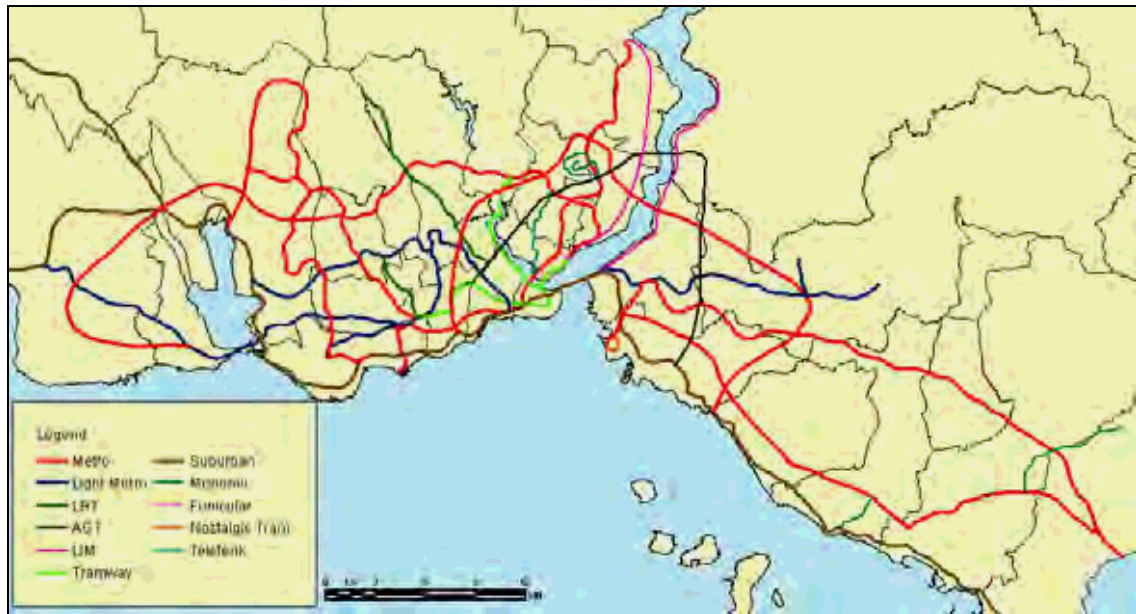
To promote the development in Silivri area, one of the stations of Istanbul–Kapikule High Speed Train should be planned near the new development area and new International airport.

### 14.3 Maximum Network

The maximum network is the ideal and realistic network without consideration of the schedule for its completion. The Master Plan network is proposed from the Maximum Network taking into account of the priority and budget constraints.

The Maximum Network is formulated based on the Base Network, the modified planning stage projects, and new proposed railway lines.

Figure 14.3.1 and 14.3.2 show the Maximum Network.



Source: *ibid.*

**Figure 14.3.1 Maximum Network (by System)**



Source: *ibid.*

**Figure 14.3.2 Railway Network in Newly Urbanized Area (Silivri District)**

## **14.4 Identification of Railway Projects**

The railway projects of the Maximum Network are classified into three groups as follows:

- Under Construction Projects
- Committed Projects
- Planning Stage Projects
- New Railway Projects

### **14.4.1 Under Construction Projects**

This group consists of eight projects: Taksim - Yenikapi Metro (5.2 km), Edirnekapi - Sultanciftligi Tramway (Edirnekapi–Topkapi section, 3.0 km), Kadikoy - Kartal Metro (21.7 km), 4.levent - Ayazaga - Haciosman Metro (8.0 km), Otogar - Bagcilar (Kirazli) Light Metro (5.6 km), Bagcilar - Ikitelli Olimpiyat koyu Metro (15.9 km), Marmaray Project (76.5 km), and Aksaray - Yenikapi Light Metro (0.7 km). The total length of these projects is 136.6 km. The details of these projects are summarized in Chapter 4 (4.2.1).

### **14.4.2 Committed Projects**

This group consists of two Tender Stage Projects and six Design Stage Projects that are listed in IMM 2008 Investment Plan.

