GENERAL DIRECTORATE OF HIGHWAYS
MINISTRY OF TRANSPORT MARITIME AFFAIRS AND COMMUNICATIONS
THE REPUBLIC OF TURKEY

PREPARATORY SURVEY
ON
THE PROJECT FOR CONSTRUCTION OF DARDANELLES STRAIT CROSSING AND MOTORWAY UNDER PPP SCHEME
IN
THE REPUBLIC OF TURKEY

FINAL REPORT

JULY 2016

JAPAN INTERNATIONAL COOPERATION AGENCY

ITOCHU CORPORATION
IHI CORPORATION
IHI INFRASTRUCTURE SYSTEMS CO., LTD.
JAPAN EXPRESSWAY INTERNATIONAL CO., LTD.
ORIENTAL CONSULTANTS GLOBAL CO., LTD.

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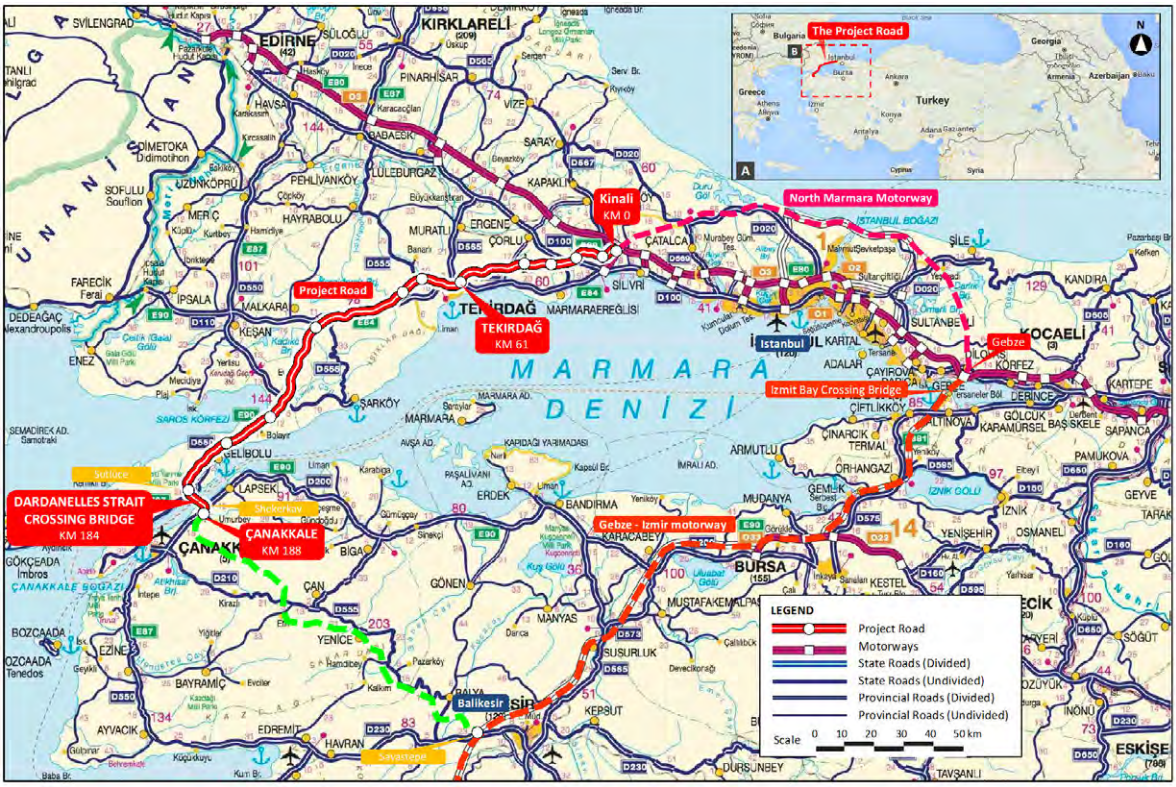

PROJECT LOCATION MAP

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1. INTRODUCTION

1.1 Background of the Survey

Turkey is located at the cross point between Asia and Europe, but the road connecting East and West continents is only suspension bridges over Bosporus strait, and sea transportation is the only way to go across Marmora sea and Dardanelles strait. In-flow traffic from East Europe through Bulgaria has been increasing, and the number of registered cars in the country increased from 8 million in 2000 to over 16 million in 2012. The increase of traffic demand due to rapid economic growth has caused chronical traffic congestion, and it is an urgent issue to set up efficient automobile network in the country. Turkey government raised its government program, so called “2023 vision”, and in this vision, the government is aiming to enter into one of the top ten large economies in the world by 2023. Turkish Motorway Authority “KGM” has also worked out “motorway development programs in order to achieve the government goal. In this development program, KGM is aiming to expand mobility, strengthen the network for automobile roads, increase the length of roads with more than two lanes, decrease the mortality due to traffic accident and etc. In addition, near sea of Marmara is one of the most developing area economically. And in order to keep the economic growth, Turkish government is planning to complete Gebze-Izmir Motorway which is under construction. This would be a surrounding road of this area and is the last place to be constructed in this surrounding network. Besides, similar to Japan, Turkey is a country with frequent earthquakes and the existence of an active fault in Maramara Sea is recognized. Thus, it is an urgent issue to establish an alternative route which bypasses Istanbul.

1.2 Survey Objectives

The purpose of the survey is to work out the detailed plan for the captioned project (demand forecast, project scope of work, project cost, schedule,, way of implementation, project implementation structure, O&M structure, environmental and social considerations, of the project and etc.) and to implement necessary survey for application of Private Sector Investment Finance.

1.3 Survey Area

The project motor way starts from Kinali, which is European side of Istanbul, via Dardanelles straits-bridge (west north of Canakkale city) through Tekirdag province, and reaches to Savastepe city of Balikesir province**.**

2. REVIEW OF CURRENT STATUS AND ROAD TRANSPORTATION SECTOR IN TURKEY

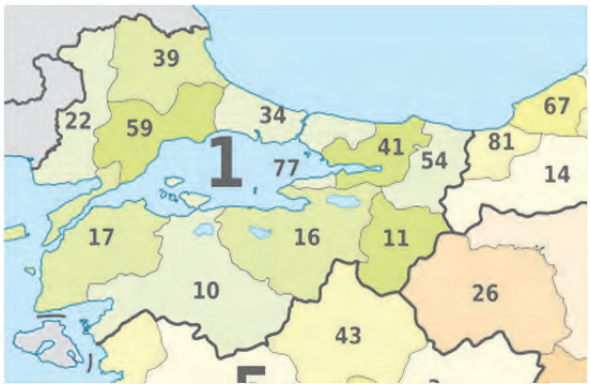
2.1 Current Status of Social and Economic Conditions in the Region of the Project

2.1.1 Socio-Economy

(1) Population

The project site of the Dardanelles Strait Crossing and Motorway is located in Marmara Region which is at the north-west end of Turkey and faces Greece and Bulgaria. The growth of the population of Republic of Turkey is shown in Figure 2.1.2 and the Marmara Region is shown in Figure 2.1.3. Marmara Region consists of 11 provinces, which are 22 Edirne, 39 Kırklareli, 59 Tekirdağ, 34 İstanbul, 41 Kocaeli, 54 Sakarya, 77 Yalova, 11 Bilecik, 16 Bursa, 10 Balıkesir, 17 Çanakkale, (see Figure 2.1.1). The population in 2014 are 77.7 million in the country and 23.6 in the region. The growth rates from 2007 are 10.1% and 13.9% respectively, with significant growth. They are rated highly with 1.4% and 1.9% annual respectively. The country's capital city, Istanbul is in Marmara Region, and the population is 30.4% of total population of the country. However, the land area is only 9.4% of the national territory and the population density exceeds 300 people per km^2.

The population of 4 provinces (34 İstanbul, 59 Tekirdağ, 17 Çanakkale, 10 Balıkesir) along the planned route of the motorway is about 17.0 million and the growth rate from 2004 is 14.0% and annual average growth rate is 1.9%. (see Figure 2.1.4)



Source: Turkey Statistical Institute

Figure 2.1.1 Map of Marmara Region

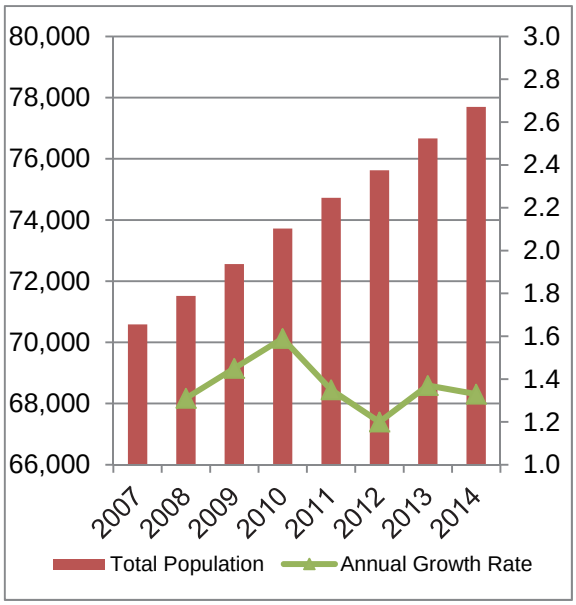
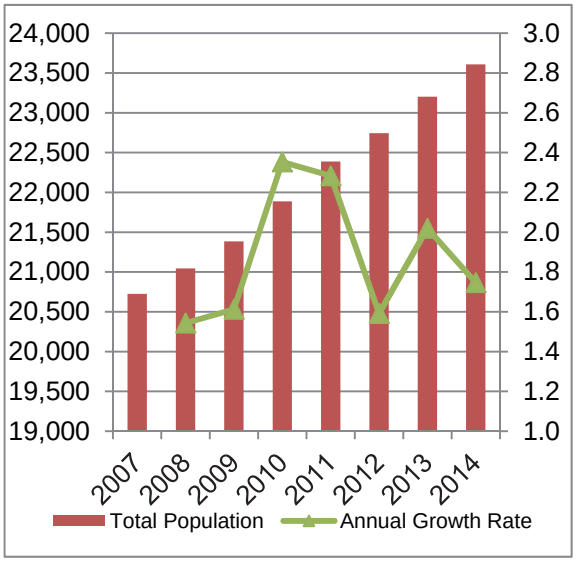
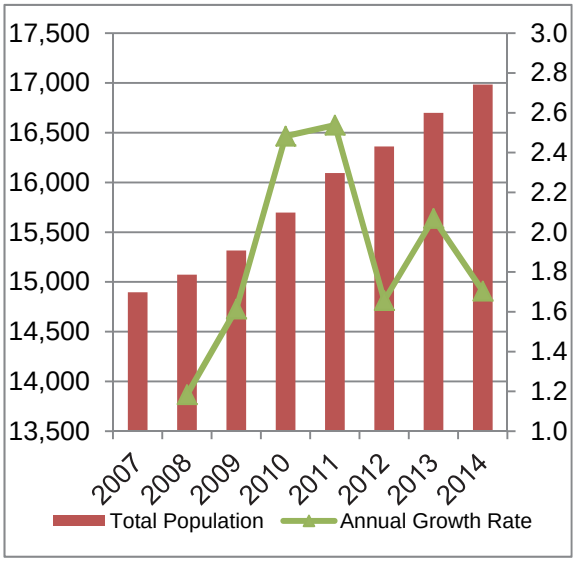


Figure 2.1.2 Population Growth in Republic of Turkey ('000)





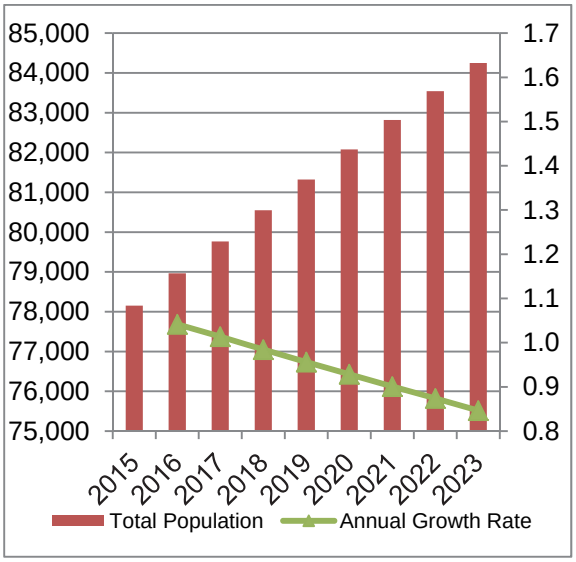
Source: Turkey Statistical Institute

Figure 2.1.3 Population Growth in Marmara Region ('000)

Figure 2.1.4 Population Growth in Four Provinces along the Planned Route

(2) Population Forecast

Population Forecast of the country, Marmara Region, and four provinces along the route are demonstrated in Figure 2.1.5, Figure 2.1.6, and Figure 2.1.7. The annual growth rate of whole country is gradually reduces from 1.6 to 1.3%. The annual growth rates of Marmara Region and four provinces along the route also gradually reduce from 1.5～1.2% and 1.6～1.3%. and Population in 2023 is projected to be 84.2 million in whole country, and 26.7 in Marmara Region, and 19.4 million in the four provinces. The percentage of the Marmara Region of whole republic would increase to 31.7% and the population density to 370 approximately.



Source: Turkey Statistical Institute

Figure 2.1.5 Population Forecast of Republic of Turkey (‘000)

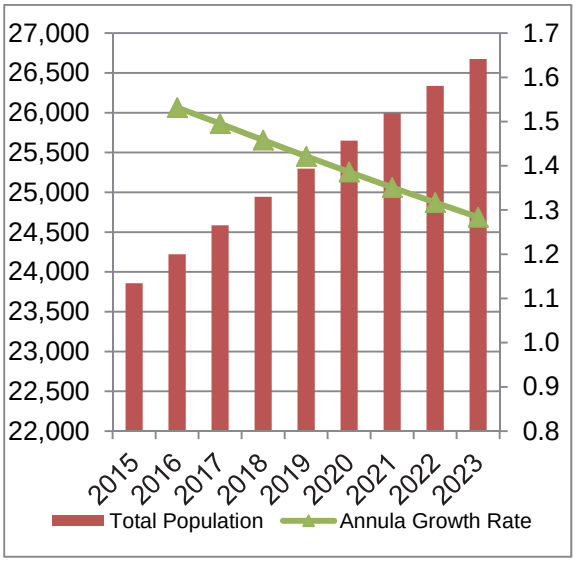
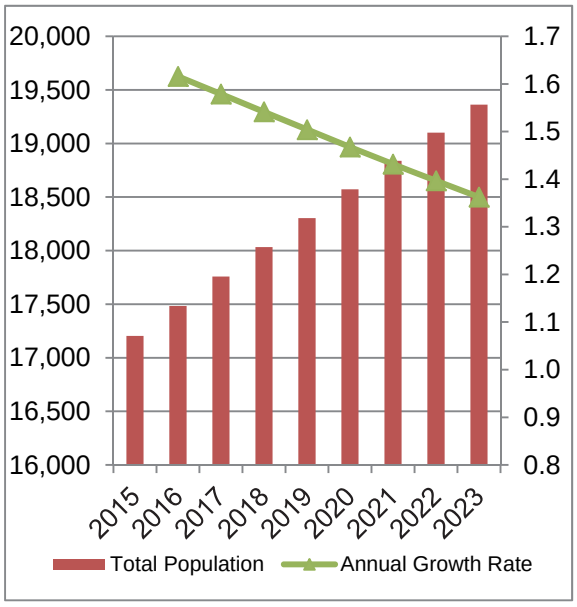


Figure 2.1.6 Population Forecast of Marmara Region (‘000)

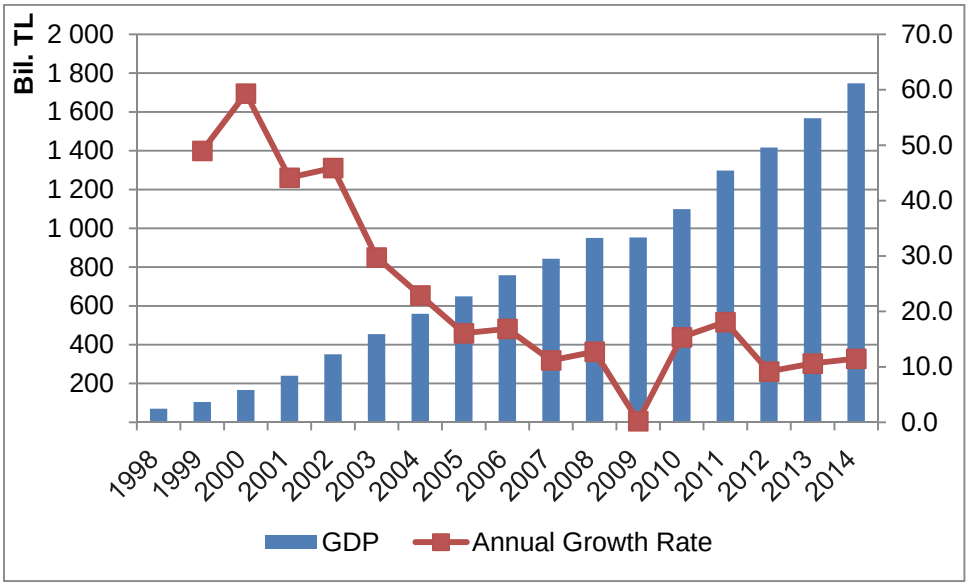


Source: Turkey Statistical Institute

Figure 2.1.7 Population Forecast in Four Provinces along the Planned Route (‘000)

(3) GDP and GRDP

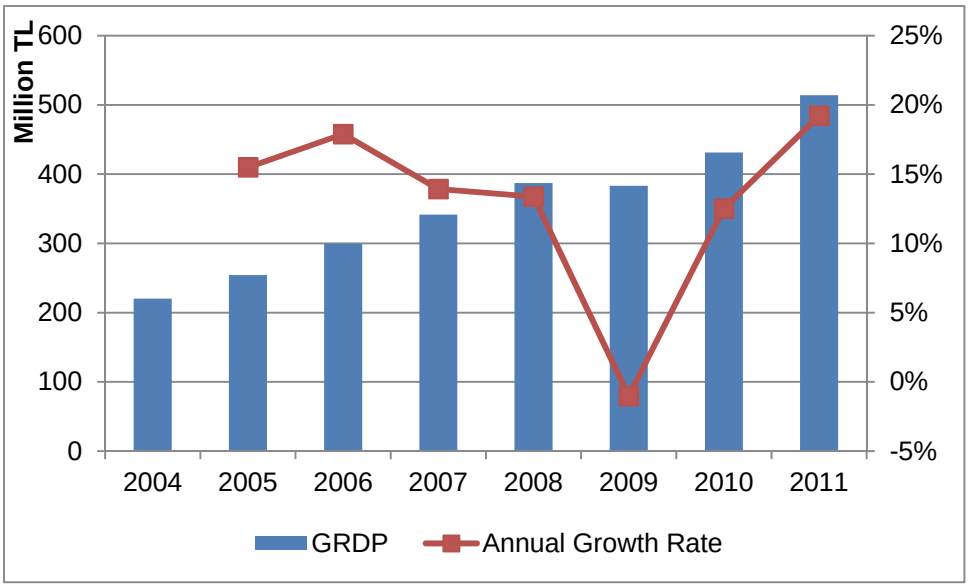
GDP of the Republic is grown significantly from 1998 to 2014. GDP of 2014 is about 25 times of GDP in 1998. The growth rate has kept more than 10% annual except 2009 due to the worldwide recession started by Lehman Brothers bankruptcy. Turkish economy is growing steadily recently.



Source: Turkey Statistical Institute

Figure 2.1.8 GDP Growth of Republic of Turkey

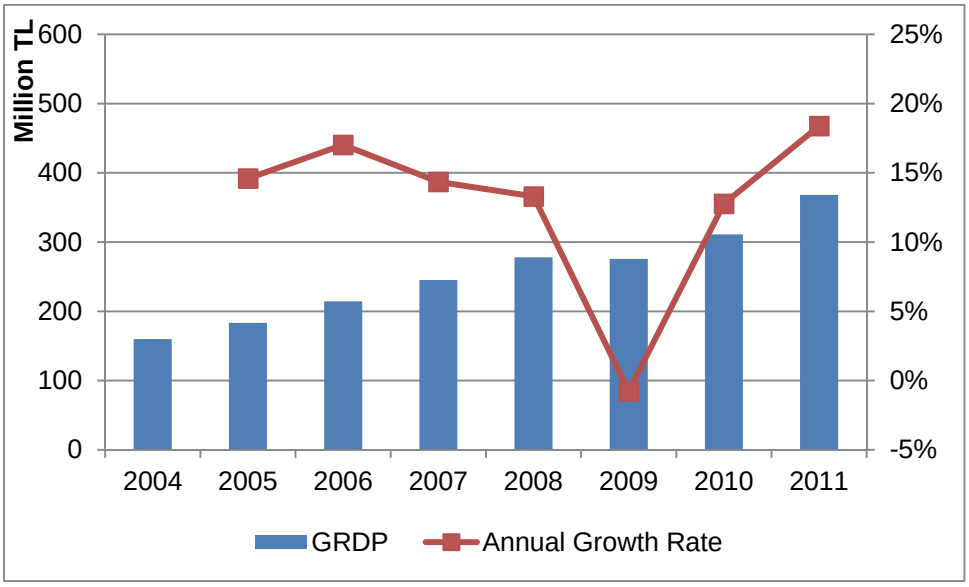
The following Figure 2.1.9 shows the GRDP growth of Marmara Region and three provinces (26 Eskişehir, 14 Bolu, 81 Düzce. See Figure 2.1.1) and its growth rate. This region also has been performing very strong growth during last decade with more than 12% except 2009.



Source: Turkey Statistical Institute

Figure 2.1.9 GRDP Growth of Marmara Region and 3 provinces

The following Figure 2.1.10 shows the GRDP growth of six provinces along the planned motorway route. (34 İstanbul, 59 Tekirdağ, 17 Çanakkale, 10 Balıkesir, 22 Edirne, 39 Kırklareli. See Figure 2.1.1) This area has been performing very strong growth during last decade with more than 12% except 2009.

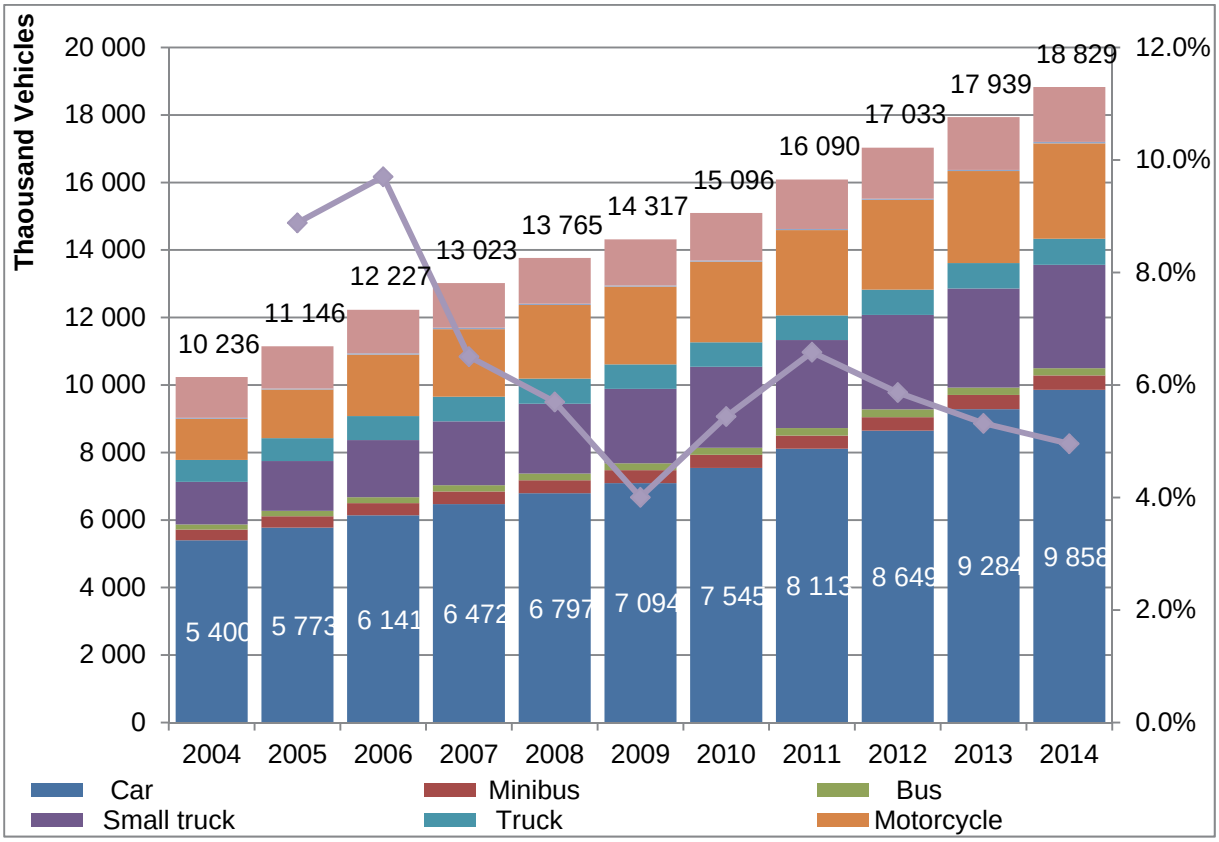


Source: Turkey Statistical Institute

Figure 2.1.10 GRDP Growth of Six Provinces along the Planned Route

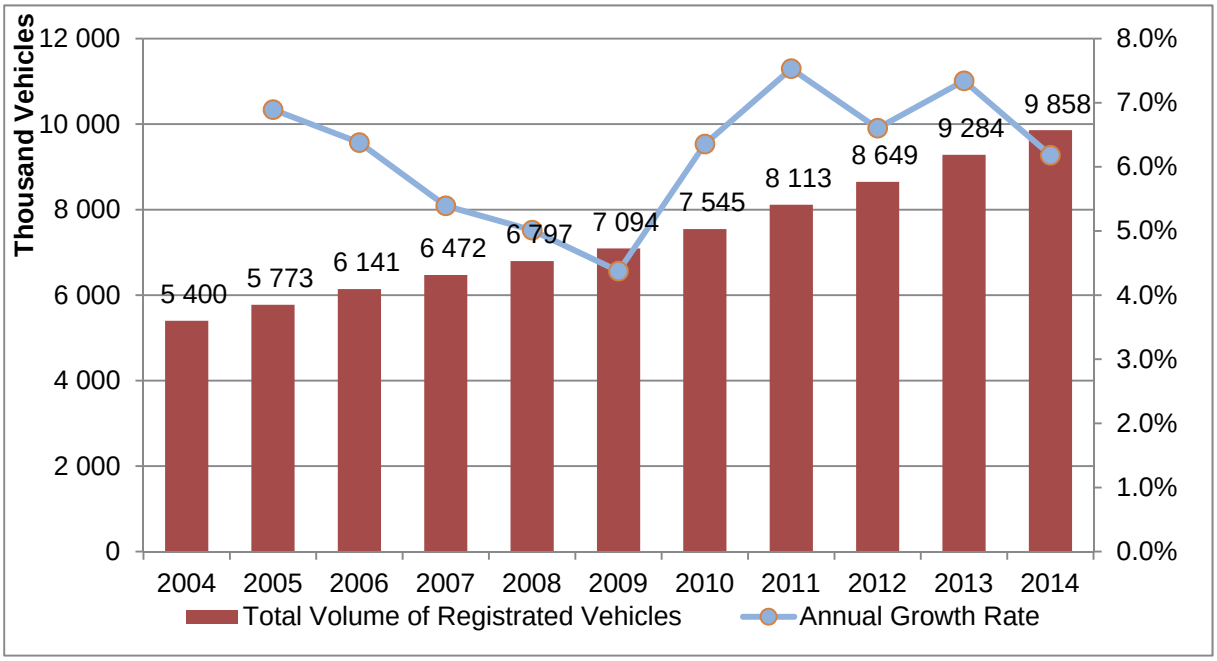
(4) Number of Road Motor Vehicles and Distribution of Cars Registered to the Traffic

This chapter describes the number of road motor vehicles and distribution of cars registered to the traffic in Turkey. The total number of road motor vehicles rose up to 1.9 million in 2014, which is 1.8 times larger than that of 2004 in a decade. The annual growth rate of this period is 6.3%. The number of distribution of cars registered to the traffic is also grew more than 1.8 times with annual growth rate of 6.2%.



Source: Turkey Statistical Institute

Figure 2.1.11 Number of Road Motor Vehicles in Republic of Turkey



Source: Turkey Statistical Institute

Figure 2.1.12 Number of Distribution of Cars Registered to the Traffic in Republic of Turkey

2.2 Current Status and Challenges of the Transportation Sector and Policy/ Development Plan and Budget for the Sector

As of now, the public roads in Turkey are classified in six-tier system; motorway, state road, provisional road are governed by KGM, city road is governed by city administrative agency, and village road and forest road are governed by special local administrative agency. Total road length governed by KGM is 65,551km and is composed of motorway road (3.4%), state road (47.8%) and local road (48.7%). On the other hand, the proportion for freight and passenger transport volume of automobile-only roads is 22.6% and 22.00% respectively, which is higher compared to the extension distance. To strengthen regional disparities and the international competitiveness of domestic east and west, immediate of motorway development and expansion have been demanded strongly.

In 2003, there was only 6,101km for more than two lanes each way road. Afterwards, from traffic safety point of view, multi-lane had been encouraged and resulted in the decrease the rate of traffic accident per 1km, per 1 hundred million from 5.72 to 2.63. As a result, a percentage of road infrastructure investments of GDP has been swollen from 0.4 % (2003) to 3 times the maximum 1.2% (2011). In addition, although KGM is said that the organization has been operating with an independent budget system, according to the KGM public documents, among the expenditures 15.944.055.079 TRY by KGM of 2013, which was funded by the central government 14.905.753.101 Turkish Lira is a ($ 1 about 2.8 lira (August 2015)), and relies on assistance from the government which accounts more than 90%. Hence road expansion and maintenance have been necessary for the PPP approach that leverages private funds and know-how.

Figure 2.2.1 Network of Motorway in Republic of Turkey

As following the motorway projects that aim to complete by the PPP to the Turkish government until 2023.

Table 2.2.1 PPP motorway projects list of the Turkish government aims to complete in 2023

	TARGET BOT MOTORWAY PROJECTS 2023	Length (km)	Status
1	Gebze-Orhangazi-Izmir Motorway	421	Contracted IC
2	North Marmar Motorway	414	Tender announced. (except for 3rd Bosphourous Bridge and Access Road).
3	Ankara-Nigde Motorway	342	Approved by HPC
4	Ankara-Samsun Motorway I-Ankara=Kirikkale=delice Section	112	-
	Ankara Samsun Motorway II-Delice-Samsun Section	320	-
5	Aydin-Denizli-Burdur Motorway Aydin-Denizli Section	175	-
	Aydin-Denizli-Burdur Motorway Denizli-burdur Section	155	-
6	***Kinali- TekirdAg -Canakkale-Balikesir Motorway***	***370***	***Completed FS. Under judgement***
7	Sabuncubeli Turnnnel	4	Due to default, resulted in public work.
8	Ankara-Izmir-Motorway	535	-
9	Afyonkarahisar-Antalya-Alanya Motorway	490	-
10	Sibrihisar-Bursa Motorway	202	-
11	Shanliurfa-Habur Motorway (Including Diyarbakir Connecting)	445	-
12	Gerede-Merzifon-Gurbulak Motorway I-Gerede=Merzifon Section	357	-
	Gerede-Merzifon-Gurbulak Motorway II-Merzifon-Gurbulak Section	908	-
	Total	**5,250**	

Note: number 6 is the project which includes this project.

2.3 Current PPP Infrastructure Situation in Turkey, especially for Motorway Projects

In Turkey, Sabuncubeli Tunnel is the only project which was initiated by Turkish local company. But as a result of default caused by project company, KGM have taken over the project and now initiated it as public work. As a large PPP (BOT) motorway projects that foreigners are involved, there are the following projects.

