

Chapter 15 Evaluation and Prioritization of Maximum Network Projects

In this Chapter, all the projects contained in the maximum network stated in Chapter 13 and 14 are evaluated from the economic, financial and environmental points of view. Finally, those projects are prioritized and classified into the short-, medium- and long-term projects.

15.1 Economic Evaluation

15.1.1 Methodology and Assumptions

Following the method of the cost-benefit analysis, all the road and railway projects composing the maximum network were evaluated from the economic or social point of view. As the economic (or social) benefits of a project, two direct effects by the projects were taken into consideration; one was savings in vehicle operating cost (VOC) and the other was savings in travel time cost (TTC). They were measured by so-called “with-and without” comparison, that is, comparison of traffic assignment results on a network with the project and without the project.

There are many projects to be evaluated and a main purpose of evaluation is to put a comparative priority on each project. Therefore, the following assumptions and standardizations were adopted for simplification and convenience for comparison.

- 1) Construction period is assumed to be three years of 2009 to 2011 for all the projects. Construction cost was distributed evenly among the three years, In case of a railway project; however, rolling stock cost of the project was allocated only in 2011.
- 2) Project life is thirty years after starting operation of 2012 to 2042. No residual value is considered.
- 3) Traffic assignment was done for the year of 2011 and 2023, and the economic benefits were estimated for the two years and made an interpolation was done for intermediate years.
- 4) After 2023, economic benefit was assumed not to change because population would not change.
- 5) In traffic loading, external traffic to/from the outside area of the Study Area.
- 6) To calculate the Net Present Value, the discount rate was assumed at 12% which was generally used in Turkey.
- 7) Annual maintenance cost of a road project was assumed to be 1.5% of construction cost of the project. As for a railway project, annual operation and maintenance cost was estimated separately for each project.
- 8) Economic cost of a project was assumed to be 85% of the financial cost of the project, taking into consideration that the current rate of VAT was 18% in Turkey.

15.1.2 VOC and TTC

As savings in VOC and TTC were selected as the economic benefit of a project, unit costs of VOC and TTC were needed to estimate those benefits. The unit costs were estimated in February, 2008. Details of the estimates were in Appendix to Chapter 15 shown at the end

of this Report.

1) VOC Estimation

- All components of vehicle operating cost, i.e., unit prices of the representative vehicles, types, fuel, lubricants, repair and maintenance, insurance and so on were obtained from the information collected from manufacturers, governmental statistics and interviews with IETT responsible officers. The following vehicle types and parameters are used in the estimations:

(1) Vehicle Procurement Cost

- A major factor in determining vehicle operating cost is to form a fleet profile in Istanbul consisting of representative vehicles. Based on sales and market share data, the study selects eight (8) vehicle types in Istanbul: motorcycle, taxi, compact car, luxury car, small bus, ordinary bus, small truck and large truck.
- The automobile industry in Turkey manufactured 906 thousand vehicles in 2005 while 892 thousand vehicles were newly registered in the same year. However Turkish made vehicles do not seem dominant on roads. Major automobile manufacturers set the prices in Euro regardless of factory location and therefore their factories in Turkey work for European markets. Trade statistics shows that the traded values of transport vehicles, aircraft and vessels in 2005 were US\$ 11.1 billion for export and US\$ 12.1 billion for import. In the estimation, representative vehicles were selected by type, not considering their manufactured places.
- When people buy a passenger car, the car price is multiplied by two taxes: excise tax (27%, 46% and 50%) and VAT (18%). As a result, the average tax ratio in passenger car selling prices is estimated at 61.6% in Turkey. On the other hand, rather moderate excise tax of 8-9% is applied to other types such as motorcycle, minibus and truck. Policy incentive is given to bus operators since the excise tax on bus is as small as 1%.

(2) Vehicle Operating Cost

- **Vehicle body depreciation.** Durable years (10 – 20 years) and scrap value (1 – 10%) are duly set based on actual practices.
- **Wearing tires.** The local market prices of tires for the representative vehicles were obtained from retail dealers in Istanbul. Durable distance by tire set ranges from 40,000 – 60,000 km.
- **Fuel and lubricant.** The local retail prices of fuel and lubricant were obtained. Actual fuel usage is considered in this calculation such as passenger car (gasoline: diesel: Autogas = 62:30:8) and bus (diesel: Autogas = 97: 3).
- **Repair and maintenance.** Its yearly ratio to vehicle price is assumed between 0.4% at minimum for passenger car and 6.0% for large truck.
- **Wage costs of crew.** Direct costs (monthly salary and bonus) and indirect costs (social insurance 21.5% and other management cost) are included in the

calculation taking into account actual wage conditions.

- **Insurance cost.** Obligatory insurance cost is counted by vehicle type, ranging from 20 YTL for motorcycle to 981 YTL for bus.

Table 15.1.1 Summary of Representative Vehicles

(1) Vehicle Characteristics

Vehicle Type	Motorcycle	Taxi	Compact Car	Luxury Car	Service Bus	Bus	Small Truck	Truck
Vehicle Name/Code	Honda CBP 150	Fiat Albea 1.3	Renault Clio 1.5 DCI	BMW 520D	Ford Transit	Mercedes Citaro	Nissan Skystar	Mercedes Axor 295
Fuel Type	Gasoline	Diesel	Gasoline/Diesel/LPG	Diesel	Diesel	Diesel/LPG	Diesel	Diesel
Engine Size (cm3)	150	1,300	1,500	4,000	2,200	6,370	2,500	12,000
Engine Power (hp)	11	70	80	163	130	279	133	401

Source: Assumed by Study Team mainly based on hearing from vehicle dealers

(2) Vehicle Prices (YTL)

Vehicle Type	Motorcycle	Taxi	Compact Car	Luxury Car	Service Bus	Bus	Small Truck	Truck
Market Price	3,640	22,500	31,000	132,500	38,600	250,000	42,000	126,700
Economic Price	2,830	15,014	20,686	74,859	30,011	209,767	32,957	99,419
No. of Tires	2	2	4	4	4	4	4	6
Tire Set at Market Price	236	566	566	1,200	1,200	4,085	1,200	9,532
Tire Set at Economic Price	200	480	480	1,017	1,017	3,462	1,017	8,078
Annual Running Distance (km)	17,000	83,000	21,000	21,000	68,000	68,000	41,000	79,000
Average Travel Speed (km/hr)	25	30	35	35	25	25	35	40
Estimated Annual Driving Hours	680	2,767	600	600	2,720	2,720	1,171	1,975

Source1: The data of annual running distance for a passenger car (6,500km) comes from HIS 2006-2007

Source2: The data of annual running distance for a bus coach (68,000km) comes from IETT statistics

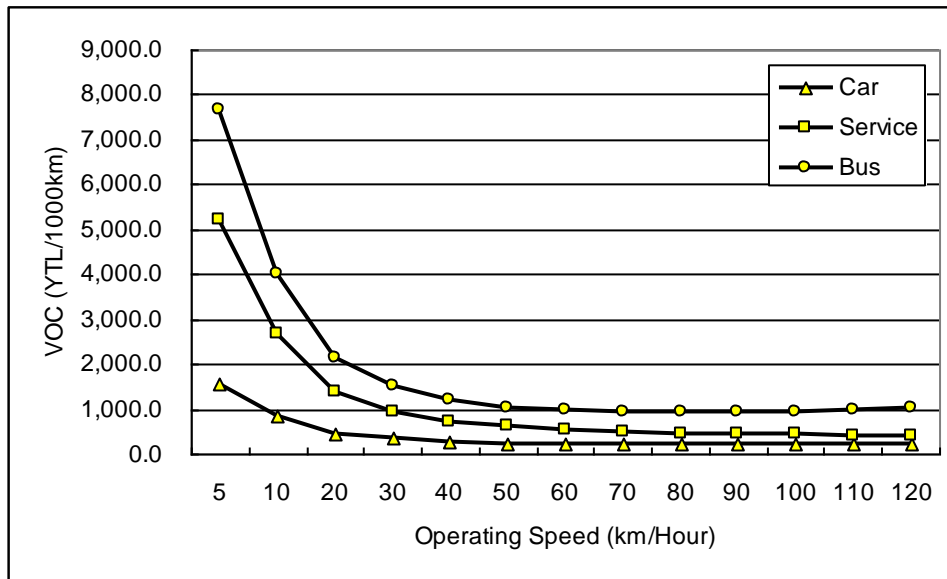
Source3: Vehicle economic price is not inclusive of transferable costs such as Special Purpose Tax on Vehicle (1% to 50% depending on vehicle type and engine size) and VAT (18%).

(3) Economic Cost of Vehicles

	Special Vehicle Tax (%)	VAT (%)	Market Price (YTL)	Economic Price (YTL)
Compact Car	27	18	31,000	20,686
Luxury Car	50	18	132,500	74,859
Taxi	27	18	22,500	15,014
Minibus	9	18	38,600	30,011
Bus	1	18	250,000	209,767
Small Truck	8	18	42,000	32,957
Truck	8	18	126,700	99,419
Motorcycle	9	18	3,640	2,830

Note : Composition of Compact Car and Luxury Car is 92% : 8%

Source: Assumed by Study Team mainly based on hearing from vehicle dealers



Source: Study Team

Figure 15.1.1 VOC Curve by Vehicle Type

Table 15.1.2 Summary of VOC Estimations

(1) Motor Vehicles

(YTL/1,000km)

	Speed (Km/hour)	Car	Service	Bus	Metro-Bus
Market Price	5	2,636.9	8,103.0	14,819.4	96,484.7
	10	1,427.2	4,177.0	7,748.0	50,643.5
	20	814.7	2,205.8	4,197.1	27,623.0
	30	605.9	1,542.6	3,011.5	19,953.8
	40	499.7	1,210.2	2,408.6	16,037.5
	50	445.3	1,022.6	2,121.2	14,267.6
	60	419.3	911.1	2,004.8	13,669.8
	70	409.8	843.2	1,983.6	13,719.4
	80	411.6	806.9	2,017.7	14,124.7
	90	424.3	794.9	2,058.4	14,503.6
	100	437.3	790.0	2,113.5	14,979.5
	110	456.2	797.8	2,201.7	15,688.0
120	480.2	816.4	2,318.3	16,597.5	
Economic Price	5	1,573.6	5,200.7	7,682.3	46,683.6
	10	838.8	2,655.4	4,004.9	24,523.0
	20	467.3	1,378.5	2,153.0	13,346.9
	30	340.9	948.5	1,523.2	9,531.7
	40	276.9	733.6	1,204.3	7,590.3
	50	243.1	610.5	1,042.6	6,653.6
	60	225.4	534.7	964.6	6,255.9
	70	216.9	485.7	932.4	6,150.8
	80	214.5	456.0	930.8	6,236.9
	90	217.2	439.3	939.0	6,360.3
	100	220.3	427.0	948.3	6,478.9
	110	226.2	421.7	976.0	6,728.0
120	234.5	422.1	1,016.1	7,060.5	

(2) Rail Transit

(US\$/Passenger-km)

Sub-Sector	Mode	Operating Cost
Rail Transit	Tram	0.813
	LRT	0.212
	Metro	0.256
	National Railway	0.212
	Marmaray	0.212
Ferry Boat		0.281

Source: *ibid.*

2) Time Value

The Household Interview Survey (HIS) (2006-2007) interviewed household income and obtained the result: 3.64 YTL/hour as working earnings per hour. It is acceptable when comparing with the minimum wage in Istanbul in 2007: 562 YTL/month or 3.12 YTL/hour. It is therefore suggested that travel time cost during working hours such as trips on business be set at 3.64 YTL and adequate discounted rates be adapted to other travel time costs.

15.1.3 Evaluation Results

Economic Benefit and economic internal rate of return (E-IRR) of each project is shown in Table 15.1.3. As the threshold of E-IRR is 12%, most projects are judged economically feasible with several exceptions. Generally, many projects show extraordinarily high E-IRR because of severe congestion in “without project” case.

Due to the excessive simplification of the method, the economic-IRR should be referred to only for project prioritization.

Table 15.1.3 Result of Economic Evaluation

(1) Road Project

Code	Project	Length (km)	Construction Cost (US\$ mil.)	O&M Cost (US\$ Mil.)	Benefit (US\$ Million)		IRR (%)
					2011	2023	
RD001	Tophane - Iplikci Tunnel	1.67	62.8	0.9	66.0	130.1	77.5
RD002	Widening of Hatboyu street (Coastal road Linkage) in Umraniye	8.07	195.2	2.9	41.9	90.4	26.4
RD003	Bakirkoy between D-100 Land Route (Incirli Junction) - Coastal Road (Atakoy Junction) underpass - flyover project	9.45	118.3	1.8	50.3	7.5	29.6
RD004	Widening project between Kirac and Esenyurt construction road	2.83	9.4	0.1	27.4	41.5	140.0
RD005	Between Hadimkoy bridge- Yassioren road, road, junction project	9.23	28.6	0.4	80.9	14.1	131.1
RD006	Beykoz, Mihrabat Street-TEM Highway Linkage project	1.44	12.3	0.2	37.7	20.9	139.6
RD007	Umraniye, between Kucuksu junction- Isfalt association (Kucuksu street) road rehabilitation project	12.85	50.6	0.8	62.1	140.6	86.9
RD008	Beylerbeyi - Harem Tunnel	4.15	210.0	3.2	81.5	119.1	36.9
RD009	Beylerbeyi - Hekimbasi Tunnel	3.09	175.8	2.8	13.9	61.2	11.9
RD010	Kadikoy - Kusdili Tunnel	1.03	48.4	0.7	58.2	12.5	74.7
RD011	Tophane - Haskoy Tunnel	1.19	24.9	0.4	35.0	66.6	92.7
RD012	Road Construction For W. Trade Center by Private Sector	9.24	40.3	0.6	55.2	65.1	87.6
RD013	Kucukcekmece D-100 Highway Cobancesme Junction - Olympics Road Linkage Road and Junction Project	26.54	291.8	4.4	24.8	84.2	16.2
RD014	Yakuplu Kumcular Servis Road Project	7.29	24.5	0.4	30.6	22.2	80.0
RD015	Derbent Haciosman Tunnel Project	2.87	61.9	0.9	14.4	37.1	29.8
RD016	Armutlualti - Poligon Mah. Tunnel Project	2.68	68.1	1.0	90.1	139.5	87.5
RD017	Armutlualti - Ayazaga Tunnel Project	2.55	73.5	1.1	2.4	94.7	31.5
RD018	Kuyumcu Kent - Otogar - Eyup Tunnel Project	13.83	332.8	5.0	119.5	51.1	27.4
RD019	Road rehabilitation project between Bagcilar, Malazgirt underpass-Mehmet Akif avenue (8.St-1/3St-1/13 St-2/13 St)	3.10	8.8	0.1	44.5	16.7	2.6
RD020	Tuzla Formula-1 Road Network 6 numbered road project	5.70	25.0	0.4	25.0	10.5	66.4
RD021	Link Road between Malazgirt Rd and Mahmat Akif Bulvari	0.90	4.3	0.1	3.4	16.9	76.1
RD022	Road project in Bakirkoy,(D-100 Highway Sefakoy junction - airport A-14 Apron linkage road)	0.52	9.7	0.1	16.2	2.8	93.7
RD023	Sultanbeyli Necip Fazil street - Kartal TEM linkage road project	0.33	4.1	0.1	2.6	18.6	73.4
RD024	Between Umraniye Mandira st - Bag st road project	0.60	4.5	0.1	62.4	7.7	-5.2
RD025	New linkage road project between Umraniye Karadeniz street - Mandira street (continuous section of Hatboyu street)	0.21	4.5	0.1	6.6	4.3	88.4
RD026	Kartal Sehith Ahmet Yalcin St - Arkoz St - Cavusoglu St, Adnan Kahveci Viaduct Linkage road junction project	2.02	12.7	0.2	28.5	48.2	121.5
RD027	Umraniye, between Sile Road Yenidogan junction - Pasakoy junction road, junction implementation project	4.24	19.3	0.3	24.3	4.2	76.9
RD028	Re-organizing The existing road in Umraniye Cekmekoy Cavusbasi street according to the construction plan as 20m	2.49	7.5	0.1	8.1	1.4	68.6
RD029	Kartal between Tekel street - D-100 road, junction implementation project	2.48	25.0	0.4	54.5	29.8	113.7
RD030	Uskudar between Zubeyde Hanim Street - Hekimbaşı Ciftlik street construction roads implementation projects	1.34	13.8	0.2	13.7	11.4	68.8
RD031	Beykoz , between Kavacik junction – Cekmekoy junction (Cavusbasi road) road, junction implementation project	11.10	31.6	0.5	3.0	68.5	41.9
RD032	West Buyukcekmece Road Network Package	40.46	495.6	7.4	276.3	9.1	37.9
RD033	East Silivri Road network Package	66.30	842.0	12.6	81.6	185.2	14.4
RD034	Silivri Center Road network Package	74.57	827.2	12.4	148.5	192.3	18.9
RD035	West Silivri (Port Area and University Area) Road Network Package	91.85	844.6	12.7	170.4	169.2	19.0
RD037	Tuzla Center Road Network Package	58.51	477.7	7.2	154.2	204.7	31.2
RD038	New Motorway west section Package	102.43	965.4	14.5	609.5	426.1	48.2
RD039	New Motorway Kucucekmece section Package	40.49	547.7	8.2	138.8	126.4	22.9
RD040	New Motorway Kagithane section Package	17.30	520.5	7.8	61.7	143.4	17.3