The Tender Stage Projects are Uskudar - Cekmekoy Light Metro (19.0 km) and Bakirkoy - Beylikduzu Light Metro (25.0 km). The Design Stage Projects are Bakirkoy - Bahcelievler - Bagcilar Metro (9.0 km), Kabatas - Besiktas - Sisli - Giymkent - Bagcilar Metro (25.0 km), Yenikapi - Bakirkoy Metro (7.0 km), Halic Surround Tramway (9.6 km), Yesilkoy - Ataturk Airport - Ikitelli Metro (14.3 km), and Beyoglu Monorail (5.8 km).

The existing railways, under construction projects, and the committed projects form the Base Network. The details of the committed projects are summarized in Chapter 4 (4.2.2 and 4.2.3).

### **14.4.3 Planning Stage Projects**

This group consists of the planning stage projects and their modification with a total length of 171.4km. Table 14.4.1 shows the list of the Planning Stage Projects. The system type of some projects is tentative because it will be determined by demand analysis. The details of these projects are described in section 14.2.1 and 14.2.2. The project code number starting with “P1” means the first stage while “P2” means the second stage in the original plan. Since the implementation schedule is reviewed in this master plan, the project code does not necessarily indicate the development stage.

**Table 14.4.1 List of Planning Stage Projects**

Project Code	Route Name	Type	Length (km)
P1-1	Bagcilar – Halkali Light Metro (Extension of C-5)	Light Metro	7.5
P1-2	Tekstilkent – Istoc – Olimpiyat Koyu – Bahcesehir (Ispartakule) Metro (Extension of D-2)	Metro	12.0
P1-3	Umraniye – Bostanci Metro (New Line)	Metro	14.0
P1-4	Kartal – Pendik (S.Gokcen Havaalani) – Tuzla Metro (Extension of C-3)	Metro	18.1
P2-1	Seyrantepe – Alibeykoy – Gop – Kazlicesme Metro	Metro	16.3
P2-2	Kartal E5 – Kartal IDO Monorail	Monorail	3.0
P2-3	S.Gokcen Havaalani – Formula1 Monorail	Monorail	7.7
P2-4	Hasiosman – Cayirbasi Metro (Extension of C-4)	Metro	2.7
P2-5	4. Levent – Gultepe Mah. – Sanayi Mah. – Celiktepe Mah. Monorail	Monorail	8.7
P2-6	Besiktas – Sariyer Metro	AGT/Linear Metro	14.5
P2-7	Esenyurt – Avcilar Merkez Metro	Metro	10.5
P2-8	Ispartakule – Kirac – Buyukcekmece – Gumusyaka Suburban Railway	Suburban Railway	25.8
P2-9	Uskudar – Beykoz Metro	AGT/Linear Metro	15.0
P2-10	Basaksehir – Olimpiyat Koyu – Metro	Metro	13.0
P2-11	Atatulk Airport Access Rail	Suburban Railway	2.6

Source: *ibid.*

#### 14.4.4 New Railway Projects

New Railway Projects are newly proposed projects. Table 14.4.2 shows the list of the New Railway Projects. The system type in this list is tentative.

**Table 14.4.2 List of New Railway Projects**

Project Code	Route Name	Type	Length (km)
PP-1	Seyrantepe – New Bosphorus Bridge – Umraniye Metro	Metro	9.8
PP-2	Topkapi – 2nd Bosphorus Bridge – Goztepe AGT	AGT	34.7
PP-3	Ibrahimaga – Esensehir - Sabiha Gokcen Airport Metro	Metro	36.8
PP-4	Halkali – Hadimkoy Upgrading Track (Extension of Marmaray Project)	Suburban	20.4
PP-5	Bakirkoy – Beylukzudu Extension	Light Metro	1.0
PP-6	Celaliye Silivri – Suburban Railway	Suburban/Metro	18.9

Source: *ibid.*

### 14.5 Project Cost Estimate

#### 14.5.1 Cost Estimate of the Base Network

The total of under construction, tender stage and design stage projects was estimated as US\$ 14.6 billion including the cost of US\$ 3.2 for the rolling stock procurement. For the cost estimate of the committed projects (tender stage and design stage), it is assumed that the unit price of the rolling stock are 1.7 million US\$ per car for metro and suburban, and 1.5 million US\$ for others.