- Istanbul - Bosporus (Eurasia) tunnel project
- Gebze - Izmir motorway project
- Third Bosporus Bridge and access road project

(1) Istanbul - Bosporus (Eurasia) tunnel project

Figure 2.3.1 Istanbul - Bosporus (Eurasia) Tunnel Position Diagram

The project is a highway tunnel construction and operation project connecting European side of Istanbul, the Asia side. The competent authority is the General Directorate of Infrastructure Investments (AYGM), BOT entities Yapi Merkezi (Turkey general contractor) and SK E & C (Korea) SPC, which consists of a "Avrasya Tüneli İşletme İnşaat ve Yatırım A.Ş. (ATAŞ)". It signed a concession agreement with the ministry in 2011. Project cost is about $ 1.25 billion and the project period is five months and 24 years, which is currently under construction. Financing outlines of the project are as follows:

- Total project cost: $ 1.25 billion
- Equity: $ 0.29 billion
- Finance: $ 0.96 billion (Tenor 18 years)
- Finance details:
  - $ 0.55 billion: Direct finance from EIB, EBRD, K-EXIM
  - $ 0.21 billion: Commercial banks covered by K-EIM and K-Sure
  - $ 0.2 billion: Commercial banks based in Turkey

(2) Gebze - Izmir Motorway Project

Figure 2.3.2 Gebze - Izmir Motorway Position Diagram

The project is the construction and operation projects of the motorway connecting from Gebze which is located about 50km from Istanbul to the east until the third largest city Izmir in Turkey. The competent authority is the same of KGM and this project, BOT entities Nurol, Ozaltin, Makyol, Yuksel, a Gocay (all Turkish companies), Astaldi (Italy) consists of SPC "OTOYOL". In 2009 the concession agreement was signed between KGM and OTOYOL. Project cost is approximately $ 6.5 billion and the project period is for 22 years and four months. This motorway will, when completed with a central span 1,550m includes the Izmit Bay Crossing Bridge, be the fourth-largest long suspension bridge in the world. IHI Infrastructure Systems (IIS) and ITOCHU consortium got orders the bridge, which is currently under construction.

Financing outline of the project is as follows:

- Total project cost: Approx. $ 6.5 billion
- Equity: Approx. $ 1.5 billion
- Finance: Approx. $ 5 billion
- Lenders: Deutsche Bank, Local Banks in Turkey (Akbank, Garanti Bankasi, Finansbank, Is Bankasi, Halkbank, Ziraat Bankasi, Yapi Kredi and Vakfbank）

(3) Third Bosphorus Bridge and Access Road Project

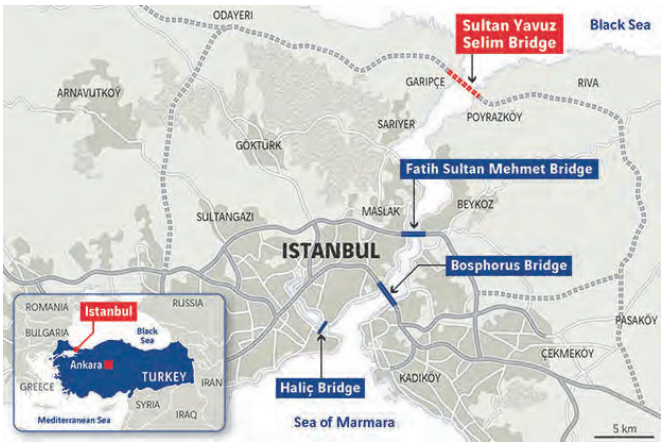


Figure 2.3.3 Third Bosporus Bridge Position Diagram

The project is the construction and operation of the third Bosporus Bridge and its access road about 100km which covers a part of the North Marmara Motorway, including Istanbul. This project is the part of North Marmara Motorway project, which is one of the project of 15 projects and is tried to completed by 2023. Except for this part, the other parts had been announced and bidding date would be 1st 2016. The competent authority is KGM and BOT entity is SPC “ICA” which is composed of ICitas (Turkey) and Astaldi (Italy) ". ICA signed a concession agreement with KGM in 2012. Project cost is about $ 2.5 billion and the project period is for 10 years and 2 months, which is currently, under construction by Korean companies and others.

Financing outline of the project is as follows:

- Total Project Cost: Approx. $ 2.5 billion
- Equity: Approx. $ 0.5 billion
- Finance: Approx. $ 2 billion (Tenor 9 years)
- Lenders: 7 Local Banks in Turkey (Isbank, Yapi Kredi, Vakifbank, Garanti, Halkbank, Ziraat Bank and Garanti Bank International NV）

2.4 Current Conditions of the Project Site

As described above, based on the growth target of the Turkish countries "VISION 2023", KGM has set ideal goals; the expansion of mobility, strengthening of the motorway network, an increase of two or more lanes of the road extension, a reduction in the traffic accident death rate. As already mentioned, surrounding motorway of Marmara would be necessary for keeping economic growth and this project is one of the projects they mentioned. Hence, necessity of this project would be extremely high.

The effects of this project to be achieved are as follows;

Development of local economy

This road is an arterial road starting from Kinali located at Europe side of Istanbul through Tekirdag and Dardanelles strait crossing bridge (northwest side of Caanakkalle City), to Savastepe, Balikesir Prefecture - starting from the European side and the Kunar (Kinali) Le, through the Tekiruda (Tekirdag) prefecture. With the completion of the road, this bridge would enable direct access from Europe to Turkey southwest, which is industrial area like Izmir and Aydin, and contribute to development the large ring road around the Sea of Marmara networks and at the same time to promote the economic development of Turkish western region.

Solve the traffic jam

With the completion of the motorway, it would enable direct access to southwest side of Turkey from Europe and form the large ring road network around the Marmara Sea networks and its surrounding areas. This would contribute to mitigate the traffic jam in Istanbul city which is caused by the inflow traffic from Europe.

Traffic Safety

With the completion of the motorway, this traffic which was passing the street would be converted to the motorway, and it would reduce the number of traffic at the intersection which is the major cause of the traffic accidents. This would improve traffic safety in this country.

3. STUDY ON THE OUTLINE OF THE PROJECT

3.1 Project Scope

This project is one of the parts of the motorway from Kinali to Balikesir. The motorway is divided as follows in terms of region;

Table 3.1.1 Motorway from Kinali to Balikesir

Block	Motorway from Kinali to Balikesir	Block distance
Motorway Europe side	Kinali to Silivri-Gelibolu	183 km
Bridge	Dardanelles Strait Crossing Bridge	3 km
Motorway Asian side	Shekerkav to Baikesir	144 km

Scope of the BOT bid has not been determined yet, but population in Tekirdag prefecture has grown up rapidly much more than the average rate in Turkey. (this area: 36% against average 13.3% in year 2013 and 2014.) Such growth would continue and so the demand for infrastructure would be stable. Hence we presumed the scope of this project which consists of motorway Europe side and Dardanelles Strait Crossing Bridge and analyzed in the following part. If Asia side construction work delayed, the original purpose would be achieved, which would contribute to development the road surrounding Marmara area leads to Asia.

3.2 Traffic Demand Forecast based on the Result of OD Interview Survey

(Undisclosed)

3.3 Design Condition

3.3.1 Highway Design

Feasibility Study of the Proposed Motorway has been completed by the government of Turkey so that this survey basically reviews the designated corridor which is disclosed to public. The following table summarizes the required geometric design conditions for the motorway based on the geometric design standard in Turkey (e.g.: "Motorways Project Engineering Services Criterion Report" and "Highway Design Handbook"). Some of the elements are determined in reference to AASHTO standard "A Policy on Geometric Design of Highways and Streets, 6th Edition (2011)" or Japanese standards (e.g. : Road Structure Ordinance and NEXCO[1] Design Standard).

[1] Nippon Expressway Company Limited

Table 3.3.1 Geometric Design Conditions

Elements of Design			Unit	Motorway	Interchange Ramp		Remarks
					Loop	Others	
Design Speed			km/h	120	40	60	
Cross Sectional Elements							
Number of Lanes			-	3-lane per direction	1-lane per direction		
Carriageway Width			m	3.75	3.75		
Shoulder Width	Outer Shoulder		m	3.00	2.00		
	Inner Shoulder		m	1.00	1.00		
Mergin			m	1.00	1.00		
Median (excluding Shoulder)			m	5.00	3.00		
Widening at Curve Section			m	30 × n/R (>0.5m)			R<130m n: Number of lanes
ROW Width			m	15 m outside from edge of slope			
Normal Crossfall			---	2.5%			
Max. Superelevation			---	6.0%			
Slope Gradient	Fill Slope		---	H<1.5m: 1/4, 1.5m<H<3.0m: 1/3 3.0m<H<5.0m: 1/2 H>5.0m: Determined by Stability Analysis			
	Cut Slope		---	Determined by Stability Analysis			
Horizontal Alignment							
Min. Curve Radius			m	1,000	80	130	
Min. Transition Curve Parameter			m	350	60	80	
				R/3 < A < R			
Min. Curve Radius without Transition Curve			m	3,000	280	410	$\sqrt[3]{(A^4/24S)}$, S=0.20
Min. Curve Radius without Super elevation			m	5,000	550	1,250	$R=V^2/127(i+f)$, i=2.5%, f=4.8%
Max. Length of Single Element Section			m	3,000			
Vertical Alignment							
Grade		Max.	---	4.0%	Ascending: 5% Descending: 6%		
		Min.	---	0.5%			
Min. Rate of Vertical Curvature		Crest	K	200	15	20	K=R/100
		Sag	K	100	7.5	10	Ditto
Stopping Sight Distance			m	275	60	80	
Vertical Clearance			m	5.00			
Interchange							
Carriageway Width			m	---	3.75		
Acceleration Lane to Main Highway	Min. Length		m	---	345		
	Type			---	Parallel		
Deceleration Lane from Main Highway	Min. Length		m	---	280		
	Type			---	Parallel		

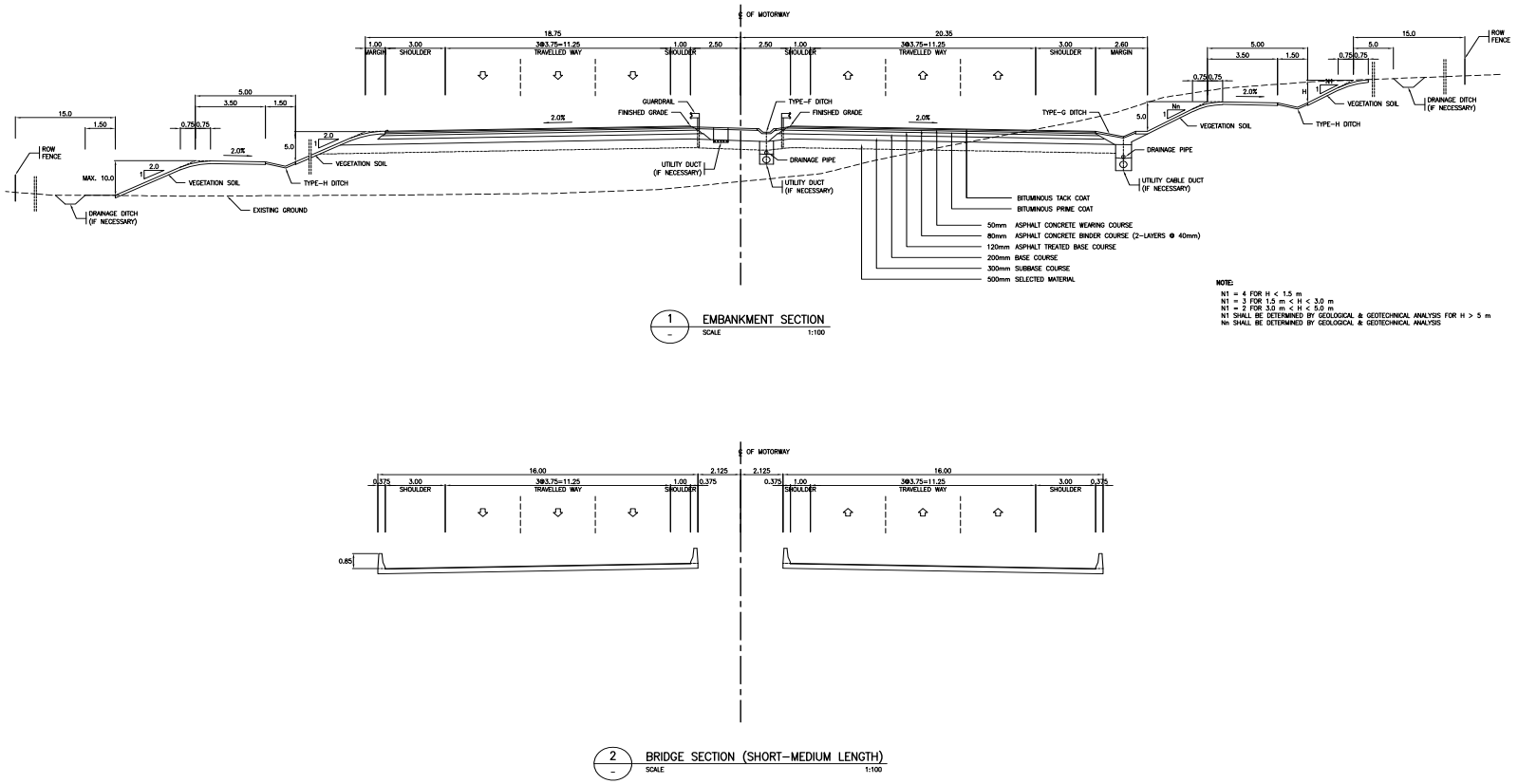
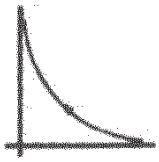
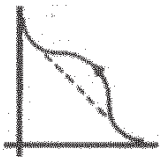
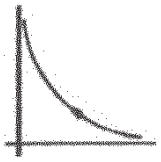
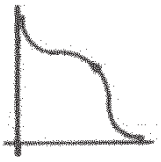
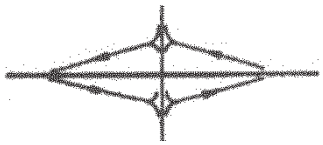
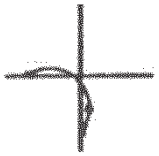
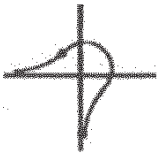
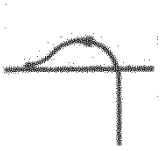
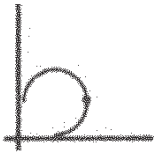
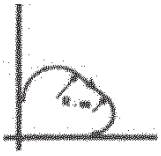
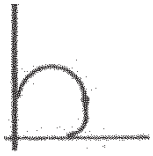
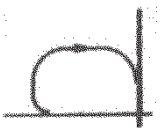


Figure 3.3.1 Typical Cross Section

(1) Design Speed

Turkish standard unify the design speed of motorway as 120 km/h. Whereas Japanese standard or AASHTO standard suggest several design speeds depending on the land use, topographic condition, projected future traffic volume and economical point of view but the Turkish standard is not the same.

On the other hand, as shown in the table below, there are several design speeds from 30 to 80 km/h for interchange ramp ways depending on the shape of ramps or inter-connectivity to connecting roads.

Ramp Type	Main Expressway: Non-Intersecting Connecting Road: Non-Intersecting		Main Expressway: Non-Intersecting Connecting Road: At Grade	
Directional	 60 – 80	 50 – 60	 40 – 60	 40 – 60
	Service Road 60 – 80		 40 – 60	
Semi-directional	 60 – 80	 40 – 60	***	 40 – 60
Non-directional	 40	 30 – 40	 40	 30 – 40

Source: Motorways Project Engineering Services Criterion Reportays Project Design Handbook

(2) Cross Section Elements

Turkish standard specifies 3.75 m of carriageway width for both main expressway and interchange ramps. Three (3) lanes are typical regardless of the projected future traffic volume. Considering that NEXCO standard use 3.75 m of carriageway width for the middle lane of expressway whose design speed is over 100 km/h and the number of lanes is more than three (3) and AASHTO standard suggests 3.60 m of carriageway width for expressways, the carriageway width under Turkish standard is relatively wider than other standards.

(3) Horizontal Alignment

Minimum horizontal curve radius under Turkish standard is 1,000 m which is equal to the desirable minimum radius under NEXCO standard. Considering that the minimum horizontal curve radius under NEXCO standard or AASHTO standard are 710 m and 756 m respectively, it can be said that the Turkish standard is safer side than other standards.

Standards		Minimum Horizontal Curve Radius (m)	Maximum Superelevation Rate	Side Friction Factor
Turkish Standard		1,000	6.0%	***
NEXCO Standard	Desirable	1,000	***	***
	Minimum	710	6.0%	0.10
AASHTO Standard		756	6.0%	0.09

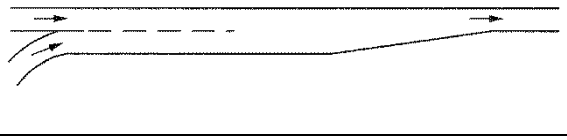
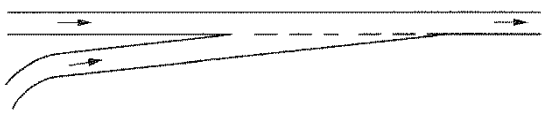
(4) Vertical Alignment

The maximum grade of vertical alignment under Turkish standard is 4.0% which is steeper than that of NEXCO standard (2.0% for design speed of 120 km/h). However, as mentioned earlier, Turkish standard has design speed of 120 km/h only and the topographic condition at the vicinity of the project site varies from flat to mountainous terrains. In reference to NEXCO standard, it can be said that 4.0% of grade would be reasonable. However, gentle grade should be adopted as much as possible for actual design unless otherwise the existence of limitation due to topographic condition or land use.

Standards		Maximum Grade		
Turkish Standard		4%		
NEXCO Standard		Minimum	Special Case	
	Design Speed: 120km/h	2%	5%	
	Design Speed: 100km/h	3%	6%	
	Design Speed: 80km/h	4%	7%	
AASHTO Standard		Flat	Rolling	Mountain
	Design Speed: 120km/h	3%	4%	***
	Design Speed: 100km/h	3%	4%	6%
	Design Speed: 80km/h	4%	5%	6%

(5) Interchange Ramp Terminal

There are two (2) types of shape for interchange ramp terminal, namely paralleled type and tapered type. Based on the actual condition surveys in Japan about the movement of vehicles, the paralleled type and tapered type are typically adopted for acceleration lane and deceleration lane respectively. On the other hand, Turkish standard unify the type of ramp terminal as paralleled type. This would be based on the experience in Turkey or drivers' characteristics of driving. Therefore, adopting paralleled type for both acceleration/deceleration lanes would be reasonable.

	
Paralleled Type	Tapered Type

3.3.2 Strait Crossing Bridge Design

Considering the distance crossing Chanakkale strait of some 4km, the suspension bridge can be the most suitable solution. To define the basic bridge conditions to be used in this F/S, the preliminary studies about meteorological conditions and seismic hazard risk analysis have been performed, and then the conceptual design was made accordingly.

Figure 3.3.2 Bridge location

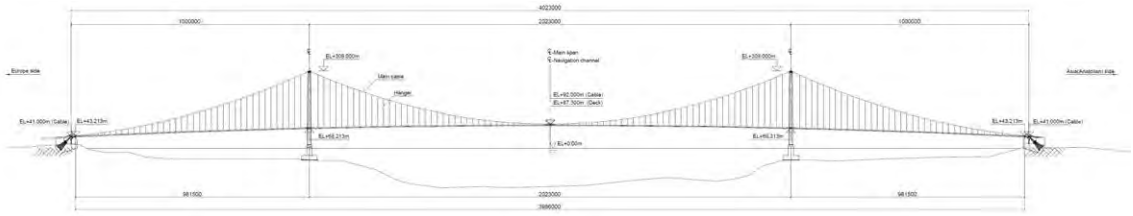


Figure 3.3.3 General arrangement of suspension bridge

(1) Meteorological conditions

To have an idea for criteria about wind, wave and current, the computational approach has been applied and the results in the mid centre for wind and at the tower foundation for wave and current are obtained based on the available data at the time of this study, respectively. The locations analyzed in this report are illustrated in Figure 3.3.4.

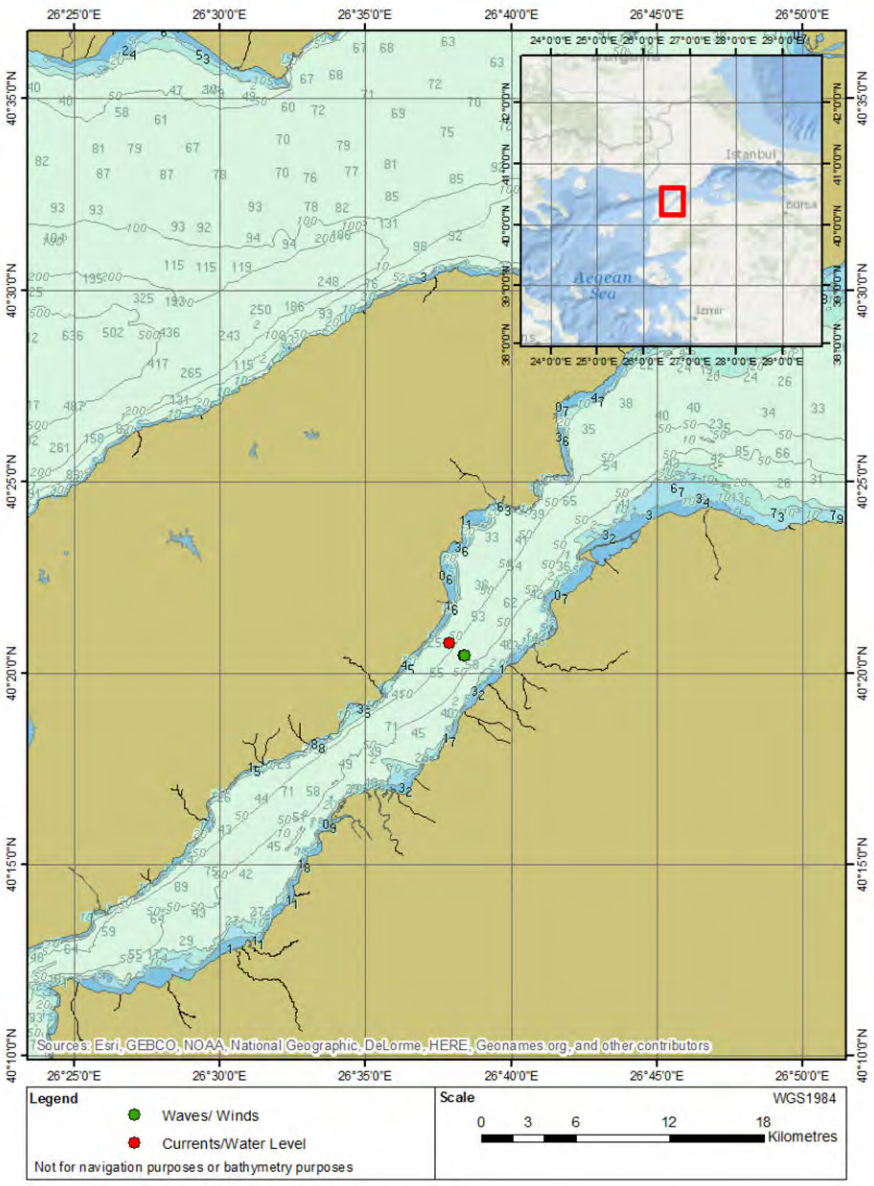


Figure 3.3.4 Analyzed locations

1) Wind condition

The preliminary wind criteria were derived using a 10 year hindcast of wind date sourced from American National Centers for Environmental Prediction Climate Forecast System Renanalysis data or sourced from the European Centre for Medium-range Weather Forecasts ERA-Interim data. Since the bridge location is very close to the coast, the hindcast wind data at a coarse resolution might not accurately represent local wind features. The collected hindcast wind data was calibrated by the observations collected at WMO meteorological network stations.

All-year operational wind criteria are presented in Figure 3.3.5. Wind direction is expressed in compass points, relative to true north, and describes the direction from which the winds were blowing. 42% of wind is from NE direction, i.e. the wind along the strait toward Aegean sea. The wind speed looks moderate and lower than 6m/s in 90% in a year.

The extreme wind speed has been derived using the peaks over the threshold method. The extreme omni-directional all-year wind criterion is shown in Table 3.3.2.

It should be highlighted that the date is very preliminary and the wind speed measurement exactly at the bridge location by using an anemometer is of importance to define the project wind criteria since the wind stability is one of the most critical technical issues for such a long span bridge.

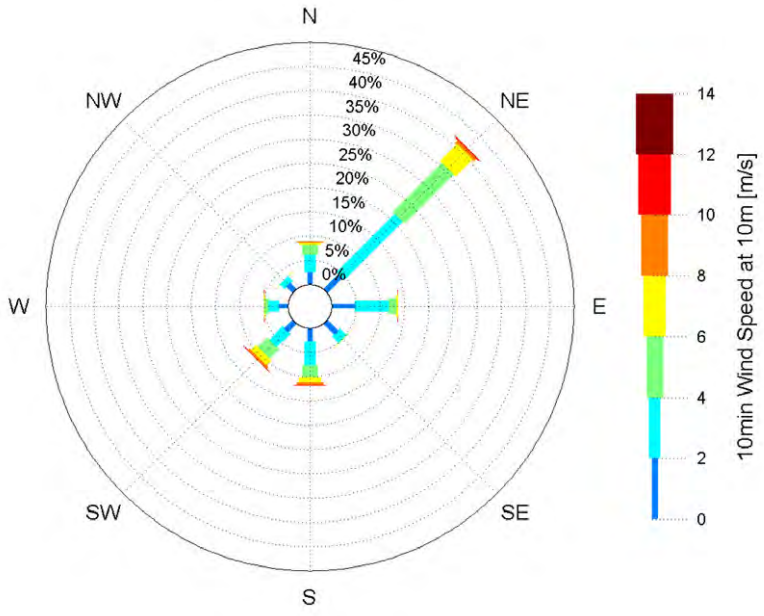


Figure 3.3.5 Percentage occurrence of 10-minute mean wind speed at 10m above sea level

Table 3.3.2 Extreme omni-directional all-year wind criterion

Return period	10-minute mean wind speed at 10m above sea level (m/s)
100 years	18.1

2) Wave condition

Spectral wave data at offshore locations have been transformed into the target locations using the Simulating Waves Nearshore (SWAN) model to provide wave statistics at the bridge location. The SWAN wave model consists of three model domains, i.e. regional, intermediate and local, in order to maintain a proper ratio between grid resolution. Extreme all-year wave criteria are summarized in Table 3.3.3.

Table 3.3.3 Extreme all-year wave criteria

Return period	100-years
Significant wave height (Hs)	1.6m
Mean zero-crossing period (Tz)	3.2s
Peak period (Tp)	4.8s
Maximum crest height (Cmax)	1.9m
Maximum wave height (Hmax)	2.9m
Wave period associated with Hmax	4.8s

3) Current condition

Current criteria have been derived using the peaks over threshold method, from MIT General Circulation Model (MITgcm).

All-year operational current criteria at 0m (near-surface) and at 19.7m (near-bed) are presented in Figure 3.3.6. Wave direction is expressed in compass points, relative to true north, and describes the direction from which the waves were travelling.

It is noted that the current below 20m is rather slow and in the opposite direction. Extreme current criteria are presented in Table 3.3.4.

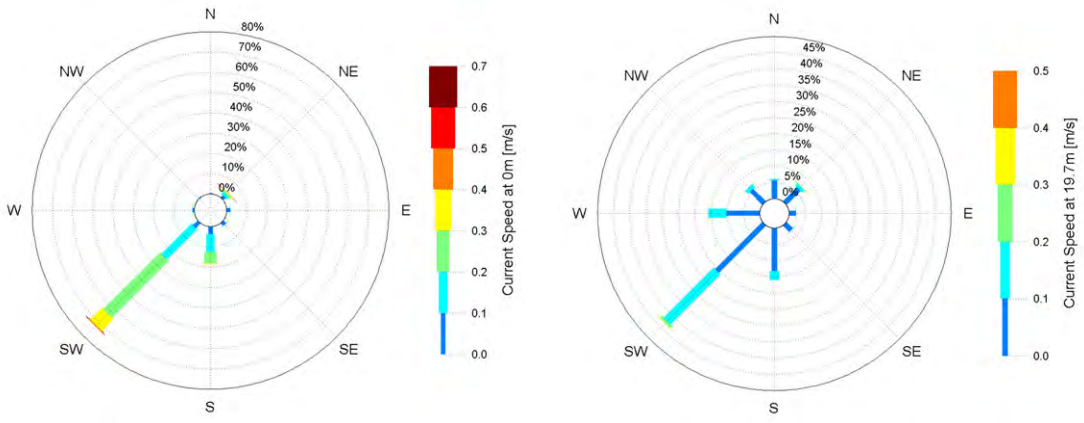


Figure 3.3.6 Percentage occurrence of total current speed and direction at 0m (left) and at 19.7m (right)

Table 3.3.4 Extreme current criteria

Return period	Near-surface (0m)	Near-bed (19.7m)
100-years	0.75 m/s	0.50 m/s

(2) Bathymetric investigation

Offshore bathymetric survey was performed on a corridor of 4.5km length and 1.0km width, crossing Canakkale strait, from the European shore to the Anatolian shore.

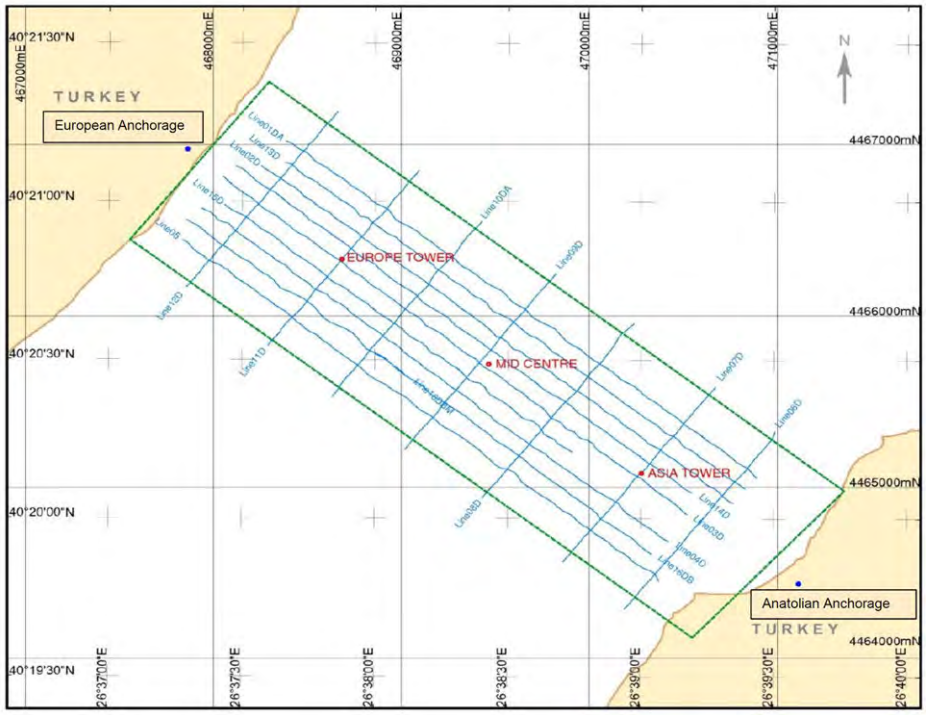


Figure 3.3.7 Offshore bathymetric survey track lines

The average width of Canakale strait around the investigation area is 3.9km. The bathymetry of the strait presents V-shaped channel geometry (Figure 3.3.8). The sea-floor comprises three sub-physiographic divisions, i.e. the eastern and western slopes, and the inner channel in-between. The sea-floor displays an asymmetric profile along East-West sections. Except the near shore portion, the western slope connects to the inner channel with a stable inclination. On the other hand, the eastern slope presents a stepping profile with sub-platforms separated by slope-breaks (Figure 3.3.9). The inner channel is the deepest part of the strait, where the deepest point of the survey area is at 88m below sea level.