RD041	New Bosphorus Crossing	7.77	843.0	12.6	17.7	52.6	0.5
RD042	New Motorway Kadikoy Branch Package	10.97	332.5	5.0	57.6	164.5	25.1
RD043	New Motorway Uskudar-Umraniye Package	20.75	360.0	5.4	71.5	33.3	14.2
RD044	New Motorway Umraniye-Tuzla Package	55.98	683.5	10.3	136.9	101.4	17.0
RD045	Widening of TEM Highway (Umraniye-Tuzla) Package	69.48	490.4	7.4	97.2	102.6	19.1
RD046	Widening of Connection road (TEM-D100) in Kartal	15.23	112.0	1.7	26.8	53.9	28.0
RD047	Kucucekmece Road Network Package	17.50	135.8	2.0	74.4	105.4	47.5
RD048	Bahcesehir Road Network Package in Avcilar	10.68	202.7	3.0	28.4	220.4	32.9
RD049	New Truck Route for Ambarli Port - Logistic Center(tunnel for about half length)	11.89	358.9	5.4	70.6	127.6	23.2
RD050	E-W Missing Linkage in Gungoren (tunnel)	1.10	57.4	0.9	80.9	14.1	83.4
RD051	N-S Missing Link in Bahcelievler (tunnel)	2.40	121.4	1.8	3.9	98.6	25.1
RD052	Connection Tunnel between Bosna Bulvari and Hatboyu St (tunnel)	1.13	52.4	0.8	48.5	8.5	61.0
RD053	Re-Construction of Ankara Road between Pendik and Baglanti Road (incl. 2km new road)	15.43	63.0	0.9	34.3	91.5	53.4
RD054	Connection Road between New Motorway and Uskudar Tunnel (50% tunnel)	4.06	123.9	1.9	80.9	14.1	45.4
RD055	Widening of Kennedy Street between Road Tunnel and Mustafa Kemal St. in Eminonu	1.93	38.2	0.6	10.9	127.3	56.2

Source: *ibid.***(2) Railway Project**

Code	Project Code	Project	Length (km)	Project Cost (US\$ Mil)	O&M Cost (US\$ Mil.)	Benefit (US\$ Mil)		IRR (%)
						2011	2023	
RL001	P1-1	Bagcilar - Halkali Light Metro (Extension of C-5 line)	7.5	493.7	13.2	97.3	154.8	13.0
RL002	P1-2	Tekstilkent - Istoc - Olimpiyat Koyu - Bahcesehir (Ispartakule) Metro (Extension of D-2 line)	12.0	1196.8	52.1	136.9	456.9	12.0
RL003	P1-3	Umraniye - Bostanci Metro	14.0	1225.4	55.0	39.4	162.7	1.4
RL004	P1-4	Kartal - Pendik (Sabiha Gokcen Airport) - Tuzla Metro (Extension of C-3)	18.1	1261.3	56.7	108.7	563.5	12.7
RL005	P2-1	Seyrantepe - Alibeykoy - Gaziosmanpasa - Kazlicesme Metro	19.5	1186.8	58.2	117.8	316.0	8.3
RL006	P2-2	Kartal D-100 - Kartal IDO Monorail	3.0	94.3	5.4	102.9	13.1	41.6
RL007	P2-3	Sabiha Gokcen Airport - Formula 1 Monorail	7.7	242.2	13.5	23.0	271.9	22.0
RL008	P2-4	Darussafaka - Cayirbasi Metro (Extension of C-4 line)	2.7	193.5	8.9	100.9	143.2	28.9
RL009	P2-5	4. Levent - Gultepe Mah. - Sanayi Mah. - Celiktepe Mah. Monorail	8.6	248.0	10.0	27.3	253.9	21.7
RL010	P2-6	Besiktas - Sariyer Metro	14.1	787.0	24.0	79.3	28.8	12.0
RL011	P2-7	Ispartakule -Ambarli - Yakuplu Metro	10.5	1197.0	53.0	69.6	396.1	9.5
RL012	P2-8	Ispartakule - Kirac - Buyukcekmece - Silivri Suburban Railway	25.8	1319.2	69.3	392.4	654.3	18.5
RL013	P2-9	Uskudar - Beykoz Metro	15.0	881.0	37.0	17.5	91.6	-0.6
RL014	P2-10	Ikiteilli Olimpiyat Koyu - Altinsehir Metro (Extension of C-6 line)	13.0	932.0	40.0	88.1	98.5	1.2
RL015	P2-11	Ataturk Airport Access Rail (Extension of Marmaray railway)	2.5	160.0	3.0	-5.4	80.2	12.4
RL017	PP-1	Seyrantepe - Bosphorus Crossing - Umraniye metro	9.8	816.2	27.9	-2.2	323.2	10.3
RL018	PP-2	Topkapi - 2nd Bosphorus Bridge - Goztepe AGT	8.6	776.4	35.2	98.8	288.1	12.0
RL019	PP-3	Kadikoy - Ibrahimaga - Esensehir - Sabiha Gokcen Airport Metro	36.8	2364.8	103.9	88.3	350.3	2.5
RL020	PP-5	Bakirkoy - Beylikduzu Extension	1.0	65.8	1.8	0.0	36.6	14.3
RL021	PP-6	Silivri - Gumusyaka Extension	48.9	2200.0	90.0	220.8	847.2	11.9
RL022	PP-4	Halkali - Hadimkoy Suburban Railway (Extension of Marmaray Project)(Electrification)	20.4	536.0	33.7	135.4	520.8	42.0

Source: *ibid.*

15.2 Financial Evaluation

15.2.1 Scope and Methodology

Among the projects composing the maximum network, income generating projects such as railway projects were evaluated from the financial viewpoint, by comparing cash inflow (fare revenue) and cash outflow (construction cost and operation and maintenance cost). Overall profitability of a project was measured with the financial internal rate of return (F-IRR), not considering the distribution of the profit. This is because the purpose of analysis is just for priority setting on projects.

Main assumptions for analysis are as follows:

- 1) Construction period is assumed to be three years of 2009 to 2011 for all the projects. Construction cost was distributed evenly among the three years. In case of a railway project, however, rolling stock cost of the project was allocated only in 2011.
- 2) Project life is thirty years after starting operation of 2012 to 2042. No residual value is considered.
- 3) Traffic assignment was done for the year of 2011 and 2023, and the economic benefits were estimated for the two years and made an interpolation was done for intermediate years.
- 4) After 2023, economic revenue was assumed not to change because population would not change.
- 5) In traffic loading, external traffic to/from the outside area of the Study Area.
- 6) To calculate the Net Present Value, the discount rate was assumed at 12% which was generally used in Turkey. (Items 1-6 above are common to the economic evaluation.)
- 7) If the profit distribution is not needed, tax payment and accordingly depreciation are not necessary to analyze.
- 8) A uniform fare was assumed at 1.00 YTL per ride, considering various discounting currently applied.

15.2.2 Evaluation Results

Table 15.1.4 summarizes the results of financial evaluation. Out of 22 projects, seven projects have no F-IRR value because the sum of revenue is less than the initial cost. The F-IRRs of other projects are rather low with some exceptional projects. Overall F-IRR of all the railway project is estimated at 8.6%. If excluding several poor projects, however, it is improved to 10.3%.

Table 15.2.1 Financial Evaluation Results of Railway Projects

Code	Project Code	Project	Length (km)	Project Cost (US\$ Mil)	O&M (US\$ Mil)	Revenue		F-IRR (%)
						2011	2023	
RL001	P1-1	Bagcilar - Halkali Light Metro (Extension of C-5 line)	7.5	493.7	13.2	64.3	141.3	13.3
RL002	P1-2	Tekstilkent - Istoc - Olimpiyat Koyu - Bahcesehir (Ispartakule) Metro	12.0	1196.8	52.1	176.8	235.0	10.3
RL003	P1-3	Umraniye - Bostanci Metro	14.0	1225.4	55.0	77.0	187.7	5.2
RL004	P1-4	Kartal - Pendik (Sabiha Gokcen Airport) - Tuzla Metro (Extension of C-3)	18.1	1261.3	56.7	60.3	331.8	9.3
RL005	P2-1	Seyrantepe - Alibeykoy - Gaziosmanpasa - Kazlicesme Metro	19.5	1186.8	58.2	133.0	292.0	10.5
RL006	P2-2	Kartal D-100 - Kartal IDO Monorail	3.0	94.3	5.4	3.9	17.2	5.4
RL007	P2-3	Sabiha Gokcen Airport - Formula 1 Monorail	7.7	242.2	13.5	1.8	32.4	1.5
RL008	P2-4	Darussafaka - Cayirbasi Metro (Extension of C-4 line)	2.7	193.5	8.9	2.5	4.0	N.A.
RL009	P2-5	4. Levent - Gultepe Mah. - Sanayi Mah. - Celiktepe Mah. Monorail	8.6	248.0	10.0	0.6	1.6	N.A.
RL010	P2-6	Besiktas - Sariyer Metro	14.1	787.0	24.0	8.0	19.6	N.A.
RL011	P2-7	Ispartakule - Ambarli - Yakuplu Metro	10.5	1197.0	53.0	29.7	227.3	5.9
RL012	P2-8	Ispartakule - Kirac - Buyukcekmece - Silivri Suburban Railway	25.8	1319.2	69.3	228.4	883.2	21.9
RL013	P2-9	Uskudar - Beykoz Metro	15.0	881.0	37.0	60.9	80.5	1.1
RL014	P2-10	Ikitepli Olimpiyat Koyu - Altinsehir Metro (Extension of C-6 line)	13.0	932.0	40.0	11.8	102.0	0.9
RL015	P2-11	Ataturk Airport Access Rail (Extension of Marmaray railway)	2.5	160.0	3.0	2.4	6.0	-4.5
RL017	PP-1	Seyrantepe - Bosphorus Crossing - Umraniye metro	9.8	816.2	27.9	63.5	190.4	9.9
RL018	PP-2	Topkapi - 2nd Bosphorus Bridge - Goztepe AGT	8.6	776.4	35.2	124.7	477.6	20.9
RL019	PP-3	Kadikoy - Ibrahimaga - Esensehir - Sabiha Gokcen Airport Metro	36.8	2364.8	103.9	201.0	427.2	7.3
RL020	PP-5	Bakirkoy - Beylikpuzu Extension	1.0	65.8	1.8	12.4	26.9	20.1
RL021	PP-6	Silivri - Gumusyaka Extension	48.9	2200.0	90.0	13.0	912.7	12.6
RL022	PP-4	Halkali - Hadimkoy Suburban Railway (Extension of Marmaray Project)	20.4	536.0	33.7	120.0	181.0	18.4

Source: *ibid.*

15.3 Environmental Evaluation

15.3.1 Objectives and Methodology of ESC

ESC study in consideration of Turkish legislation and JICA's requirement set force objectives and methodology as follows:

(1) Objectives

The objectives were set as follows:

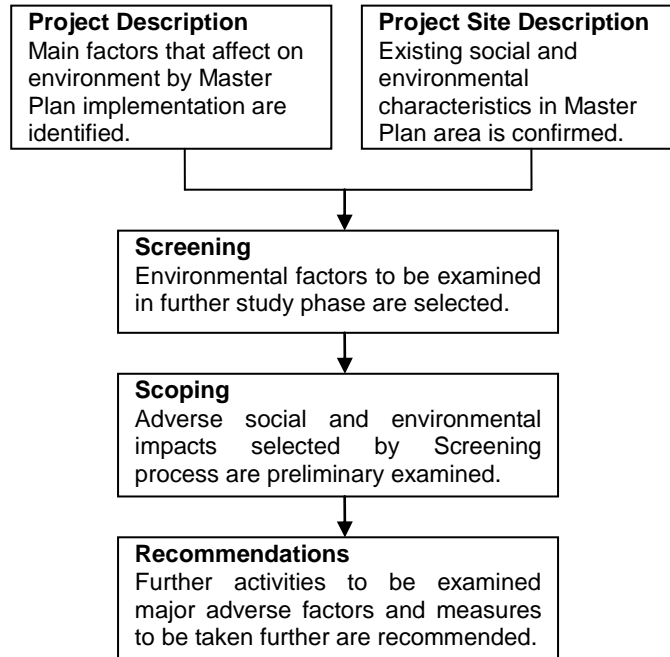
- To identify major adverse social and environmental impacts caused by the implementation of Master Plan project
- To realize environmental factors which should carefully be paid attention to the implementation stage
- To Review legislations and baseline information concerned

(2) Methodology and Contents

The methodology of ESC was based on secondary data and information with qualitative and quantitative analysis regard to Impact Identification Network Diagram by Project Phases comprising Pre-construction, construction and operation phases.

In addition, sensitive areas in the study area and global environmental issue, Green House Gas, and air pollutants were also examined and evaluated. The ESC study covered following topics.

- 1) Feature of the study area and Master Plan projects
- 2) Scoping in consideration of sensitive areas set force by the regulation
- 3) Preliminary assessment of adverse environmental impact for master plan projects
- 4) Recommendations for further environmental considerations regards to sensitive factors to be paid attention and alleviation measures of adverse environmental impacts caused by project activities.