**Table 14.5.1 Cost of Base Network (under construction & committed projects)**

Project Code	Project Section	Type	Length (km)	No. of Rolling Stock	Cost (US\$ Mil)		
					Civil+M&E	Rolling Stock	Total
<b>Under Construction Project</b>							
C-1	Taksim-Yenikapi	Metro	5.2	92	312	156	468
C-2	Edirnekapi-Topkapi	Tram	3.0	0	62	0	62
C-3	Kadikoy-Kartal	Metro	21.7	144	1,302	245	1,547
C-4	4.Levent-Ayazoga-Haciosman	Metro	8.0	0	480	0	480
C-5	Otogara-Bagcilar (Kilazli)	Light Metro	5.6	20	324	34	358
C-6	Bagcilar-Ikitelli-Olimpiyat Koyu	Metro	15.9	68	954	116	1,070
C-7	Marmaray Orojekt	Suburban	76.5	440	2,000	1,000	3,000
C-8	Aksaray-Yenikapi	Light Metro	0.7	0	42	0	42
Total			136.6		5,476	1,551	7,027
<b>Tender Stage Project</b>							
T-1	Uskudar-Cekmekoy	Light Metro	19.0	214	950	364	1,314
T-2	Bakirkoy-Beylikzudu	Light Metro	25.0	126	1,250	214	1,464
Total			44.0		2,200	578	2,776
<b>Design Stage Project</b>							
D-1	Bakirkoy-Bahcelievler-Bagcilar	Metro	9.0	100	540	170	710
D-2	Kabatas-Besiktas-Sisli-iGiyimkent-Bagcilar	Metro	25.0	260	1,470	442	1,912
D-3	Yenikapi-Bakirkoy	Metro	7.0	36	420	61	481
D-4	Halic-Cevresi	Tram	9.6	30	192	51	243
D-5	Yesilkoy-Ataturk Airport-Ikitelli	Metro	14.3	160	858	272	1,130
D-6	Sishane-Kulakasiz-Cemal Kamaci Guzergahi	Monorail	5.8	26	250	39	289
Total			70.7		3,730	1,035	4,765
Grand Total			251.3		11,406	3,164	14,570

Source: *ibid.***14.5.2 Cost Estimate of Planning Stage and New Railway Projects**

## 1) Condition of Cost Estimate

The cost estimate for the planning stage and new railway projects is based on the average unit cost of civil works per kilometer of similar projects in Istanbul. Land acquisition cost and compensation cost for resettlement are not taken into consideration. The unit cost of a vehicle is taken from the recent procurement contracts in Istanbul and abroad. The unit cost of the major construction works and rolling stock assumed for each system is presented in Table 14.5.2.

**Table 14.5.2 Estimated Unit Cost for Planning Stage Projects**

System	Construction Cost (Civil Work + E&M) Million US\$ per km			Rolling Stock Million US\$ per car
	Underground	Elevated	At Grade	
Metro	60	-	-	1.7
Light Metro	60	30	15	1.5
Suburban	60	30	20	1.7
AGT	-	25	-	1.5
LIM	50	-	-	1.5
Monorail	-	25	-	1.5

Source: Estimation by Study Team

As for the rolling stock procurement, the number of rolling stock required for each project is calculated based on some assumed operation plans as shown in Table 14.5.3.

**Table 14.5.3 No. of Cars per KM for Cost Estimate**

	Headway (H)	No. of cars per train (CT)	Speed (S)	No. of cars per KM (CK)
Metro	4	8	35	6.86
Light Metro	4	4	35	3.43
Suburban	6	8	40	4.00
Tramway	4	3	25	3.60
AGT	4	5	35	4.29
LIM	4	5	35	5.14
Monorail	4	4	30	4.29

\*:  $CK = 2 \times 60 \times CT / (S \times H)$

Source: *ibid.*

## 2) Project Cost Estimate

The construction and the rolling stock procurement cost for planning stage projects and new projects proposed by Study Team are presented in Table 14.5.4.