The most characteristic seabed feature of the eastern slope is subaqueous ridges lying parallel to the shore. Such ascending bathymetry corresponds to sand bars developing along the shore. Ridges across the east-west profile are asymmetric. To the West, it starts with a concave break in the slope between to the 43m isobaths, reaching up to 12m depth in the shallowest part. Between the axes of the ridges and the shoreline, shallow depressions are observed parallel to the shore. A closed depression has been interpreted at the southeastern edge of the mapping area. Along the steeper dipping western slope of the ridge, erosional channels have developed, which most probably are related to debris-flows (Figure 3.3.10). Sandbars are actual sedimentary features along Lapseki shore which are related to longshore currents and longshore drift.

The inner channel defines the deepest section of the strait starting from about 50m isobaths. It displays an asymmetric form with steeper western slope. The lowest platform along the eastern slope is located

within the inner channel. The average basal-width of the inner channel is approximately 150m. The channel floor in the survey area is between depths of 83-92 m with an inclination from north to south.

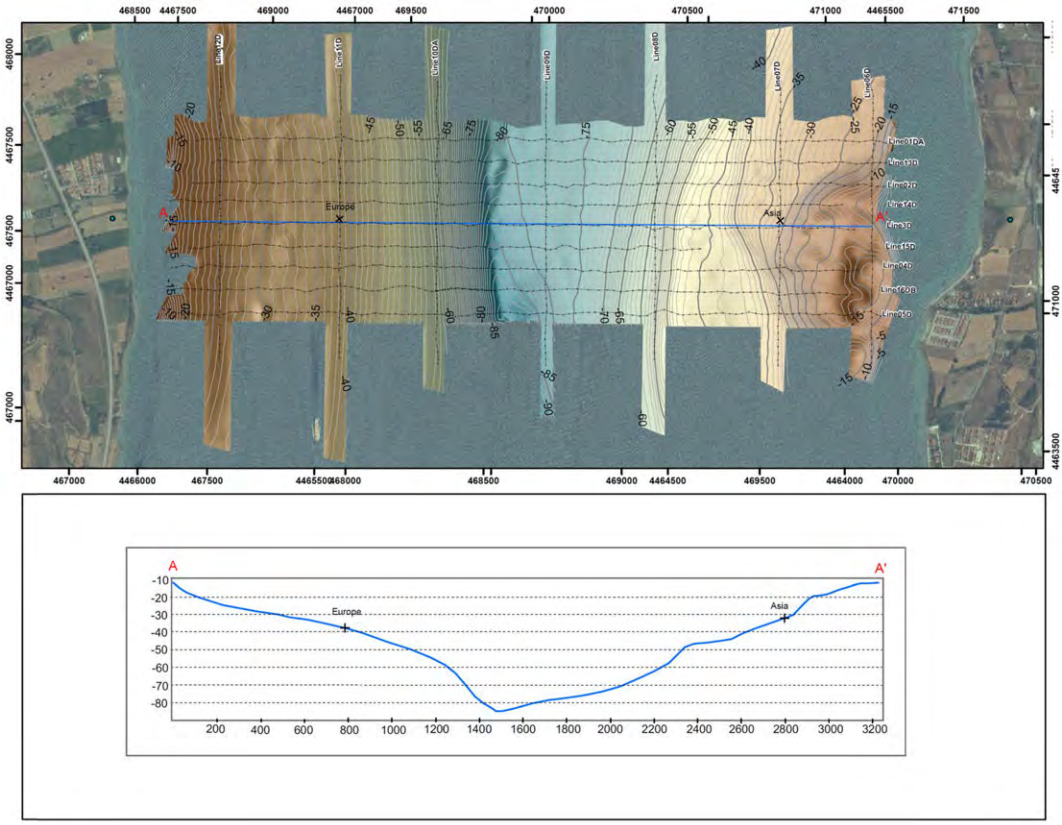


Figure 3.3.8 Bathymetry and shaded relief map

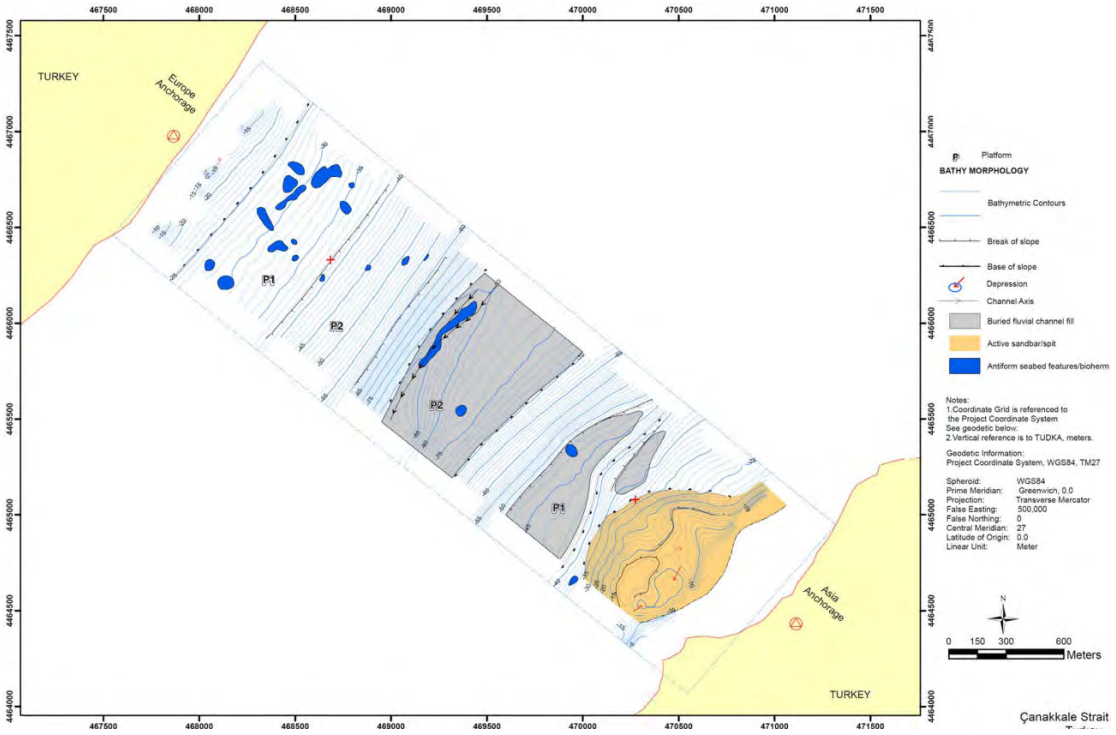
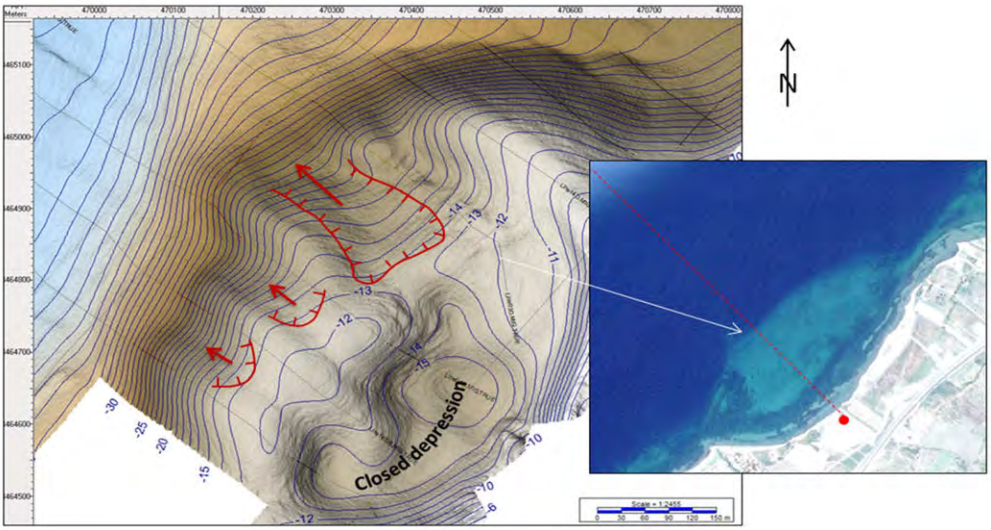


Figure 3.3.9 Bathy-Morphology map



(Red arrow indicates debris-flow direction)

Figure 3.3.10 Sandbars and spit formations along Eastern slope

(3) Seismic hazard

Turkey is located within the 'Mediterranean Earthquake Belt', where complex deformation results from the continental collision between the African and Eurasian plates, and which is one of the most seismically active regions in the world. Post-collisional intracontinental convergence -and tectonic escape- related deformation, and the consequent structures that include fold and thrust belts, suture zones, active strike-slip faulting, active normal faulting and the associated basin formation are observed in Turkey. Three major structures govern the neotectonics of Turkey; these are the dextral North Anatolian Fault Zone (NAFZ), the sinistral East Anatolian Fault Zone (EAFZ) and the Aegean–Cyprus Arc (Figure 3.3.11). Within the plate boundary network of the eastern Mediterranean–Arabian region, the Dead Sea Fault Zone links seafloor spreading in the Red Sea with the northern boundary of the Arabian Plate. The coincidence of the timing of escape tectonics in Anatolia and the commencement of seafloor spreading in the southern Red Sea and in the eastern Gulf of Aden indicate that the active tectonics of Turkey is the result of Red Sea opening and northward differential relative motions of the African and Arabian plates (Hempton, 1987).

Following the demise of intracontinental collision across the Bitlis–Zagros Suture Zone, the earlier compressional-contractional tectonic regime in eastern Anatolia was replaced by a new compressional–extensional tectonic regime (tectonic escape) by the early Early Pliocene. This has resulted in the generation of intracontinental transform faults, namely the NAFZ and EAFZ. These strike slip faults accommodate the westward motion of Anatolian Block between the Arabian and the Eurasian plates (Şengör and Yılmaz, 1981; Şengör, et al. 1985) at a rate of ~ 20mm/year on average (Barka, 1992; Straub et al., 1995; Reilinger et al., 1997 and 2006). Present-day kinematic studies show the Arabian Plate moving in a N–NW direction at a rate of ~15 mm/year while the African Plate is also moving to the north but at a rate of only ~5 mm/year (Relienger et al., 2006). The westward motion of the Anatolian block reaches up to 21 mm/year and it increases through the Aegean Sea (Figures 3.3.11 and 3.3.12).

Continuous deformation along the NAFZ and EAFZ has resulted in the WSW extrusion of the intervening Anatolian plate onto the Eastern Mediterranean lithosphere, accompanied by its counter-clockwise rotation, between the converging Eurasian and Arabian plates (Rotstein 1984). The Aegean Sea is a rather complicated physico-geographic unit within the active margin of the Eurasian Plate behind the active Hellenic arc and trench system. It is controlled by approximately N-S oriented continental extension. The Aegean Sea, as a part of the 'Aegean Extensional Province', is a region of distributed extension that covers parts of Greece, Macedonia, Bulgaria, Albania and Turkey.

The proposed Cannakale Straits Bridge alignment crosses the Cannakale Strait close to the mouth of Marmara Sea. The center point of the bridge is located approximately 20 km south of the main (northern) strand of the NAF which forms the main tectonic boundary between the Anatolian block of the African plate on the south and the Eurasian plate on the north. Thus, the seismic hazard at the site is primarily related to the relative motion between the Anatolian Block and the Eurasian Plate. The major historical seismic events of the northern branch of NAF are listed in Table 3.3.5. The regional tectonics and historical earthquakes are plotted in Figure 3.3.13. It shows that at least 27 earthquakes of magnitude Mw6.8 or greater have occurred along or adjacent to the NAF within the site region over the past approximately 2000 years.

In addition to those major faults, there must be number of minor, secondary or hidden faults close to or under the bridge location. The detailed field investigation at the bridge location shall be performed for the detailed design of suspension bridge.

Since the bridge location is minimum 20km away from major faults, the difference of ground motion due to fault normal and fault parallel is expected small. Considering the regional seismic feature and other available data along NAF, the peak ground acceleration is estimated approximately 0.3-0.4g for the 145-year return period, 0.6-0.7g for the 975-year return period and 0.8-1.0g for 2475-year return period, respectively.

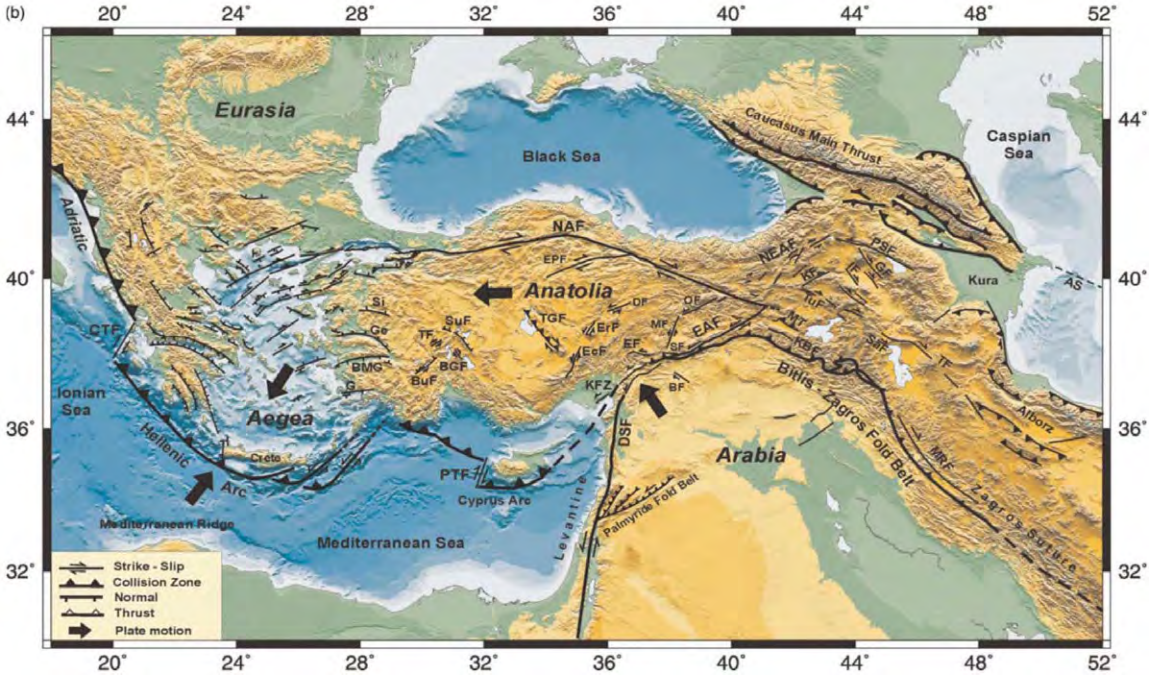


Figure 3.3.11 Summary sketch map of the faulting and batymetri in the eastern Mediterranean region (TAYMAZ et al., 2014)

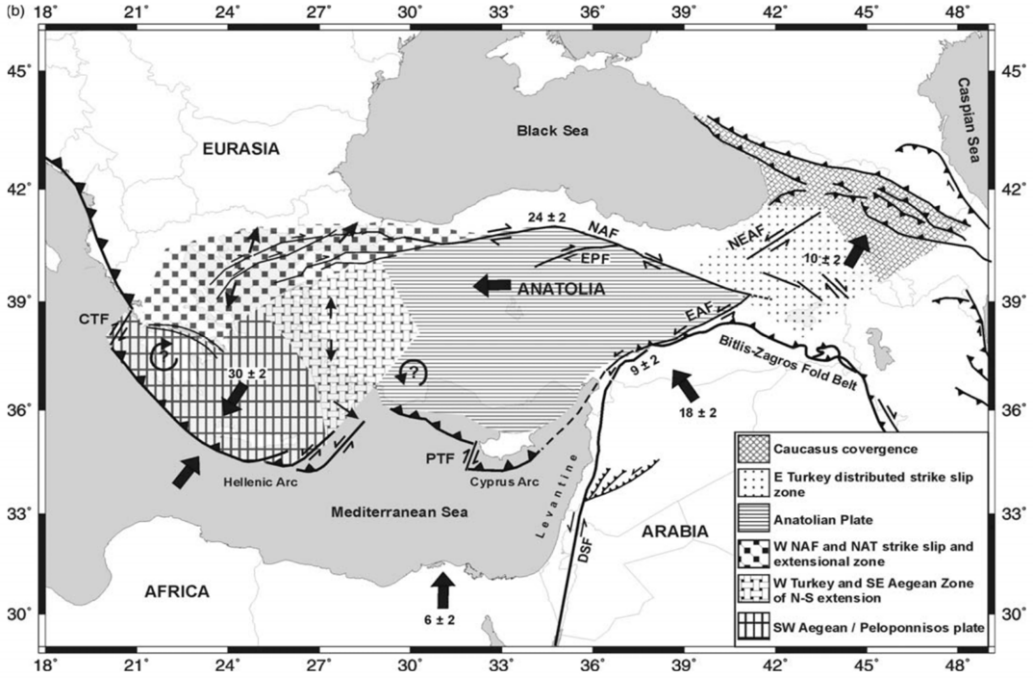


Figure 3.3.12 Schematic map of principal tectonic settings in the eastern Mediterranean (TAYMAZ et al., 2014)

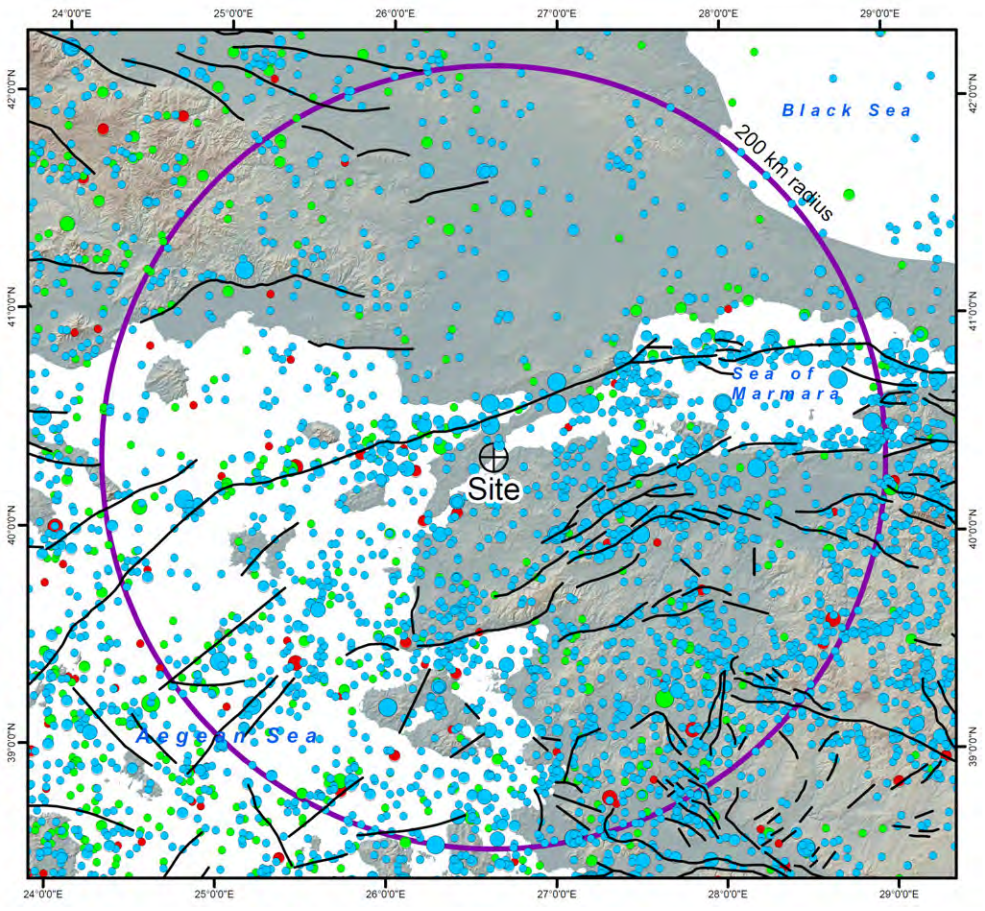


Figure 3.3.13 Regional tectonics and historically earthquakes

Table 3.3.5 Major historical seismic events of Northern branch of NAF

Date	Coordinate		Magnitude Ms	Localities with heavy damage
	Lat.	Long		
477-08-25	40.8	29.5	7.2	Canakkale, Gelibolu, Saros
832-10	40.9	27.4	-	Panion, Marmala Eregli
1063-09-23	41.0	29.0	7.4	Saros, Murefte, Tekirdag, Istanbul
1343-10-18	41.0	29.0	7.0	Istanbul
1344-11-06	40.7	27.4	-	Tekirdag, Istanbul
1354-03-01	40.6	26.9	7.4	Tekirdag, Canakkale, Gelibolu, Saros
1659-02-17	40.5	26.4	7.2	Tekirdag
1766-05-22	41.0	29.0	7.4	Istanbul, Bospohorus, Gulf of Mundaya, Bursa, Izmit, Tekirdag
1766-08-05	40.6	27.0	7.4	Bozcaada, Canakkale, Gelibolu, Saros, Tekirdag
1912-08-09	40.7	27.2	7.3	Gelibolu, Saros, Tekirdag
1912-09-13	40.7	27.0	6.9	Gelibolu, Saros, Murefte

(4) Onshore boring

The onshore geotechnical borings were performed at the bridge site to collect subsurface soil and rock cores and characterize stratigraphic variations, and to characterize the strength and stiffness of the underlying soils and rocks.

Drilling operations started after collecting personal permissions of the land owners. AAN-1 borehole on the Anatolian side was terminated at a depth of 63.8m due to the withdrawal of the permission by the land owner. The drill rig was mobilized to an alternative location (AAN-1A) and the borehole was completed to 150-meters depth.

After the completion of AAN-1A borehole artesian water was observed. By observations in the field, the artesian head was approximately 3 m with a flow rate of about 0.5 liter/sec.

Figure 3.3.14 Boring locations

Figure 3.3.15 Drilling and Core logging operations

Table 3.3.6 Boring coordinates

Location	Area	Eastern	Northern	Completion depth
AAN-1	Anatolia	471140.00	4464476.00	64.8m
AAN-1A	Anatolia	471091.00	4464510.00	150.0m
EAN-1	Europe	467944.00	4467032.00	150.0m

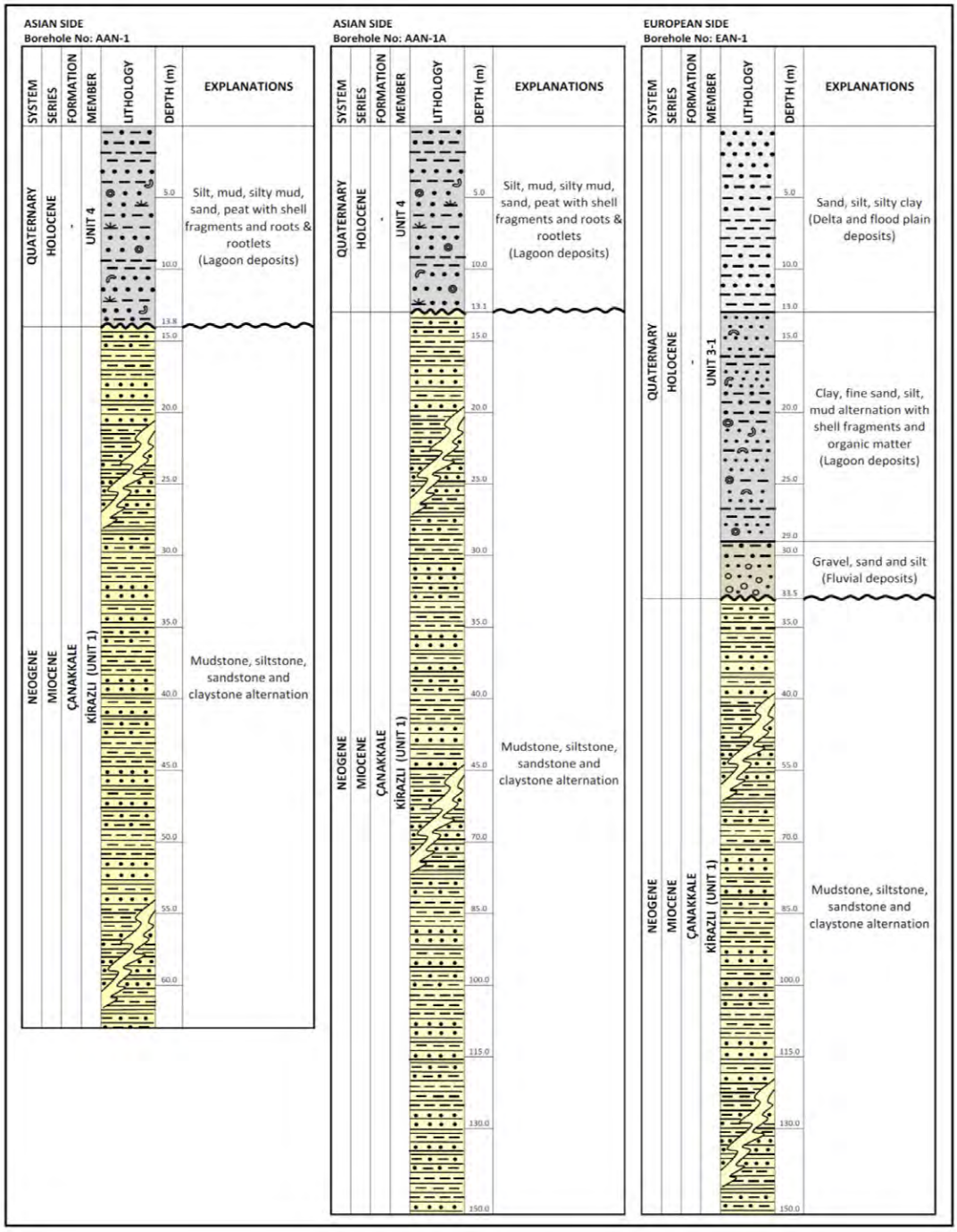


Figure 3.3.16 Stratigraphic columnar section for onshore geology based on borehole data

1) European side

The coastal zone of Gelibolu Peninsula around the project site displays an indented pattern due to the presence of delta lobes and small bays. Along the İyisu Cape cliffs and to the west, erosional highland comprises the Çamrakdere member of the Canakkale formation outcrops from North to South. To the North, marine terrace deposits overlying the Kirazlı member of the Canakkale formation were observed. The base and top surfaces of the marine terrace are 3 to 4 m and 25 m above sea level, respectively.

Marine terrace deposits comprise of sandstone, siltstone and conglomerate. This unit is abundant in macro fossils where Ostrea banks have been formed.

The European side Anchorage is located at the mouth of Münipbey stream which is distinguished by a wave-dominated delta. Borehole stratigraphy presented on Figure 3.3.16 reveals that the thickness of the delta deposits at the anchorage is about 30 m. Marine layers including shells indicate that it is a sea-ward prograding delta sequence. Considering the paleo-channels encountered in the offshore data it appears that the Munipbey stream has a paleo river channel beneath the delta sequence. Therefore we have interpreted that the Munipbey river paleo-valley has turned into a small bay or lagoon at the beginning of Holocene transgression; and later a recent delta lobe was developed during the Holocene period.

The 150 meter-deep borehole drilled at the European side encountered the Münipbey stream delta sequence between 0 and 33.5 meters depth, underlain by the Miocene age Çanakkale formation.

The Miocene sequence encountered in the boreholes can be divided into two sublithostratigraphical units.

- The Miocene sequence encountered between depths of 95 and 150 meters consists of carbonaceous, moderately-thick bedded sandstone –siltstonemudstone -claystone alternation. This unit can likely be correlated with the westdipping Çamrakdere member outcropping at Cape İyisu.
- The sandstone dominated sequence overlying this unit between 33.5 and 95 meters depth, is evaluated as corresponding to the Kirazlı member outcropping at Sütlüce district.

Based on the samples from drilling, the Holocene age Münipbey stream delta sequence is approximately 30 meters thick, and can be divided into three sublithostratigraphical units.

- The lowermost sub-sequence is encountered between 29.0 to 33.5 meters depth with yellowish-brown, grayish, rounded to sub-rounded gravelstone and sandstones of fluvial origin which likely represent pre-Holocene transgression fluvial deposits of the Münipbey stream paleo-valley. The high levels of alteration within the Miocene units below this sequence support this theory.
- Above this subsequence, extending between between 15.0 to 29.0 meters depth, a second sub lithostratigraphical unit was encountered which consists of thinmoderately bedded, dark gray-greenish colored fat clay, fine sand, silt, clay and mud alternations with local carbonate nodules and intercalations. These faces represents still or low energetic wavy water conditions indicative of deposition in a lagoon or shallow cove environment during the initiation of Holocene transgression.
- The uppermost sub-lithostratigraphy encountered in the upper 15 m of the borehole comprises a typical delta sequence with inputs of marine deposits including shells. The dominant lithology at this sub-sequence is unconsolidated, grayish yellow sand, silt and mud with scattered pebbles.

2) Anatolian side

In contrast to the European side the Anatolian side of the CS along the Lapseki section displays a linear trend. Wave-dominant small deltas and coastal plains are the characteristic geomorphic features of the Anatolian coast. Longitudinal sand bars parallel to the shoreline, spits, lagoons and back-swamps indicate that currents are the dominant process affecting the formation of landforms along the coast (Figure 3.3.17).

The Anatolian side anchorage is located on the narrow coastal plain between the Lapseki-Çanakkale high way and the shoreline. The geomorphology of the plain is represented by a beach and a back-swamp behind it. To the North, the coastal plain merges to the Lapseki delta which is a wave-dominant delta. Actual sandbars and spits suggest that delta materials are transported towards the Southwest along the coast.

(Arrows show current direction)

Figure 3.3.17 Main geomorphological units of Asian coast

Borehole logs of two boreholes at the Anatolian side are presented on Figure 3.3.16. Two main stratigraphical units have been encountered in these two boreholes. The uppermost unit is part of the Holocene sequence. It consists of dark gray, greenish black colored silt, mud, silty sand, silty sandy clay alternations at both boreholes which indicate a deposition at back-swamp or lagoon facies. All these lithologies are rich in shell fragments, and root marks are common where local peat horizons were observed. Such characteristics support swamp-lagoon deposition as are distinctive as surficial morphology of the Holocene sequence. The Miocene sequences at both drilling locations display similar lithologies. These are moderately-thick bedded mudstone, siltstone, claystone, sandstone alternations. The mudstones are characterized with mottled red color. The sandstone thickness encountered increases towards the basal parts of the sequence. The lowermost strata of Boring ANN-1A consist of thick bedded and massive sandstones. Miocene sequences at both boreholes can likely be correlated with the Kirazlı member of the Çanakkale formation.

(5) Geohazards and preliminary conclusions at substructure locations

1) European anchorage location

Relatively thick deltaic Holocene deposits (i.e. about 35 meters thickness) are present at the European Anchorage location. Liquefiable coarse-grained layers within this unit extend to a depth of about 25 meters within these deposits. An approximately 15-m-thick liquefiable layer is present below the ground surface and a 5-meter thick layer is present between approximately 20 and 25 meters depth (Figure 3.3.18). The factor of safety (FOS) against liquefaction is calculated as the ratio of the cyclic resistance ratio (CRR) to the cyclic stress ratio (CSR), i.e. FOS = CRR/CSR. Liquefaction evaluation was made based on National Center for Earthquake Engineering Research and the more recent Boulanger and Idriss method.