Source: *ibid.*

Figure 15.3.1 Study Flow of Environmental and Social Consideration Study

15.3.2 Project Description of Master Plan

1) Project Site

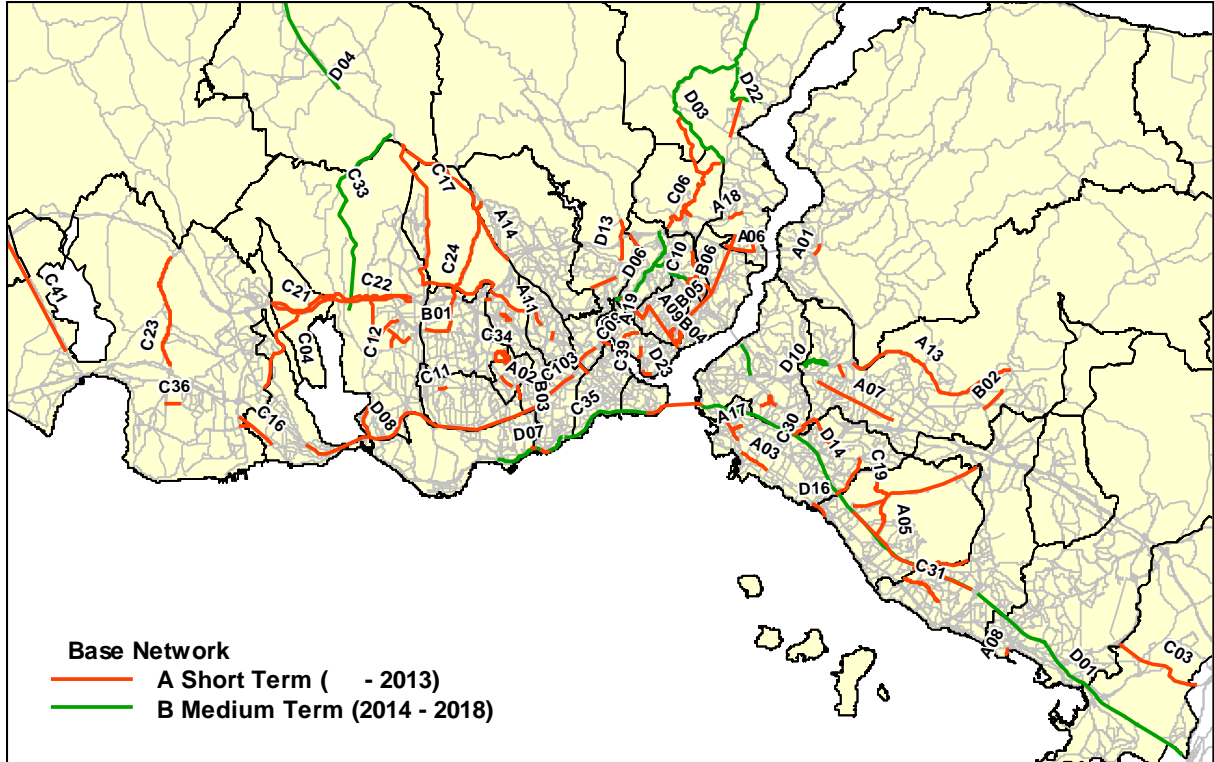
Master Plan covers Istanbul Metropolitan Municipality Area and Gebze District in Kocaeli Province. It is stretching approximately 120 km from west to east and is approximately 60 km from south to north on the Calata and Anatolian peninsulas. Geographically it is located from latitude N40 degree 28 to N41 degree 33' and longitude E28 degree 1' – E29 degree 55'.

2) Project Contents

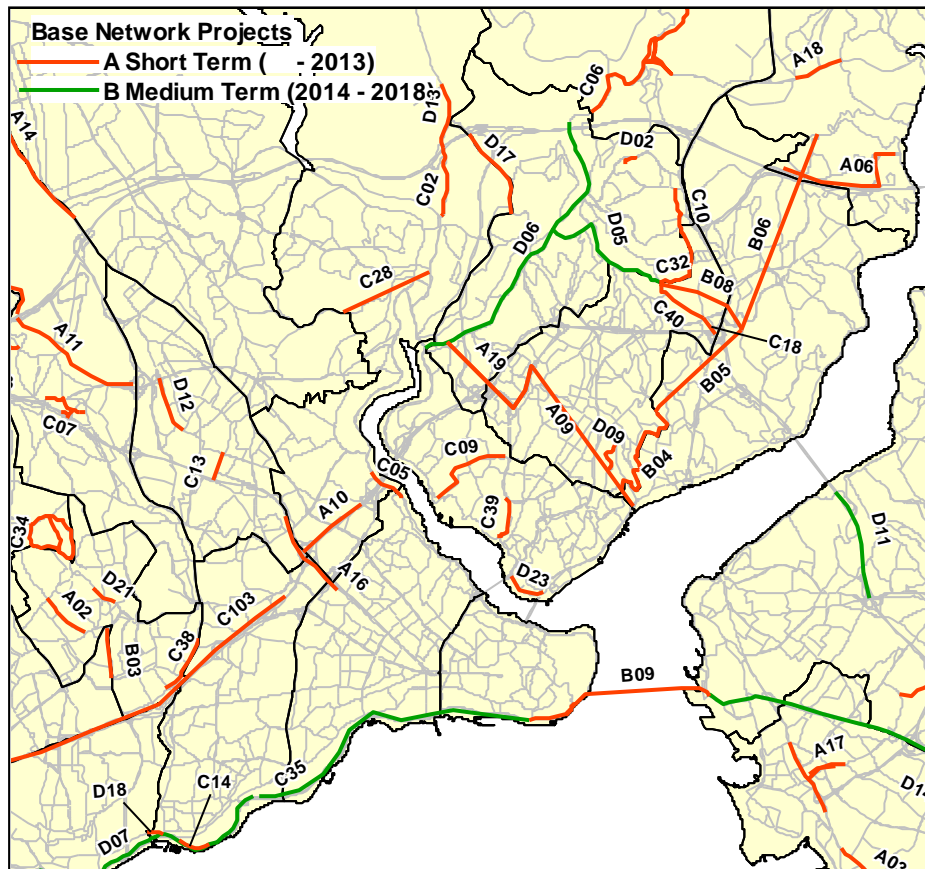
(1) Project Locations

Master Plan projects mainly comprise of road and rail projects which targets year 2023 explained in the previous chapter, and there are fifty four (54) roads and twenty two (22) railways proposed projects which lie southern half of the study area. The proposed alignments are shown in following figures, and the network shows strengthening connectivity among existing urban and future urban areas of both peninsulas.

(1) Committed Road Projects in Base network



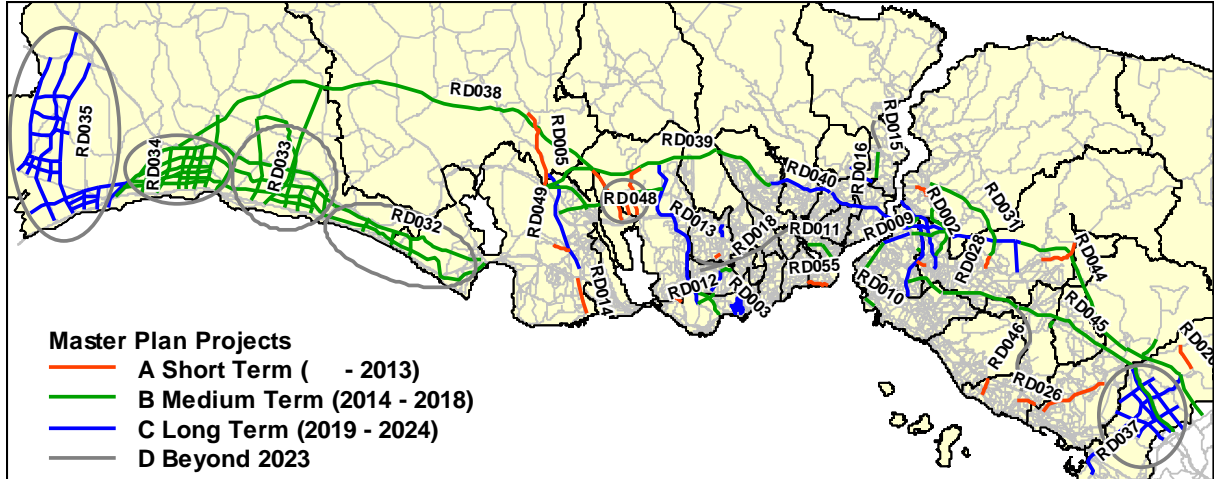
(2) Committed Road Projects in Base Network (Central Area)



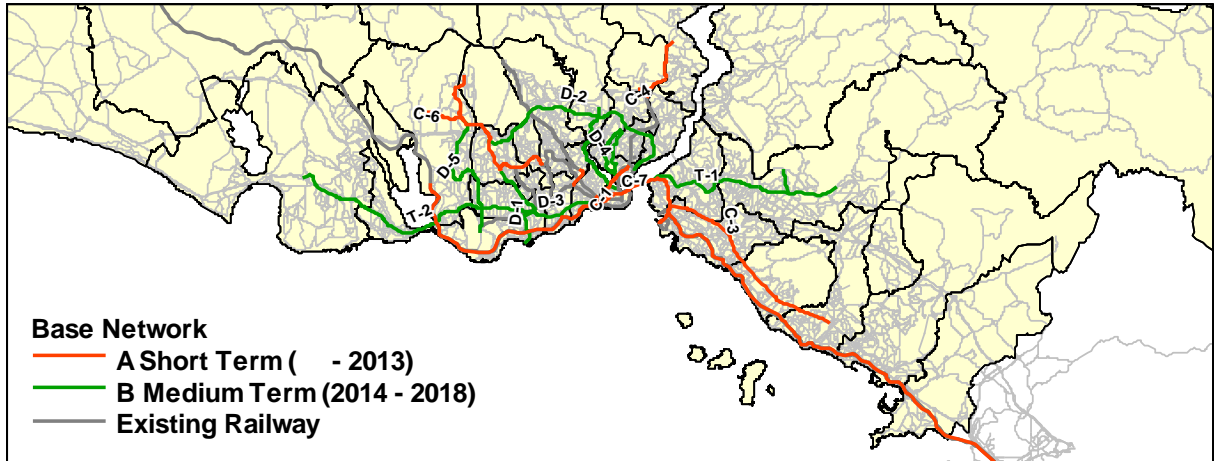
Source: *ibid.*

Figure 15.3.2 Location Map of Master Plan Projects

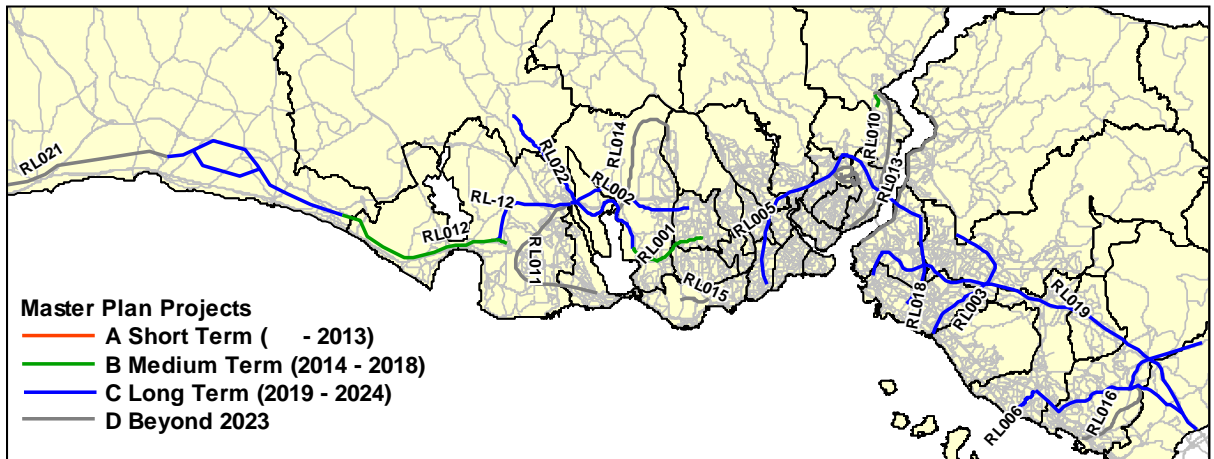
(3) Master Plan Road Projects



(4) Committed Railway Projects in Base Network



(5) Master Plan Railway Projects



Source: *ibid.*

Figure 15.3.2 Location Map of Master Plan Projects (Cont'd)

(2) Project Features

Total length of road and railway networks are 893.25 km and 309.9 km respectively. The road projects include bridge, junction, new road, tunnel, widening and rehabilitation of motorway, national and municipal roads. The railway projects consist of metro (underground or subway), monorail, suburban railway and AGT with at grade, elevated, underground and bridge structure or combination with each other shown in the following tables.

Table 15.3.1 Feature of Master Plan Projects

Road	No. of Project	Length (km)	Railway	No. of Project	Length (km)
Project Type			Type		
Bridge	1	7.8	Metro	13	175.9
Junction	2	11.7	Monorail	3	19.3
New Road	31	714.6	Suburban railway	5	103.8
Tunnel	12	40.7	AGT	1	10.9
Widening	5	97.5	Total	22	309.9
Rehabilitation	3	21.0	Structure		
Total	54	893.3	At Grade	4	70.7
By Category			At Grade/Elevated	6	108.9
Road	43	542.0	Elevated	3	19.3
Motorway	11	351.3	At Grade/Underground	2	23.5
Total	54	893.3	Bridge/Underground	1	8.2
			Underground	6	79.3
			Total	22	309.9

Source: *ibid.*

15.3.3 Sensitive Areas in Master Plan Area

Environmentally sensitive areas in the study area are designated by laws and regulations or international conventions such as natural and cultural assets, Bosphorus Strait area, water basin, biodiversity area, etc. shown in Table 15.3.2. In addition, land expropriation practice in the study area was also examined. It is vital to consider these areas for project planning and implementation, and major concerned sensitive areas were examined.