The project cost for Phase-I (58.9 km) is approximately US\$ 4.17 billion of which US\$ 0.64 billion for rolling stock procurement, and that of Phase-II (125.3 km) is approximately US\$ 7.24 billion of which US\$ 1.09 billion is allocated for rolling stock procurement. The cost of the new railway projects of a length of 141 km is approximately US\$ 6.68 billion of which US\$ 1.16 billion is for rolling stock procurement.

**Table 14.5.4 Cost of Planning Stage Projects for Phase-I**

Project Code	Project Section	Type	Length (km)	No. of Rolling Stock	Cost (US\$ Mil)		
					Civil+M&E	Rolling Stock	Total
<b>Planning Stage Project (Phase I)</b>							
P1-1	Bagcilar - Halkali	Light Metro	7.5	26	450	44	494
P1-2	Tekstilkent – Isoc - Olimpiyat Koyu - Ispartakule	Metro	12.0	115	1,002	195	1,197
P1-3	Umraniye - Bostanci Metro	Metro	14.0	117	1,026	199	1,225
P1-4	Kartal - S.G.Airport - Tuzla	Metro	18.1	121	1,056	205	1,261
Total			51.6		3,534	643	4,177
<b>Planning Stage Project (Phase II)</b>							
P2-1	Seyrantepe – Alibeykoy – Gop - Kazlicesme	Metro	16.3	114	993	194	1,187
P2-2	Kartal D100 - Kartal IDO	Monorail	3.0	13	75	19	94
P2-3	S.Gokcen Airport - Formula 1	Monorail	7.7	33	193	50	242
P2-4	Haciosman - Cayirbasi	Metro	2.7	19	162	31	193
P2-5	4.Levent - Gultepe Mah. - Celiktepe Mah.	Monorail	8.7	22	215	33	248
P2-6	Besiktas - Sariyer	LIM	14.5	48	705	82	787
P2-7	Esenyurt - Avcilar Merkez Metro	Metro	10.5	115	1,002	195	1,197
P2-8	Ispartakule-Kirac-Buyukcekmece-silvri	Metro	25.8	114	1,125	194	1,319
P2-9	Uskudar-Bykoz	LIM	15.0	77	750	131	881
P2-10	Basaksehir - Olimpiyat koyu Metro	Metro	13.0	89	780	152	932
P2-11	Ataturk Airport Access	Suburban	2.6	6	150	10	160
Total			119.8		6,150	1,091	7,240
<b>Planning Stage Project (New Proposal)</b>							
PP-1	Seyrantepe - Bosphorus Crossing - Umraniye	Metro	9.8	69	450	117	567
PP-2	Topkapi - 2 <sup>nd</sup> Bosphorus Bridge - Goztepe	AGT	34.7	129	750	193	943
PP-3	Kadikoy – Ibrahimaga – Esensehir - S.G.Airport	Metro	36.8	226	1,980	385	2,365
PP-4	Halkali - Hadimkoy	Suburban	20.4	80	400	136	536
PP-5	Bakirkoy - Beylikzudu Extension	Light Metro	1.0	3	60	6	66
PP-6	Celaliye Silivri Extension	Metro	18.9	188	1,880	320	2,200
Total			121.6		5,520	1,156	6,676
Grand Total			293.0		15,204	2,890	18,094

\*: cost of new Bosphorus bridge is not included, it will be road&rail combined bridge and calculated in road project.

Source: Study Team



### 14.5.3 Summary of Cost Estimate

Summary of the cost estimate is presented in the following table.