2) Anatolian anchorage location

Miocene Age deposits are present close to the surface at the Anatolian Anchorage location consisting of weak sedimentary rocks/stiff to hard soil. These materials will provide relatively good foundation support for a deep foundation system (i.e. pile foundation or caisson foundation) at the anchorage location. However, it shall be noted that liquefiable coarse-grained deposits are present in the upper 5 meters of the soil profile at the Anatolian Anchorage location. (Figure 3.3.19)

3) Tower foundation locations

Along the Anatolian submarine slope, the areas shallower than ~ 35 to 40 meters are characterized by gully-type erosional channels on the offshore facing slopes of the sand bars. The sand bars along the Anatolian coast are active formations related to longshore currents of up to 2 knots (~3.7 km/h). The erosional channels on the steeper slopes of these sand bars are shaped by sand / debris flows. Additionally the sea-floor morphology of the platform where the Anatolian Tower is planned also shows similar erosional channels. These channels eroding into the platform indicate that the material derived from the upper part of the slope is transported farther downslope into deeper waters. Sandbars represent sedimentary environments that are vulnerable to slope instability and various types of mass flow, especially those triggered by earthquakes.

The European side Tower is situated on an area that does not show surface evidence of recent instability.

Deltaic sediments encountered at the European Anchorage may extend into the Canakkale strait. Therefore mitigation measures for liquefaction may also be required for the Tower foundations in addition to the European Anchorage.

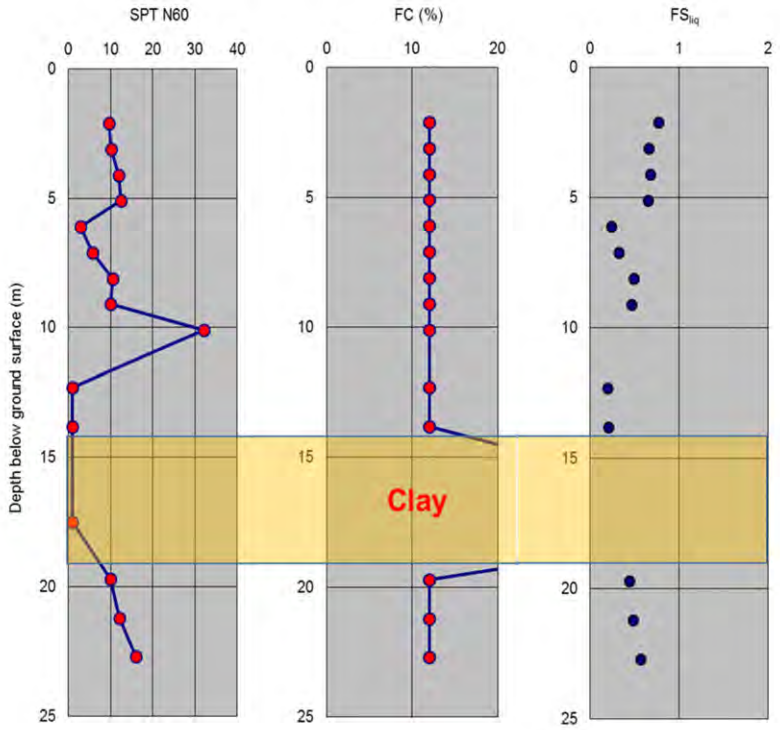


Figure 3.3.18 Liquefaction triggering assessment – European anchorage location

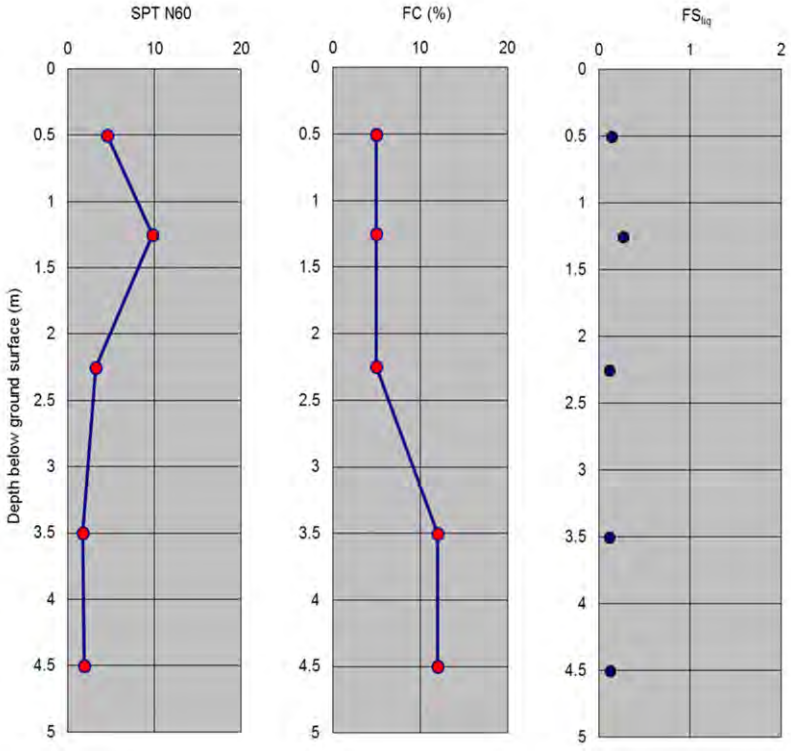


Figure 3.3.19 Liquefaction triggering assessment – Anatolian anchorage location

(6) Design basis

Considering the results of studies and the past similar projects in Turkey, the design basis adopted in this report is defined as shown in Table 3.3.7. The load combinations considered in this F/S are summarized in Table 3.3.8. The concept design of suspension bridge in this F/S has been performed under the selected situations which can provide the plausible result with sufficient accuracy in this stage. In the detailed design, more combinations in SLS and ULS and such the accidental design situations as Ship impact, Rupture of hanger cable, Fire and Seismic shall be considered.

Table 3.3.7 Design basis

Usage	For vehicle passing
Lane arrangement	3 vehicle lanes (3@3.65m) in each direction 1 maintenance lane (2.5m) in each direction Note: Functional cross section is shown in the drawing
Navigation clearance	1000m x 64m
Highway clearance	Minimum 5.7m headroom to ancillary structures
Design life	100 years
Highway traffic load	EN1991-2
Temperature	Reference temperature = 15 degrees centigrade Max: 65 degrees centigrade Min: -10 degrees centigrade

Table 3.3.8 Combinations of actions

		SLS	ULS		Accident
Permanent loads		1.00	1.35	1.15	1.00
Variable loads	Traffic	1.00	1.00	1.35	0.30
	Wind (with traffic)	1.00	1.60	1.60	-
	Thermal	0.60	1.00	1.00	-
	Seismic	-	-	-	1.00

3.4 Outline Design

3.4.1 Motorway Design

(1) Terrain Conditions and Alignment of Motorway

According to the disclosed route map of the proposed motorway, which was presented at Stake Holders' Meetings, the terrain conditions along the alignment and the outline of the alignment are summarized as shown in the table below.

Table 3.4.1 Terrain Conditions and Outline of Alignment

Province	Station	Section Length	Description
Istanbul	KM 01 - KM 19	19 km	• Terrain conditions vary along the alignment. Altitude of ground level along the alignment varies within 20 to 150 m above sea level. • The motorway alignment intersects with National Road D-100 with almost perpendicular angle and avoids residential area and hilly area. • The alignment passes two (2) hilly areas with gentle gradient. • Vertical alignments passing through hilly area would apply 4% of maximum grade. • Maximum heights of fill and cut sections would be about 10 m and 15 m respectively. • The provincial boundary between Istanbul and Tekirdağ is located at Kiniki River. The terrain at this area is valley with gentle gradient.
Tekirdağ	KM 19 - KM 125	106 km	• This section also has variation in terrain condition along the motorway alignment. Altitude of ground level along the alignment varies 20 to 300 m above sea level. • Due to 3 km of maximum length of horizontal alignment element section under geometric design standard, the disclosed motorway alignment meanders every 3 km. • Vertical alignments passing through hill area would apply 4% of maximum grade. • There are mountainous sections, which are necessary to be considered for tunnel construction. • Maximum heights of fill and cut sections would be about 25 m and 25 m respectively. • The provincial boundary between Tekirdağ and Çanakkale is located at mountain range between 300 and 650 m of altitude. The highest ground level along the motorway alignment would be about 300 m above sea level.
Çanakkale	KM 125 - KM 188	63 km	• About 30 km-long section after passing through the above mountainous area is flat terrain. • The motorway alignment designed in parallel to the National Road D-550 with meandering at every 3 km as well as the above section. • Maximum heights of fill and cut sections would be about 30 m and 25 m respectively. • The terrain condition of the surrounding area of Dardanelles Strait is formed with about 6% of slope. The height of cut slope at the end of the section would be about 20 m.

Source: JICA Study Team

Figure 3.4.1 Proposed Alignment of Motorway Based on Disclosed Route Map

(2) Alignment at Strait Crossing

The construction cost of Dardanelles Strait Bridge composes a large share of total construction cost so that more detailed study, including topographic survey and geotechnical investigation, was conducted for design of the strait crossing structure in order to estimate more accurate level.

The horizontal alignment of the motorway at strait crossing is straight and avoids mountainous area before and after the strait crossing with curve. According to the disclosed route map, the curve radius of these curves would be assumed 1,000 m and 1,200 m respectively. Although, these elements of curves comply with the design standard in Turkey, it should be noticed that the designed curvetures do not meet the Japanese expressway design standard, namely NEXCO Standard, for designing of main expressway before/after interchanges (minimum radius: 2,000 m, special case: 1,600 m).

The NEXCO standard suggests the special requirement for main expressway design in order to provide better sight distance around diverging/merging ramp terminal and to provide smoother traffic flow at ramp terminal. But Turkish standard or AASHTO standard do not have such requirement.

However, Turkish standard and AASHTO standard require longer length of acceleration/deceleration lanes than NEXCO standard (about 1.5 to 3.0 times) and the traffic safety around interchange ramp terminal is secured with this section lengths.

Due to the mountainous terrain along the strait with consideration of construction cost for earthworks as well as the above mentioned difference of the policy of each countries' design standard, it can be said that the designed alignment would be reasonable.

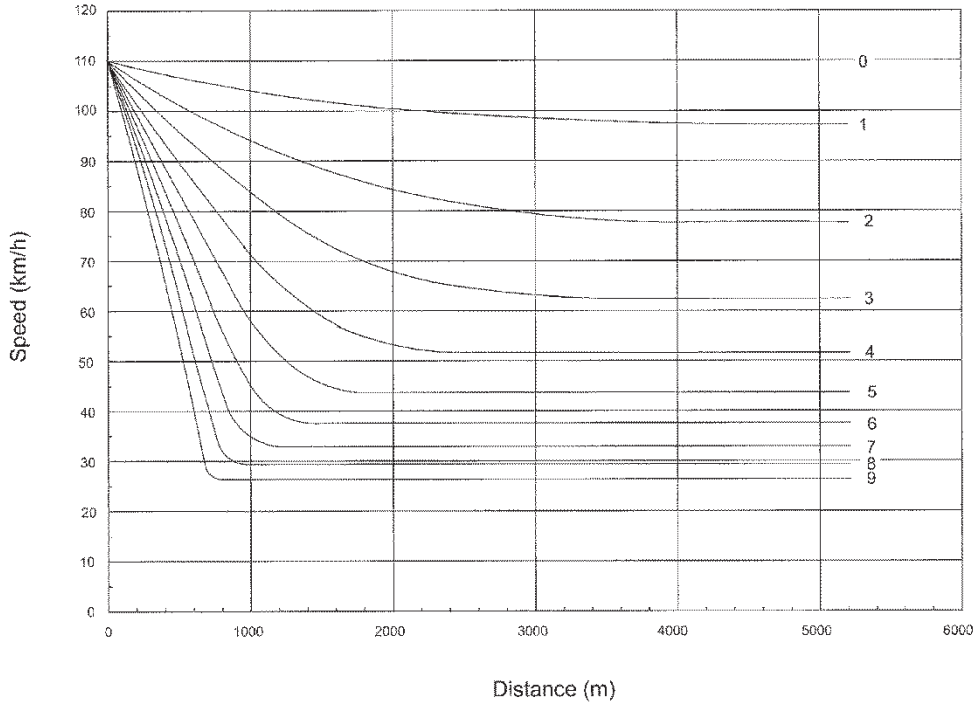
	Acceleration Lane Length (excluding taper length)	Deceleration Lane Length (excluding taper length)
Turkish Standard	345m	280
NEXCO Standard	200m (for 1-lane acceleration lane)	100m (for 1-lane deceleration lane)

Therefore, this study follows the disclosed route map.

There is no disclosed information regarding vertical alignment of the motorway so that this study conducted a comparative study on the vertical alignment of the strait crossing bridge. The alternative options are (i) 4% of vertical grade as maximum grade and (ii) 2.5% of vertical grade as acceptable grade for deceleration on upgrades for a typical heavy truck, which is acceptable up to the half of the design speed. As a result of this comparative study, it was concluded that 2.5% of vertical grade would be recommended in consideration of deceleration of heavy trucks and aesthetic point of view (For more details, see Table 3.4.2).

On the other hand, Japanese geometric ordinance, namely Road Structure Ordinance, provides the maximum vertical grade as 2.0% for design speed of 120 km/h (in special exception case, up to 5.0% of grade is allowed) so that adoption of 2.0% would be more preferable for traffic. However, because of the following two (2) reasons, adoption of 2.5% would be reasonable:

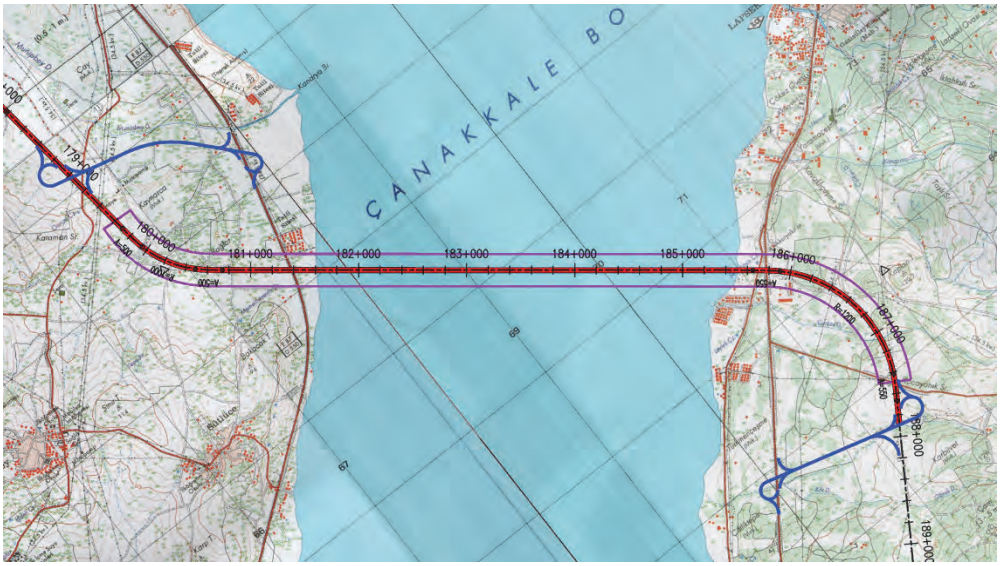
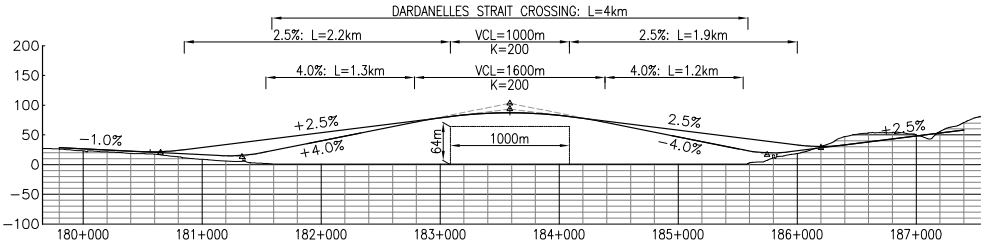
- There is no significant difference between the deceleration on upgrades for heavy truck at 2.0% and 2.5%
- 2.0% of grade requires longer length of approach bridge (about 500 m each side and 1 km in total) and more construction cost than 2.5% of that.



Source: A Policy on Geometric Design of Highways and Streets, 6th Edition (2011), AASHTO

Figure 3.4.2 Speed-Distance Curves for a Typical Heavy Truck for Deceleration on Upgrades

Table 3.4.2 Comparizon of Vertical Grades at Strait Crossing

	Option 1 (4.0 %)	Option 2 (2.5 %)
Plan	 Note: Purple color frame shows the area where topographic survey was conducted under this study.	
Profile		
Vertical Grade	4.0 %	2.5 %
Deceleration on Upgrades	• Length of 4.0% grade section would be 1.2 to 1.3 km and travel speed of a typical truck would decelerate up to 70 km/h at 1 km point and 60 km/h at 1.4 km point from the lowest point.	• Length of 2.5% grade section would be 1.9 to 2.2 km but travel speed of a typical truck would not decelerate below 70 km/h.
Aesthetic point of view	• About 1 km-long 4.0% grade section looks like wall for driver. • Appearance of the bridge from surrounding area would not be so good to be an iconic symbol of this area.	• Drivers would not feel 2.5% of grade as steep slope. • The gentle slope would match with the flat terrain along the strait got caught between mountainous terrains.
Construction cost	• Construction cost would be minimal.	• Construction cost would be higher than 4.0% option. • Motorway elevation at anchorage would be about 40 m above ground level so that higher anchorages, like Tokyo Rainbow Bridge, would be required.

(3) Interchanges and Intersecting Roads

According to the disclosed route map, there are 15 proposed interchanges in total along the 188 km-long section and the distances between the neighboring interchanges varies between 2 km to 40 km (See Table 3.4.3). In comparison with NEXCO Standard, which provides standard distance between the neighboring interchanges as minimum 4 km and maximum 30 km, the some interchanges

are doesn't meet. However, considering that Turkish standard does not have such requirement and the site conditions, proposed interchange locations would be reasonable due to the following reasons:

- Motorway O-3 and National Road D-100 are close to the study route around the beginning point.
- There are no large towns and major roads between Km 75 and Km 146.

In addition, construction of "Smart Interchange", which is a service area direct-connection interchange, would be worth consideration at the sections where the distance between interchanges are longer than 30 km.

Table 3.4.3 Proposed Interchanges and its Intersecting Roads

No.	Station	Name of Interchange	Intersecting Road	Distance (km)
***	-1+000	Kinali-1 Interchange	Motorway O-3	***
1	3+700	Kinali-2 Interchange	Kinali Link Road	4.7
2	14+000	Canta Interchange	National Road D-100	10.3
3	22+400	Marmara Interchange	National Road D-567	8.4
4	26+000	Corlu Interchange	Corlu Airport Access Road	3.6
5	40+600	Karatepe Interchange	Provincial Road 59-05	14.6
6	55+200	Tekirdag East Interchange	National Road D-110	14.6
7	61+400	Tekirdag Interchange	National Road D-565	6.2
8	68+000	Hayrabolu Interchange	National Road D-555	6.6
9	75+000	Tekirdag West Interchange	National Road D-110	7.0
10	108+000	Malkara Interchange	National Road D-110	33.0
11	146+200	Bolayir-Evrese Interchange	National Road D-550	38.2
12	163+200	Gelibolu North Interchange	National Road D-550	17.0
13	179+000	Gelibolu South Interchange	National Road D-55	15.8
14	188+000	Canakkale Interchange	National Road D-200	9.0

(4) Service Area

According to the disclosed route map, there are 7 proposed service areas in total along the 188 km-long section and the distanses between the neighboring service areas vary between 13 km to 30 km (See Table 3.4.4). Whereas NEXCO Standard provides standard distance between the neighboring service areas as standard 15 km and maximum 25 km, Turkish standard suggests it as 5 to 60 km. Therefore, the proposed service area locations would be reasonable.

Table 3.4.4 Proposed Service Areas

No.	Station		Distance (km)
1	18+200	Service Area	***
2	31+600	Service Area	13.4
3	47+500	Service Area	15.9
4	70+500	Service Area	23.0
5	99+400	Service Area	28.9
6	112+500	Service Area	13.1
7	140+500	Service Area	28.0

(5) Major Structures

The structural types of each road crossing have not yet been disclosed to the public so that, in reference to the disclosed route map and its terrain conditions, this study set out major structures based on the following criteria:

- Underpass Bridge: For major road crossing (more than 4-lane in total)
- Overpass Bridge: For minor road crossing (narrower than 2-lane in total)
- Viaduct or Bridge : For major river crossing

Table 3.4.5 Major Structures

Structure Type		Numbers	Remarks
Road Crossing	Underpass Bridge	22	Over 4-lane, about 80m of Bridge
	Overpass Bridge	93	2-lane, about 60m of Bridge
	Box Culvert	32	
River Crossing	Viaduct/Bride	9	About 80 m to 1.2 km of Bridge
Tunnel		3	About 500 m to 1 km of Tunnel

(6) Pavement Design

According to “Motorways Project Engineering Services Criterion Report”, typical pavement structure for motorway is summarized in the table below.

Table 3.4.6 Typical Pavment Structure

Pavement Layers	Thickness (mm)
Asphalt Concrete Wearing Course	50
Asphalt Concrete Binder Course	80
Asphalt Treated Base Course	120
Base Course	200
Subbase Course	300
Subgrade (Selected Material)	500

3.4.2 Strait Crossing Bridge Design

The conceptual design of suspension bridge was made based on the available data and under the assumptions described in Section 3.4. The general arrangement of bridge is shown in Figure 3.4.3. The description for each major component is available in the following sub-sections.

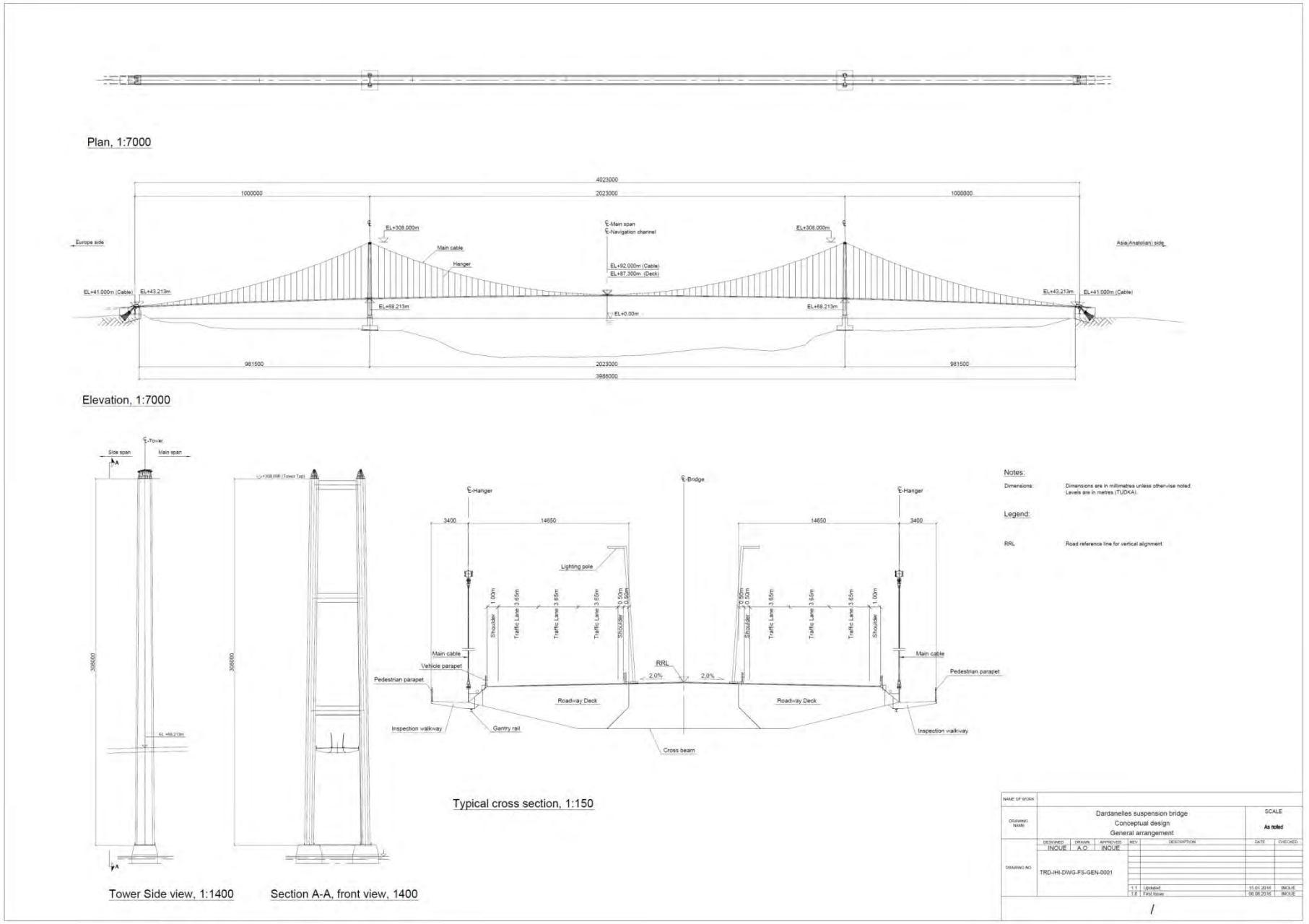


Figure 3.4.3 General Arrangement

(1) Anchorage

The anchorages are located on land. This condition makes the span arrangement similar to Akashi bridge in Japan which is the current world longest bridge. As described in the previous sections, there is liquefiable soil in both European (up to 25-30m depth) and Anatolian sides (up to 5-7m), and a large scale soil improvement or replacement is mandatory required prior to the construction of anchorage. Rather stiff ground is available in around 30m depth for European side and 15m depth for Anatolian side, respectively, and the gravity type conventional anchorage on those ground is considered the plausible solution.

(2) Tower foundation

Since the same or similar geological features at the European Anchorage is expected to extend into the Chanakkale strait, the soil improvement to liquefiable soils are mandatory required prior to the construction of tower foundation base, otherwise it is very difficult to provide the structure sufficiently enough against Live loads on the bridge, Seismic action and Ship collision.

The tower foundation consists of the caisson, two shafts, plinths and the tie beam. Depending on the installation method, the steel-concrete hybrid structure may be adopted to the shaft to make the floating stability better.

Since the Chanakkale strait has heavy marine traffics with large size tankers/vessels, the design of ship collision protection is one of key items. Considering the water depth, environmental impact and schedule, solutions with a dolphin or an artificial islands cannot be feasible, instead the design of tower foundation withstanding the ship collisions as well seems to be reasonable.

(3) Tower

To achieve the short construction duration which is one of the most important issues for BOT project, the steel tower is considered suitable. Some aerodynamic approach to mitigate the vortex-induced-vibration is required, and the corner-cut shape is assumed in this F/S. The tower is at EL +316m at Cable IP and has three crossbeams connecting each leg. The general arrangement is shown in Figure 3.4.4.

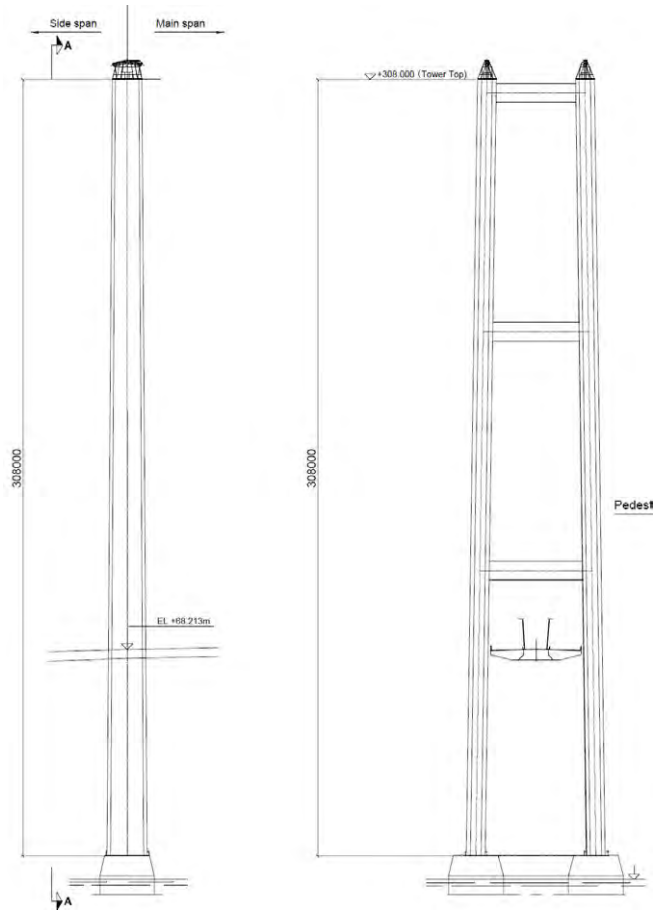


Figure 3.4.4 General arrangement of Tower

(4) Cable

The pre-fabricated parallel wire strand (PPWS) method is appropriate to meet the demand of the short construction duration. The extra strands in the side span are not expected because of the span arrangement. Considering the appropriate balance among the total number of PPWS, the construction schedule, the bridge stiffness, the fabrication schedule etc, the tensile strength of 1760 – 1860MPa can be a reasonable solution.

(5) Deck

The design of deck with appropriate wind stability is one of the most important and critical issues for a long span suspension bridge. Such flutter instability is the major problem and becomes worse and worse with increasing a span length. This is due to the fact that the ratio between the first rotational frequency and the vertical one is decreasing with increasing span length since the contribution of the main cables in the overall bridge dynamics is increased as the span length increases. The reduction of natural frequency as a function of the span length for different types of deck profiles is shown in Figure 3.4.5. When the vertical and rotational frequencies become closer, the equivalent rotational stiffness related to the aerodynamic contribution easily makes the frequencies equal and gives rise to flutter instability at lower wind speed.

Either the truss type (as similar to Akashi bridge) or the twin-box type can be the solution to have sufficient aerodynamic stability, the twin-box type is considered the plausible solution mainly because of its weight. The spacing between the decks is assumed 10m based on the past studies. The assumed cross-section is shown in Figure 3.4.6.