Table 15.3.2 Sensitive Areas Designated by Laws

Sensitive Areas	Legislations and Conventions
Cultural and natural assets	Protection of natural and cultural assets law No.2863
Bosphorus strait area	Bosphorus law No.2960
Water basin	Drinking water basin regulation on law No.2560
Forest	Forest law No.6831
Natural park	National parks law No. 2873
Key biodiversity area	Evaluated by nature association with IUCN*
Important bird area	Evaluated by bird life international regards to RAMSAR
Green house gas	Intergovernmental panel on climate change (IPCC)

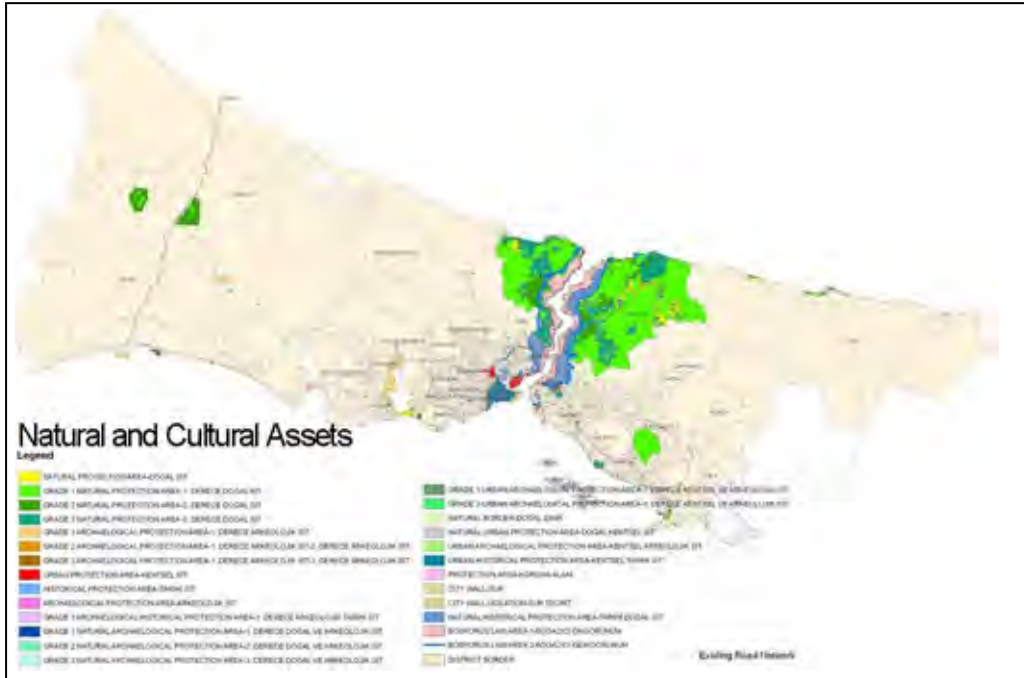
Source: *ibid.*

Note *: International Union for Conservation of Nature (IUCN)

1) Natural and Cultural Assets

Natural and cultural assets are protected by Natural and Cultural Protection Law No.2863 and the Bosphorus Law No. 2960. There are 150 protected areas and 26,327 assets in Istanbul. Both natural and cultural assets are located in central part of the city where cultural assets are concentrated in Historical Peninsula, while natural assets are located in

along each side of northern part of the Bosphorus Strait. In addition, the Bosphorus Law stipulates strictly control of development along the Bosphorus Strait (frontage area) and is conserving cultural and natural landscape. Furthermore, Istanbul Historical Peninsula is designated entirely by Natural and Protection Law, and of which four areas are World Cultural Heritage by UNESCO.



Source: Istanbul Comprehensive Master Plan, 2007

Figure 15.3.3 Natural and Cultural Assets and Bosphorus Law Areas

2) Biodiversity

There are eleven (11) Key Biodiversity Areas proposed by IUCN and Nature Association of Turkey, and of which five (5) areas are covered by Protection of Nature and Cultural Assets Law. In accordance with Global Red List, there is no CR (Critically Endangered), while there are 1 EN (Endangered), 9 VU (Vulnerable), 10 NT (Near Threatened) and 50 LC (Least Concern). Endangered (EN) includes white-headed duck (*Oxyrura leucocephala*) who inhabits Kucukcekmece Lake, and VU (Vulnerable) are two bird species (*Aquila clanga*, *Branta ruficollis*), 6 mammal (*Myotis capaccinii*, *Nannospalax leucodon*, *Rhinolophus euryale*, *Spermophilus citellus*, *Spermophilus citellus thracicus*, *Rhinolophus mehelyi*) and 1 reptile (*Testudo graeca*).

Concerning Important Bird Area which is related to Ramsar Convention, there are four Important Bird Areas (Ramsar designation of IBA lacking) comprising of Buyukcekmece Lake, Kucukcekmece Lake, Bosphorus area and Sile Islands.

Both Key Biodiversity Area and Important Bird Area are located in forest and water reservoir zone and water basin adjacent to existing urban areas in both peninsulas. Especially Kucukcekmece Lake area is surrounded by recent urbanization.



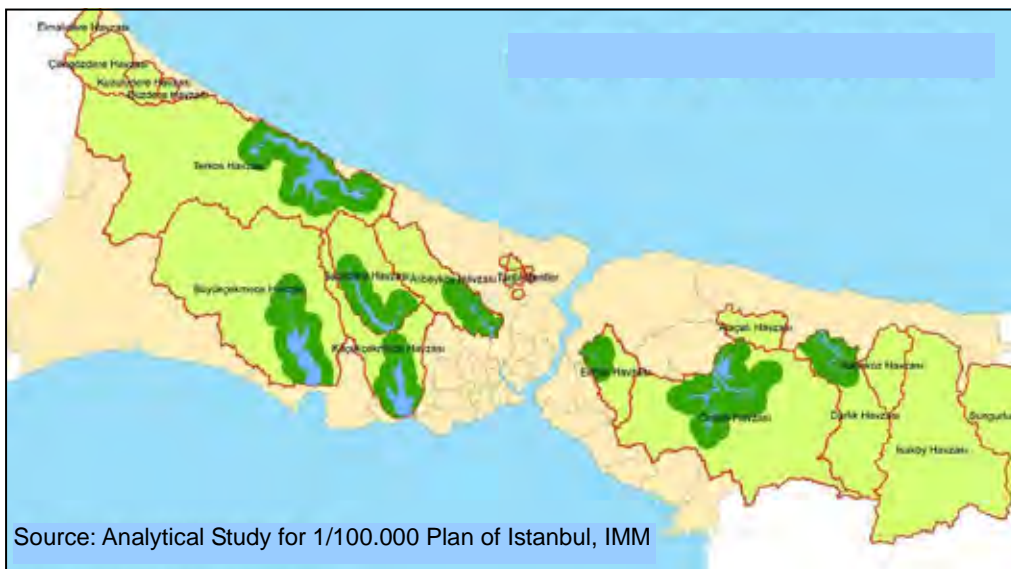
Source: Nature Association of Turkey

Figure 15.3.4 Key Biodiversity and Important Bird Areas

3) Water Basin

Water basins and rivers are designated by Drinking Water Basin Regulation on Law No.2560. There are seven (7) basins in Istanbul namely Buyukcecece, Sazlidere, Terkos, Alibeykoy, Omerli (European side), Elmali, Darlik, Sile (Asian side) and the total area covers approximately 46% of IMM area. Of which three basins (Terkos, Buyukcecece, Omerli), it shares 75% of the total basin area.

Within 2000 meters from the water reservoir is restricted for development activities and it is strongly controlled within 1000 meters zone from the reservoir that any kind of building structure is prohibited, and 100meters from both sides of designated river is also prohibited to build any structure.



Source: Analytical Study for 1/100.000 Plan of Istanbul, IMM

Figure 15.3.5 Water Basin Protected Area

4) Land Expropriation

Land expropriation will be occurred for provision of new project implementation while practices of land expropriation in Istanbul are fairly done by both procedures voluntary (contractual) and involuntary (court decision) cases in accordance with Land Expropriation Law No.2942 and No.4650, and market land value is applied for procurement of necessary lands.

In practice in year 2007, IMM acquired 24.2ha equivalent to 191 Million YTL value, of which the total land expropriation area, 59% were done by voluntary procedure (Article 8 of at Law) and 11% were involuntary case (Article 10 of at Law). The rest 30% were confiscated without any notice and procedure (both IMM and landlords did not aware that lands were used for public projects.). Average land expropriation unit cost in 2007 was 790 YTL/m². Although there are some landlords who disagree land expropriation, the procedure for public projects has been fairly done in accordance with the law.

Table 15.3.3 Land Acquisition Practice in Year 2007

Activities	Total Price (YTL)	Share	Acquired Area m ²	Share
Article 8. Contractual	81,976,612.68	43%	143,881.82	59%
Article 10. Material cost and Registration	43,635,134.16	23%	27,159.11	11%
Confiscating without expropriating/Judgmental	65,711,609.44	34%	71,215.81	30%
Total	191,323,356.28	100%	242,256.74	100%

Source: Expropriation Department, IMM

5) Green House Gas and Air Pollutants

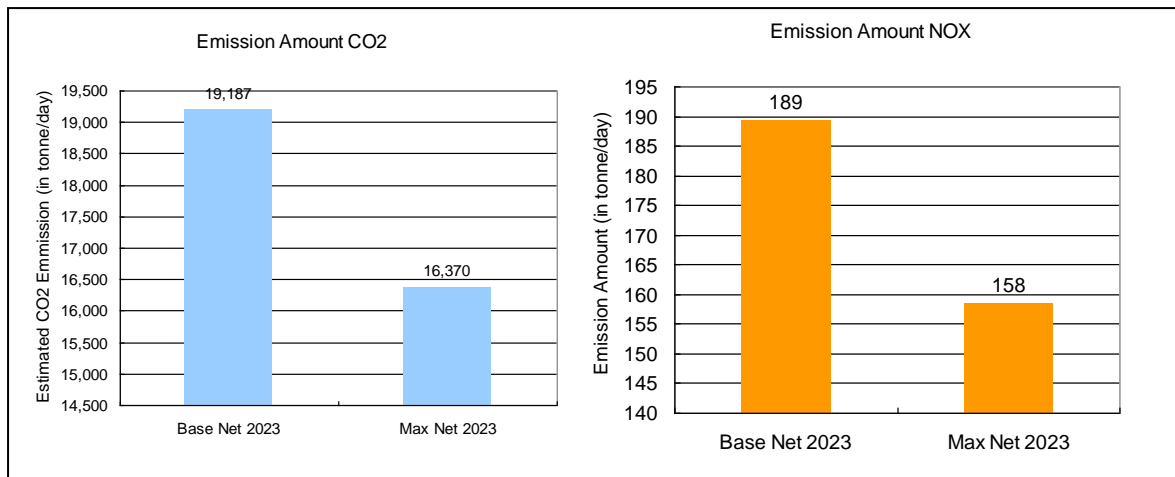
Green House Gas and air pollutants such as NO_x and PM (Particulate Matter) Total Suspended Particulate (TSP) generated by vehicle combustion were examined based on traffic demand forecast results in different scenarios. The examination has applied speed related emission factors in different engine type of vehicle and different substances for each road network link. The estimated emission amounts were summarized in following table.

As the result, Max Net 2023 (Master Plan) generates environmental benefit for both Green House Gas and NO_x as a major source of air pollution compared to Base Net 2023 by 14.7% and 16.2 % respectively. Other substances show similar benefit for Master Plan case.

Table 15.3.4 Environmental Benefit on Proposed Transport Plan Alternatives

Unit: Kg/day	HC	CO	CO ₂	NO _x	Total Suspended Particulate
Base Net 2023	197,439	1,546,546	19,186,900	189,162	12,532
Max Net 2023	164,900	1,299,448	16,369,790	158,487	9,742
Benefit	16.5%	16.0%	14.7%	16.2%	22.3%

Source: Study Team



Source: *ibid.*

Figure 15.3.6 Emission Amount of CO2 and NOx on Base Net and Max Net 2023

6) Summary of Project Site Description

Characteristics of the Study Area and remarks concerning transport using JICA SEC Guideline are summarized in following table.

Table 15.3.5 Summary of Project Site Description

No.	Impacts	Characteristics	Concerning Transport
Social Environment			
1	Involuntary Resettlement	Resettlement occurred by land expropriation has been done by IMM and it is well managed. Besides there are on-going housing improvements of Informal housing areas by TOKI and KIPTAS.	Procurement of lands for infrastructure is required
2	Local economy such as employment and livelihood, etc.	Istanbul is Turkish economic pillar with 9.8% GDP growth last 10 years average with 22.3% share of all turkey, while it is 9.9% (2006) unemployment rate.	Transport network provides quality of life.
3	Land use and utilization of local resources	Istanbul Environmental Regulatory Plan in Istanbul Comprehensive Plan 2006-2023 proposes 16 million pop. It will reach in 2015.	Transit Oriented Development and poly centric urban form shall be concerned.
4	Social institutions such as social infrastructure and local decision-making institutions	There are 39 districts (Ilce) in Istanbul and each district has elected mayor.	
5	Existing social infrastructures and services	There are private and public educational, medical and social facilities, and there are also religious facilities in the study area.	
6	The poor, indigenous and ethnic people	Roman has lived near the City Wall in Historical Peninsula; there is an on-going relocation programme. An informal housing area (Gecekondu) located in fringe and inside of urban area are also under improvement.	Relocation of informal housing areas may be occurred.
7	Misdistribution of benefit and damage	There is no report.	None
8	Cultural heritage	There are valuable cultural heritage in the study area especially Historical Peninsula, Beyoglu and along the Bosphorus Strait.	New project may affect on degradation of cultural heritages.
9	Local conflict of interests	Minibus as a feeder transit is operated by private sector and it may be affected by easing minibus by MRT or Metrobus development.	
10	Water Usage or Water Rights and Rights of Common	Water basin is strictly controlled for development.	Special attention shall be made for water basins.
11	Sanitation	Drinking water 99.8%, sewerage 90.2%, 2 land fills for waste and 1 medical incinerator.	Route of haulage of house hold waste to final land fill site through transfer stations.
12	Hazards (Risk), Infectious	It is located near active fault (North Anatolian Fault).	Increasing of inflow worker

No.	Impacts	Characteristics	Concerning Transport
	diseases such as HIV/AIDS		may carry unknown diseases
Natural Environment			
13	Topography and Geographical features	It is divided by two peninsulas with hilly topographic condition.	Steep topographic condition along the Bosphorus shall be conserved.
14	Soil Erosion	Some erosion in suburban area are seen	
15	Groundwater	There is no detail information; however it is crucial aspect in terms of water resource.	
16	Hydrological Situation	Water resource is limited in Istanbul and some excessive water is transported from a part of the Ergene basin.	Large scale transport infrastructure may affect on water system.
17	Coastal Zone (Mangroves, Coral reefs, Tidal flats, etc.)	Steep coastal topographic condition along the Bosphorus Strait.	Large scale transport infrastructure may affect on coastal topography.
18	Flora, Fauna and Biodiversity	Nearly half of the study area is covered by forest, and there are no EN, 1 CR, 9VN, 10NT (IUCN).	
19	Meteorology	Mediterranean climate with much rain in autumn and winter. Total amount of precipitation is 600-800mm annually.	
20	Landscape	There are comparatively rich landscape both natural and cultural landscape in the study area and there are large structure along the Bosphorus Strait namely two bridges.	Large scale transport infrastructure may affect on rich landscape.
21	Global Warming	331.8 Million Tonnel CO2 equivalent was emitted in 2006, of which transport sector accounts 16%.	Emission from motor vehicle generates CO2.
Pollution			
22	Air Pollution	It was serious air pollution by SO2 due to coal combustion for heating at home, however, it was solved after natural gas introduction beginning of year 2000.	NOx is emitted by mortar vehicle as major source of pollutant is concerned.
23	Water Pollution	There is no report and sewerage are being provided for 90.2% of total IMM population	
24	Soil Contamination	There is no report	
25	Waste	Domestic solid waste are properly disposed in land fill sites and incinerated in northern part of Istanbul	Construction waste and debris are generated by projects
26	Noise and Vibration	Noise from entertainment facilities are concerned mostly. Recently it has started to monitor road side noise along motorway.	Road side noise on motorway is concerned as an EU accession country.
27	Ground Subsidence	There is no report	None
28	Offensive Odour	There is no report.	None
29	Bottom sediment	There is no report	None
30	Accidents	It is increasing traffic accident and no detail data on that.	Traffic safety measures shall be considered.

Source: *ibid.*

15.3.4 Scoping of the Plan

Inevitable resettlement, protection of cultural and natural assets including landscape, hydrology, air pollution and noise were identified as factors which will be potential adverse impacts either “some impact is predicted” or “extent of impact is predicted or unknown”, and there is no “serious impact is predicted”. The result of scoping is shown in following table.