**Table 14.5.5 Summary of Cost Estimate**

Stage	No. of Project	Length (km)	Project Cost (US\$ Mil.)
<b>Base Network</b>			
Under Construction Project	8	136.5	7,027
Tender Stage Project	2	44.0	2,778
Under Design Stage Project	6	74.4	4,765
Total	16	254.9	14,570
<b>Maximum Network</b>			
Under Planning Stage Project (Phase-I)	4	58.9	4,177
Under Planning Stage Project (Phase-II)	11	126.4	7,240
New Project (Study Team)	6	141.0	6,676
Total	21	326.3	18,094
<b>GRAND TOTAL</b>	37	581.2	32,663

Source: *ibid.*

### 14.5.4 Operation and Maintenance Cost

#### 1) Methodology of O&M calculation

The operation and maintenance (O&M) costs are “variable costs” which depend on the quantity of the railway services, and the costs per the service volume such as train-km, passenger-km, or the number of passengers or trains are usually used to estimate the O&M costs on the assumption that the costs increase in proportion to the service volumes. This assumption can be applied when the volume is large; if it is small, the portion of “fix cost” in the O&M costs effects the unit cost.

The O&M costs were estimated from two methods: 1) usage of the unit costs calculated from the financial data of Ulasim A.S., and 2) usage of the unit costs calculated from Japanese experience. Since detail statistics for the analysis of operation and maintenance is available for all rail operators in Japan, usage of Japanese data is useful especially for underground railway, suburban railway, monorail, and AGT system whose international average is difficult to estimate. On the other hand, the international rough average was used for tramway because the number of examples of tramway is very small in Japan.

The O&M costs consist of 1) personnel cost, 2) general administrative cost, 3) station operation cost, 4) train operation cost, 5) transport management cost, and 6) maintenance costs. The O&M costs of the nostalgic tram, funicular, and telefelik were not estimated because these O&M costs are difficult to estimate while they are very small in the total network in the future.

#### 2) No of Staff

The number of station staff can be estimated from the number of station and the size of each station, while the number of other staff like drivers and engineers depends on the transport volume. Transport volume is usually expressed as the number of passengers, passenger-kilometers, train-kilometers, and car-kilometers. The number of drivers is related to train-kilometers while the number of rolling stock engineers is related to car-kilometers. In master plan stage, detail break down is not possible then the number of

drivers and maintenance staff is calculated by car-kilometers.

Table 14.5.6 and Table 14.5.7 show the number of staff per station and car-kilometers in the case of Istanbul and Japan. In addition, the unit number of general administration staff per route-kilometer is calculated as 3.0 in Istanbul case (Ulasim A.S.), 4.0 in Japanese metro and suburban case, and 2.3 in Japanese monorail case.

**Table 14.5.6 No. of Station Staff per Station**

	Metro	Light Metro	Suburban	Tramway	Monorail	AGT
Istanbul <sup>a)</sup>	30.7	13.3	N.A.	8.3	-	-
Japan <sup>b)</sup>	9.5 <sup>*1</sup>	N.A.	9.9 <sup>*2</sup>	N.A.	3.4 <sup>*3</sup>	3.4 <sup>*4</sup>

Note: \*1. The average of Sendai, Tokyo, Yokohama, Osaka, Kobe, Fukuoka metros

\*2. The average of six private operators (Tobu, Seibu, Keisei, Keio, Tokyu, Odakyu)

\*3. The average of seven monorails

\*4. The average of four AGT (Tokyo, Kobe (2), Hiroshima)

Source: a) Estimated by the Study Team using the data provided by Ulasim A.S.

b) Estimated by the Study Team using "Railway Statistic Yearbook in Japan, 2005"

**Table 14.5.7 No. of Drivers and Maintenance Staff per 1000 car-km/day**

	Metro	Light Metro	Suburban	Tramway	Monorail	AGT
Istanbul	13.2	10.1	N.A.	25.1	-	-
Japan	6.7	N.A.	3.4	N.A.	7.3	3.0

Note: The same Note as Table 14.5.6

Source: The same as Table 14.5.6

### 3) Operation and Maintenance Expenses

Operation and maintenance expenses include general administration cost, train operation cost, transport management cost, and maintenance cost. Electricity cost is included in the train operation cost, and the work cost in stations is the major item of the transport management cost. Table 14.5.8 shows the O&M expenses per car-kilometers in the case of Istanbul and Japan.