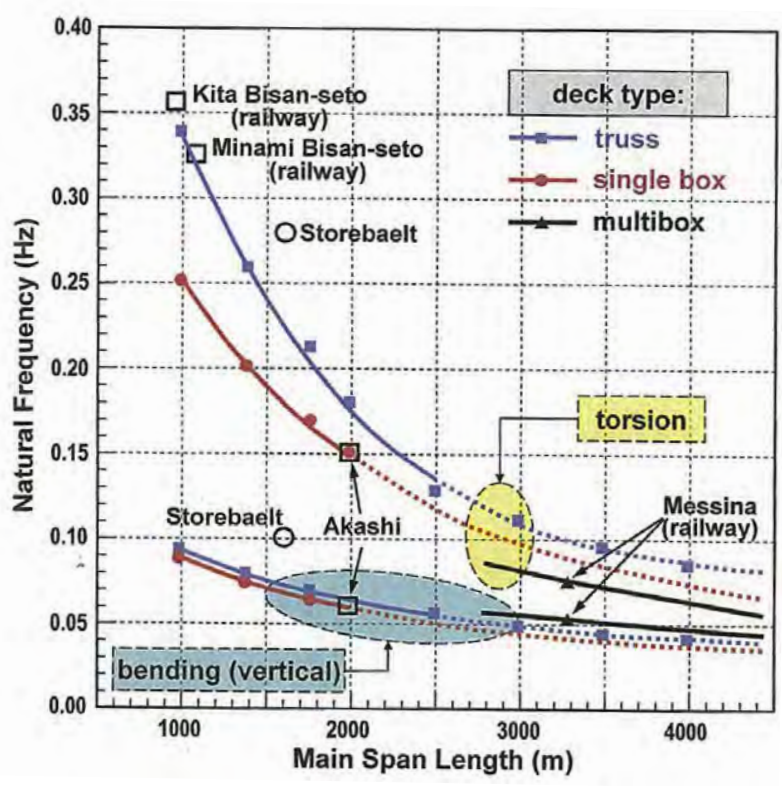


Figure 3.4.5 Reduction of natural frequency as a function of main span length

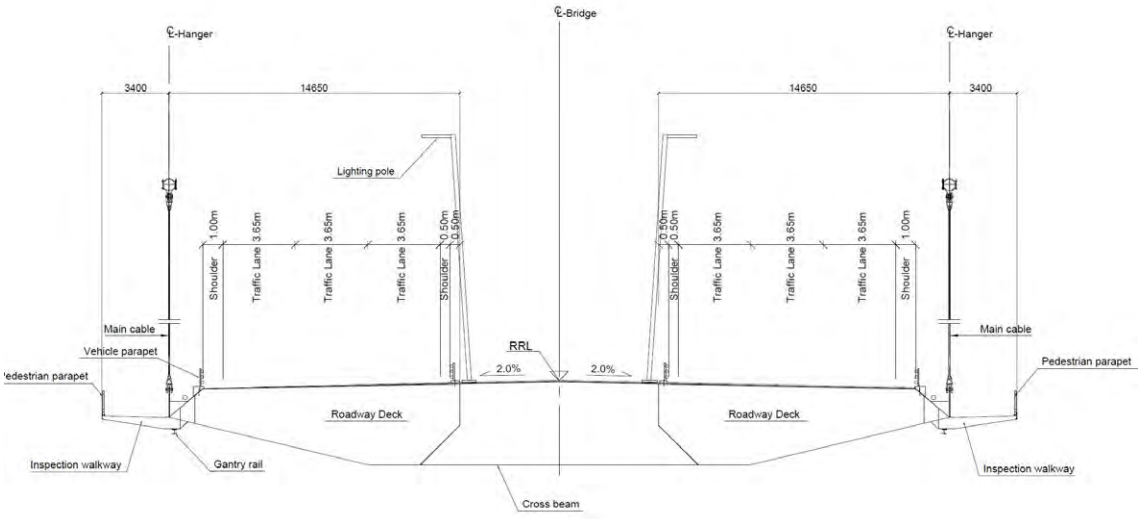


Figure 3.4.6 General arrangement of Deck

3.5 Construction Plan

3.5.1 Road

(1) Overview

Target road project length is 188 km (including Strait Bridge 4km length), major facilities is 7,900m total length of bridges, tunnel extension 2,000m total length of tunnel, 15 interchanges and 7 service areas.

The construction period of the road section is shown in Figure 3.5.1.

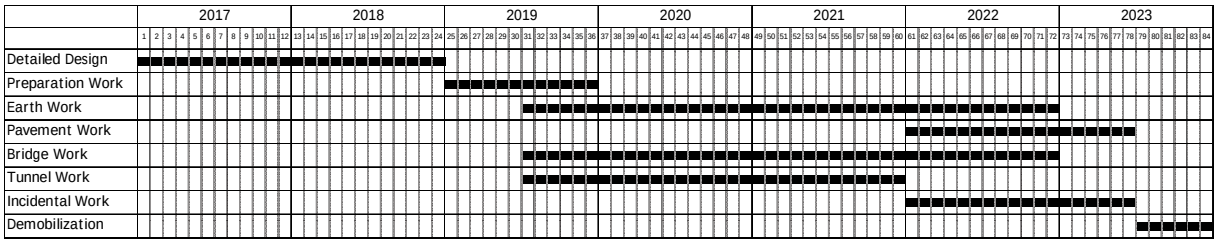


Figure 3.5.1 Implementation schedule

(2) Development Plan of Temporary Facility location

As shown in Figure 3.5.2, existing quarry plants are scattered along planned route. Thus, it can be utilized these existing facilities.

In addition, the port of Tekirdag with gantry crane is located almost center of the route and near. Hence, this port can be utilized for loading of imported materials and equipment by sea transport.

Therefore, it is desirable to set up base camp around Tekirdag

Figure 3.5.2 Location of existing quarry site and candidate site of Base Camp

3.5.2 Strait Crossing Bridge

(1) Anchorages

The construction of anchorage consists of the soil improvement/replacement, excavation, piles (if any), construction of large concrete blocks and construction of triangular cable anchorage.

Against liquefiable soils at the anchorage locations, such the soil improvement methods as Compaction, Jet-grouting and Replacement are possible and/or the pile foundations may also be applicable. Among those methods, the most suitable method shall be selected with the consideration of availability of large size equipment, experience, schedule, environmental impact and schedule.

(2) Tower foundation

The construction of the caissons is made in the purpose built dry dock. The remaining part of the caisson and the shaft are completed in a wet dock in the floating condition, where both the dry and the wed docks are prepared somewhere close to the site. Then, the structure is towed out and immersed at its final position by filling the caisson cells with ballast water. After the immersing operation, the remaining concreting for the plinth and the tie-beam are cast in-situ.

Since the towing and immersing operations restrict the ship traffic in the Chanakkale strait, appropriate approvals from the relevant authorities have to be obtained including temporary diversion and navigational buoys plan prior to the start of works.

Prior to the tower foundation installation, the soil improvement against the liquefiable soil and the gravel bed preparation on the basement and the seabed are performed. Since the water depth at the tower foundation is approximately 40m, the available methods for the soil improvement are limited. The most suitable method shall be selected with the consideration of availability of large size equipment, experience, schedule, environmental impact and schedule.

Finally, the scour protection is made by using anti-scour rock placement around the caisson by a floating crane vessel with skip and/or clamshell attachment.

(3) Tower

The fabrication process consists of the panel fabrication, the block assembly and the trial assembly. The trial assembly is carried out either in horizontal or in vertical position, where the design alignment and root gap at the horizontal joint (in case of weld joint) are achieved within the specified tolerance. After the trial assembly, the blocks are dismantled/unbolted and stored in the storage area.

The tower leg segments are mostly erected by the combination of a floating crane and a self-climbing crane. Depending on those capacities and any limitations of fabrication and transportation, the steel tower shall be divided into blocks and/or panels.

(4) Cable

There are two ways that the main cables can be assembled; by areal spinning and using prefabricated parallel wire strands (PPWS). In the aerial spinning method, individual wires are pulled across the bridge from one anchorage to the other using a spinning wheel, possibly two to twelve wires at a time. The individual wires of a strand are looped around a shoe at each end that is anchored into the anchor block.

In PPWS method, a number of wires are arranged in a parallel bundle that is held together by special bindings and socketed at both ends. The sockets are typically cast steel blocks with a conical hollow into which the wires are inserted and bonded using a polymeric resin or a molten metal alloy. PPWS is delivered to site on large drums and pulled across from one end to the other one at a time until the full number of strands in the cable have been erected and attached to the anchorage at each end. PPWS must be made to the full length of the finished cable, so for longer spans, there are practical weight and size limitations to the number of wires that can be built into one strand. The first bridge to be constructed using PPWS was New-ort-Pell bridge in USA. To date, the largest PPWS have contained 127 wires. This limitation will no doubt be improved upon as more bridges are built using this method. The largest bridge built using this method of cable construction is Akashi bridge in Japan, which has a main span of 1991m. Each main cable comprises 290 strands of 127 wires each, making a total of 36830 wires of 5.23mm diameter. The completed compacted cables are 1.12m in diameter.

In this F/S, it is considered that PPWS method is suitable for this bridge.

(5) Deck

The suspended deck is divided into number of segments depending on the limitations of fabrication, transportation, storage and erection. The general fabrication process consists of the panel fabrication, the segment assembly and the trial assembly. The fabricated segments are loaded on a barge and transported under the bridge.

The deck erection is carried out by two different ways, i.e. the unsuspended deck segments are lifted using a floating crane and the suspended deck segments are lifted using a lifting device mounted on the main cable. The suspended deck segments are connected to the end of the previously erected deck segments before the deck weight is released from the floating crane or the lifting device with the temporary connections.

3.6 Operation and Maintenance Plan and Organization Framework

3.6.1 Policy of Operation and Maintenance Plan

For the plan of Operation and Maintenance (O&M) established in this document, the O&M Manual regulated by KGM which is used as the specification for the International Competitive Bidding should be based because this project is developed as BOT project. The standards of the Japanese expressway

companies should apply to the items that are not specified in KGM O&M manual. However, due to the differences in the climates or the conditions in Turkey and Japan, the items the Japanese standards applied should be reviewed from time to time in order to match the circumstance of the site in Turkey during the operation period. Also, the tender document for "Gebze-Orhangazi-Izmir Motorway Project" ,which is a BOT project developed in Turkey, is used as reference for the O&M plan. In consideration of preventive maintenance for a sustainable and appropriate operation and maintenance system in the future, this O&M plan is established in order to meet the performance requirement for road superstructure at the end of operation period specified in the tender documents for "Gebze-Orhangazi-Izmir Motorway Project".

(1) Reviewed Standards

The standards had reviewed are shown below. Besides those standards, the interviews with the maintenance staffs in KGM, the field study in Turkey, and the experiences as the Japanese expressway companies are taken into account for this O&M plan.

Turkey	• KGM O&M Manual • Tender Documents for Gebze-Orhangazi-Izmir Motorway Project
Japan	• Maintenance and Repair Specification for the Chūō Expressway Fujiyoshida Route • Maintenance and Repair Specification for Japan National Route 28(Honshu-Shikoku Connection Road, Kobe-Naruto Route)

Chapter 20 in KGM O&M Manual mentioned that the operator shall follow the specification, regulations, and standards below, and this O&M also covers these documents.

- Highway General Technical Specification: ANKARA-2006
- Highway Project Engineering Services Technical Specification: ANKARA-2008
- Highway Project Engineering Services Criteria Report: ANKARA-2009
- Highway Project-Construction and Maintenance Works Landscaping Services Technical Specification: MART-2010
- Highway Landscape-2 Planting With Spray Method (Hydroseeding) Technical Specification: ANKARA-2008
- Bidding Terms of Design Of The Service Facilities, Construction, Maintenance, Operation and Transfer Related to Voyage on Highway: Mayis-2006
- Technical Specification Of The Service Facilities, Maintenance And Operation Related To Voyage on Highway:Eylül-2010
- Technical Specification of The Service Facilities Related to Voyage on Highway: Mayıs 2010
- Handbook of The Service Facilities, Maintenance And Operation Related to Voyage on Highway:Eylül-2010
- Technical Specifications for Fare Collection Business in Roads and Bridges: Eylül 2008
- Acquisition Plan Generation Engineering Technical Specification: Nisan 2011
- Technical Specification s of highways and terrestrial photogrammetric map Engineering Services: ANKARA − 2011

- Surveying Engineering Services Technical Specification, ANKARA−TEMMUZ 2005
- Highway Maintenance Manual: ANKARA − 1998
- Access Controlled Highways Traffic Signs Standards: 1999
- Highway Flexible Pavement Design Guide!: ANKARA − 2008
- Environmental Impact Assessment Regulation: Mart − 2006

(2) Operator's Obligation for Performance Criteria

This project will be developed as a BOT project, and the performance criteria the operator shall accomplish for both of the operation period and the end of the operation period are specified. The performance criteria are mainly divided into the road structure field and the operation field, which are described in Tables 3.6.1 and 3.6.2

Table 3.6.1 Performance Criteria of Road Superstructure

Item	Parameter
Functional Performance Criteria	• IRI/International Roughness Index (Driving Quality) • Settling of Ruts • Slip Resistance on Road Surface
Structural Performance Criteria	• Deflection (Deflection measurements shall be performed at the end of winter and the beginning of spring.)

Source: Motorway Operation Maintenance and Repair Technical Principles, PART III, Highway Superstructure Performance Criteria

Table 3.6.2 Maintenance and Operation Performance Table of the Highways and Bridges

	Article	Planned service level
1	The response time during event	15 minutes
2	Time for repairing the damaged equipment endangering the users	Action should be taken within 12 hours
3	Time for repairing the other important equipment	Action should be taken within 24 hours
4	Toll collection systems The toll passage systems should run with 99% performance	The service quality, error should not exceed 1%
5	The intervention to the event scene after the event / accident	Within 1 hour, day - night
6	Warning the users	Within 1 hour
7	Cleaning the debris and removing the objects	Just after or whenever it is required
8	Alligator cracks, block cracks	14 days
9	Crosswise cracks, lengthwise cracks	14 days
10	Settlement in the tire truck	14 days
11	Patches in the pitches and defective cases	24 hours
12	Road vertical signs	24 hours
13	Information signs	2 weeks
14	Roadway guardrail	48 hours
15	Roadway guardrails and pedestrian guardrails in the viaducts	48 hours
16	Wire fences	24 hours
17	Irrigating the plants, cleaning the garbage and waste materials in the road sides	7 days
18	Irrigating the plants at the sides of the toll control centers	Once a day

	Article	Planned service level
19	Highway inventory	It shall be updated for every change
20	Highway guardrails, vertical-horizontal signs, making patching, local asphalt defects, etc. (except the ones occurring due to the accidents)	Within 48 hours
21	Ventilation, tunnel illumination	Within 48 hours
22	Fire extinguishing systems	Within 24 hours
23	Power source and distribution systems	Within 24 hours
24	Emergency power source	Within 6 hours
25	Emergency telephones	Within 6 hours
26	Radio communication systems	Within 24 hours
27	Toll collection systems	Within 2 hours
28	Closed circuit TV (CCTV) inside tunnel	Within 6 hours
29	Struggle against snow and ice	Immediate intervention
30	Varnishing in the top structure	14 days
31	The incidents endangering the traffic Chemical effect danger	Immediate intervention
32	Expansion joint damages	14 days

Source: KGM O&M Manual, Chapter 18, General performance criteria of highway and bridges maintenance operation

3.6.2 Planning of Maintenance and Operation

(1) Basic Policy

1) Basic Policy

To ensure the safe and comfortable driving to the customers who uses the expressway (“Users”), the crisis management including accident and disaster responses shall be performed 24 hours, 365 days a year. Also, the appropriate performance of operation and maintenance is essential to preserve the expressway in a proper condition over 100 years.

2) Project Scope

This project covers 188.0km section from Kunar to Çanakkale, and the main road structures and facilities are bridges (total length: 7,900m), tunnels (total length 2,000m), 15 interchanges, 7 service areas.

3) Categories of Operation and Maintenance

Operation and maintenance is categorized mainly into 1) Maintenance, 2) Repair, 3) Toll Collection and 4) Traffic Operation. The detail is as follows:

- Maintenance: to maintain the road spaces for the safe and comfortable driving for Users
- Repair: to repair or replace of any items to restore the function or performance of road structures, facilities and vehicles
- Toll Collection: to collect the tolls from Users and the auxiliary services
- Traffic Operation: to prevent any abnormal event and ensure an early resolution to occurred abnormal events for the safe and smooth driving of the Users

(2) Characteristics of Project

1) Characteristics of the Location

Geographical Characteristics

The expressway is located along the gently undulating hills at an altitude below 300 m and passing through the mountainous areas at the border between Tekirdağ Province and Çanakkale Province.

Meteorological Characteristics

The climate type of the project location, the surrounding area of Sea of Marmara, belongs to the classification of humid subtropical climate and Mediterranean climate which is cool summer and snow winter. Snow ice control is needed because the monthly average temperature in winter is below 0 degrees C in Istanbul Province and Tekirdağ Province.

2) Toll Structure

Toll Structure

Toll structure is classified into 1) Closed toll system and 2) Open toll system. This expressway will connect with the existing expressways and Gebze-Orhangazi-Izmir Motorway, which is under construction as BOT project. The networking of these expressways is expected, therefore, “Closed toll system” is more appropriate for this project

However, the special toll rate shall be applied for the bridge over Dardanelles because the construction cost of the bridge is significantly higher than the construction cost of the road section and the considerable number of the customers who use the bridge only.

Vehicle Classification

In Turkey, the 5 vehicle classification has been used for toll collection, which shall also apply for this project. The vehicle classification in Turkey is described in Table 3.6.3

Table 3.6.3 Vehicle Classification

Vehicle Class	Vehicle Type
1	2 axle vehicles whose axle space is smaller than 3.20m Automobile, motor cycle including small truck, van and minibus of whose axle space is smaller than 3.20m
2	including every kind of 2 axle vehicles of whose axle space is greater than 3.20m Van, pick-up jeep, ambulance and funeral carrier Midi bus bus truck
3	every kind of 3 axle vehicles Bus, truck and trailer (Classes 1 and 2 with one extra axle)
4	every kind 4 and 5 axle vehicles Bus, truck and trailer (Classes 1 with two extra axle) (Classes 2 with two extra axle)
5	6 and over axle vehicles Tug truck and trailer

Source: KGM Home Page(http://www.kgm.gov.tr/Sayfalar/KGM/SiteEng/Root/TollsBogazKopruleri.aspx)

Scope of Toll Collection

Toll shall be collected from the all Users, and toll plazas shall be set up at the all interchange gateways.

Location of Toll Collection

Toll collection facilities (hereinafter toll plazas) shall be set up at the interchange gateway, and the entrance information of the passing vehicle is identified at the entrance, and the toll is collected from the passing vehicle at the exit by reading the entrance information.

Toll Collection Method

Manual collection (cash collection) on the expressway operated by KGM had been performed in the past; however, at the present day, automatic/unmanned collection using OGS and HGS is commonly adopted. For this project, automatic/unmanned collection using OGS and HGS is expected.

While, OTOYOL, the Operation and Maintenance Company of Gebze-Orhangazi-Izmir Motorway Project, mentioned there is the possibility that automatic/unmanned collection method by used KGM is inoperable and manual collection is implemented on its expressway. Therefore, when manual collection is applied for this project, another structure shall be discussed and decided.

Layout of Toll Plazas and Lanes

The layout plan of toll plazas in case of ETC lanes (No cash collection) is described in Figures 3.6.1 and 3.6.2. The minimum number of toll booths, 2 lanes at the entrance and 2 lanes at the exit in consideration of backup of the down-time, is applied for the layout due to ETC only.

After the future traffic volume and the practical processing capacity per unit time of ETC gates in Turkey are evaluated, the final confirmed number of toll booths shall be decided.

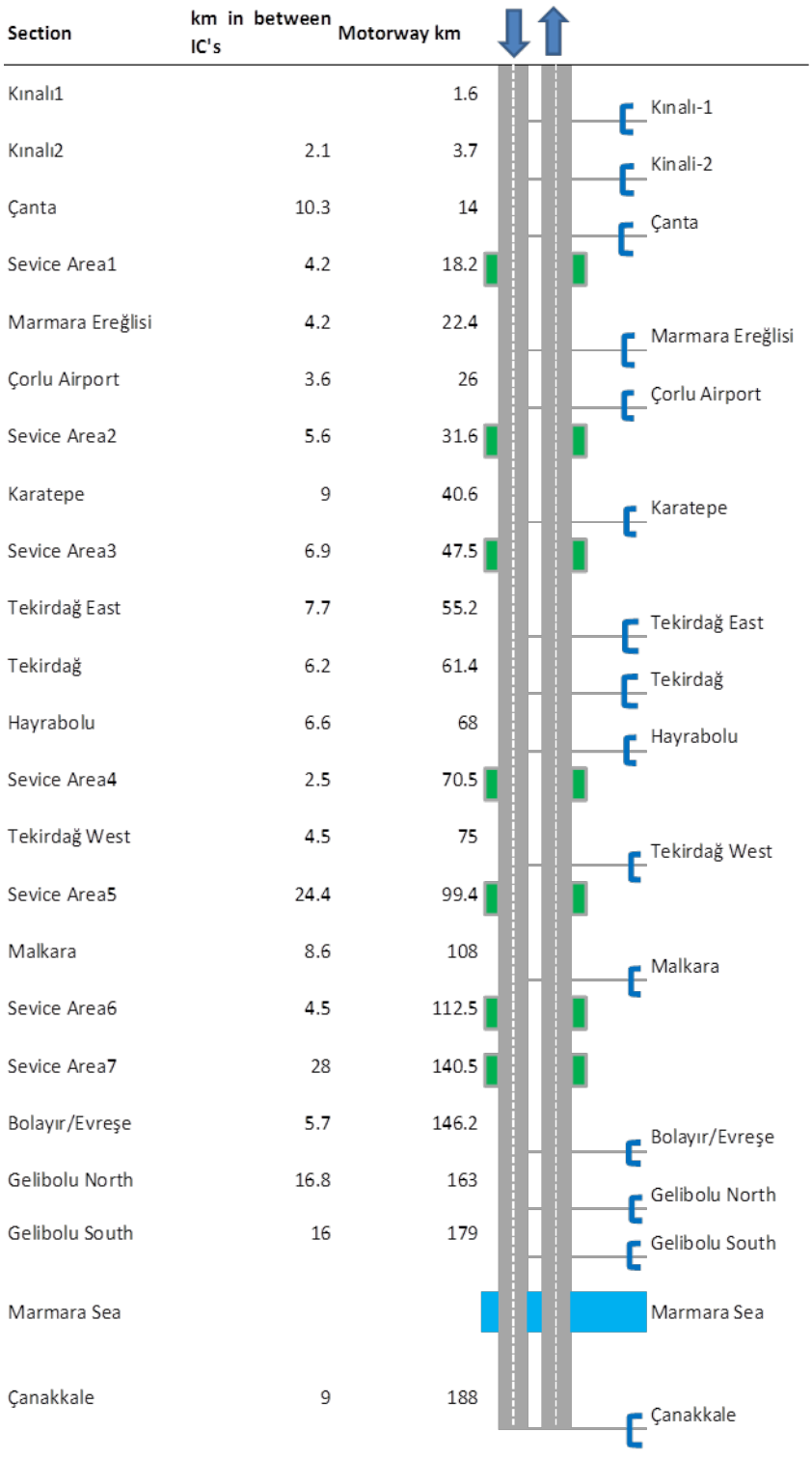
For the layout of toll booths, the lane toll barrier on the main road of expressway is not set up, In case the overall operation of the section ends Balıkesir is realized.

While, just for reference, in case the overall operation is not realized, the lane layout of the toll barrier on the main road on the bridge is described in Figure 3.6.2

A peak ratio 12% and a heavier direction traffic ratio 60% are applied to 34,000 vehicles and 2,448 vehicles are calculated for a peak hour. The processing number of one ETC lane is 700-900 vehicles per hour, and 2448 vehicles are divided by 700 vehicles per hour. As the result, 4 ETC lanes (2,800 vehicles per hour can be processed.) are needed on the one direction.

Therefore, the sufficient number of ETC lanes for the processing of 34,000 vehicles per day is 5 lanes at the entrance and 5 lanes at the exit, which consists of 4 lanes for peak hour traffic and 1 lane for backup.

Section	km in between IC's	Motorway km
Kınalı1		1.6
Kınalı2	2.1	3.7
Çanta	10.3	14
Sevice Area1	4.2	18.2
Marmara Ereğlisi	4.2	22.4
Çorlu Airport	3.6	26
Sevice Area2	5.6	31.6
Karatepe	9	40.6
Sevice Area3	6.9	47.5
Tekirdağ East	7.7	55.2
Tekirdağ	6.2	61.4
Hayrabolu	6.6	68
Sevice Area4	2.5	70.5
Tekirdağ West	4.5	75
Sevice Area5	24.4	99.4
Malkara	8.6	108
Sevice Area6	4.5	112.5
Sevice Area7	28	140.5
Bolayır/Evreşe	5.7	146.2
Gelibolu North	16.8	163
Gelibolu South	16	179
Marmara Sea		
Çanakkale	9	188
Total	**188**	



Souse：JICA Study Team

Figure 3.6.1　Layout of Toll Booths

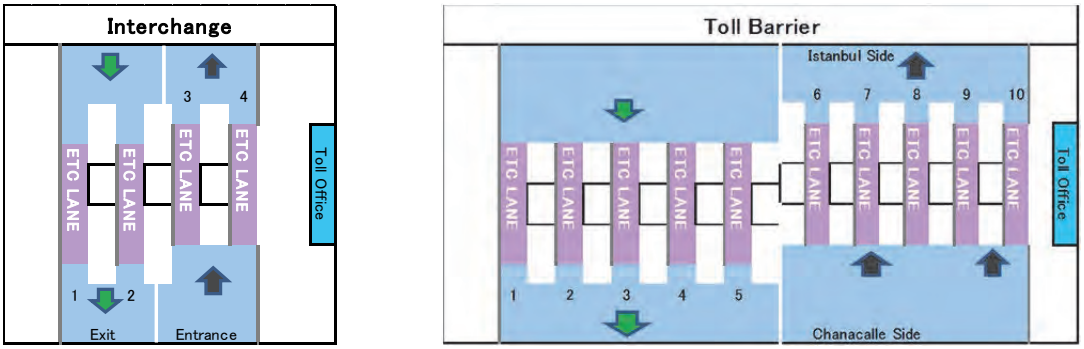


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Figure 3.6.2　Layout of ETC Lanes (Interchanges and Bridge over Dardanelles)

Discount System

At this point, the discount system in Turkey is not discussed. In Japan, there is the discount system including quantity discount and mileage service according to usage frequency. The discount system in Turkey shall be discussed after the existing toll structure system becomes recognized by the public, so the discount system is not specified in this O&M plan.

(3)　Operation and Maintenance System/Structure

1)　Operation and Maintenance System and Layout of Facilities

In order to provide operation and maintenance services, the operation center and, the operation and maintenance offices shall be established. The operation center controls 2 maintenance offices and the traffic control center. The maintenance offices provide the operation and maintenance services on the expressway in its charge.

The roll of these organizations is described in Table 3.6.4.

Table 3.6.4　The Roll of Organizations

Operation Center		• Supervision of Maintenance Offices • Planning and Verification of Maintenance • Planning and Verification of Repair • Planning and Verification of Traffic Operation • Planning and Verification of Toll Collection • Planning of Long-Term Maintenance Plan
	Traffic control center	• Road Monitoring 24 hours a day, 365 days a year • Collecting, Processing and Providing Traffic Information
Maintenance Office		• Supervision of Toll Plaza Offices • Implementation of Maintenance work • Implementation of Repair work • Implementation of Traffic Operation work
	Toll Plaza Office	• Implementation of Toll collection work

Source：JICA Study Team

KGM has implemented the operation and maintenance by three-layer structure, a head office, branch offices and O&M offices. This project covers 188km which is shorter than the expressway operated by KGM, so the functions of head office and branch office should be integrated into an operation center and the two-layer structure shall be adopted.

The organization structure is described in Figure 3.6.3.

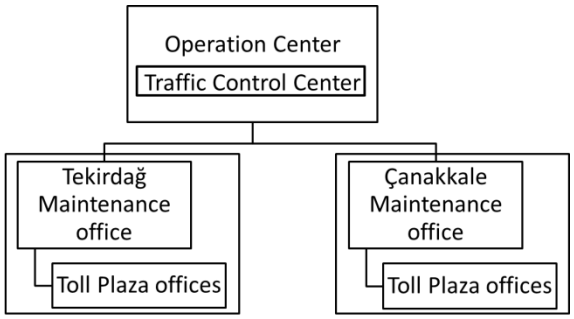

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Figure 3.6.3　Organization Structure

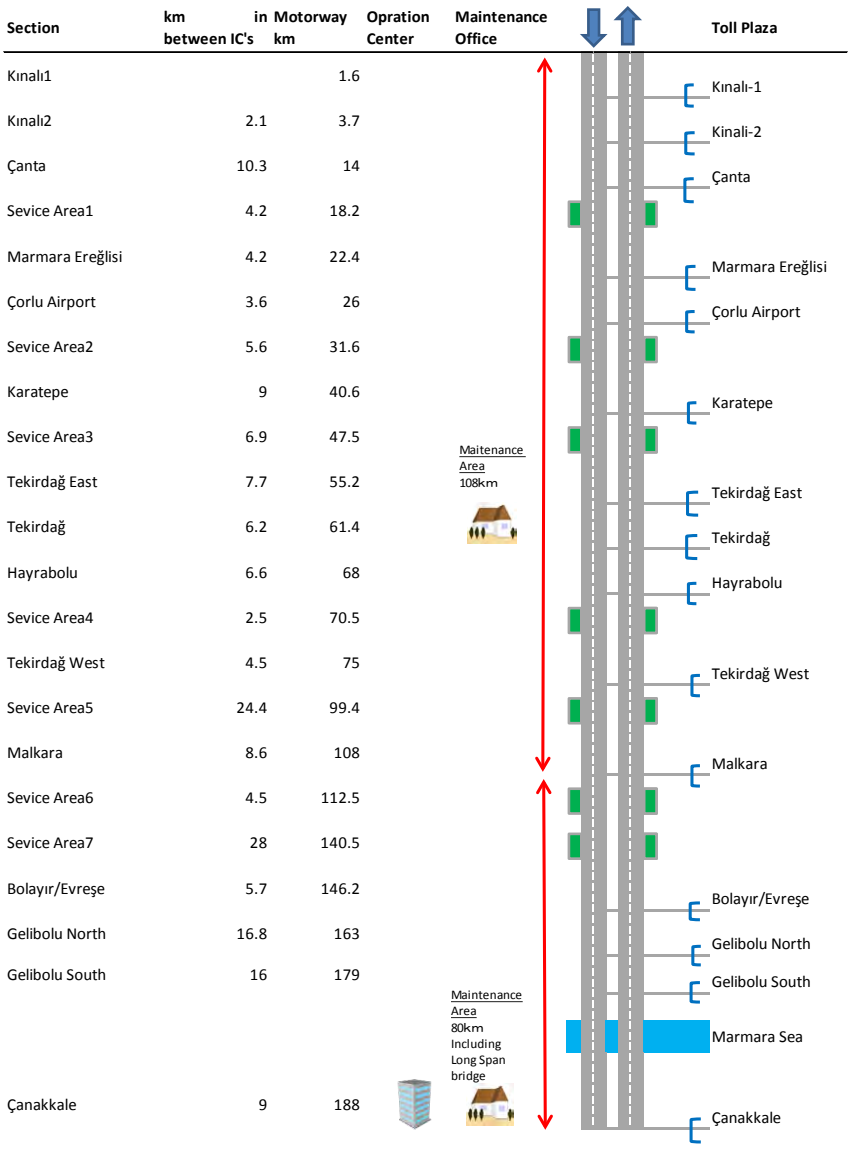

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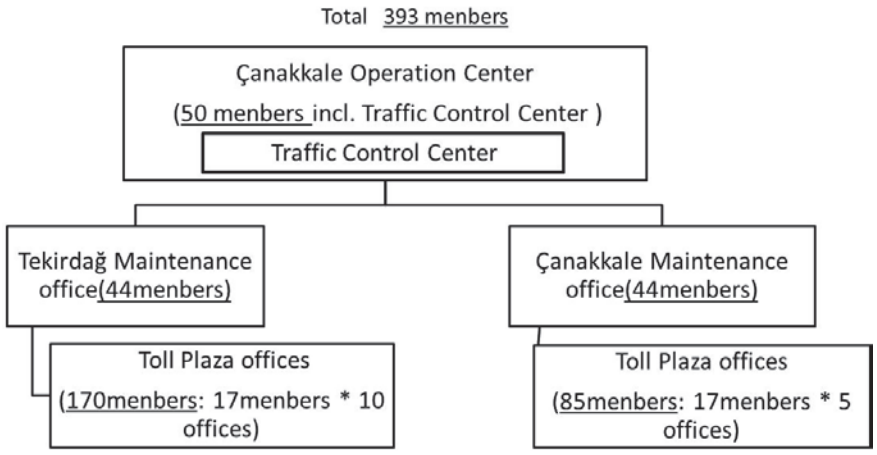
Figure 3.6.4　Layout of Organization

2) Distribution of Personnel

The organizational structure and the distribution of personnel are described in Table 3.6.5, Table 3.6.6, and Table 3.6.7. Total numbers of staff are described in Figure 3.6.5



Souce: JICA Study Team

Figure 3.6.5 Layout of Organization

The Duties of each division are as below.