Table 15.3.6 Scoping of the Master Plan

No.	Impacts	A Brief Description
Social Environment: *Regarding the impacts on “Gender” and “Children’s Right”, might be related to all criteria of Social Environment.		
1	Involuntary Resettlement	It is inevitable to have some resettlement in order to provide lands for the projects in preconstruction stage. Number of resettlement and compensation in accordance with related laws shall be examined in the implementation stage.
2	Local economy such as employment and livelihood, etc.	Changes of economic activities and employment opportunity caused by land use transformation may affect on local economy.
3	Land use and utilization of local resources	Consistency of proposed land use plan and the plan shall be examined.
4	Social institutions such as social infrastructure and local decision-making institutions	
5	Existing social infrastructures and services	
6	The poor, indigenous and ethnic people	There are informal housing areas in the project area, and the propjets may affect on informal housing settler such as poor and illegal inhabitants on land expropriation activities.
7	Misdistribution of benefit and damage	
8	Cultural heritage	There are various kinds of cultural assets in Istanbul in different places and different values. Detail examinations shall be made in each project implementation.
9	Local conflict of interests	
10	Water Usage or Water Rights and Rights of Common	Water resources shall be conserved due lack of water resource in Istanbul
11	Sanitation	
12	Hazards (Risk) Infectious diseases such as HIV/AIDS	Infection diseases such as HIV/AIDS may have potential to spread by incoming construction workers.
Natural Environment		
13	Topography and Geographical features	Change of topography in steep areas shall be considered especially along the Bosphorus Strait
14	Soil Erosion	
15	Groundwater	
16	Hydrological Situation	Extent of water basin and project alignment shall be confirmed.
17	Coastal Zone (Mangroves, Coral reefs, Tidal flats, etc.)	Location of proposed alignments shall b examined with topographic and geological conditions.
18	Flora, Fauna and Biodiversity	Location of proposed project shall be examined.
19	Meteorology	
20	Landscape	Protected areas and along the Bosphorus Strait are carefully examined.
21	Global Warming	Amount of Green House Gas generated by the project implementations is estimated.
Pollution		
22	Air Pollution	Source of pollutants shall be estimated in different development scenario.
23	Water Pollution	
24	Soil Contamination	
25	Waste	Construction waste and debris generated by projects may affect on flora and fauna if the waste would not be managed properly.
26	Noise and Vibration	Detail examination shall be done in the implementation stage.
27	Ground Subsidence	
28	Offensive Odour	
29	Bottom sediment	
30	Accidents	Causes of traffic accident shall be identified.

Source: *ibid.*

As the results of Scoping, 12 environmental factors in different stages were identified. These are involuntary resettlement, low income group, cultural heritage in pre-construction stage, risks, topography, hydrology, coastal zone and waste in construction stage, and local economy, land use, air pollution and noise, traffic accident in operation stage summarized in following table. In summary, historical and natural assets, landscape especially Bosphorus Strait area and water basins are the most important factors in the study area.

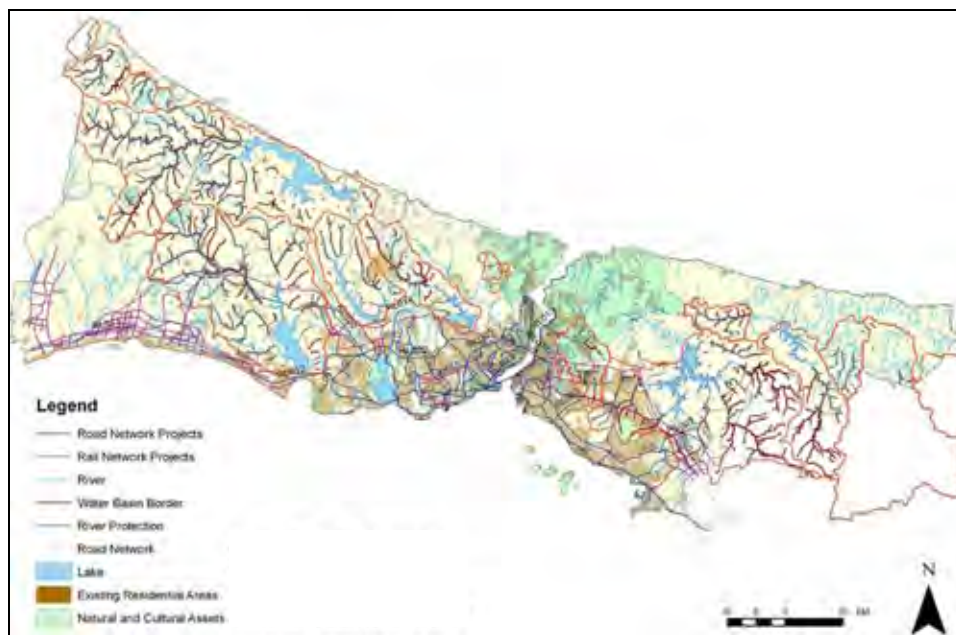
Table 15.3.7 Summary of Scoping for Master Plan Projects

Environmental Factors	Project Stage	Remarks and General Mitigation Measures
Involuntary resettlement	Pre-construction stage	It is inevitable work in urban area, and proper relocation program according to the law has to be done through local authorities.
Local Economy	Operation stage	Transformation of land use may affect on local economic activities.
Land use	Operation stage	Change of land use may be predicted by the projects, and compliance of and use plan shall be kept in Key affect areas.
Low income group	Pre-construction stage	There exist informal housing areas and appropriate compensation and relocation measures shall be done.
Cultural heritage	Pre-construction stage	Cultural heritages designated by laws especially for historical peninsula and its adjacent area shall be conserved.
Hazards (Risk) Infectious diseases	Construction stage	Health management program for workers and guidance shall be done in order to preventing spread of infection disease by incoming worker from outside.
Topography	Construction stage	Construction works in steep areas shall carefully be paid attention and measures such as slope protection, inclined leachate collection system, etc. shall be considered.
Hydrology	Construction stage	Water basins and rivers are strongly protected in accordance with the protection laws and regulations. Alignment of road and railway shall carefully be designed.
Coastal zone	Construction stage	Steep topographic condition along the Bosphorus Strait area shall carefully be worked in steep areas and vegetation..
Landscape	Construction and operation	Frontage of the Bosphorus Strait and rich natural and cultural landscape shall be conserved. Design of large scale structure shall harmonize with existing landscape.
Air Pollution and Noise	Operation	Motor vehicle generates source of air pollution and noise, and compliance with EU Emission standard will decrease emission concentration.
Waste	Construction stage	Construction waste and debris shall properly be disposed in proper sites.
Accident	Operation	Traffic accident analysis, traffic safety education and road improvement are considered.

Source: *ibid.*

15.3.5 Results of Social and Environmental Considerations

Master Plan projects comprising fifty four (54) road projects and twenty two 22 railway projects were examined in order to identify major adverse social and environmental impacts. Sensitive areas namely protected areas, Bosphorus area, natural and cultural assets area, water basin and resettlements, etc. were assessed through related legislations and the project features and locations as shown in Figure 15.3.7.



Source: *ibid.*

Figure 15.3.7 Sensitive Areas of Istanbul and Master Plan Projects

1) Road Projects

Nine (9) projects out of fifty four (54) proposed projects are highly concerned that special attention to be paid for pre-construction phase especially projects located along the Bosphorus Law area including a bridge crossing the strait and highly urbanized area listed in Table 15.3.8.

In addition, 12 tunnels in total 40.65km length were proposed. These are located in central part of urbanized area and the Bosphorus Law area with steep topography. It is also special attention for alleviation of environmental impact in the stage of pre-construction.

Furthermore, RD044 and RD039 align water basin areas partially and some more detail examination and alternatives shall be considered. Summary of SEC for road projects are shown in Table 15.3.9.

Table 15.3.8 Road Projects in need of Further Examination

Code	Project	Length (km)	Type	Category	Considerable Aspects	Natural	Social
RD041	New Bosphorus Crossing	7.77	Bridge	Motorway	It is controversial project to have third Bosphorus bridge in terms of landscape and natural assets.	C	C
RD042	New Motorway Kadikoy Branch Package	10.97	New Road	Motorway	High density urbanized area	B	C
RD003	Bakirkoy between D-100 Land Route (Incirli Junction) - Coastal Road (Atakoy Junction) underpass - flyover project	9.45	Junction	Road	Coastal area and large structure and prestigious residential area	A	C
RD015	Derbent Haciosman Tunnel Project	2.87	Tunnel	Road	Within Bosphorus Law and Natural and Cultural Assets areas with steep topographic conditions.	C	B
RD044	New Motorway Umraniye-Tuzla Package	55.98	New Road	Motorway	Proposed alignment is crossing water basin and protected rivers.	C	B
RD001	Tophane - Iplikci Tunnel	1.67	Tunnel	Road	Tunnel under historical area	B	B
RD008	Beylerbeyi - Harem Tunnel	4.15	Tunnel	Road	Tunnel, steep topography, high density area and Bosphorus area	B	B
RD009	Beylerbeyi - Hekimbasi Tunnel	3.09	Tunnel	Road	Extension of RD008, Tunnel, steep topography, high density area and Bosphorus area	B	B
RD016	Armutlualti - Poligon Mah. Tunnel Project	2.68	Tunnel	Road	Within Bosphorus Law and Natural and Cultural Assets areas with steep topographic conditions.	B	B

Source: *ibid.*

Note1: A; No impact is predicted, B; some impact is predicted or unknown, C: serious impact is predicted

Note2: Criteria used for this table was for multiple evaluation on master plan project only.

Category: Motorway; National roads as well as TEM and D100, Road; Municipal roads

Table 15.3.9 Summary of SEC for Road Projects

Code	Project	Length (km)	Project Type	Structure	Natural	Social
RD001	Tophane - Iplikci Tunnel	1.67	Tunnel	Road	C	C
RD002	Widening of Hatboyu street (Coastal road Linkage) in Umraniye	8.07	Widening	Road	A	B
RD003	Bakirkoy between D-100 Land Route (Incirli Junction) - Coastal Road (Atakoy Junction) underpass - flyover project	9.45	New Road	Motorway	A	A
RD004	Widening project between Kirac and Esenyurt construction road	2.83	Widening	Road	A	C
RD005	Between Hadimkoy bridge- Yassiorend road, road, junction project	9.23	Junction	Road	A	A
RD006	Beykoz, Mihrabat Street-TEM Highway Linkage project	1.44	New Road	Motorway	A	B
RD007	Umraniye, between Kucuksu junction- Isfalt association (Kucuksu street) road rehabilitation project	12.85	New Road	Road	A	A
RD008	Beylerbeyi - Harem Tunnel	4.15	Tunnel	Road	A	A

Code	Project	Length (km)	Project Type	Structure	Natural	Social
RD009	Beylerbeyi - Hekimbasi Tunnel	3.09	Tunnel	Road	A	A
RD010	Kadikoy - Moda Tunnel	1.03	Tunnel	Road	A	A
RD011	Tophane - Haskoy Tunnel	1.19	Tunnel	Road	A	B
RD012	Road Construction For W. Trade Center by Private Sector	9.24	New Road	Road	A	A
RD013	Kucukcekmece D-100 Highway Cobancesme Junction - Olympics Road Linkage Road and Junction Project	26.54	New Road	Road	A	B
RD014	Yakuplu Kumcular Servis Road Project	7.29	New Road	Road	A	A
RD015	Derbent Haciosman Tunnel Project	2.87	Tunnel	Road	A	A
RD016	Armutlualti - Poligon Mah. Tunnel Project	2.68	Tunnel	Road	A	A
RD017	Armutlualti - Ayazaga Tunnel Project	2.55	Tunnel	Road	A	A
RD018	Kuyumcu Kent - Otogar - Eyup Tunnel Project	13.83	Tunnel	Road	A	B
RD019	Road rehabilitation project between Bagcilar, Malazgirt underpass-Mehmet Akif avenue (8.St-1/3St-1/13 St-2/13 St)	3.10	Rehabilitation	Road	A	B
RD020	Tuzla Formula-1 Road Network 6 numbered road project	5.70	New Road	Road	A	B
RD021	Link Road between Malazgirt Rd and Mahmat Akif Bulbari	0.90	New Road	Road	A	B
RD022	Road project in Bakirkoy,(D-100 Highway Sefakoy junction - airport A-14 Apron linkage road)	0.52	New Road	Road	A	B
RD023	Sultanbeyli Necip Fazil street - Kartal TEM linkage road project	0.33	New Road	Road	A	B
RD024	Between Umraniye Mandira st – Bag st road project	0.60	New Road	Road	A	B
RD025	New linkage road project between Umraniye Karadeniz street - Mandira street (continuous section of Hatboyu street)	0.21	New Road	Road	A	B
RD026	Kartal Sehif Ahmet Yalcin St - Arkoz St - Cavusoglu St, Adnan Kahveci Viaduct Linkage road junction project	2.02	New Road	Road	A	B
RD027	Umraniye, between Sile Road Yenidogan junction - Pasakoy junction road, junction implementation project	4.24	New Road	Road	A	B
RD028	Re-organizing The existing road in Umraniye Cekmekoy Cavusbasi street according to the construction plan as 20m	2.49	Rehabilitation	Road	B	C
RD029	Kartal between Tekel street - D-100 road, junction implementation project	2.48	Junction	Road	A	A
RD030	Uskudar between Zubeyde Hanim Street - Hekimbasi Ciftlik street construction roads implementation projects	1.34	New Road	Road	C	B
RD031	Beykoz , between Kavacik junction – Cekmekoy junction (Cavusbasi road) road, junction implementation project	11.10	New Road	Road	A	B
RD032	West Buyukcekmece Road Network Package	40.46	New Road	Road	A	B
RD033	East Silivri Road network Package	66.30	New Road	Road	A	B
RD034	Silivri Center Road network Package	74.57	New Road	Road	A	B
RD035	West Silivri (Port Area and University Area) Road Network Package	91.85	New Road	Road	A	A
RD037	Tuzla Center Road Network Package	58.51	New Road	Road	A	A
RD038	New Motorway west section Package	102.43	New Road	Motorway	A	A
RD039	New Motorway Kucucekmece section Package	40.49	New Road	Motorway	B	B
RD040	New Motorway Kagithane section Package	17.30	New Road	Motorway	B	B
RD041	New Bosphorus Crossing	7.77	Bridge	Motorway	B	B
RD042	New Motorway Kadikoy Branch Package	10.97	New Road	Motorway	A	B
RD043	New Motorway Uskdar-Umraniye Package	20.75	New Road	Motorway	A	B
RD044	New Motorway Umraniye-Tuzla Package	55.98	New Road	Motorway	C	B
RD045	Widening of TEM Highway (Umranye-Tuzla) Package	69.48	Widening	Motorway	B	B
RD046	Widening of Connection road (TEM-D100) in Kartal	15.23	Widening	Motorway	A	B
RD047	Kucucekmece Road Network Package	17.50	New Road	Road	A	B
RD048	Bahcesehir Road Network Package in Avcilar	10.68	New Road	Road	A	B
RD049	New Truck Route for Ambarli Port - Logistic Center(tunnel for about half length)	11.89	New Road	Road	A	A
RD050	E-W Missing Linkage in Gungoren (tunnel)	1.10	New Road	Road	A	B
RD051	N-S Missing Link inBahcelievler (tunnel)	2.40	Tunnel	Road	A	A
RD052	Connection Tunnel between Bosna Bulvari and Hatboyu St (tunnel)	1.13	Tunnel	Road	A	A
RD053	Re-Construction of Ankara Road between Pendik and Baglanti Road (incl. 2km new road)	15.43	Rehabilitation	Road	A	B
RD054	Connection Road between New Motorway and Uskudar Tunnel (50% tunnel)	4.06	Tunnel	Road	A	B
RD055	Widening of Kennedy Street between Road Tunnel and Mustafa Kemal St. in Eminonu	1.93	Widening	Road	A	A
		893.25				

Source: *ibid*.