**Table 14.5.8 Operation and Maintenance Expenses per Car-Km**

	Metro	Light Metro	Suburban	Tramway	Monorail	AGT
Istanbul (YTL)	4.08	2.91	N.A.	13.63	-	-
Japan (100JPY)	3.34	N.A.	2.07	N.A.	2.85	1.85

Note: The same Note as Table 14.5.6

Source: The same as Table 14.5.6

### 4) Unit Number and Cost for O&M Cost Estimate

From the above analysis, the unit number of staff and the unit O&M expenses in Table 14.5.9 are used to estimate the operation and maintenance costs in this master plan.

**Table 14.5.9 Assumed Unit of No. of Staff and O&M Expenses**

	No. of Staff			Expenses (YTL)
	General Administration	Station	Other	
	Per route-km	Per station	Per 1000 car-km/day	Per car-km
Metro/ LRT	3.0	10.0	6.7	3.34
Tramway	3.0	8.3	25.0	13.6
Suburban	3.0	9.9	3.4	2.07
Monorail	3.0	3.4	7.2	2.85
AGT	3.0	3.4	3.0	1.85

Source: Estimation by the Study Team

## 5) Operation Type for O&amp;M Estimate

This O&M cost model requires the railway route information about the number of stations, the revenue kilometer, and car-kilometer. For the estimation of them, the following operation type by traffic volume was assumed for metro and suburban rail.

**Table 14.5.10 Operation Type of Metro for O&M Estimation**

	Peak		Off-Peak		Number		
	Hours	Head-way (minutes)	Hours	Head-way (minutes)	cars per train	trains per day	cars per day
Metro	4	4	12	7.5	8	312	2,496
LRT	4	4	12	7.5	4	312	1,248
Tramway	4	4	12	7.5	3	312	936
Marmaray	4	4	12	7.5	10	312	3,120
Suburban	4	6	12	7.5	8	272	2,176
Monorail	4	4	12	7.5	3 or 5	312	936 or 1,560
AGT	4	4	12	7.5	5	312	1,560

Source: Calculation by the Study Team

## 6) Result of O&amp;M Cost Estimate

The railway operation and maintenance costs are estimated as shown in Table 14.5.11.