- General Affairs Division: General affairs, Personnel affairs, the accounting, advertising
- Administration Division: The real estate acquisition, traffic management
- Toll Management Division: Toll collection services
- Engineering Division: Budgeting, Asset management, disaster management
- Road Maintenance Division: Planning and execution of Maintenance work, inspection of pavement or bridge, Improvement work
- Service Aria Division: Service management at Service Area
- ITS Maintenance Division: Planning and execution of inspection of ITS Facilities and Improvement work

Table 3.6.5 Distribution of Personnel in Operation Center

Division	Director General	Deputy Director General	Manager	Staff	Total
	1	2			3
General Affairs Division			1	5	6
Administration Division			1	2	3
Toll Management Division			1	2	3
Engineering Division			1	2	3
Road Maintenance Division			1	2	3
Service Area Division			1	2	3
ITS Maintenance Division			1	2	3
Traffic Control Center		1	2	20	23
Total	**1**	**3**	**9**	**20**	**50**

Source: JICA Study Team

Table 3.6.6 Distribution of Personnel in Operation and Maintenance Office

Division	Director General	Deputy Director General	Manager	Staff	Total
	1	2			3
General Affairs Division			1	2	3
Administration Division			1	6	7
Toll Management Division			1	4	5
Engineering Division			1	2	3
Road Maintenance Division			1	8	9
Service Area Division			1	8	9
ITS Maintenance Division			1	4	5
Total	**1**	**2**	**7**	**34**	**44**

Source: JICA Study Team

Table 3.6.7 Distribution of Personnel in Toll Plaza Office(automatic/unmanned collection)

	Type	Chief	Office Staff	Monitoring Staff	Total
Toll Plaza Office	Office staff	2	3		5
	Monitoring	3		3	6
Total		**5**	**3**	**3**	**11**

Source: JICA Study Team

Table 3.6.8 Distribution of Personnel in Toll Plaza Office(manual collection)

	Type	Chief	Office Staff	Tall Collection Staff	Total
Toll Plaza Office	Office staff	2	3		5
	Monitoring	3		9	12
Total		**5**	**3**	**9**	**17**

Source: JICA Study Team

(Reference: Distribution of Personnel in Operation and Maintenance Office in Japan)
The organizational structure and the distribution of personnel in Japan are described below.

Maintenance conditions

- Length: 90km
- Meteorological Characteristics: Snow and ice control is needed because the monthly average temperature in winter is below 0 degrees C
- Service Area: 4 Service Areas and 6 rest Areas
- Average Traffic Volume: 45,000 vehicles per days
- Total Tall Offices: 8 offices
- Total number of employees: 245 employees

Operation and Maintenance Office: 30 employees
(Breakdown)

- Director General: 1
- Deputy Director General: 2
- Manager: 8
- Staff: 19

Outsourcing : 215 employees
(Breakdown)

- Service Area: 3
- Tall Collection: 115
- Asset Management: 9
- Traffic Control: 31
- Cleaning: 11
- Engineering: 46

3) Vehicles and Equipment for Operation and Maintenance

The description and the number of equipment for operation and maintenance are shown in Table 3.6.9 The number of the equipment based on Chapter 1 in KGM O&M Manual. The number of equipment for snow control shall be changed depending on weather conditions.

Table 3.6.9 Description and Number of Vehicles for Maintenance offices

Type of Vehicle	Description	Number
Passenger Car	for the lead engineer	1
Passenger Car	for the engineers	3
Patrol Car	for maintenance	3
Watering Cart	for washing the road surface	2
Solution sprinkler vehicle	to spray chemical solution against icing	2
Road sweeping vehicle (vacuum)	to clean the road	1
High pressure washing car	to clean the stuck dirt	1
Sewage truck	to clean the manholes (inspection openings)	1
Vehicle with signboard (double s.m.)	traffic control during road construction and maintenance	4
Lamp crane	for the maintenance of lighting and informative signboards	1
BARIN bridge control vehicle (with attachment)	to check the bottom of the bridge deck	1
UNIMOG Truck (with attachment, 10t)	For snow clearing, salting and other purposes	12
UNIMOG Truck (with attachment, 7t)	For snow clearing, salting and other purposes	6
Truck (10 tons)	For snow clearing	2
Truck (7 tons)	For snow clearing	2
Mobile Generator (30-50 KVA)		1
Liquid fuel tanker (at least 5t)	for onsite liquid fuel supply	1
Lawn mowing machine	for the upkeep of green areas	2
Rubber tire tractor	with attachment for several purposes	2
Trailer with maintenance platform (at least 16 m)	equipped for maintenance works	1
Compressor		1
Trimmer (small type)		1
Seam cutting machine		1
Hot mix plant (with small capacity)		1
Maintenance cylinder (5t)		1
Mobile welding machine		1
Rubber tire grab	for salt loading and other purposes	1
Rubber tire reverse grab	for conduit maintenance	1
Waste truck		1
Mobile vehicle radio		40
Handheld radio		5

Source：KGM O&M Manual

Table 3.6.10 UNIMOG Truck Attachments

UNIMOG Truck Attachments	Number
Snow blade	18
Bladed router type rotary press	9
Closed salt silo and laying tool	18
Roadway railing and curb stone washing	1
Roadway railing installation and dismantling	1
Borer	1
Lawn mower	1
Grab	1
Pistol (with crusher and drillers)	2
Front brush	2
Mud pump	1

Source: KGM O&M Manual

Table 3.6.11 Description of Vehicles for Snow Ice Control

Purpose	Type of Vehicle	Maximum Snow Precipitation (average of the last decade)					
		4 lanes			2 lanes		
		Above > 1.0 m	Between 0.3-1.0 m	Less than < 0.3 m	Above > 1.0 m	Between 0.3-1.0 m	Less than < 0.3 m
Fresh Snow Clearing	10t truck	2	1				
	7t truck	2	1				
	10t truck + snow blade	4	2		2		
	7t truck + snow blade	3	1	2		1	1
Icing Examination	Solution sprayer vehicle	2	2	1	1	1	1
	Sprinkler vehicle	2	2	2	1	1	1

Source: KGM O&M Manual

4) Support of Operation and Maintenance

This project includes the opening of 188 km new expressway. In the early period after the opening, the unexpected various troubles may occur, and the maintenance of the world-class long span bridge and the snow ice control in winter season are required, so the operation and maintenance for this project is considered as a tough task. Therefore, the support from the experienced organization is important.

The supports are expected as follows:

- Manual creation ant training by the experts dispatched from Japan for 6 months before the opening, and;
- Monitoring and trouble solution by the experts dispatched from Japan after the opening, (first 5 years: 2 times a year, from 6th year: once a year).

3.6.3 Maintenance

This section covers the plan of maintenance services.

As a result of review of the specifications in Turkey and Japan, the maintenance services are mainly categorized into 9 items;

- Cleaning
- Cleaning of Facilities,
- Landscaping,
- Ice and Snow Control,
- Road Structure Inspection,
- Facility Inspection,
- Vehicle Legal Inspection,
- Urgent Response and
- Recovery Operation after Accidents

(1) Cleaning

1) Scope

This section covers the maintenance service concerning cleaning of road surface, facility interior, public toilets, tunnel sidewalls, drainage, accessories to roads. Applicable Criteria

2) Applicable Criteria

Chapter 1in KGM O&M Manual mentioned cleaning of road structures, and other chapters also described the cleaning for respective road structures, which shall be applied basically for this O&M plan. Moreover, Japanese standards are used as reference for some items.

3) Purpose, Description and Service Level

Cleaning of Road Surface

Cleaning to protect road function from any garbage or dust on the road for the safe and smooth drive of Users

Cleaning of Service Area

Cleaning to maintain appropriate condition of service areas and parking area under normal social conventions

Cleaning of Public Bathrooms

Cleaning to maintain appropriate condition of public bathrooms under normal social conventions

Cleaning of Tunnel Sidewall

Cleaning to maintain proper visual environment in tunnel and to ensure the safety and smooth driving of the users

Cleaning of Drain Facilities

Cleaning to maintain appropriate conditions of drain facilities during raining and snowing to ensure the safety and smooth driving of users, specially focusing on the place where garbage or dust tends to accumulate such as the bridge, the open cut structure and so on.

Cleaning of Road Accessories

Cleaning to maintain the proper function of road auxiliaries, to prevent deteriorating of road auxiliaries, and to ensure the safety and smooth driving of the users.

Table 3.6.12 Description of Cleaning

Item	Type	Description	Application guideline	Service Level
6Cleaning of Road Surface	Road Surface Cleaning A	Cleaning by sweeper	-	Frequency shall be set up in consideration of the road characteristics and garbage amount in the past of the respective section and season variation. Regular frequency is shown in Table 3.6.13.
	Road Surface Cleaning B	Cleaning by automobile sprinkler	-	The cleaning work shall be performed If needed after the handling of an accident
	Road Surface Cleaning C	Cleaning by Manpower	-	Frequency shall be set up in consideration of the road characteristics and garbage amount in the past of the respective section and season variation. Regular frequency is shown in Table 3.6.14.
	Road Surface Cleaning D	Cleaning by Manpower (Within 1.5m from the edges of berm)	Road is not applied Road Cleaning A or B	In case of necessity
Cleaning of interchanges and service areas	Internal Cleaning A	Cleaning of Parking areas by Manpower	Traffic Volume: Over 10,000 vehicles/day	Once/2days
			Traffic Volume: Under 10,000 vehicles/day	Twice/Week
	Internal Cleaning B	Cleaning of Service areas by Manpower	Traffic Volume: Over 10,000 vehicles/day	Once/2days
			Spot Traffic Volume: Under 10,000 vehicles/day	Twice/Week
	Internal Cleaning C	Cleaning of Internal areas of interchanges by manpower	-	Once/ Year

Item	Type	Description	Application guideline	Service Level
Cleaning of Public Bathrooms	-	Cleaning of public bathrooms in service areas	-	Once/Day
Cleaning of tunnel sidewall	-	Cleaning of tunnel sidewall by machineries	Traffic Volume: Over 20,000 vehicles/day	Twice/ Year
			Traffic Volume: Under 20,000 vehicles/day	Once/Year
Cleaning of drain facilities	-	Cleaning of drain pipes, drain ditch and catch basin by manpower or machineries	Hotspot of garbage and dusts	Once/ Year
			other spots than the above	In Case of Necessity
Cleaning of Road Auxiliaries	Cleaning of Guard fences	Cleaning of guardrails and handrails by manpower or machineries	-	In principle, the cleaning is not performed because the performance loss of lane departure prevention does not occur.
	Cleaning of Signs	Cleaning of Signs by manpower or machineries	-	When communication performance of signs is lost, the cleaning shall be performed.
	Cleaning of Joints	Cleaning of steel finger joints by manpower or machineries	-	In case of buffering performance loss of brides, the cleaning shall be performed.

Table 3.6.13 Regular Frequency of Road Surface Cleaning A

Regular Frequency *1
25 times/Year

*1 Regular frequency of the cleaning based on the works performed in the past

Table 3.6.14 Regular Frequency of Road Surface Cleaning C

Regular Frequency*1
139 times/Year

*1 Regular frequency of the cleaning based on the works performed in the past

(2) Cleaning of Facility

1) Scope

This section covers the cleaning of facilities for road machineries, electric, communication.

2) Applicable Criteria

Frequency and description for the cleaning specified in Chapter 1 in KGM Manual and other chapters for respective road structures are mail applied for the O&M, however, the standards and experiences in Japan is also used as reference for some items.

3) Service Level

Road Lightening

Cleaning to maintain proper visual environment in main roads, interchanges and service areas during the night and to ensure the safety and smooth driving of the users

Tunnel Lightening

Cleaning to maintain proper visual environment in tunnels and service areas during the night and to ensure the safety and smooth driving of Users

Sign Lightening

Cleaning to maintain proper visual environment of the signs in tunnels and to ensure the safety and smooth driving of Users

Sign Lightening in Tunnels

Cleaning to maintain proper visual environment of the signs in tunnels and to ensure the safety and smooth driving of Users

Jet Fans

Cleaning to maintain the ventilation performance for exhaust fumes and smoke from fire and to ensure the safety and smooth driving of Users

Delineators

Cleaning to maintain proper visual environment of the delineators in main roads, and interchanges and to ensure the safety and smooth driving of Users

Receiving Tanks

Cleaning to provide constantly safe drinking water to Users at service areas

Variable Message Signs

Cleaning of variable road message signs and variable speed limit signs to maintain proper visual environment in main roads, and interchanges and to ensure the safety and smooth driving of User

Fire Hydrants

Cleaning to maintain the proper function of fire hydrants in tunnels and to ensure the safety and smooth driving of User

Emergency Telephones

Cleaning to maintain proper visual environment in main roads, and interchanges and to ensure the safety and smooth driving of Users.

Septic Tank

Cleaning of septic tanks in service areas to maintain the function

Building

Cleaning work of ventilating fans in the buildings to maintain the function.

Table 3.6.15 Cleaning of Facilities

Item	Description	Application guideline	Service Level
a. Road lighting light fixture cleaning	street light fixture cleaning by manpower		enforced by the damage situation
b. Tunnel lighting light fixture cleaning	Tunnel light fixture cleaning by mechanical and manpower	All tunnel	enforced by the damage situation
c. Beacon lighting light fixture cleaning	lighting fixture cleaning by manpower	Inner and outer illumination	When replacing the lamp
d. Tunnel signs lighting light fixture cleaning	Cleaning of the tunnel signs lighting fixture by manpower	Inner illumination	enforced by visibility and the damage situation
e. Jet fan cleaning	Jet fan cleaning by manpower	Including the booster fan	enforced by the damage situation
f. Self-luminous delineator cleaning	Self-luminous cleaning by manpower	-	enforced by visibility and the damage situation
g. Cleaning water tank etc.	Cleaning of water tank etc. by manpower	Water tank, elevated water tanks and high position water tank	enforced by the statutory period and the damage situation
h. Cleaning the variable information board etc.	Cleaning of the variable road information plates and cleaning of the variable speed control signs by manpower	Including variable speed control signs	enforced by visibility and the damage situation
i. Cleaning fire hydrants etc.	Work aimed at original features that have a fire hydrant etc. in the tunnel to hold good for cleaning the safe and smooth flow of users	Fire hydrant, fire box, fire detector	enforced by visibility and the damage situation
j. Cleaning, emergency phones etc.	Emergency phones etc. cleaning by manpower	Emergency phones	enforced by visibility and the damage situation
k. Induction line cleaning for radio reruns	Induction line cleaning for radio reruns by manpower	-	enforced by hearing
l. Septic tank cleaning	Cleaning of septic tank etc. by manpower	Including sludge removal	enforced by the statutory period and the damage situation
m. Building cleaning	Cleaning of ventilation of the rest facility building by manpower	cleaning of Bathroom ventilation	enforced by the damage situation

Source: Survey Team

(3) Landscaping

1) Scope

This section covers management of the whole plant within the project scope including roadside of main line, median strip and road slope.

2) Applicable Criteria

Landscaping is described in Chapter 1 2.2 Routine Maintenance and Chapter 2 Environment and Landscaping, KGM Manual, which is applied for the O&M Manual.

3) Service Level

The management of planting, cutting trees and protecting trees, should be performed to avoid any inconvenience for the driver of expressways and the neighborhood and to ensure the appropriate condition of the environment and landscape.

Table 3.6.16 Landscaping

Items	Type	Description
Management of planting	Management of shapes (cutting the glass)	Performed in case of disturbing traffic safety by blocking visual perception or any complaints from neighborhood
	Management of growth (Compost, Chemical spray)	Performed in case of the growth problem or loss of planting function

Source: Survey Team

(4) Ice and Snow Control

1) Scope

This section covers ice and snow control including road deicing and snow removal.

2) Applicable Criteria

Ice and snow control is described in Routine Maintenance, Chapter 1, KGM O&M Manual; however, the latest Japanese specification covers new knowledge concerning snow ice control, so Japanese specification is used as reference.

3) Service Level

Road Deicing

In case road surface freezing is predicted due to low temperature, spray of deicing agent is shall be performed before the freezing for freezing-point depression.

If the road surface freezing predicted in consideration of Road condition, traffic characteristics, site condition, work efficiency, based on the weather observation and information from the road patrol team, the uniform spray of deicing agent before the freezing is standardized. In principle, “sodium chloride (Nacl) “is utilized as deicing agent, the regular amount of the spry is described below. Method of spray is basically same as the wetted salt spray described below, however, in case solid or liquid form of the deicing agent, or fixed spray machine is utilized, the most effective method shall be applied.

Snow Removal

The most appropriate removal method shall be performed snow on the road in consideration of the snow depth, condition, and traffic volume,

In consideration of Road condition, traffic characteristics, site condition, work efficiency, based on the weather observation and information from the road patrol team, the uniform spray of deicing agent before the freezing is standardized

The snow removal is performed by a few trucks lining up side by side. The number of trucks is decided by the number of lanes, weather condition and the road width,

For the compacted snow or the accumulated snow on the beam, the appropriate machineries or method for each circumstance shall be selected. The following types of snow ice control shall be combined to minimize the impact of the snow on the road surface.

Table 3.6.17 Description of Snow Ice Control

Items	Type	Description	spray volume	Service Level
a. Deicing	Wetted salt spray	Mixture or solid and liquid of NaCl is sprayed by spray vehicles	20 g/ m^2 *1	Performed in time a road surface freezing is predicted
	Solid Spray	Solid of NaCl is sprayed by spray vehicles.	20 g/ m^2	
	Liquid Spray	Liquid of NaCl is sprayed by spray vehicles	0.1 liter/ m^2 *2	
	Fixed Type Spray	Liquid of NaCl is sprayed from fixed machines on roadsides.	0.1 liter /m^2 *2	
b. Snow Removal	Removal of fresh snow	Removal of fresh snow on road surface	—	Performed timely according to the snowing conditions
	Removal of compacted snow	Removal of compacted snow or unevenness flattening	—	
	Widening by snow removal	Removal of accumulated snow on beam	—	
	Snow Hauling	Snow hauled by dump trucks	—	
	Others	Prevention action against snow slide of snow cornice and snow mound Removal work of snowcap, snow accretion or icicle to ensure facility function	—	

*1: Salt15g/m^2+Water5g/m^2
*2: 12% Water Solution
Source: Survey Team

4) Considerations

In order to ensure safe traffic in winter the snow ice control specified above, educational activity, public relations, traffic regulation, and information provision shall be performed mutually in an integrated manner.

Mutual Collaboration with the Relevant Public Organizations

For the implementation of speed limit or snow tire chain control, the close collaboration with the relevant public organizations n consideration of the site condition is needed.

Implementation of Public Relations for Safety and Information Provision

To accomplish more efficient snow ice control and to ensure the safe traffic in winter, the public relations for the correct understanding regarding the snow ice on road surface is needed for the users, and information provision shall be performed timely and appropriately.

(5) Road Structure Inspection

1) Scope

This section covers inspection of roads structures and road accessories of the expressway.

In this section, the general information regarding the inspection of road superstructures and the road accessories excluding the initial inspection is specified.

Road superstructure is defined as the superstructures to ensure the function of the expressway, which consists 2 types, main semi-permanent structures (floor slab, curb, bridge railing、upper girder, bridge pier, bridge abutment, foundation, retaining wall, tunnel, etc.) and replaceable structures (pavement, paint, concrete paint, bridge bearing, suspension device, drop preventive device of girder, etc.)

Facilities is defined as the all facilities to ensure the associated function including traffic management facilities, traffic control facilities, lighting equipment, environment preservation facilities, tunnel facilities, toll collection facilities, drain facilities, parking area, etc.

2) Applicable Criteria

KGM Manual, Chapter 1 “MAINTENANCE PERIOD- MAINTENACE SCHEDULE” be applied for frequency, object and damage criteria for the inspection, which specified routine inspection, periodic inspection, and custom inspection, on the other hand, Japanese standard has specified the frequency of the routine inspection according to the traffic volume on the section. In this section, the inspection description in Turkey is used and the inspection frequency in Japan is used as reference.

3) Purposes, Type, and Description

Road inspection is the significantly important maintenance to evaluate the road condition and traffic situation.

Road Structure Inspection

The road structure inspection is shall be performed to recognize damage or abnormality of the road structures promptly for the prevention of the damage to the third parties. The inspection result is evaluated and used as the basic data for the appropriate repair scheduling.

The road structure inspection is categorized into some types according to the frequency and the inspection description. These all inspection shall function together for the efficient implementation, and the comprehensive inspection schedule shall be established to l function together.

Table 3.6.18 Road Structure Inspection

Item	Type	Description
a. Road Structure Inspection	Routine Inspection	Inspect the condition of road surface from the patrol car, focusing on any deformation of the structure which disturb traffic safety. If there are any damages, inspectors should inspect the damages on the road surface directly if necessary.
	Periodical Inspection	Inspect the condition of road structure by walking, looking from the distance or closely if necessary. There are two types of periodical inspection A and B. Periodical inspection A is performed to check any damages to the structure as a whole. Periodical inspection B is performed by looking at closely to the structure and by listening to the sound of hitting the structure to ensure the soundness of the structure.
	Detailed Inspection	Inspect the details of the structure by looking closely or by listening the sound of hitting structure regarding the damages with complex mechanism and estimate the condition in the future by evaluating the soundness of the structure considering characteristics of the structure and deterioration mechanism with highly technical knowledge.
	Landscaping	Inspect the condition of trees and glasses according to its purpose and weather conditions, and estimate the condition in the future by evaluating with highly technical knowledge.
	Emergency Inspection	Inspect in case of earthquake, unusual weather conditions or any difficulties in routine inspection.

Source: Survey Team

4) Service Level

Table 3.6.19 Service Level of Road Structure Inspection

	Type		Applicable Guideline (Average Traffic Volume /Vehicles per Day)	Service Level
Routine Inspection	Safety Inspection		Under 25,000	4 days／2 weeks
			25,000-49,999	5 days／2 weeks
			50,000-79,999	6 days／2 weeks
			More than 80,000	7 days／2 weeks
	Abnormality Diagnostic Examination	Follow-Up	―	As Needed
		Simple Diagnosis	―	As Needed
Periodical Inspection	A Periodical Inspection A		―	One or more times/ Year
	Periodical Inspection B			Once/5-10 years
Detailed Inspection				Same as Periodical Inspection B

Source: Survey Team

(6) Facility inspection

1) Scope

This section covers the Power/Electrical systems, Motorway Service Facilities and Operation Buildings and Facilities to maintain the proper condition of the function.

2) Applicable Criteria

Frequency, object and damage criteria for the inspection are specified in KGM O&M Manual Chapter. 9 “Maintenance and Operation Principles of the Power/Electrical systems、Chapter 11 “Operation and Maintenance Principles of Motorway Service Facilities”, and Chapter 13 “Maintenance and Repair of the Operation Buildings and Facilities , which are applied for this O&M plan.

Regarding the facilities, inspection requirement has been regulated by applicable laws and regulations, so the standards in Turkey shall be used.

(7) Vehicle Legal Inspection

1) Scope

This section covers the legal inspection and maintenance of the vehicles utilized by the operator for road sign, road maintenance, operation, and patrol and cleaning, special vehicles or trucks for maintenance and ice control.

2) Applicable Criteria

The legal inspection and maintenance for vehicles is not specified in KGM O&M Manual, which shall be performed in accordance with the applicable law and regulation and in Turkey. Just for reference, the service level in japan is summarized below.

Reference: Vehicle Legal Inspection and Maintenance in Japan (Description and Service Level)

a. Description
The inspection and maintenance for the vehicles utilized by the operator shall be performed in accordance with the applicable law and regulation for the safety driving,
Vehicle Legal Inspection in Japan

Item	Type	Description	Frequency
Vehicle Legal Inspection	Periodical Inspection	Periodical inspection of the vehicles utilized by the operator for road sign, road maintenance, operation, and patrol and cleaning, special vehicles or trucks for maintenance and ice control shall be performed in accordance with the applicable law and regulation in order to maintain the proper function.	1 time (12, 24, 36 months)
	Safety Inspection	Safety inspection of the vehicles utilized by the operator for road sign, road maintenance, operation, and patrol and cleaning, special vehicles or trucks for maintenance and ice control shall be performed in accordance with the applicable law and regulation in order to maintain the proper function. The inspection includes inspection by testing equipment, visual inspection, and confirmation of vehicle identification.	1 time(12, 24, 36 months)
	Component Maintenance	In accordance with the applicable law and regulation, the component adjustment, replacement of the components shall be performed to maintain the proper function.	Depending on the result of periodic inspection

Source: Survey Team

(8) Urgent Response

1) Scope

This section covers the urgent response in case an abnormal events caused by traffic accidents or natural disasters affected the assurance of the traffic.

2) Applicable Criteria

"Maintenance and Operation Performance Table of the highways and bridges" is specified in the KGM O&M Manual Chapter. 18. The operator shall meet the required service level. (See Table 3.6.2)

3) Purpose, Description and Service Level

Urgent Response: Incident Response

In case the damage of the road structures or accessories caused by traffic accidents or natural disasters affects the road function, the emergency procedures including traffic safety securement and information provision to restore the road function immediately shall be implemented.

Table 3.6.20 Urgent Response

Item	Description	Service Level
Urgent Response	Depending on the damage level of road structures or accessories caused by traffic accidents or natural disasters, the appropriate restoration or cleaning shall be implemented urgently and temporarily in order to restore the road functions.	As needed

Source: Survey Team

(9) Recovery operation after accident

1) Scope

This section covers the accident recovery operation to restore the function in the event of any damage caused by traffic accident being incurred by the road structures, road accessories (fence, road signs, and etc.) or facilities (machinery, electric, and communication facilities).

2) Applicable Criteria

The service level for the major road structures is specified in KGM O&M Manual Chapter. 18 "General Performance Criteria of Highway and Bridges Maintenance Operation" and the operator shall meet the criteria. In this section, the accident recovery excluding the urgent response mentioned above shall be specified

3) Purpose, Description and Service Level

Accident Recovery: to restore the road function including traffic safety securement and information provision in the event of any damage caused by traffic accident being incurred by the road structures, road accessories (fence, road signs, and etc.) or facilities (machinery, electric, and communication facilities).

Table 3.6.21 Recovery Operation after Accident

Item	Description	Service Level
Accident Recovery	In event of any damage caused by traffic accident being incurred by road structure, road accessories (fence, road signs, and etc.) or facilities (machinery, electric, and communication facilities); the damage of road structures shall be repaired and the all or a part of road accessories or facilities shall be replaced. The accident recovery shall be implemented immediately and appropriately in order to restore to the origin condition.	As Needed

Source: Survey Team

3.6.4 Repair

This section covers the repair plan, and the repair service is mainly divided into two categories.

- Repair/Replacement of Road Structures and Accessories
- Repair/Replacement of Facility Equipment and Facilities

The repair and the replacement of pavement surface are especially described in Turkish standards, and the detail description is also listed in the O&M plan. Moreover, the repair and the replacement for expansion devise and the paint of steel bridge are also listed due to the key structures.

As the result of comparative review of the standards in Turkey and Japan, the items regarding the repair and the replacement of road structures and accessories in KGM O&M Manual are not systematized .(See Table 3.6.22.) Therefore, Japanese systematized standard is used as reference.

Table 3.6.22 Correspondence Table for Repair/Replacement

Item	KGM O&M Manual	
Bridges, Expansion joints, metal bridges	Chapter 6	Bridge, Viaduct and Other Engineering Structures
Tunnel	Chapter 7	Principles of O&M of Motorway Tunnels
Pavement	Chapter 2, Chapter 3	Maintenance and Repair of the Motorway Superstructure Performance Criteria of the Motorway Superstructure
Earthworks	Chapter 10	Environment and Landscaping
Road slope	Chapter 19	Maintenance Principles for Reinforced Earth Walls
Signs	Chapter 4	Traffic and Motorway Safety
Traffic safety and management facilities	Chapter 4	Traffic and Motorway Safety
Planting	Chapter 10	Environment and Landscaping

Source: Survey Team

(1) Repair and Replacement of Road Structures and Accessories

1) Scope

This section covers the repair and the replacement of any items of road structures and accessories including bridges, tunnel, pavement, earthworks, road slope, signs, traffic facilities, and landscaping to restore their function.

2) Applicable Criteria

In KGM Manual, the items regarding repair and replacement of road structures and accessories are not systematized, so Japanese systematized standards is used as reference.

3) Purpose and Description

Repair and Replacement

The purposes of the repair and the replacement are 1) preservation and restoration of the road function, and 2) preventive measure of damage caused by the deterioration of the road structures and accessories to the third parties according to the results of road structure inspection.

Table 3.6.23 Repair or Replacement of Road Structures and Accessories

Item	Description
a. Repair or Replacement of Road Structures and Accessories	According to the road structure inspection specified , the deterioration or damage is evaluated, and the items of the damage E or AA・E・AA・A (or A1, A2) shall be repaired or replaced appropriately in order to restore the road function.

Source: Survey Team

4) Service Level

Table 3.6.24 Service Level of Repair or Replacement of Road Structures and Accessories

Items	Damage Level Evaluation Classification		Condition	Service Level
Repair or Replacement of Road Structures and Accessories	Function Evaluation	AA	Significant damage or abnormity is found, and the decline in the structure function has occurred.	Repair immediately
		A	Damage or abnormity is found, and the decline in the structure function is in progress	Repair needed
		A1	Damage or abnormality is in progress, the affection degree for the structure function is high.	in 2 years
		A2	Damage or abnormality is in progress, and the affection degree for the structure is low.	in 5 years
		B	Damage or abnormality is in progress, but it has not affect to the function of the road structures.	
	Evaluation for the damage to third patties	E	Interference to safe traffic or the third parties may occur, the urgent response is needed	Urgent Repair

Source: Survey Team

(2) Repair/ Replacements of Pavement

1) Scope

This section covers the repair or replacement of the damaged pavement in order to restore the function.

2) Applicable Criteria

KGM O&M Manual Chapter. 2 “Maintenance and Repair of the Motorway Structure” is basically applied to the pavement inspection and repair. KGM O&M Manual Chapter. 3 “Performance Criteria of

the Motorway Superstructure" （performance criteria for pavement） is applied to the details of maintaining the pavement condition. However, "4) Purpose and Description" below refers to the Japanese Expressway standards.

3) Guideline for Renewal of Pavement

The renewal of pavement in the section shall be carried out following cases.

- In case the section asphalt pavement area where the deformities in the shape of crocodile back rippling and block cracks covers more than 30 % of the area.
- In case the settled rut is over 3.0 cm deep (average), and
- If ration of the deformed area with the potholes or patches is more than 30%.

4) Purpose and Description

Repair/Replacement of Pavement

Repair of replacement of pavement appropriately according to the result of road structure inspection, road patrols and road surface condition survey performed at the time of need in order to sustain or restore the road surface function for traffic safety and avoidance of noise and vibration caused by the pavement.

Table 3.6.25 Repair/Replacement of Pavement

Items	Type	Description
Repair/Replacement of Pavement	Repair/Replacement A	The repair shall be performed for small scale damage found by daily inspection or road patrol, and the repair method shall be selected appropriately in the following types
	Potholes Repair	Asphalt mixture filling to the localized potholes
	Seal Coat	Sealing material filling to the clack on the road surface
	Reconstruction replacing reprocessing	Localized damaged area of pavement is repaired.
	Ramp Repair	Partial overlay by asphalt mixture on the ramp located at the facing surface between the ground and the structures.
	Repair/Replacement B	Road surface condition survey shall be performed at the time of need for quantitative and serial evaluation of the ratio of setting ruts an crack , according to the result and performance of pavement, the following repair and replace method shall be selected and implemented for the damaged area to restore the function.
	Cutting & Overlay	Cutting and Overlay of the damaged pavement surface
	Replacement	Cutting and Repair of the damaged layers
	Leveling	Leveling of road surface asperity or floor slab of bridges for easy upper layer paving.
	Concrete Cutting	Cutting and Polish on Concreate Pavement Surface for improvement of slipping resistance

Source: Survey Team

5) Performance Criteria of Pavement

Performance criteria for pavement condition are specified in KGM O&M Manual Chapter 3, which is summarized below.

Roughness

Measurement values shall be presented as International Roughness Index (IRI).