Note1: A; No impact is predicted, B; some impact is predicted or unknown, C: serious impact is predicted

Note2: Criteria used for this table was for multiple evaluation on master plan project only.

Category: Motorway; National roads as well as TEM and D100, Road; Municipal roads

2) Railway Projects

Six projects out of 22 projects are highly concerned that special attention to be paid for pre-construction phase especially projects located along the Bosphorus Law area including a bridge crossing the strait and highly urbanized area as well as proposed road projects listed in Table 15.3.10 and Table 15.3.11. Two metro lines, RL010 and RL013, proposed along the Bosphorus Strait for both European and Asian side are highly concerned and RL017 which is Bosphorus crossing line through a new bridge, it is controversial project with steep topographic condition, rich landscape and prestigious residential area.

Table 15.3.10 Railway Projects in need of Further Examination

Code	Project	Length (km)	Type	Structure	Considerable aspects	Natural	Social
RL010	Besiktas - Sariyer Metro	14.1	Metro	Underground	Protection Area, Bosphorus Law area, steep topography, and urbanized area.	C	C
RL013	Uskdar - Beykoz Metro	15.0	Metro	Underground	It is Asian side and same condition as RL010	C	C
RL017	Seyrantepe - Bosphorus Crossing - Umraniye metro	9.8	Metro	Bridge/ underground	It is controversial project to have third Bosphorus bridge in terms of landscape and natural assets.	C	C
RL012	Ispartakule - Kirac - Buyukcekmece - Silivri Suburban Railway	25.8	Suburban railway	At grade/ elevated	Urban area	C	B
RL014	Ikitelli Olimpiyat Koyu - Altinsehir Metro (Extension of C-6 line)	13.0	Metro	At grade	Urban Area	B	B
RL021	Silivri - Gumusyaka Extension	48.0	Suburban railway	At grade	Urban Area	B	B

Source: *ibid.*

Note: A; No impact is predicted, B; some impact is predicted or unknown, C: Serious impact is predicted

Note2: Criteria used for this table was for multiple evaluation on master plan project only.

Table 15.3.11 Summary of SEC for Railway Projects

Code	Project	Length (km)	Project Type	Structure	Natural	Social
RL001	Bagcilar - Halkali Light Metro (Extension of C-5 line)	7.5	Metro	At Grade/ Elevated	A	B
RL002	Tekstilkent - Istoc - Olimpiyat Koyu - Bahcesehir (Ispartakule) Metro (Extension of D-2 line)	12.0	Metro	At Grade	A	B
RL003	Umraniye - Bostanci Metro	14.0	Metro	Underground	A	B
RL004	Kartal - Pendik (S. Gokcen Airport) - Tuzla Metro (Extension of C-3)	18.1	Metro	At Grade/ Elevated	A	B
RL005	Seyrantepe – Alibeykoy – Gop - Kazlicesme Metro	19.5	Metro	Underground	A	A
RL006	Kartal D-100 - Kartal IDO Monorail	3.0	Monorail	Elevated	A	A
RL007	S. Gokcen Airport - Formula 1 Monorail	7.7	Monorail	Elevated	A	A
RL008	Darusafaka - Cayirbasi Metro (Extension of C-4 line)	2.7	Metro	Underground	A	B
RL009	4. Levent - Gultepe Mah. - Sanayi Mah. - Celiktepe Mah. Monorail	8.6	Monorail	Elevated	A	B
RL010	Besiktas - Sariyer Metro	14.1	Metro	Underground	C	C
RL011	Ispartakule -Ambarli - Yakuplu Metro	10.5	Metro	Underground/ At Grade	A	B
RL012	Ispartakule - Kirac - Buyukcekmece - Silivri Suburban Railway	25.8	Suburban railway	At Grade/ Elevated	C	B
RL013	Uskdar - Beykoz Metro	15.0	Metro	Underground	C	C
RL014	Ikitelli Olimpiyat Koyu - Altinsehir Metro (Extension of C-6 line)	13.0	Metro	At Grade/ Underground	B	B
RL015	Ataturk Airport Access Rail (Extension of Marmaray railway)	2.5	Suburban railway	At Grade/ Elevated	A	A
RL016	Sabiha Gokcen Airport Access Rail	9.3	Suburban railway	At Grade/ Elevated	A	B
RL017	Seyrantepe - Bosporus Crossing - Umraniye metro	9.8	Metro	Bridge/ Underground	C	C
RL018	Topkapi - 2nd Bosporus Bridge - Goztepe AGT	8.6	AGT	Underground	A	A
RL019	Kadikoy - Ibrahimaga - Esensehir - Sabiha Gokcen Airport Metro	36.8	Metro	At Grade	A	B
RL020	Bakirkoy - Beylikpuzu Extension	1.0	Metro	At Grade	A	B
RL021	Silivri - Gumusyaka Extension	48.9	Suburban railway	At Grade/Elevated	B	B
RL022	Halkali - Hadimkoy Suburban Railway (Extension of Marmaray Project)(Electrification)	20.4	Suburban railway	At Grade	B	A
		308.8				

Source: *ibid.*

Note: A; No impact is predicted, B; some impact is predicted or unknown, C: serious impact is predicted

Note2: Criteria used for this table was for multiple evaluation on master plan project only.

15.3.6 Recommendation for Further Activities of Master Plan Projects

In overall, the ESC was subjective to Master Plan projects and it was comprehensively examined with available secondary data and information in order to identify potential adverse impacts caused by the project implementation. Remarkable environmental factors were clarified through scoping work by association with features and characteristics of the projects. This result can be an appraisal document for further environmental studies, and each component of proposed projects shall fully be assessed when the project is implemented in compliance with Turkish legislations. Hence, recommendations were made summarized as follows:

- 1) Primary data and information shall be used for further environmental study

Examination of ESC was to identify major adverse impact initially caused by the master plan implementation and to clarify factors which shall be examined in the implementation stage. In this regard, recommendations were made for further activities as follows:

- 2) Special attention to be paid for both frontage sides of the Bosporus Strait

It is steep topographic conditions with rich landscape including natural and cultural assets along the Bosporus Strait, and it is important for international shipping route. Projects

proposed in this area should carefully be attention to exceptional affluent landscape and fragile topographic features.

3) Large Scale Project shall have full EIA Study

Although it is not required full EIA by Turkish Law for the most proposed projects, some large scale project are perhaps subjective to full EIA such as new motorway, tunnel and third Bosphorus crossing, and it is controversial materials for the people. Large scale infrastructure projects may affect on social and natural environment widely and extent of negative impact is unknown. Practically it is recommended to carry out full scale EIA study for these large scale projects.

4) Protecting Water Basin and Forest

Istanbul Metropolitan Municipality has been facing lack of drinking water resources by rapid economic and population growth. Currently it is depending on seven water basins within the municipal and neighboring basins. Therefore deforestation and change of Water basin should be minimized in compliance with Law for Drinking Water Basin Regulation on Law No.2560.

5) Decoupling Environmental Impacts

Not only reduction of Green House Gas and Pollutants, adverse environmental impacts shall be decoupled with economic growth by technical, construction, economic and traffic measures. Table below shows example measures taken in EU countries. In Turkey, indeed, economic instruments has been strongly applied especially for vehicle purchasing tax, vehicle ownership tax and fuel tax that are highest charge level in the world. On the other hand, development of public transport system such as mass rapid transit is still backlog. Other measures such as emission standard and fuel quality standard are scheduled to catch up compliance with EU standards.

Table 15.3.12 Example of Environmental Measures in EU

<p>Technical Measures:</p> <ul style="list-style-type: none"> ▪ Compliance with current EU Emission Standard for all kinds of vehicles; ▪ Fuel quality standards concerning for lead, sulphur and benzene; ▪ Noise standards for motor vehicle; ▪ Introduction of CNG car. <p>Construction measures:</p> <ul style="list-style-type: none"> ▪ Low noise asphalt, noise protection walls along major roads; ▪ Integration of transport infrastructure into landscape; ▪ Bridges and tunnels for water flow, animal crossing roads and railways. <p>Transport Planning and Traffic Management:</p> <ul style="list-style-type: none"> ▪ Provision and improvement of public transport facilities; ▪ Introduction Traffic Oriented Development; ▪ Provision of separate cycling trucks and along the roads and in cities; ▪ Restriction of car use in inner cities and residential areas through pedestrian zones, speed limitation, parking restriction, road safety measures, alternate odd and even number plate access; ▪ Extension of rail, sea transport and combined transport; ▪ Bans on through traffic; ▪ Traffic safety enforcement. 	<p>Economic Instruments:</p> <ul style="list-style-type: none"> ▪ Internalization of external costs for all transport modes through taxes and fees (e.g. energy tax, fuel tax, road pricing and parking fees); ▪ Differentiated purchase taxes (e.g. capacity of engine and type of engine) ▪ Scrape benefits to encourage owners to replace older polluting vehicles with cleaner vehicle facilitated EU standard; ▪ Differential circulation taxes (e.g. in EU). <p>Others:</p> <ul style="list-style-type: none"> ▪ Regular in-service emission tests for vehicles; ▪ Time restrictions on transport movements (e.g. bans on night and weekend driving for heavy vehicles); ▪ Lowering and enforcement of speed limits for vehicles ▪ Encouraging for smooth driving behavior; ▪ Educational campaigns; ▪ Car pooling; ▪ Staggered working hours.
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Source: various sources for EU member countries

15.4 Project Prioritization

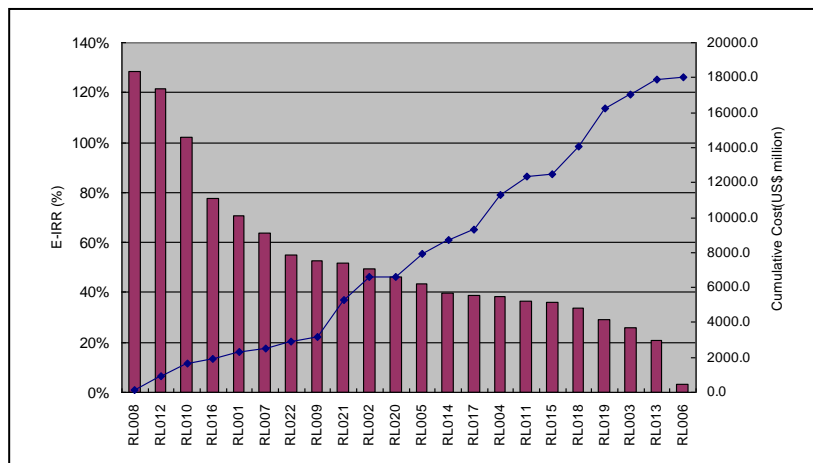
When the public sector invests in transport facilities, the primary purpose is “the public service”, or the social benefit. The proposed projects were evaluated for their economic IRRs to assign priority in accordance. The social benefit of a given project can be paraphrased as its impact in serving the twin purposes of reducing the operational cost of all the transport means available and reducing the travel time of all the passengers on the available transport means.

Figure 15.4.1 shows the cumulative cost curve of the evaluated projects in the ascending order of E-IRR from left to right. If the social benefit of project implementation should be more important than other criteria, the project selection for the master plan would begin from the left-hand end of the graph and move rightward up to the point where the cumulative cost reaches the limit of the available financial envelope. This was the first step of project prioritization.

In addition, the projects were evaluated on the following aspects of implementation.

- Contribution to the alleviation of congestion
- Contribution to the improvement of transport capacity
- Financial viability
- Environmental impact
- Other idiosyncratic circumstances of each project

The scores were aggregated per project and used to review, and reorder when deemed necessary, the prioritization by E-IRR. The projects were then assigned to three time periods of short and medium and long terms.



Source: Study Team

Figure 15.4.1 E-IRR and Cumulative Cost of Railway Projects

Table 15.4.1 Ranking and Priority of Maximum Network Projects

(1) Road Project

Code	Project	Length (km)	Const. Cost (US\$ mil.)	Economic Return	Demand	Congestion Alleviation	Land Use	Financial Return	Environment		Non-Economic Aggregated
									Natural	Social	
RD001	Tophane - Iplikci Tunnel	1.67	62.8	A	B	B	B	C	B	B	C
RD002	Widening of Hatboyu street (Coastal road Linkage) in Umraniye	8.07	195.2	B	C	B	B	C	A	A	B
RD003	Bakirkoy between D-100 Land Route (Incirli Junction) - Coastal Road (Atakoy Junction) underpass - flyover project	9.45	118.3	B	B	C	B	C	A	C	C
RD004	Widening project between Kiraç and Esenyurt construction road	2.83	9.4	A	A	C	B	C	A	A	B
RD005	Between Hadimkoy bridge- Yassiren road, road, junction project	9.23	28.6	A	A	C	B	C	A	B	B
RD006	Beykoz, Miharabat Street-TEM Highway Linkage project	1.44	12.3	A	B	C	B	C	A	A	B
RD007	Umraniye, between Kucuksu junction- İsfalt association (Kucuksu street) road rehabilitation project	12.85	50.6	A	C	B	B	C	A	B	C
RD008	Beylerbeyi - Harem Tunnel	4.15	210.0	A	B	C	B	C	B	B	C
RD009	Beylerbeyi - Hekimbasi Tunnel	3.09	175.8	C	B	C	B	C	B	B	C
RD010	Kadikoy - Kusdili Tunnel	1.03	48.4	A	C	C	B	C	A	B	C
RD011	Tophane - Haskoy Tunnel	1.19	24.9	A	B	C	B	C	A	B	C
RD012	Road Construction For W. Trade Center by Private Sector	9.24	40.3	A	C	C	B	C	A	A	C
RD013	Kucukcekmece D-100 Highway Cbancesme Junction - Olympics Road Linkage Road and Junction Project	26.54	291.8	C	B	B	B	C	A	A	B
RD014	Yakuplu Kumcular Servis Road Project	7.29	24.5	A	B	C	B	C	A	A	B
RD015	Derbent Haciosman Tunnel Project	2.87	61.9	B	B	C	B	C	C	B	C
RD016	Armutlualti - Poligon Mah. Tunnel Project	2.68	68.1	A	B	B	C	C	B	BB	C
RD017	Armutlualti - Ayazaga Tunnel Project	2.55	73.5	B	B	B	B	C	A	B	B
RD018	Kuyumcu Kent - Otagar - Eyüp Tunnel Project	13.83	332.8	B	B	C	B	C	A	B	C
RD019	Road rehabilitation project between Bagcilar, Malazgirt underpass-Mehmet Akif avenue (8.St-1/3St-1/13 St-2/13 St)	3.10	8.8	C	B	C	B	C	A	A	B
RD020	Tuzla Formula-1 Road Network 6 numbered road project	5.70	25.0	A	A	C	B	C	A	A	B
RD021	Link Road between Malazgirt Rd and Mahmat Akif Bulbari	0.90	4.3	A	B	A	B	C	A	B	B
RD022	Road project in Bakirkoy,(D-100 Highway Sefakoy junction - airport A-14 Apron linkage road)	0.52	9.7	A	B	C	B	C	A	A	B
RD023	Sultanbeyli Necip Fazil street - Kartal TEM linkage road project	0.33	4.1	A	B	C	B	C	A	B	C
RD024	Between Umraniye Mandira st - Bag st road project	0.60	4.5	C	C	C	B	C	A	A	C
RD025	New linkage road project between Umraniye Karadeniz street - Mandira street (continuous section of Hatboyu street)	0.21	4.5	A	C	C	B	C	A	A	C
RD026	Kartal Sehit Ahmet Yalcin St - Arkoz St - Cavusoglu St, Adnan Kahveci Viaduct Linkage road junction project	2.02	12.7	A	B	C	B	C	A	A	B
RD027	Umraniye, between Sile Road Yenidogan junction - Pasakoy junction road, junction implementation project	4.24	19.3	A	A	C	B	C	A	A	B
RD028	Re-organizing The existing road in Umraniye Cekmekoy Cavusbasi street according to the construction plan as 20m	2.49	7.5	A	B	C	B	C	A	A	B
RD029	Kartal between Tekel street - D-100 road, junction implementation project	2.48	25.0	A	B	C	B	C	A	A	B
RD030	Uskudar between Zubeyde Hanim Street - Hekimbasi Ciftlik street construction roads implementation projects	1.34	13.8	A	C	C	B	C	A	B	C
RD031	Beykoz , between Kavacik junction – Cekmekoy junction (Cavusbasi road) road, junction implementation project	11.10	31.6	A	B	C	B	C	A	B	C
RD032	West Buyukcekmece Road Network Package	40.46	495.6	A	A	B	A	C	A	B	A
RD033	East Silivri Road network Package	66.30	842.0	B	B	A	A	C	A	B	A
RD034	Silivri Center Road network Package	74.57	827.2	B	B	A	A	C	A	B	A
RD035	West Silivri (Port Area and University Area) Road Network Package	91.85	844.6	C	B	A	A	C	A	B	A
RD037	Tuzla Center Road Network Package	58.51	477.7	C	A	A	A	C	A	B	A
RD038	New Motorway west section Package	102.43	965.4	A	A	A	A	AA	A	B	A
RD039	New Motorway Kucucekmece section Package	40.49	547.7	B	A	A	A	C	A	B	A