**Table 14.5.11 Estimation of Railway O&M Costs**

Project Code	Railway Section	System	Length (km)	No. of stations	Car-km per day in 1000	No. of staff	Cost (Million US\$)		
							Personnel Expense	Other Expense	Total
<b>Existing Lines</b>									
E-1	Taksim - 4.Levent	Metro	8.5	6	21.2	228	6	21	27
E-2	Aksaray - Airport	Light Metro	19.3	18	24.1	399	11	24	35
E-3	Kabatas - Zeytinburnu	Tram	14.1	24	13.2	571	15	53	69
E-4	Zeytinburnu - Bagcilar	Tram	5.5	9	5.1	220	6	21	27
E-12	Edirnekapi – Sultanciftligi	Light Metro	12.4	18	15.5	321	9	15	24
	Total		59.8			1,739	47	134	181
<b>Under Construction Project</b>									
C-1	Taksim - Yenikapi	Metro	5.2	4	13.0	143	4	13	17
C-2	Edirnekapi - Topkapi	Tram	3.0	2	3.9	123	3	16	19
C-3	Kadikoy - Kartal	Metro	21.7	16	54.2	588	16	54	70
C-4	4. Levent - Ayazoga - Haciosman	Metro	8.0	5	20.0	208	6	20	25
C-5	Otogar - Bagcilar (Kilazli)	Light Metro	5.6	4	6.7	101	3	7	9
C-6	Bagcilar - Ikitelli - Olimpiyat Koyu	Metro	15.9	11	39.7	424	11	39	51
C-7	Marmaray Project	Suburban	76.5	45	238.8	1,487	40	147	187
C-8	Aksaray - Yenikapi	Light Metro	0.7	1	0.9	18	0	1	1
	Total		136.6			3,091	83	296	379
<b>Tender Stage Project</b>									
T-1	Uskdar - Cekmekoy	Light Metro	19.0	17	23.7	386	10	24	34
T-2	Bakirkoy - Beylikduzu	Light Metro	25.0	19	31.2	474	13	31	44
	Total		44.0			860	23	54	78
<b>Design Stage Project</b>									
D-1	Bakirkoy-Bahcelievler-Bagcilar	Metro	9.0	7	22.5	248	7	22	29
D-2	Kabatas - Besiktas - Sisli - Giyimkent - Bagcilar	Metro	25.0	19	61.2	673	18	61	79
D-3	Yenikapi - Bakirkoy	Metro	7.0	6	17.5	198	5	17	23
D-4	Halic - Cevresi	Tram	9.6	13	9.0	361	10	36	46
D-5	Yesilkoy - Ataturk Airport - Ikitelli	Metro	14.3	10	35.7	382	10	35	46
D-6	Sishane - Kulakasiz - Cemal kamaci Guzergahi	Monorail	5.8	10	9.4	131	4	8	11
	Total		70.7			1,994	54	180	234
<b>Planning Stage Project (1)</b>									
P1-1	Bagcilar - Halkali	Light Metro	7.5	6	9.4	145	4	9	13
P1-2	Tekstilkent - Istoc - Olimpiyat Koyu - Ispartakule	Metro	12.0	7	41.7	399	11	41	52
P1-3	Umraniye - Bostanci Metro	Metro	14.0	13	42.7	467	13	42	55
P1-4	Kartal - S. Gokcen Airport - Tuzla	Metro	18.1	14	43.9	487	13	44	57
	Total		51.6			1,499	40	137	177
<b>Planning Stage Project (2)</b>									
P2-1	Seyrantepe - Alibeykoy - Gop - Kazlicesme	Metro	16.3	14	45.2	497	13	45	58
P2-2	Kartal D-100 - Kartal IDO	Monorail	3.0	3	4.7	53	1	4	5
P2-3	S. Gokcen Airport - Formula 1	Monorail	7.7	4	12.0	123	3	10	13
P2-4	Haciosman - Cayirbasi Metro	Metro	2.7	1	6.7	63	2	7	8
P2-5	4. Levent-Gultepe Mah.-Celiktepe Mah.	Monorail	8.7	8	8.0	111	3	7	10
P2-6	Besiktas - Sariyer	LIM	14.5	10	17.6	260	7	17	24
P2-7	Esenyurt-Avcilar Merkez Metro	Metro	10.5	10	41.7	429	12	41	53
P2-8	Ispartakule - Kirac - Buyukcekmece - Silivri	Metro	25.8	13	54.4	569	15	54	69
P2-9	Uskudar - Beykoz	LIM	15.0	10	28.1	333	9	28	37
P2-10	Basaksehir - Olimpiyat Koyu Metro	Metro	13.0	4	32.4	296	8	32	40
P2-11	Ataturk Airport Access	Suburban	2.6	2	2.7	37	1	2	3
	Total		119.8			2,772	75	247	322
<b>Planning Stage Project (2)</b>									
PP-1	Seyrantepe - Bosphorus Crossing - Umraniye	Metro	9.8	3	25.0	227	6	25	31
PP-2	Topkapi - 2nd Bosphorus Bridge - Goztepe	AGT	34.7	12	46.8	271	7	26	33
PP-3	Kadikoy-Ibrahimaga-Esensehir-S. G. Airport	Metro	36.8	17	82.4	821	22	82	104
PP-4	Halkali - Hadimkoy	Suburban	20.4	5	43.5	257	7	27	34
PP-5	Bakirkoy - Beylukzudu Extension	Light Metro	1.0	1	1.2	21	1	1	2
PP-6	Celaliye Silivri Extension	Metro	18.9	30	102.3	1,126	30	101	132
	Total		121.6			2,724	74	262	335
	Grand Total		604.1			14,679	396	1,310	1,706

Note: 1YTL = 0.9 US\$

Source: Estimated by the Study Team