Table 3.6.26 Acceptance Criteria for Roughness (IRI) Values

Road Category	IRI value to form the basis for repair during the operation period (m/km)	IRI acceptance value for superstructures for which a reinforcement layer has been applied or which have been reconstructed during the operation period (m/km)	IRI value to be sought at the time of delivery by the end of the operation period (m/km)
Motorway	IRI ≥ 2.1	IRI < 1.4	IRI < 1.6 at least on 70% IRI < 2.1 on 100%
Link Roads	IRI ≥ 2.5	IRI < 1.7	IRI < 2.1
Intersection Branches	IRI ≥ 2.5	IRI < 1.7	IRI < 2.1

Source: KGM O & M Manual

Settling of Ruts

Settled ruts (T.I.O) shall be expressed as the perpendicular interval in cm arrived at by positioning of standard compliant straight edge perpendicularly to the road axis.

Table 3.6.27 Acceptance Criteria for Subsidence at Tire Track (TIO) Values/Settled Ruts (T.İ.O) Value

Road Category	TIO value to form the basis for repair during the operation period (m/km)
Motorway	TIO ≥ 1.5
Link Roads	TIO ≥ 1.5
Intersection Branches	TIO ≥ 1.5

Source: KGM O & M Manual

Slip Resistance

Measurement values for slip resistance shall be presented as Skid Number (SN).

Table 3.6.28 Acceptance Criteria for Friction Resistance

Road Category	SN value to form the basis for repair during the operation period	SN acceptance value for superstructures for which a reinforcement layer has been applied or which have been reconstructed during the operation period	SN value to be sought at the time of delivery by the end of the operation period
Motorway	SN < 35	SN ≥ 45	SN ≥ 45 in at least 50% SN ≥ 35 in 100%
Link Roads	SN < 30	SN ≥ 40	SN ≥ 40 in at least 50% SN ≥ 30 in 100%
Intersection Branches	SN < 30	SN ≥ 40	SN ≥ 40 in at least 50% SN ≥ 30 in 100%

Source: KGM O & M Manual

Deflection

Deflection shall be measured by a Falling Weight Deflectmeter (FWD).

6) Measurement Method

Measurement processes shall be performed according to following standards;

Table 3.6.29 Standards Used in Road Performance Measurements

Performance measurement	Standard	Measurement Method
International roughness Index (IRI)	ASTM-E 950	Profilometer measurement device
Friction Resistance (SN)	ASTM-E 274	Friction Resistance measurement device
Surface defects (peeling, dismantling, pits, tire track formation, undulation, lengthwise or transverse cracks, alligator cracks, side cracks, etc.)	Highways Flexible Superstructures Design Guideline ASTM-E 1703/E 1703M-95	- For cracks, pits, etc.: Observation or camera system - For tire track formation: profilometer measurement device or measurement with gauge
Deflection measurement	AASHTO-T 256-01	Deflectometer measurement device

Reference: Comparison with Japanese

Acceptance criteria needs be changed according to the site situations, and just for reference, the target values in Turkey and Japan are listed in the following table.

Target Values in Turkey and Japan

Type		Service Level			
Repair /Replacement of Pavement	A	The Same Level of Repair/Replacement of Road Structures and Accessories.			
	B	Target Value		【Target Value in Japan】	【Turkey】
			Setting of Ruts	25mm	30mm (Acceptance Criteria)
			Friction coefficient	μ (80) 0.25	Repair: SN value＞35 (μ0.35) Renewal: SN value≧45 (μ0.45)
			Roughness	Standard Deviation IRI≦3.5mm/m	Repair: IRI≦2.1(m/km) Renewal: IRI＜1.4m/km
			Difference in Level	Bridge joint: 20mm Cross-section joint: 30mm	
			Clack Ratio	20%	30% (Acceptance Criteria)

(3) Repair/Replacement of Expansion Devices

1) Scope

This section covers the repair and the replacement of suspension devices installing to the bridge and ground section in order to restore to the origin state.

2) Scope and Description

The condition of expansion devices shall be observed during the road structure inspection or patrol, and the repair or the replacement shall be performed appropriately depending on the damage level in order to sustain or restore the function for traffic safety and avoidance of noise and vibration caused by the expansion devices.

Depending on the damage level of expansion devices, the following methods shall be selected appropriately.

Table 3.6.30 Repair/Replacement of Expansion Devices

Item	Type	Description	Service Level
Repair/Replacement of Expansion Devices	Whole Replacement	New expansion with the same level function is replaced.	Same Service Level of Repair or Replacement of Road Structures and Accessories
	Partial Replacement	Partial components of the devices are repaired or replace.	
	Others(Repair)	Function recovery including expansion gap adjustment or longitudinal is performed. Leakage prevention of water is performed for the steel expansion device	

Source: Survey Team

(4) Repaint of Steel bridges

1) Scope

This section covers the repaint of the painting surface of steel bridges in order to restore the function to origin state.

2) Applicable Criteria

The repaint is described in KGM O&M Manual; however, the latest Japanese specification covers new knowledge concerning repaint, so Japanese specification is used as reference.

3) Scope and Description

The paint condition of steel brides shall be observed during the road structure inspection, and the deterioration level shall be evaluated by the visual inspection and the diagnostic system for the deterioration level of painting of steel bridge. Depending on the deterioration level, the repaint or maintenance shall be implemented in order to ensure the proper function of the steel bridges.

Depending on the evaluation result, the following methods shall be selected appropriately.

Table 3.6.31 Repaint of Steel Bridge

Item	Type	Description	Service Level
a. Repaint of Steel Bridge	Whole Repaint	Whole repaint with the same level function is performed	Depending on the evaluation by the visual inspection and the diagnostic system for the deterioration level of painting of steel bridge.
	Partial Repaint	Partial repaint with the same level function is performed	

Source: Survey Team

(5) Repair /Replacement of Equipment

1) Scope

This section covers the repair and the replacement of the equipment including electric equipment, communication equipment tunnel equipment management/rest equipment in order to restore the function.

2) Reviewed Standards and Proposal Details

The items to be inspected are specified in KGM O&M Manual Chapter 13 “Maintenance and Repair of the Operation Buildings and Facilities, however, there is no description regarding the repair. Japanese standard is used as reference for the repair.

3) Scope Description

The repair and replacement of the expressway facilities is performed in a timely and appropriate way according to the conditions and the damages to the facilities to ensure the driver’s safety and comfort.

Table 3.6.32 The repair or the replacement of Equipment

Items	Description
Repair/Replacement of facilities and buildings	The appropriate repair and replacement is performed according to the inspection of facilities and buildings, if the damages are evaluated as the rank of AA and A.

Source: Survey Team

4) Service Level

Table 3.6.33 Facilities, Buildings(Service level by work types)

Service level	Description
AA	Emergency repair is necessary due to the severe damage
A	Repair is necessary due to the damages
B	Continuous observation is necessary even though there are damages but no functional depression
OK	No damages
Damages to Third Party	Emergency repair is necessary if there is a possibility of damages to traffic safety or third party.

Source: Survey Team

3.6.5 Repair/Maintenance of Long Span Bridges

The bridge over Dardanelles, which does not have any alternative route, is located in the severe corrosive environment, and the deterioration speed of subtle abnormalities is rapid. Therefore, the subtle abnormalities in the early stage shall be repaired for minimizing life cycle cost, ensuring safe and smooth traffic, and preserving the bridge over a long duration. In this O&M plan, the important items regarding the bridge are specified below.

The description of the inspection for long span bridges specified in KGM O&M Manual shall be used for this O&M plan. For the repair of the bridge, KGM O&M Manual Chapter.5 shall be adopted; however, Maintenance and Repair Specification for Japan National Route 28 shall be used for the items that are not specified in KGM O&M Manual.

(1) Inspection of long span bridges

1) Applicable Criteria

KGM O&M Manual Chapter. 5 “PRINCIPLES OF MAINTENANCE REPAIR REINFORCEMENT AND OPERATION OF STRAIT BRIDGES” shall be applied for the inspection of long span bridges.

2) Description and Frequency of Inspection

- Routine Inspection: The routine inspection consists of the short inspection and the simple repair shall be implemented by inspectors on daily or weekly basis. This inspection shall be performed to remove or minimize the small danger of the Users.
- Periodical Inspection: The inspection is performed by inspectors at a longer interval. The inspectors shall decide whether maintenance, replacement or repair is needed during the inspection. The condition of main cables and suspension cables is examined and analyzed at the specific interval, which are the main objects to be inspected in this inspection.
- Special Inspection: The inspection shall be performed promptly after severe weather or natural disaster, and the emergency repair to restore the function is included in the inspection.

Table 3.6.34 Inspection and Service Level of long span bridges

Chapter 5 – Maintenance, Repair, Support and Operation Principles of Bosporus Straits			
Examination and Performance Criteria This table should be considered together with the related sections in this chapter			
Type of Examination	General Description	Frequency	Activity to be Performed
Routine	Visual (General inspection for damages cannot be found in advance)	Daily	To report any damage, defects and dangers. Take precautionary measures according to dangers degree.
Periodic	Anchorage Rooms	Weekly	Authorized responsible personnel shall enter inside the anchorage blocks and perform visual inspection.
	Expansion seams	3 months	
	Abutments	2 year	
	Deck	Monthly	
	Drainage system determination of clogged grills and pipes, cracks in pipes and damaged seals	Monthly	
	Fatigue, abrasion	6 months	The action to be taken shall be determined according to the annual work schedule
Periodic Periodic	Deck Internal Sections	3 months	
	Suspension cables, Clamps, Connection Plates and Pins	3 months	Determination of crack, wire severance and wear; precaution to be performed and necessary
	Dyeing	2 years	The action to be taken shall be determined according to the annual work schedule
	Weld	annual	The action to be taken shall be decided according to the annual work schedule.
	Tower Internal Areas and elevators	annual	The action to be taken shall be decided according to the annual work schedule.
	Main Cable and Saddle	2 years	The action to be taken shall be decided according to the annual work schedule.
	Deck External Surface	annual	The action to be taken shall be decided according to the annual work schedule.
	Tower Foundations	2 years	The action to be taken shall be decided according to the annual work schedule.
	Approach viaduct pedestals, foundations, capping beam, deck, abutments	2 years	The action to be taken shall be decided according to the annual work schedule.
	Viaduct beams maintenance rooms (Bosporus Bridges)	2 years	The action to be taken shall be decided according to the annual work schedule.
	Tower External Surface	3 years	The action to be taken shall be decided according to the annual work schedule.
Scientific Periodic	Main Bridge Audit Detailed examination, test and analysis (scientific [experimental] review)	6 years	Works and detailed report to be prepared in mutual agreement with KGM
Periodic	Main Cable Internal Inspection	6 years	Works and detailed report to be prepared in mutual agreement with KGM
Emergency	Required examination in case of emergency	Action shall be taken as necessary	Intervention shall be made as deemed necessary and as mutually decided together with KGM

Source: KGM O & M Manual

The description of the items in Table 3.6.34 is as follows;

1. GENERAL WORKING SUBJECTS IN SUSPENSION BRIDGE MAINTENANCE
(Summary of Technical Specification for Gebze-Orhangazi-Izmir Motorway Project, Part 10 Motorway Operation Maintenance and Repair Technical Principles)

Paint
Scratches in the paintwork, fallout, blistering and cracks may be observed on the painted surfaces of the bridge. Paint peeling is mostly found on the edges of banisters, from vehicles scraping the collision barriers and posts or from vehicle accidents. Paint peeling may result from water seeping under the paint whence the paint blisters; after drying the blisters fall off as well as from the temperature difference when the paint which is applied on galvanized steel surfaces expands. These situations are mostly evident in painted surfaces which have been exposed to outdoor conditions. Paint cracks when the applied paint coat is incompatible with the steel material underneath it and this can be observed anywhere in the steel structure. In addition to these situations, paint may crease and peel as a result of fire. At first the painted surface cracks and buckles, followed by creasing and peeling. In this case by vigorously grinding or brushing the naked metal surface and repainting immediately prevents a serious case of rusting. The overall paint situation of the bridge shall be viewed during the periodic inspections and spot repairs shall be applied where necessary. If the spots which need to be repaired are close to each other the surface shall be united and completely painted, if the areas requiring repair are large, they shall be cleaned with a sand scraper rather than with a brush. A total of 160 micron thick paint consisting of two coats (lining) and two coats (final layer) shall be applied onto cleaned and bare steel outer surfaces; the thickness of the paint shall be checked with a paint measuring device.

Rusting
Rusting found in the bridge structure usually forms at welded and bolted junction points and in welding sutures, bolt caps and around the bolt pin. When rust is found at these points, before deciding that a structural fault is the reason for the rusting, one must investigate whether vibrations have caused a slackening of the junctions (cracking at source) and if rust spots are observed on the paint surface whether or not the rusting is deeper must be investigated and according to the results of these investigations paint may be applied.
The transversal and latitudinal bolted junctions of the towers may allow water to seep in and cause rusting throughout the junction seam which must be taken into consideration and thus care must be taken to ensure that the seams are caulked from outside the tower.
It is certain that the water seeping through the electricity poles in the center island of the road surface or through pedestrian walks onto the suspended apron of the bridge and through the gaps in the entrance cover may result in rusting. Plastic gaskets and seam fill material are certainly used at these points. The seams and gaskets must be checked and if necessary impermeability secured by changing or repairing them. The weld sutures which connect the apron units to each other being under the apron and above sea level facilitate paint cracking caused by vaporization and thus the development of rust on these sutures. This is why the underside of the apron must be inspected at least once per year after which the rust is cleaned off and the area repainted.

Cinder, Ash and Dust
When cinder, ash and dust come into contact with water, a heat reaction takes place. A byproduct of this reaction which is a corrosive acid (corrosive) is harmful to paint and steel. Cinder, ash and dust usually accumulate in expanding seams, drainage pipes, on top of portal beams. Layers also adhere to the surface of traffic lanes facing road level of the towers, on the painted surface of lines and posts of collision barriers. Weather conditions permitting, the cinder, ash and dust must be cleaned immediately.

Welding
The presences of nondescript cracks are noticed during periodic inspections when paint peeling and rusting are observed. In these situations, if possible, an x-ray film of the suspicious area is taken, if this is not feasible, a decision on the applicable procedure shall be taken as a result of non-invasive investigation methods.
When a cracked or broken surface is observed, the surrounding paint shall be completely cleaned off with a non-corrosive (corrodent) solution (solvent) or with a thin scraper. Poles, banister and posts and places with little or no torsion shall be welded in place.

Extraordinary Sound
Extraordinary sounds heard from the towers and suspension apron are to be expected. Some sounds may be heard from the vicinity of expanding seams and suspension lines. This warrants a careful inspection of these areas. Indicators such as broken seam fills, rusting and visual movement must be carefully investigated. When rattling and creaking sounds reach an abnormal dimension and this is can generally lead to structural malfunctions means that the junction bolts, screws, welding and suspension line socket pins must be carefully scrutinized. Medium to

loud knocking sounds coming from the vicinity of the expansion seams needs to be checked while traffic is passing over the seams. The malfunction shall be eliminated by firstly tightening the connecting elements at the place where the sound was determined; any broken or extremely corroded parts shall be replaced.

2 BRIDGE SECTIONS TO UNDERGO PERIODIC INSPECTIONS

The bridge sections which have been listed in the periodic maintenance log shall be inspected by the operator's maintenance and inspection team within the time frame specified in the log. A report shall be prepared for the bridge section undergoing inspection after which maintenance and repairs shall be carried out in accordance with given instructions.
The major bridge sections to undergo maintenance inspection and issues to be checked are specified below:

Anchorage Expansion Seams
- Whether the expansion seams at the point where bridge anchorage connects with viaduct apron are free of foreign objects and cinder,
- Whether the elastic coil is free of any tearing
- Whether the wall beamed ceiling covering of the anchorage North and South chamber concrete structure is free of cracks and disconnecting, free of water seepage from the ceiling, breaking and splitting in the stairs and banisters of the entrance and descending level,
- The situation of the cable circulation support used for illuminating descent into the control rooms, whether there is any rusting on the cable line wires and water seepage,
- Whether there is any splitting in the cable wires, any slackening is determined in the front and back terminals,
- Whether any cinder and dust is present on the cable wires and other steel parts of the anchorage cells shall be determined.

Apron Expansion Seams
- Whether there is an extraordinary knocking sound in the sounds emitted during traffic passing over the expansion seams,
- Whether there is any slackening in the nuts and bolts of expansion seam plates due to bridge vibration,
- Whether rocks or similar hard objects and accumulations between the sliding and tongue plates prevents motion,
- Whether any visible cracking and corrosion are present shall be determined.

Note: Scientific inspections of these seams must be carried out every 6 years

Apron Maintenance Rooms
- Whether any paint blistering is present inside and on the inner surfaces of the maintenance rooms which allow entry onto the apron from outside between the isolated sections of the apron units,
- Whether any decay and corrosion is evident on the gaskets and nuts-bolts of the maintenance rooms entrance covers shall be determined.

Viaduct Beams Maintenance Rooms (for Suspension Bridge)

It shall be determined whether any paint blistering and corrosion is present on the inside surfaces of the maintenance rooms which are not isolated by the anchorage of the main beams of the north and south viaduct.

Tower Internal Surface
- Whether paint blistering is present on the inner surfaces of the tower,
- Whether water seepage is present in the latitudinal and longitudinal bolted junctions,
- Whether and slackening of the bolts, corrosion is present,
- Whether there is any malfunctioning in the wire mesh platform casing and steel construction of the elevator,
- Whether there is any slackening in the fundamental connections of tower foundations and whether any water accumulates at these points,
- Whether the elevators are in proper working order,
- Whether the electric equipment of the machine room and tower internal illumination system is active shall be determined.

Tower External Surfaces

Inspection of the external surfaces shall be carried out from the cable supports until the ground unit by using the controlled suspension tower maintenance platforms. These inspections shall include looking for;
- Blistering, cracking and peeling of paint on the four surfaces of the towers,
- Whether the flexible materials fitting the specifications of Çekomastik which has been caulked into the fine aperture on the latitudinal and longitudinal seams has dried, subsequently cracked and peeled off,
- Whether there is any water seepage, bolt slackening and rusting in the junctions points of the portal beams,

- Whether the obstacle lights on the top of the tower illuminate.

Main Cables

The main cables shall be inspected from anchorage to anchorage separately from south to north. These inspections include looking for:

- Slackening of the fixation elements in anchorage cells,
- The presence of any water or moisture at these points, whether there are splits in any of the cables, any slippage in the circulation support,
- Whether there is any visible damage in the cover and paint conditions of the main cables which are exposed to outdoor weather conditions and any splitting, slackening and damage in the wrapping coil,
- Whether there is any slipping and cracking in the cable clamps, any drying and peeling of fill and caulking material between clamp and cogs, slackening and rusting in the cog bolts connecting the clamp jaws,
- Continued impermeability of cable cover (support safeguard) on the tower support,
- Rusting, slackening along the steel line banisters reaching throughout the bridge length of the cables.

Internal surfaces of the Apron

- The route apron consists of the rigidity beam. The internal surfaces of the case profile and hollow apron shall be checked for paintwork and humidity.
- Although the entrance covers inside the apron are impermeable, humidity formation is unavoidable because of temperature differences. For this reason the checks must include checking the paintwork inside the apron for blistering and peeling, any water seepage and rusting around the electricity cables over the apron and intake entry of the apron, drying and peeling of the caulking material which has been used to isolate sections from external effects must be checked

External surfaces of the Apron

- The underside of the apron between the bridge towers is situated over the sea which makes this surface the most susceptible to the vaporizing effects of salt and sulfate containing sea water. This surface needs to be inspected thoroughly with apron maintenance platforms. The inspection includes checking whether paint has blistered and peeled,
- Even if a visible crack is not observed in the weld sutures, the welding must be checked for cracks with audio alerting equipment which have been developed for this purpose in case a crack is found beneath the paintwork,
- Whether there is any rusting on the welding sutures,
- The impermeability of the apron intake covers at pedestrian walkway level above apron, the paintwork of flanking surfaces and banister panels, the condition of bituminous rubber paving of pedestrian walkways shall be checked.

Drainage System

- The drainage grates over the traffic and pedestrian walks of suspension apron shall be checked for clogging, the drainage pipes running through the apron shall be checked for cracks and impermeability,
- The conditions of neoprene gaskets and caulking material of intake and outlet points apron entrance points especially of drainage pipes, these points must also be checked for water seepage,
- Whether there is any splitting in the drainage pipe extensions under viaduct apron,
- The junction points of drainage pipes descending from the viaduct apron and pedestrian way shall be checked for splitting and water seepage,
- Smooth flow of main drainage pipe collecting water descending from apron beneath viaduct shall be checked,

Suspension Line and Sockets

- The behavior of the single sinuous suspension lines suspending the suspended apron to the main carrier cables against external effects and burdens shall be studied.
- The wires forming the suspension line shall be checked for splitting, rusting and corrosion,
- The socket, pins and pin sockets at points where both the main cable clamps are fitted and underneath the apron elevation shall be checked for rust and cleanliness.

(2) Repair of Long Span Bridge

1) Scope

This section covers the repair of long span bridges.

2) Applicable Standards

KGM O&M Manual Chapter 5 shall be applied for the repair of long span bridges, and Japanese standards are used as reference for the some items are not specified in KGM O&M Manual.

3) Description

The following description is specified in Maintenance and Repair Specification for Japan National Route 28(Honshu-Shikoku Connection Road, Kobe-Naruto Route), which includes the items that are not specified in KGM O&M Manual. For easy identification, the items are underlined.

For example, the air drying system*, which is utilized in Japan as standard equipment, shall be set up at the main cable of the bridge over Dardanelles for corrosion control of the internal of main cables. Moreover, in Japan, the corrosion control of undersea structures, the concreate deterioration prediction based on the result of non-destructive testing, the fatigue damage control of steel floor slabs is implemented. The detail is listed below.

Table 3.6.35 Repair of Long Span Bridge

Item		Description	Evaluation method
Repair Paint	Repair Paint of Main Cables	Depending of the abnormality level of the paint observed by inspection, the partial repair paint is performed.	Control Value for Humidity, Patrol and Routine Inspection
	Repair Paint of Suspension Cables	According to the result of inspection, the partial repair paint is performed	Patrol and Routine Inspection
	Repair Paint of Towers and Stiffening Girder	According to the result of inspection, the partial repair paint is performed.	Patrol and Routine Inspection
Corrosion Control of Undersea Structures		According to the results of inspections, appropriate partial rust preventive repairs shall be performed depending on the abnormality level of steel caissons and the multi-pile foundations	Patrol and Routine Inspection
Open Steel Floor Grating		According to the results of inspections, appropriate partial repairs and/or replacements shall be performed depending on the abnormality level.	Patrol and Routine Inspection
Maintenance passages		According to the results of inspections, appropriate partial repair paintings and/or replacements shall be performed depending on the abnormality level.	Patrol and Routine Inspection
Ensuring Airtightness of Main Cables		For the ventilating system of the main cables to meet the demanded performance requirements, airtightness of the cables is crucial. If the deterioration of the caulking material or the air leakage is detected, appropriate partial repairs shall be performed depending on the abnormality level.	Patrol, Routine Inspection, Target Control Value for Humidity,
Repair of concrete		Depending on the results of the nondestructive inspection, deterioration prediction 200 years after completion shall be estimated, time and methods for the measures be examined, and the measures be conducted with the economic methods.	Deterioration Prediction,

Item		Description	Evaluation method
Measures for fatigue damages		If the occurrence of the fatigue damages on the floor system structures including steel floor slabs are detected, according to the results of inspections, appropriate partial repairs and/or replacements are performed depending on the abnormality level.	Patrol and Routine Inspection
Small-scale structures		According to the results of inspections, appropriate partial repairs and/or replacement are performed depending on the abnormality level of the bridge.	Patrol and Routine Inspection
Large-scale expansion devices		According to the results of inspections, appropriate partial repairs and/or replacements are performed depending on the abnormality level.	Patrol and Routine Inspection
Stringer supports of steel floor slabs		According to the results of inspections, appropriate partial repairs and/or partial repair paintings shall be performed depending on the abnormality level of the stringer supports supporting on the stiffening girders of the bridge.	Patrol and Routine Inspection
Guard fence		According to the results of inspections, appropriate partial repairs and/or partial repair paintings shall be performed before the corrosion starts depending on the abnormality level.	Patrol and Routine Inspection
Suspension cables	Rustproof measures of suspension cables	According to the results of inspections, appropriate partial repairs shall be performed depending on the abnormality level of the fixing sections of the suspension cables.	Rustproof measures of suspension cables
Shock-buffering structures for the ships		According to the results of inspections, appropriate partial repairs and/or replacements shall be performed depending on the abnormality level.	Patrol and Routine Inspection

4) Evaluation of Service Level

The following items shall be analyzed for evaluation of the service level for the bridge repair, and the service level shall be reviewed from time to time to meet the appropriate control level.

- Patrol and Routine Inspection
- Detailed Underwater Examination
- Target Control Value for Humidity

3.6.6 Toll Collection

This section covers the plan of toll collection service.

Toll collection service in Turkey is mainly divided into 2 categories;

- Operation service regarding the toll collection and arrangement and reporting of the information obtained from toll collection service
- Maintenance and repair of the all machineries for Toll Collection Service

(1) Applicable Criteria

Method of the toll collection service varies considerably between countries, so the criteria, KGM O&M Manual Chapter 12, is used mainly in this O&M plan. However, the operation method of the lanes in Japan is used as reference.

(2) Operation Service

1) Purpose

The operation service covers the collection of toll from the passing vehicles at the toll booths correctly and smoothly to ensure the appropriate toll collection structure. Moreover, the information including amount of toll collection and traffic volume obtained from toll collection machineries shall be organized and, reported to KGM at the regulated frequency.

2) Description

The services that the operator is expected to provide during operating of Toll Collection Centers include the following:

- Organizing the traffic entering and exiting Toll Collection Centers and collecting transit fees with existing fee collection systems.
- Training and employing human resources for operating Toll Collection Centers.
- Sustaining and developing electronic hardware and software of existing Cash Toll Collection system, Electronic Toll Collection System, Smart Card Toll Collection System and all other mechanical systems.
- Collecting, processing and reporting all statistical information pertaining to vehicle transit, fees collected from vehicles, vehicle categories and all other user information.
- Accommodating relationships with public authorities relevant to highway operation.
- Ensuring every kind of security precaution in Toll Collection Centers.

The operation and maintenance of Toll Collection Centers must comply with following conditions.

- Toll Collection Centers must function 24 hours per day throughout the year.
- The toll fee for each vehicle group, must be displayed in such a way that it is evident and visible to every vehicle transiting the booth,
- The conditions of each toll booth (whether it is open or closed and the kind of payment form accepted) must be clearly stated in such a way that it does not lead to any confusion,
- Any new fee payment methods to be implemented by the operator during operation period must be compatible with the software used in toll booths on highways which are under the authority of KGM. Any new payment method and/or new fee payment cards and/or operator cards must be approved by KGM.

- The operator shall make access available to Republic of Turkey Ministry of Finance and KGM all computer data regarding fee collecting, fee control and traffic data in a “read only” mode.
- The operator should inform road users that their allegations or complaints shall be taken into consideration. The operator must consider all reasonable allegations and complaints, take relevant necessary action and file them.
- If the operator feels the necessity of constructing additional fee collection booths, control centers or similar facilities on the highway, this should be allowed. However, any additional facilities must be compliant with the existing system and approval of KGM should be applied for beforehand.

(3) Maintenance and Repair

1) Purpose

The maintenance and repair of toll collection machineries shall be performed appropriately to maintain the proper condition and prevent the damage, and the inspection shall be also performed for the efficient toll collection service.

The Maintenance and Repair Services consist of carrying periodic maintenance of Electronic Toll Collection System, Smart Card Toll Collection System and Cash Toll Collection System, repairing or replacing malfunctioning software, equipment or cards. Checking and repair of cables and cable connections are also included among these services.

The internal and external cleaning of Toll Collection Center buildings and the cleaning of entry and exit booths, structural maintenance and repair of buildings within Toll Collection Centers, maintenance of transformer, electricity, water, sewerage system, central heating system and facilities are included in Maintenance and Repair Services.

2) Description and Service Level

Table 3.6.36 Description of Inspection

Type of Examination	General Description	Frequency
Routine	Status examination and check / hardware error notification for computer used in toll collection control	Daily
	Examination and controls related to the physical elements of entry booths	Daily
	Status examination and check / error notification related to the system used at the toll collection control center	Daily
	Status examination and check / error notification related to the system used at the main control center and regional control center	Daily
	Status examination and check / analysis related to the computer of the toll booth control center	Weekly
	Examination, control and cleaning of exit booths	Monthly
	Examination, control and cleaning of entry booths	Monthly
	Examination, maintenance, cleaning of electrical control at toll booths	Weekly
	Status examination and check / analysis / cleaning of hardware and software at the main control center	Monthly
	Status examination and check / analysis / cleaning of hardware and software at the regional control center	Monthly
	Status examination and check / analysis / cleaning of hardware and software at the toll booth control center	Monthly
	Physical element examination, control and cleaning of OGS and KGS at the exit toll booths	Monthly
	Physical element examination, control and cleaning of OGS and KGS at the entry toll booths	Monthly
	Electrical checks and maintenance related to Uninterruptible Power Supply	Monthly
Periodic	Status examination and check / analysis / cleaning of hardware and software at the computer of the tollbooth control center	Annual
	Status examination and check / analysis / cleaning of hardware and software at the exit tollbooth	Annual
	Status examination and check / analysis / cleaning of hardware and software at the entry tollbooth	Annual
	Power check and maintenance at vehicle classification and LED panel	Annual
Custom Examinations	to be needed in case of emergency	As necessary

3.6.7 Traffic Control

This section covers the plan of traffic control.

The performance criteria regarding the traffic safety are specified in Turkish O&M Manual, the operator shall meet the criteria. However, the detail of traffic control is not described in these manuals, so Japanese standards are used for reference.

The traffic control in Japan is mainly divided into 2 categories; 1) Traffic Patrol and 2) Violating Vehicle Control and Traffic Control. In this O&M plan, the description of these services is specified.

(1) Scope

The section covers traffic patrol, violation vehicle control and traffic control on the expressway.

(2) Applicable Criteria

The description of the traffic control in KGM O&M Manual Chapter 4 shall be applied for the traffic patrol, and the patrol frequency in Japan is used as reference for the O&M plan. As the result of the interview in Turkey, KGM is not responsible for the violating vehicle controls which is implemented by the different organization and the description is not specified in KGM O&M manual. The control of violation vehicle is specified based Japanese standards in this O&M plan, although the assignation of the control for violation vehicles in the project has not been decided at this point.

(3) Traffic Patrol

1) Scope and Purpose

Traffic patrol shall be provided 24 hours a day in order to prevent an abnormal event including traffic accidents or obstacles on the expressway and to ensure an early resolution to the occurred abnormal event for the safe and smooth driving of Users.

2) Description

The traffic patrol is described below;

Routine Patrol

The patrol on the expressway shall be performed based on the patrol schedule to collect and report information including the conditions of road, traffic and weather, and the obstacles observed during patrols shall be removed. The patrol frequency is listed in Table 3.6.37.

Table 3.6.37 Patrol Frequency (per day)

Traffic Volume (Annual Daily Traffic Average)	Frequency per day
Less than 5,000	3 times
More than 5,000, less than 10,000	4 times
More than 10,000, less than 15,000	5 times
More than 15,000, less than 20,000	6 times
More than 20,000, less than 25,000	7 times
More than 25,000, less than 30,000	8 times
More than 30,000, less than 40,000	9 times
More than 40,000, less than 50,000	10 times
More than 50,000, less than 70,000	11 times
More than 70,000, less than 90,000	12 times
More than 90,000, less than 110,000	13 times
More than 110,000	14 times

* The patrol time shall be scheduled during the appropriate time of a day according to the traffic volume of the sections.

* The patrol frequency above shall be changed in consideration of the road structures of the section.