RD040	New Motorway Kagithane section Package	17.30	520.5	C	A	B	B	B	A	B	C
RD041	New Bosphorus Crossing	7.77	843.0	C	A	C	B	A	C	C	B
RD042	New Motorway Kadikoy Branch Package	10.97	332.5	B	B	A	B	C	B	C	C
RD043	New Motorway Uskudar-Umraniye Package	20.75	360.0	B	B	C	B	B	A	A	B
RD044	New Motorway Umraniye-Tuzla Package	55.98	683.5	B	A	A	A	C	C	B	B
RD045	Widening of TEM Highway (Umranye-Tuzla) Package	69.48	490.4	B	A	A	B	C	A	B	A
RD046	Widening of Connection road (TEM-D100) in Kartal	15.23	112.0	B	B	C	B	C	A	B	A
RD047	Kucucekmece Road Network Package	17.50	135.8	Z	A	B	A	C	A	B	C
RD048	Bahcesehir Road Network Package in Avclar	10.68	202.7	B	A	A	A	C	A	B	A
RD049	New Truck Route for Ambarli Port - Logistic Center(tunnel for about half length)	11.89	358.9	B	B	A	B	C	A	B	A
RD050	E-W Missing Linkage in Gungoren (tunnel)	1.10	57.4	A	B	C	B	C	A	B	B
RD051	N-S Missing Link in Bahcelievler (tunnel)	2.40	121.4	C	B	C	B	C	A	B	C
RD052	Connection Tunnel between Bosna Bulvari and Hatboyu St (tunnel)	1.13	52.4	A	B	C	B	C	A	A	C
RD053	Re-Construction of Ankara Road between Pendik and Baglanti Road (incl. 2km new road)	15.43	63.0	A	B	B	B	C	A	A	B
RD054	Connection Road between New Motorway and Uskudar Tunnel (50% tunnel)	4.06	123.9	A	B	C	B	C	A	B	C
RD055	Widening of Kennedy Street between Road Tunnel and Mustafa Kemal St. in Eminonu	1.93	38.2	A	A	B	B	C	A	A	A

(2) Railway Project

Code	Project	Length (km)	Project Cost (US\$ Mil)	Economic Return	Demand	Congestion Alleviation	Land Use	Financial Return	Environment		Non-Economic Aggregated
									Natural	Social	
RL001	Bagcilar - Halkali Light Metro (Extension of C-5 line)	7.5	493.7	A	A	B	B	A	A	B	A
RL002	Tekstilkent - Istoc - Olimpiyat Koyu - Bahcesehir (Ispartakule) Metro (Extension of D-2 line)	12.0	1196.8	B	A	A	B	C	A	B	A
RL003	Umraniye - Bostanci Metro	14.0	1225.4	C	B	B	B	C	A	B	B
RL004	Kartal - Pendik (S. Gokcen Airport) - Tuzla Metro (Extension of C-3)	18.1	1261.3	B	B	A	A	C	A	B	A
RL005	Seyrantepe - Alibeykoy - Gop - Kazlıcesme Metro	19.5	1186.8	B	B	A	B	B	A	A	A
RL006	Kartal D-100 - Kartal IDO Monorail	3.0	94.3	C	C	C	B	C	A	A	C
RL007	S. Gokcen Airport - Formula 1 Monorail	7.7	242.2	A	C	B	A	C	A	A	B
RL008	Darusafaka - Cayirbasi Metro (Extension of C-4 line)	2.7	193.5	A	C	C	C	C	A	B	C
RL009	4. Levent - Gultepe Mah. - Sanayi Mah. - Celiktepe Mah. Monorail	8.6	248.0	A	C	B	B	C	A	B	C
RL010	Besiktas - Sariyer Metro	14.1	787.0	C	C	C	C	C	C	C	C
RL011	Ispartakule -Ambarli - Yakuplu Metro	10.5	1197.0	B	A	A	A	C	A	B	A
RL012	Ispartakule - Kirac - Buyukcekmece – Silivri Suburban Railway	25.8	1319.2	A	A	A	A	A	C	B	A
RL013	Uskudar - Beykoz Metro	15.0	881.0	C	C	C	C	C	C	C	C
RL014	İkitelli Olimpiyat Koyu - Altinsehir Metro (Extension of C-6 line)	13.0	932.0	B	B	C	B	C	B	B	C
RL015	Ataturk Airport Access Rail (Extension of Marmaray railway)	2.5	160.0	C	C	C	B	C	A	A	C
RL017	Seyrantepe - Bosphorus Crossing - Umraniye metro	9.8	816.2	B	B	A	B	B	C	C	C
RL018	Topkapi - 2nd Bosphorus Bridge - Goztepe AGT	8.6	776.4	C	B	B	B	B	A	A	A
RL019	Kadikoy - Ibrahimaga - Esensehir - Sabiha Gokcen Airport Metro	36.8	2364.8	C	B	A	A	C	A	B	A
RL020	Bakirkoy - Beylikpuzu Extension	1.0	65.8	B	A	C	A	A	A	B	A
RL021	Silivri - Gumusyaka Extension	48.9	2200.0	A	B	A	A	B	B	B	A
RL022	Halkali - Hadimkoy Suburban Railway (Extension of Marmaray Project)(Electrification)	20.4	536.0	A	A	A	B	A	B	A	A

Note 1: A; No impact is predicted, B; some impact is predicted or unknown, C: Serious impact is predicted.

Note 2: Criteria used for this table was for multiple evaluation on master plan project only.

Note 3: Project cost of railway project includes rolling stock cost.

Based on the economic evaluation stated in Chapter 15.1, each project was ranked as shown in Table 15.4.2. Many road projects were ranked as “A” but they were comparatively small scale in investment amount.

Table 15.4.2 Ranking by Economic IRR

(1) Road

A	RD001	RD004	RD005	RD006	RD007
	RD008	RD010	RD011	RD012	RD014
	RD016	RD020	RD021	RD022	RD023
	RD025	RD026	RD027	RD028	RD029
	RD030	RD031	RD032	RD038	RD047
B	RD050	RD052	RD053	RD054	RD055
	RD002	RD003	RD015	RD017	RD018
	RD033	RD034	RD039	RD042	RD043
C	RD044	RD045	RD046	RD048	RD049
	RD009	RD013	RD019	RD024	RD035
	RD037	RD040	RD041	RD051	

(2) Railway

A	RL001	RL007	RL008	RL009	RL012
	RL016	RL021	RL022		
B	RL002	RL004	RL005	RL011	RL014
	RL017	RL020			
C	RL003	RL006	RL010	RL013	RL015
	RL018	RL019			

(3) Investment Amount by Rank Group

	A	B	C
Road	2,472	4,838	3,153
Rail	4,537	7,044	6,442
Total	7,009	11,882	9,595

Source: *ibid.*

As the second step, each project was evaluated by the other criteria than E-IRR, following the threshold defined in Table 15.4.3. Results of the evaluation were shown in Table 15.4.1.

Table 15.4.3 Ranking Threshold by Evaluation Criteria

Criteria	Indicator	A	B	C	
Economic Return	Economic IRR	X>60%	60>X>15%	15%>X	
Demand	V-km/km	X>30000	30000-10000	10000<X	
Congestion Alleviation	$\Delta V/Q$	X>1%	1>X>0.5%	0.5%>X	
Consistency with Land Use Plan	-	Supportive	No Relation	Contradictory	
Financial Return	Financial IRR	X>15%	15>X>5%	5%>X or No income	
Environmental Evaluation	Natural	(SEC result)	No impact (no mark)	Some impact (+)	Serious impact (++)
	Social	(SEC result)	No impact (no mark)	Some impact (+)	Serious impact (++)
Urgent Needs	-	Some reason of urgency			

Source: *ibid.*

As the third step, the rankings by six non-economic criteria were aggregated into single rank, taking such process as (1) to give five points to rank “A”, three points to rank “B” and one point to rank “C”, (2) to add up each point and (3) Give rank “A” if the total is larger than 21 points, rank “B” if the total is in 17 – 21 and otherwise “C”.

Finally, combining two ranks of the economic and non-economic criteria, each project was classified into “Short-term (2009 - 2013)”, Medium-term (2014 – 2018)” and “Long-term (2019 – 2023)” following the cross-table of Table 15.4.4. Due to the ceiling of the financial envelope stated in Chapter 12, some projects were carried over beyond 2023.

Table 15.4.4 Integration of Two Rankings into Short, Medium and Long-Term

		Ranking by Non–Economic Criteria		
		A	B	C
Ranking by Economic IRR	A	Short	Short	Medium
	B	Medium	Long	Long
	C	Long / Deferred		

Source: *ibid.*

Chapter 16 Policies and Strategies for Transportation Development

16.1 Planning Goal and Policy

16.1.1 Goals of Master Plan

Prior to starting this Study, IMM clearly presented a set of goals of the Study to JICA as follows:

General Goal

To reduce motorized traffic by investing in the improvement of public transport services thereby promoting a shift in traffic demand from private passenger cars to public transportation, and ultimately contributing to upgrading of mobility and accessibility within the city and regeneration of a more livable urban environment (e.g. better traffic safety, prevention of air pollution, etc.).

Specific Goals

- (1) To improve and expand public transport services and thereby reduce dependence on private passenger cars
- (2) To improve and develop the road networks to cope with the growing vehicular traffic in the short term, and to shape and induce appropriate future spatial expansions of the city in the long term.
- (3) To put existing roads to efficient use by strengthening traffic regulations and traffic demand management.

A meaningful part in the above goals is “upgrading of mobility and accessibility within the city and regeneration of a more livable urban environment”. The other part states measures how to attain this, that is, demand shift from car use to public transport use and efficient use of existing roads.

The second specific goal seems somewhat contradictory against encouragement for using public transport. However, improvement of public transport enough to urge the modal shift will take a long time. Until completion of the rail network, minimum investment to road improvement will be needed in order to prevent the traffic condition from worsening further. Additionally, an advance investment for road construction will be essential in newly urbanized areas.

16.1.2 Basic Policy for Network Planning

The followings were kept in mind as basic policies when the Master Plan of the transport network was developed.

- To establish a reliable transport system to support people’s economic activity and daily life.
- To develop a stable and safe network strong against natural disasters.
- To pay a proper attention to environmental protection.
- To compose a Master Plan financially realistic and economically reasonable.

16.2 Toward a More Demotorized Society

Constructed ever extensive networks of trunk roads, widened streets and expanded parking spaces, while introducing better signal systems and elaborate traffic controls to improve the efficiency of the available road capacity. In most cities, nonetheless, the transport demand kept growing far more rapidly than the accretions to the transport networks. People are fed up with chronic congestion that besets urban life and the authorities are thinking less positively about investing in new transport infrastructure. The lesson learned painfully from the perseverance of the last five decades is this. The growing urban congestion is not stoppable by the supply of roads.

The growth of cities is shaped by land use and transportation. The former defines the spatial distribution of urban functions and the latter connects them. The municipal government of Istanbul plans to expedite the east – west metropolitan expansion while inhibiting the urban sprawls in the north – south dimension. It aims to establish additional CBDs in the metropolitan area. If the urbanization should extend lineally eastward and westward, the future motorized person trips would have to travel ever longer distance, overloading the already congested roads. The planned addition of CBDs is the most apposite policy option for easing the pressure of congestion.

The keynote of the future transport policy in Istanbul rests on the shift from private automobiles to public transportation and the shift from bus services to railways. Such shifts are indeed the global trend, and probably the only available option for Istanbul, the city about to face a full explosion of motorization.

The strategy of metropolitan Istanbul is aimed at transit oriented development (TOD). It mainly consists of a railway network appropriately laid down to provide stations within 500m to 700m from any place in the CBDs, the park & ride system based on the network, and the more evenly mixed distribution of urban functions suited to the expected multi-polar restructuring of the city.

IMM officially announced the railway extension of well over 500km. If the intention is to transform Istanbul to a more “demotorized” urban society, 500km is not enough. The development of the railway network should be the long-term commitment, in both planning and financing, that goes hand in hand with consistent land use planning.

16.3 Do we really need More Roads?

Quite a few people openly profess, “the demand increases precisely because more roads are provided,” or “it is of no use to construct any more roads, because the congestion will never disappear as more and more people will begin to drive their own cars,” or “the road development is the prime culprit of air pollution by exhaust gas.” This is going too far too soon.

The full development of an urban railway system takes ten to twenty years. It would probably take just as long, if not more, to have the planned shift accepted and welcomed by the city population. A demotorized society requires a long gestation period to mature, while during all that time Istanbul and other big cities in the world are burdened by seemingly unstoppable motorization.

The undeniable fact is that the roads have always buttressed and will continue to support

the urban economy. Even if the planned TOD be completed, roads would remain the mainstay for urban logistics, taking care of both trunk transportation and door-to-door delivery. The clogging up of roads means the asphyxiation of urban economy and population. It is essential to provide the road capacity that allows some reasonable service level (e.g., the V/C ratio of less than 0.7 and the average driving speed of 10km or more per hour). Istanbul, like other cities in the world, will continue investing in the road construction and improvement, while gradually shifting the primary emphasis toward railways. Notably, the investment in roads must start nearly from scratch in the city's newly urbanizing areas.

16.4 Transport Demand Management (TDM)

When the supply of transport services lags far behind the demand growth, the users need be persuaded to forfeit some of their individual freedom of mobility. In order to have them ride some public transport means instead of driving their cars, a certain combination of carrots and sticks, so to speak, is necessary. Taking into consideration many TDM alternatives tried elsewhere in the world, the following four measures are proposed for metropolitan Istanbul.

- Collection of tolls from highway users (as taxation on congestion)
- Prevention of long hour parking in the CBD by charging higher parking fees
- Introduction of the park & ride commuting system
- Introduction of the traffic cell system in the historic conservation area in the CBD

16.5 Development Finance and PPP Schemes

The master plan projects are estimated to require at least US\$40 billion as discussed in the next section. It is extremely difficult to get the necessary finance solely from the national and the municipal government coffers. Judging from the past performance, one third of the total investment must be financed by sources other than the public sector.

The government of Turkey has a tendency to resort to the BOT scheme for financing large-scale projects like tunnels, bridges and railways that charge the users. However, the operation of public transport services is not very profitable by the very nature of being "public". It takes long time to recover the large initial investment cost and the operation in the meantime must be prepared for many risks. Therefore, the private capital is hardly likely to show interest in public transportation. Moreover, there are not many instances in the world of successful ventures by the private investors.

If the external borrowing and the issuance of bonds are to be excluded, it is a very critical issue how to generate a secure source of self finance. In accordance with the user-pay-principle or the polluter-pay-principle, the tax rates on gasoline and diesel can be raised or new taxes might be introduced by earmarking them for transport investment. However, Turkey is already one of the countries where fuels are most heavily taxed (US\$2.9 per liter of gasoline as of August 2008). It will be very difficult to raise the gasoline tax any higher. The viable alternative worth consideration is to collect tolls from highway users.

Assuming that the private capital be attracted to participate, it is possible to devise the PPP scheme for railway development in which the private and the public sectors duly share the

risks involved in the investment and operation. To create a source of fund for the public sector contribution, the master plan proposes the establishment of the Transit Development Acceleration Fund (TDAF) with time-limited legislation.

16.6 Master Plan Network

16.6.1 Master Plan Projects

The projects selectively added to the base network were those currently under study and project ideas of reasonable relevancy. Moreover, a considerable number of projects were conceived and proposed out of the discussions and analyses undertaken in the course of the present study. All these projects or project ideas were added to the base network to obtain the maximum network. The addition in the maximum network totals of 55 road projects (proposals for the built-up areas are bundled into project packages) and 23 railway projects. Their total cost amounts to US\$31.9 billion (US\$12.3 billion for roads and US\$19.6 billion for railways). The amount exceeds by 33% the balance left after subtracting the total cost of the base network projects (US\$16 billion) from the financial envelope of US\$40 billion.

78 additional projects in the maximum network were evaluated by their economic, financial and environmental justifiability as well as by their relative significance for the future transport development. The results of evaluation were then comprehensively examined to select 68 projects for the master plan period (2009 - 2023), the remainder being left for completion later than 2023. In the order of priority, the projects were assigned to the short term (2009 - 2013), the medium term (2014 - 2018), the long term (2019 - 2023 and thereafter).

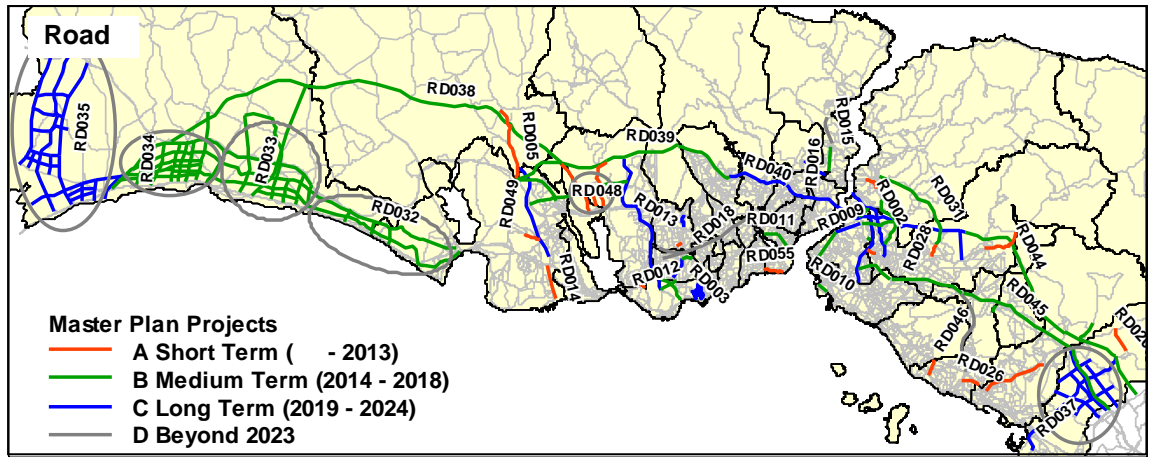
The summary of the evaluated projects is shown, with suggested implementation schedules, in Chapter 15. The short-term projects are defined as those that would be completed by the end of the said five years, and likewise for the medium- and long-term projects. If a given medium-term project takes long time to complete, its implementation must be started that much earlier to be completed by the end of the assigned five-year period.

Figure 16.6.1 shows the distribution of master plan projects per period of implementation. The largest road project concerns the east-west transversal road including the 3rd Bosphorus Bridge. The road sections on the European and the Asian side will be completed before 2019 with the bridge construction completed during 2019 - 2023.

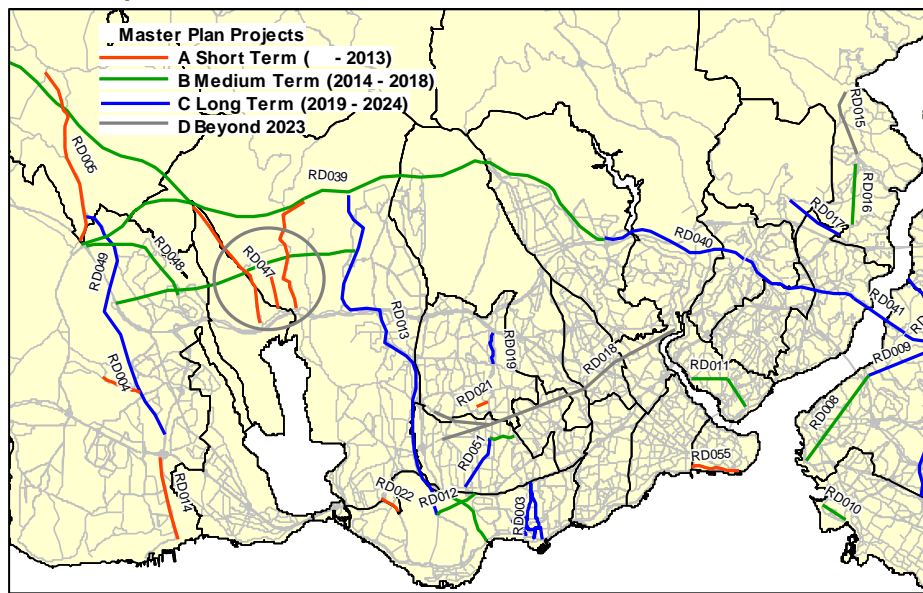
The short-term road projects mainly consist of packages of small projects with high expected economic impact in the built-up areas and similar packages for road network development in the western part of Bahcesehir District with rapid population growth. The Asian-side section of TEM will be completed during 2014 - 2018. The road network development package along B. Cekmece - Silivri - Gumusyaka is scheduled for the medium- and the long-term implementation.

None of the railway projects is for the short term, because their development takes long time to complete. Although most of the proposed projects must be started during 2009 - 2013, their completion is scheduled for the medium or the long term. The 3rd Bosphorus Bridge will serve as both road and railway links. The completion of the railway across the bridge is scheduled for the same period (2019 - 2023) as the road link.

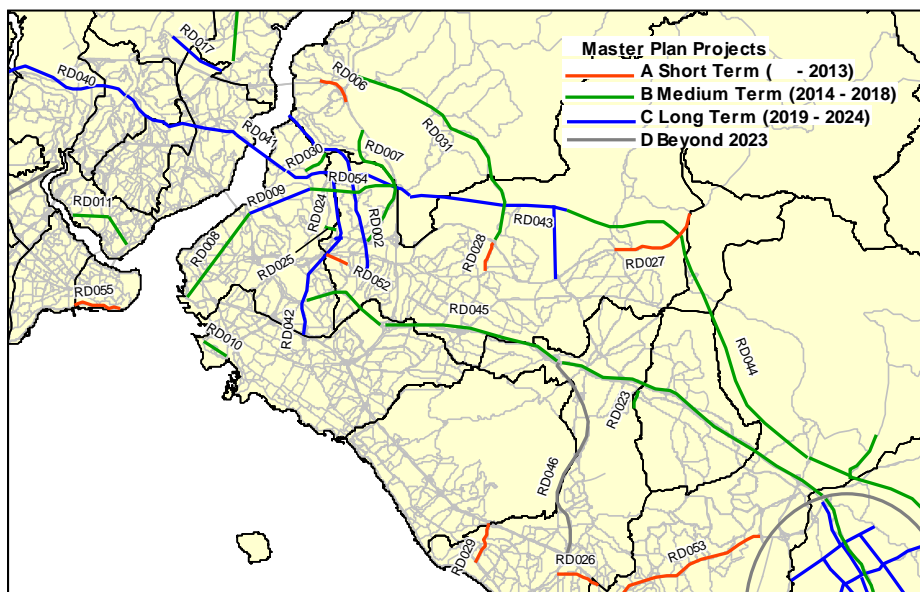
(1) Entire Study Area



(2) Eastern Part of European Side

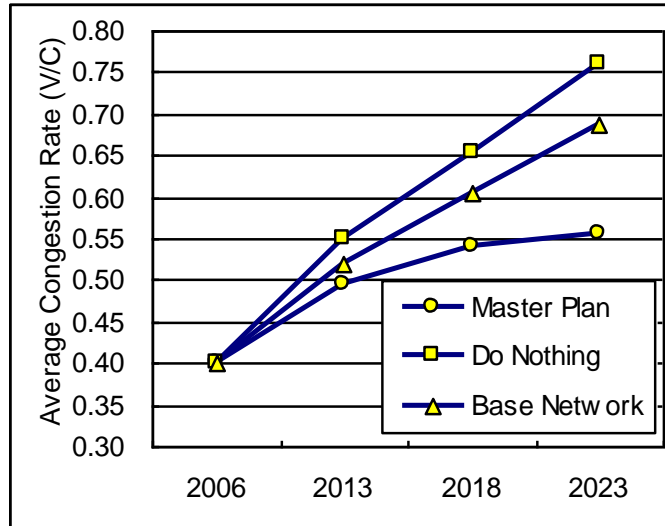


(3) Asian Side



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

Figure 16.6.1 Master Plan Projects of Road and Railway



Source: *ibid.*

Figure 16.6.2 Average Congestion Ratios by Scenario of Network Development

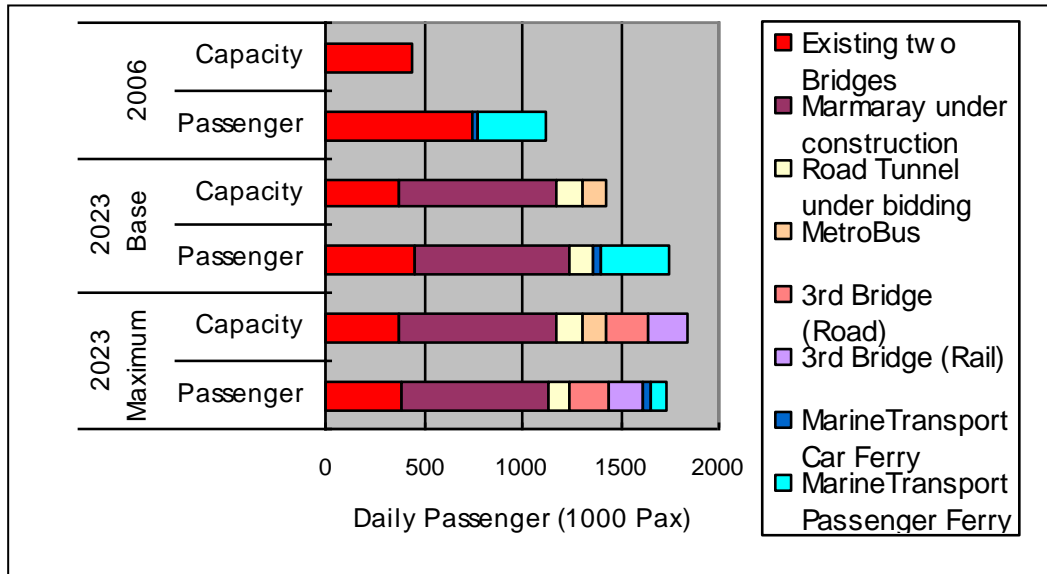
16.6.4 Bosphorus Crossing

The Bosphorus crossing has always been the biggest issue for the transport planning in Istanbul. The daily passenger trips across the Strait are currently 1.12 million, and expected to increase to 1.76 million in 2023. Figure 16.6.3 compares the present situation (2006) of capacity and passenger traffic with two cases of network development in 2023 (ferries are not included in the capacity figures).

Assuming the present modal split as given, the aggregated capacity of two existing bridges is, in theory, 440,000 passengers per day. The daily traffic continued to grow at an accelerating pace toward the end of the 20th century and thereafter, now 1.7 times the available capacity. The rapid increase of ferry passengers during the past decade was caused by this widened gap between the capacity and the demand.

When the Marmaray railway crossing and the road tunnel are completed, the total capacity for Bosphorus crossing will substantially increase. The capacity expansion will not, arguably, ease the pressure of demand for very long. The expected traffic on the new railway would probably consist of those passengers who otherwise travel by bus or ferry. The railway crossing would have only limited appeal to those who cross the Strait by car on the existing two bridges. The metro-bus route is now planned on the 1st Bridge (as of October 2008), but this will not increase the capacity of the bridge. The daily passenger traffic across the Strait will again increase to 1.2 times the available capacity by 2023.

The present master plan proposes the completion by 2023 of the 3rd bridge as both railway and road links across the Strait. The new bridge is needed simply to meet the expected growth of demand. However, there are many arguments against the new bridge. Main points of contention are the problem of land acquisition and the adverse impact on natural environment and landscape. It is necessary to undertake careful studies over these issues and explain the circumstances of project formulation until a general consensus begins to emerge.



Source: *ibid.*

Figure 16.6.3 Bosphorus Crossing Capacity and Passenger Traffic

16.6.5 Transport Infrastructure for Western Urban Development

The afore-mentioned land use plan estimates that the western area from Buyukcekmece to Silivri would absorb a population increase of 2.5 million by 2023 and concludes that the area needs the development of the urban core with appropriate urban services. To attract and absorb the population of this size, it is requisite to invest heavily, and as early as possible, in the basic economic and social infrastructure like transport, energy, water supply and sewerage.

In the transport sector, it is necessary to start the network development of trunk and access roads and the extension of railways into the area prior to other investments. At the very least, the land acquisition necessary for such transport facilities must be completed before the urbanization begins to pick up. The master plan proposes a number of project packages for road network development to be implemented over 15 years in the newly urbanizing areas.