Extra Patrol

Extra patrol shall be performed according to conditions of the traffic or the weather,

Emergency Patrol

In the request of the emergency dispatch, the patrol team shall rush to the requested site and handle the emergency event.

Processing of Abnormal Events

The following abnormal events are observed during the patrol, the patrol team shall process these events;

- Traffic Accidents
- Disabled Vehicles
- Obstacles
- Vehicle Fire
- Traffic Conjunction
- Sudden Changes of the Weather
- Road Damage (including Road Defacement)
- Any roadside structures affect traffic or road structures, or anything is likely to do so
- Any roadside fire affect traffic or road structures, or anything is likely to do so
- Others affect the safe and smooth traffic, or anything is likely to do so

In case the patrol team observed the abnormal events during the emergency patrol, the team shall receive the instruction from the director of the traffic control center.

The operator shall perform these patrol and meet the performance criteria (Table 3.6.2).

(4) Violating Vehicle Control

1) Purpose

The control of the vehicles violating any law or regulation related with vehicle restriction and the vehicles with inappropriate loadings shall be performed in order to sustain the road structures and ensure the safe and smooth traffic.

2) Description

The special team for the violation vehicle control shall be established, which control the vehicles violating any law or regulation related with vehicle restriction or the condition of permission for special vehicles, and the vehicles with inappropriate loadings. The process of the controls is described below:

- Guiding the violating vehicles observed by the team to the measurement area
- Measurement evaluation of the violating vehicles
- Correction order(request) to the violating vehicles

(5) Traffic Control

1) Scope

The information including traffic and weather conditions shall be collected and evaluated 24 hour a day, and the latest information shall be provided to the users by road traffic information boards. In case an abnormal event occurred, the traffic control team shall play the reading role and cooperate with the relevant public organization such as police and fire department. Moreover, the team shall issue the instruction to the patrol team for ensuring safe and smooth traffic.

2) Description

Cable or wireless communication with the patrol team, collection of information obtained from emergency calls, operation of information provision equipment

The specific description is listed below

- Constant monitoring of the traffic condition on the expressway
- An appropriate response to the calls from Users
- Responses to inquiries or reports
- Implementation of the instruction from traffic control center for ensuring the safe and smooth traffic.

3.6.8 ITS System

(1) Plan of ITS equipment

This section covers the plan for ITS equipment, and the description is as follows;

(2) Information Collection system

1) Traffic Volume Measuring System

Automatic traffic volume devices shall be located in each lane between the interchanges in order to analyze traffic congestions and accidents and to forecast the traffic volume in future. In the case the traffic volume increased in the future and the more detailed data is needed, the additional devices for main roads, interchanges and junctions shall be considered.

2) CCTV Camera System

The system needs to obtain the information regarding the traffic accident or congestion in the main road and interchange junctions. CCTV camera shall be arranged at 2km intervals in the main road. And fixed cameras shall be arranged for respective interchange junctions and toll gates.

3) Weight-in-Motion System

Weight-in Motion System prevents overloaded vehicles from entering the highway. In each toll station, axis weight measurement shall be arranged at wide lanes for heavy vehicles entry. And, the special team needs to be organized to measure and detect overloaded vehicles. Moreover, the setting of U-turn lane for overloaded vehicles in toll stations needs be considered.

4) Weather Observation System

Weather Observation System observes weather conditions such as an amount of rainfall and a wind speed. A system shall be set up only at the maintenance control offices due to the unvaried landscape.

5) Mobile Radio Communication System

Mobile Radio Communication System collects and provides the site information correctly and quickly.

(3) Traffic Information Provision System (Variable-Message Signs)

Variable-message Sign provides the information regarding traffic control, congestion, accidents and road surface to the drivers. The information for the drivers is collected from CCTV, Traffic Volume Measuring System and Weather Observation System. A Variable-message Sign shall be located at the respective entry of the interchanges and toll gates. Additional Valuable-message Sign shall be considered in the case traffic volume reached 10 thousand vehicles and the more detailed traffic information needs to be provided.

(4) Traffic Control System

Traffic Control System centrally manages the information collected automatically such as congestion and weather condition, and the information reported from the staff such as accidents of traffic or falling objects via traffic central processing and collection system. To achieve the uniform management of the road traffic information, the management office shall be set up.

In this investigation, the networking with other sections is not specific; therefore, the system is introduced solely. If the networking between the section and the other sections proceeded in the future, it is essential to achieve the comprehensive traffic control covering the other sections.

Moreover, the adaptation of a considerable number of CCTV cameras for the information collection method of road traffic information in the other sections is in the planning stage, however, the initial and maintenance costs and the effectives of the plan need to be considered carefully.

(5) Toll Collection System

OGS and HGS utilized in Turkey currently shall be applied to the toll collection system in this project

3.6.9 Recommendations and Considerations for Operation and Maintenance Plan

(1) onsiderations for Toll Collection Method

Manual collection (cash collection) on the expressway operated by KGM had been performed in the past; however, at the present day, automatic/unmanned collection using OGS and HGS is commonly adopted. This O&M plan is established on the assumption that automatic/unmanned collection using OGS and HGS is adopted to this expressway.

According the interview with KGM, the toll collection system for toll delinquents has been established. In case the toll collection from the passing vehicles is failed at ETC lanes due to the passing vehicles with insufficient charged amount, the deficiency amount associates the vehicle number is charged to the vehicle owners at a later date. For the vehicle owner not paying the deficiency amount, the amount is collected on a mandatory basis when selling or disposing the vehicles.

This system shall be adopted to this project.

While, according to the interview with OTOYOL, the operation and maintenance company of Gebze-Orhangazi-Izmir Motorway Project, the toll collection system for toll delinquents used by KGM is not able to be adopted for its expressway. Without the system, OTOYOL has a high uncollectible risk from the toll delinquents got off the expressway. Also, the toll rate for the long span bridge is higher than the charged amount of the expected general users and the frequent occurrence of the vehicles with insufficient charged amount passing is assumed. Therefore, there is the possibility of manual collection (cash collection) is adopted.

The minimum traffic guarantee is planned for this project. However, the risk of the toll collection for the operator increases significantly if the toll collection system for toll delinquents used by KGM is not adopted for this project.

In case the toll collection system for toll delinquents cannot be applied for this project, the manual collection method needs to be considered because the toll needs to be collected unfailingly at the toll

booths. However, the following risks are expected for the manual collection.

For these reasons, toll collection method to be applied should be considered on review for the performance of the toll collection of Izmit Bay Section of Gebze-Izmir Motorway Project.

Risk of Manual Toll Collection (Safety at the Toll Lanes)

The expressway users in Turkey are used to pass nonstop through the toll lanes because of the wide spread of OGS and HGS. The manual toll collection method requests the users to stop at the lane, thus; its increases risk of the traffic accidents.

Decreasing of Economic Effect

Expressways create the various economic effect including the reduction of cost of time and fuel but the traffic conjunction caused by the manual toll collection may affect the economic effect adversely.

Moreover, the additional staff and toll facilities for the manual toll collection are needed, and the initial cost and the management cost are increased. As the result, the concession period may be longer if the manual toll collection is adopted.

(2) Recommendation of Real-Time Severance (all along the Line) for Ensuring Safety

CCTV cameras are set up at 1-km interval of 1km on the Shin-Tomei Expressway in Japan to monitor the entire of the expressway, and any falling object is detected automatically and the information is provided to the users by message signs on order to ensure safety.

The negative events including traffic accidents occurred on expressway is unavoidable, so it is important to minimize the damage caused by the negative events and to prevent a secondary damage. The operator is able to minimize the damage by the immediate recognition and action for the negative events, and the real-time information provision to the users.

The initial time lag for the event occurrence (time difference between the event occurrence and the event recognition by the operator) has considerable effect on the traffic conjunction or secondary damage occurrences, and serious accidents have a significantly negative effect on not only the safety of users but also the life cycle cost of road structures. Moreover, the monitoring by CCTV cameras results in high efficiency of traffic patrol and traffic management. Therefore, it is key point for the operator to minimize the time lag.

3.7 Estimated Costs

3.7.1 Road

(1) Covered by Estimated Costs

Estimated cost in this study covered construction costs and engineering services expenses. Compensation costs and maintenance/operation costs are not included.

1) Construction Cost

Costs at Construction Stage are estimated in BQ (Bill of Quantities) bases as shown in Table 3.7.1 considering the consistency of "Unit Cost Description" (Refer to Table 3.7.2) to be prepared in the Basic Design stage. Some indirect costs, such as contractor's administration cost, which shall be appropriately distributed and added on each "Pay Item", are also calculated as individual item at this Preliminary Design stage.

Table 3.7.1 Bill of Quantities

No.	Item	Unit	Quantity
SECTION 1 - PREPARATION WORK			
1.1	Preparation work	lc	1
SECTION 2 - SITE CLEANING			
2.1	Clearing and Grubbing	m2	7,020,922
SECTION 3 - EARTH WORK			
3.1	Filling Work	m3	31,890,305
3.2	Excavation Work	m3	19,157,452
3.3	Slope Protection Work	m2	2,944,138
SECTION 4 - PAVEMENT			
4.1	Leveling Work	km	171
4.2	Wearing course Work	m2	5,317,747
4.3	Binder course Work	m2	5,267,197
4.4	Asphalt treated Work	m2	5,339,069
4.5	Base course Work	m2	5,482,813
4.6	Subbase course Work	m2	5,886,666
4.7	Sungrade Work	m2	7,009,239
SECTION 5 - DRAINAGE			
5.1	V-ditch Work on center median	m	171,124
5.2	Longitudinal daraina pipe Work on center median	m	171,124
5.3	V-ditch Work on shoulder	m	342,248
5.4	Longitudinal daraina Work on shoulder	m	342,248
5.5	V-ditch Work on berm	m	73,385
5.6	Box-culvert Work	no	275
SECTION 6 - INCIDENTAL			
6.1	Guard Rail Work	m	236,040
6.2	Road Marking Work	m	1,104,000
SECTION 7 - BRIDGE			
7.1	Approach viaduct Work	m2	47,275
7.2	Viaduct Work	m2	167,750
7.3	Special brisge Work	m2	2,440
7.4	Crossing bridge Work	m2	30,500
7.5	Over bridge Work	m2	45,000
7.6	Interchange bridge Work	m2	27,600
7.7	Box-culvert Work	ケ所	32
SECTION 8 - TUNNEL			
8.1	Box-culvert Work	m3	87,500
8.2	Tunnel Work	m3	135,000
SECTION 9 - INTERCHANGE			
9.1	Interchange Work	no	14
SECTION 10 - SERVICE AREA			
10.1	Service Area Work	no	7

Source: JICA Study Team

Table 3.7.2 Main Unit Price

Code No.	Description	Unit	2015 Unit Price (TRY)
KGM/03.538/2	1 hour price of the Truck	HR	
KGM/03.542/1	1 hour price of the Vibrating roller (45-61 DHP)	HR	71.71
KGM/08.104/1-K	Preparing the stone in the 0-0.250 ton category from excavation stone	M3	2.29
KGM/08.104/K	Preparing the stone in the 0-0.250 ton category from quarry stone	M3	9.85
KGM/08.106/K	Preparing the stone in the 0-0.400 ton category from quarry stone	M3	10.52
KGM/14.022/1	Tree cutting and uprooting with machine (diameter of 10-30 cm)	PCS	5.29
KGM/14.022/1-K	Grubbing with machine (the roots of the trees with a diameter of 10-30 cm)	PCS	2.45
KGM/14.022/2	Tree cutting and uprooting with machine (diameter of 30-50 cm)	PCS	13.23
KGM/14.022/2-K	Grubbing with machine (the roots of the trees with a diameter of 30-50 cm)	PCS	5.78
KGM/14.022/3	Tree cutting and uprooting with machine (diameter of 50-80 cm)	PCS	31.80
KGM/14.022/3-K	Grubbing with machine (the roots of the trees with a diameter of 50-80 cm)	PCS	13.33
KGM/14.022/4	Tree cutting and uprooting with machine (diameter of more than 80 cm)	PCS	54.79
KGM/14.022/4-K	Grubbing with machine (the roots of the trees with a diameter of more than 80 cm)	PCS	22.81
KGM/15.001/A	Excavating and using all kinds of soil with excavator (excavation to go to the filling from cleavage and side borrow)	M3	2.53
KGM/15.014/A	Excavating and using hard rock with excavator (excavation to go to the filling from cleavage and side borrow)	M3	7.41
KGM/15.044	Trimming on all kinds of soil ground with machine	KM	1,938.88
KGM/15.052/2	Making compaction with vibrating roll (50-60 HP)	HR	107.10
KGM/15.058	Compaction with roller with rubber tire (7-8 tons – 8 tons including)	HR	53.28
KGM/15.058/1	Making compaction with roller with rubber tire	HR	89.63
KGM/15.062	Laying and smoothing the shoulder material with machine or manually	M3	1.65
KGM/15.101	Procuring 50 mm (2") foundation material with sieved graveled material	M3	5.39
KGM/16.101/K-H	Plain concrete with all doses at the dry or in water in the bridge foundations (with C16/20 ready mix concrete grout)	M3	164.93
KGM/16.132/K	Reinforced concrete with all doses at the dry or in the water in the box culverts	M3	213.13
KGM/16.133/K	Reinforced concrete with all doses at the dry or in the water in the bridges	M3	227.88
KGM/16.133/K-H	Reinforced concrete with all doses at the dry or in the water in the bridges (with C 25/30 ready mix concrete grout)	M3	327.64
KGM/16.135/K-H	Reinforced concrete with all doses at the dry or in the water in the decks of the plate and composite bridges, reinforced concrete piles	M3	316.23
KGM/17.001/K	Dry rubble wall with quarry stone	M3	50.23
KGM/17.101/K	Dry riprap with quarry stone with a thickness of 20 cm	M2	23.85
KGM/18.459/K	Laying 400 dose concrete pipe with an internal diameter of Ø 80 cm (for drainage) the wall thickness is 9.5 cm)	MT	77.51
KGM/21.035/K-6	Making 1 m2 steel form for 1 prefabricated beam	M2	16.13
KGM/21.040	Concrete and reinforced concrete form with smooth surface, planed in culverts	M2	31.29
KGM/23.002/K-1	Labor for establishing cable with special steel for pre-stressed concrete	TON	1,780.19
KGM/23.002/K-2	Tensioning longitudinal cable	PCS	221.49
KGM/23.002/K-3	Tensioning transverse cable	PCS	110.75
KGM/3605/A2	Procurement and laying the drainage pipe of Ø200 mm of PVC type	MT	22.49
KGM/3780/1	Making roadway guard rail	MT	34.65
KGM/3780/1-M	Roadway guard rail assembly (Ral-Rg 620)	MT	5.56
KGM/3780/1-S	Roadway guard rail disassembling (Ral-Rg 620)	MT	6.36
KGM/3781/2	Making 3N roadway guardrail rail piece (including material price)	PCS	15.45
KGM/3781/2-M	Assembly 3N roadway guardrail rail piece	PCS	4.78
KGM/3781/3	Making 3N roadway guardrail pole (L=2400 mm, from C150 Profile) (including material price)	PCS	118.23
KGM/3781/3-M	Assembly 3N roadway guardrail pole (L=2400 mm, from C150 Profile)	PCS	17.49
KGM/3792	Procuring high strength pre-tensioning steel	TON	2,500.00
KGM/3793	Procuring casing pipe	MT	2.11
KGM/3794	Procuring anchorage matter	PCS	25.63
KGM/4393	Spraying primer bituminous material by means of distributor machine (with pipe)	DA	45.21
KGM/4398	Spraying adhesive bituminous material by means of distributor machine (with pipe)	DA	31.98
KGM/50.128	Making concrete road guardrail form (type A)	MT	135.19
KGM/50.130	Making the final element of the concrete road guardrail form (type A)	MT	270.38
KGM/50.132	Placing the type A concrete road guardrail and final element	MT	36.29
KGM/5006/K	Making standard traffic sign plate pole (of black metal sheet)	MT	26.30
KGM/5007/K	Making traffic safety guide leg	PCS	16.99
KGM/5008/K	Painting traffic sign plates (forbidden, threat and information plates)	M2	22.45
KGM/5009/K	Writing symbol, border and writing to the standard traffic sign plates	M2	5.41
KGM/60.203	Drawing the road lines by means of spraying method with thermoplastic paint (with machine), (with a thickness of 2 mm)	M2	23.95
KGM/6010	Making sub-base with sieved graveled material	M3	7.72
KGM/6040	Making the base [with quarry stone crushed and sieved (1")]	M3	24.66
KGM/6308	Making 1 M2 Asphalt Concrete Binder Layer Materials with Compressed Thickness of 8 CM (with crushed and sieved quarry stone)	M2	9.10
KGM/6330	Procuring binder layer of asphalt concrete (with crushed and sieved quarry stone) for maintenance (the transportation of the mixture is with the contractor's trucks)	TON	37.93
KGM/6454/S	Making the wearing layer of the stone mastic asphalt with a compacted thickness of 4 cm (type-1) (with crushed and sieved quarry stone)	M2	5.64
KGM/7507/2	Making precast small type (type-2) gradient gutter	MT	31.65

Source: JICA Study Team

2) Engineering Cost

Detailed design and plan costs are included in this estimate engineering cost.

(2) Not Covered by Estimated Costs

The construction costs of the strait bridge, the compensation cost before start of the project and the maintenance cost after completion of the project are not included in this estimated cost.

1) Compensation Cost

For the following items, it will be appropriated in the preparatory phase of the project.

- Land acquisition
- Relocation cost for electricity, telephone, water, sewage facilities

2) Maintenance Cost

Details on the maintenance cost are described in the section 3.7.3.

(3) Conditions of Cost Estimation

1) Term of Cost Estimation

The exchange rate, inflation rate, etc. for this cost estimation is of the time in September 2015.

2) Exchange Rate

The exchange rates adopted for this cost estimate is as follows;

- 1 US Dollar (USD) = 2.91 Turkey Lira 'TRY)
- 1 US Dollar (USD) = 120 Japanese Yen (JPY)
- 1 Turkey Lira (TRY) = 41.24 Japanese Yen (JPY)

(4) Taxes and Duties

1) The Main Tax System and Tax Rate

The main tax system and tax rate in Turkey is as shown in Table 3.7.3. In addition, the competent authority on taxes is the Ministry of Finance and the Ministry of Custom and Trade.

Table 3.7.3 The Main Tax System and Tax Rate

Maine Tax System	Corporate tax, Income tax, Value added tax, Special consumption tax
Corporation Tax	20% of corporate tax rates (Withholding tax: 10-25%)
Personal Income Tax	Personal income tax: 15-35% (Tax rate changes in four steps as from less than TRY10,000/year to more than TRY88,001/year)
Value Added Tax	General grocery 1% to 8%, other general merchandise 18%
Customs Duties	Customs duties consists general tax, most favored tax, EU tax and EFTA tax. Imports applicable tax rate of Japan: most favored nation tax rate
Interest Remittance Tax to Japan	The remittances through financial institutions : 10% Others : 15%
Dividend Remittance Tax to Japan	Capital ratio more than 25% : 10% Capital ratio less than 25% : 15%

Source: JICA Study Team

2) VAT

Value-added tax rate in Turkey is as shown in Table 3.7.4.

Table 3.7.4 Rate of Value Added Tax

Covered Transactions for the main value-added tax	Tax Rate (%)
Standard tax rate	18
Foodstuffs, textile products, pharmaceutical raw materials, prices, etc.	8
Agricultural products, newspapers, magazines, used cars, etc.	1
Export transactions, etc.	Exemption

Source: JICA Study Team

Furthermore, value-added tax will be exempted because this project is BOT project.

(5) Inflation Rate

Inflation rate in Turkey is summarized as shown in Table 3.7.5.

Table 3.7.5 Inflation Rate

Year	2015	2016	2017	8018	2019	2020	Remark
Inflation Rate (%)	7.44	8.975	6.50	6.50	6.50	6.50	

Source: IMF - World Economic Outlook Databases

(6) Inflation Consideration Period

Base year is 2015, and construction work will start from 2018 up to 2023.

However, it will be applied only for the local currency, for foreign is 0.0%.

(7) Physical Contingency

Physical contingency is 5.0% of construction cost by the similar project.

(8) Rate of Administration Cost

5.0% of direct construction cost will be the administration cost.

(9) Rate of Interest During Construction

0.8420% per year for the construction work and the consultant work will be applied by the past record of KGM.

(10) Unit Price Setting in the Preliminary Design Phase

Based on the Unit Price Code (2015 Edition) of KGM, the unit price was set for each BQ item considering the inflation described above.

(11) Cost Estimate for Preliminary Design

A result of the cost estimation for motorway is JPY 21.4 billion (USD 1.8 billion) as shown in Table

3.7.6. The project cost per year is shown in Table 3.7.7. The detailed design cost breakdown is shown in Table 3.7.8.

Table 3.7.6 Estimated Project Cost for Preliminary Design of Road

Exchange Rate: JPY120/USD JPY41.24/TRY

	Description	Quantity	Unit	Unit Price (TRY)	Amount (TRY)	Unit Price (1,000JPY)	Amount (1,000JPY)	Amount (1,000USD)	Remarks
A1	CONSTRUCTION COST								
1	Preliminary and General								
1.1	Preliminary and Gener	1	ls	10,000,000	10,000,000	412,400,000	412,400	3,437	
	Sub Total				10,000,000		412,400	3,437	
2	SITE CLEARING								
2.1	Clearing and Grubbing	7,020,922	m2	55	386,150,710	2,252	15,811,117	131,759	
	Sub Total				386,150,710		15,811,117	131,759	
3	EARTH WORK								
3.1	Excavation Work	31,890,305	m3	5	159,451,525	219	6,983,977	58,200	
3.2	Filling Work	19,157,452	m3	39	747,140,628	1,600	30,651,924	255,433	
3.3	Slope Protection	2,944,138	m2	48	141,318,624	2,000	5,888,276	49,069	
	Sub Total				1,047,910,777		43,524,177	362,702	
4	PAVEMENT								
4.1	Leveling Work	171	km	2,506	428,526	103,347	17,673	147	
4.2	Wearing course Work	5,317,747	m2	25	132,943,675	1,040	5,530,457	46,087	
4.3	Binder course Work	5,267,197	m2	34	179,084,698	1,416	7,458,351	62,153	
4.4	Asphalt treated Work	5,339,069	m2	60	320,344,140	2,478	13,230,213	110,252	
4.5	Base course Work	5,482,813	m2	24	131,587,511	1,001	5,488,296	45,736	
4.6	Subbase course Work	5,886,666	m2	26	153,053,316	1,071	6,304,620	52,539	
4.7	Subgrade Work	7,009,239	m2	5	35,046,195	219	1,535,024	12,792	
	Sub Total				952,488,061		39,564,634	329,706	
5	DRAINAGE								
5.1	V-ditch Work on cent	171,124	m	41	7,016,084	1,691	289,371	2,411	
5.2	Longitudinal drain pip	171,124	m	101	17,283,524	4,165	712,732	5,939	
5.3	V-ditch Work on shou	342,248	m	41	14,032,168	1,691	578,742	4,823	
5.4	Longitudinal drain Wo	342,248	m	101	34,567,048	4,165	1,425,463	11,879	
5.5	V-ditch Work on berm	73,385	m	41	3,008,785	1,691	124,095	1,034	
5.6	Box-culvert Work	275	no	293,404	80,686,100	12,100,000	3,327,500	27,729	
	Sub Total				156,593,709		6,457,903	53,815	
6	INCIDENTALS								
6.1	Guard Rail Work	236,040	m	62	14,634,480	2,557	603,555	5,030	
6.2	Road Marking Work	1,104,000	m	5	5,520,000	192	211,968	1,766	
6.3	ITS Facilities	21	no	2,909,796	61,105,716	120,000,000	2,520,000	21,000	
6.4	Communication Cable	184	km	121,242	22,308,528	5,000,000	920,000	7,667	
	Sub Total				103,568,724		4,255,523	35,463	
7	BRIDGE								
7.1	Approach viaduct Wor	47,275	m2	2,425	114,641,875	100,000	4,727,500	39,396	
7.2	Viaduct Work	167,750	m2	2,425	406,793,750	100,000	16,775,000	139,792	
7.3	Special bridge Work	2,440	m2	2,425	5,917,000	100,000	244,000	2,033	
7.4	Crossing bridge Work	30,500	m2	2,425	73,962,500	100,000	3,050,000	25,417	
7.5	Over bridge Work	45,000	m2	2,425	109,125,000	100,000	4,500,000	37,500	
7.6	Interchange bridge W	27,600	m2	2,425	66,930,000	100,000	2,760,000	23,000	
7.7	Box-culvert Work	32	no	492,241	15,751,712	20,300,000	649,600	5,413	
	Sub Total				793,121,837		32,706,100	272,551	
8	TUNNEL								
8.1	Box-culvert	135,000	m3	1,334	180,090,000	55,000	7,425,000	61,875	
8.2	Tunnel	87,500	m3	970	84,875,000	40,000	3,500,000	29,167	
8.3	Ventilation Facility	2.1	km	606,208	1,273,037	25,000,000	52,500	438	
	Sub Total				266,238,037		10,977,500	91,480	
9	INTERCHANGE								
9.1	Interchange Work	14	no	7,274,491	101,842,874	300,000,000	4,200,000	35,000	
	Sub Total				101,842,874		4,200,000	35,000	
10	SERVICE AREA								
10.1	Service Area Work	7	no	9,699,321	67,895,247	400,000,000	2,800,000	23,333	
	Sub Total				67,895,247		2,800,000	23,333	
11	O/M Hacility								
11.1	Operation Center	1	no	19,398,642	19,398,642	800,000,000	800,000	6,667	
11.2	Mauntenance Office	2	no	12,124,151	24,248,302	500,000,000	1,000,000	8,333	
	Sub Total				43,646,944		1,800,000	15,000	
A1	Total A1 (Σ(1~11))				3,929,456,920		162,509,354	1,354,246	
A2	PRICE ESCALATION				860,727,891		28,115,912	234,299	
	Total A2				860,727,891		28,115,912	234,299	
A3	PHYSICAL CONTIENGENCY				196,472,846		8,125,468	67,712	5% of A1
	Total A3				196,472,846		8,125,468	67,712	
	Construction Cost (A1+A2+A3)				4,986,657,657		198,750,734	1,656,257	
B	ENGINEERING Cost								
B1	Detailed Design/Planning				44,410,015		1,831,469	15,262	
B2	Physical Contingency				2,220,501		91,573	763	5% of B1
	Total B				46,630,516		1,923,042	16,025	
	Total (A+B)				5,033,288,173		200,673,776	1,672,282	
C	ADMISTARATION COST				198,693,347		8,217,041	68,475	5% of (A1+B1)
	Total C				198,693,347		8,217,041	68,475	
D	INTREST								
D1	Construction				133,584,748		5,509,035	45,909	
	Total D				133,584,748		5,509,035	45,909	
	Grand Total			TRY	5,365,566,267	JPY	214,399,852	1,786,666	

Note: VAT will be exempted for BOT project.

Source: JICA Study Team

Table 3.7.7 Estimated Project Cost for Year by Year

(Unit: x1000JPY)

Year			2017	2018	2019	2020	2021	2022	2023	Total
Construction (Except Strait Bridge)	Preliminary and General				274,933				137,467	412,400
	Site Clearing Work				5,270,372	10,540,745				15,811,117
	Earth Work				6,217,740	12,435,479	12,435,479	12,435,479		43,524,177
	Pavement Work							26,376,423	13,188,211	39,564,634
	Drainage Work				922,558	1,845,115	1,845,115	1,845,115		6,457,903
	Incidentals Work							2,837,015	1,418,508	4,255,523
	Bridge Work				4,672,300	9,344,600	9,344,600	9,344,600		32,706,100
	Tunnel Work				2,195,500	4,391,000	4,391,000			10,977,500
	Interchange Work				525,000	1,050,000	1,050,000	1,050,000	525,000	4,200,000
	Service area Work				400,000	800,000	800,000	800,000		2,800,000
	O/M Facility				257,143	514,286	514,286	514,285		1,800,000
	Sub total				20,735,546	40,921,225	30,380,480	55,202,917	15,269,186	162,509,354
	Price Escalation				6.5%	6.5%	6.5%	6.5%	6.5%	
					6,806,993	10,116,054	5,197,715	5,498,901	496,249	28,115,912
	Physical Contiengency				5.0%	5.0%	5.0%	5.0%	5.0%	
					1,036,777	2,046,061	1,519,024	2,760,146	763,459	8,125,467
	Admistaration Cost				5.0%	5.0%	5.0%	5.0%	5.0%	
					1,036,777	2,046,061	1,519,024	2,760,146	763,459	8,125,467
	Sub total				29,616,093	55,129,401	38,616,243	66,222,110	17,292,353	206,876,200
Detailed Desogn and Plan	Detailed Design and Plan		777,345	1,054,124						1,831,469
	Physical Contiengency		5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	
			38,867	52,706	0	0	0	0	0	91,573
	Admistaration Cost		5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	
			38,867	52,706	0	0	0	0	0	91,573
	Sub total		855,079	1,159,536	0	0	0	0	0	2,014,615
Total			855,079	1,159,536	29,616,093	55,129,401	38,616,243	66,222,110	17,292,353	208,890,815
Intrest			0.842%	0.842%	0.842%	0.842%	0.842%	0.842%	0.842%	
			7,200	17,024	266,535	732,970	1,064,290	1,630,841	1,790,175	5,509,035
Total		JPY	862,279	1,176,560	29,882,628	55,862,371	39,680,533	67,852,951	19,082,528	214,399,850
		USD(JPY120.00/USD)								1,786,665,417

Source: JICA Study Team

Table 3.7.8 Detailed design cost breakdown

		Position	Billing Rate		2015	2016	2017											2018												Total
			F/C JPY	LC/ INR			4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	
A	1	Team leader	3,049,000	0			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	24
A	2	Deputy team leader	3,049,000	0			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	24
A	3	Road engineer	3,049,000	0			2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	48
A	4	Bridge engineer	3,049,000	0			2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	48
A	5	Tunnel engineer	3,049,000	0			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	24
A	6	Drainage engineer	3,049,000	0			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	24
A	7	Surveying engineer	3,049,000	0			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	24
A	8	Geological and soil engineer	3,049,000	0			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	24
A	9	Material engineer	3,049,000	0			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	24
A	10	Facilities Engineer	3,049,000	0			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	24
A	11	Architect	3,049,000	0			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	24
A	12	Electrical and mechanical engineer	3,049,000	0									1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	18
A	13	Cost estimator	3,049,000	0															1	1	1	1	1	1	1	1	1	1	1	1	12
A	14	Documentation specialist	3,049,000	0															1	1	1	1	1	1	1	1	1	1	1	1	12
A	15	Compensation specialist	3,049,000	0															1	1	1	1	1	1	1	1	1	1	1	1	12
A	16	Environmental specialist	3,049,000	0															1	1	1	1	1	1	1	1	1	1	1	1	12
A	17	Maintenance specialist	3,049,000	0																					1	1	1	1	1	1	6
A	18	Traffic safety specialist	3,049,000	0																											0
B	1	Deputy team leader	0	10,000			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	24
B	2	Road engineer	0	10,000			2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	48
B	3	Bridge engineer	0	10,000			2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	48
B	4	Tunnel engineer	0	10,000			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	24
B	5	Drainage engineer	0	10,000			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	24
B	6	Surveying engineer	0	10,000			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	24
B	7	Geological and soil engineer	0	10,000			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	24
B	8	Material engineer	0	10,000			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	24
B	9	Facilities Engineer	0	10,000			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	24
B	10	Architect	0	10,000			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	24
B	11	Electrical and mechanical engineer	0	10,000									1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	18
B	12	Cost estimator	0	10,000															1	1	1	1	1	1	1	1	1	1	1	1	12
B	13	Documentation specialist	0	10,000															1	1	1	1	1	1	1	1	1	1	1	1	12
B	14	Compensation specialist	0	10,000															1	1	1	1	1	1	1	1	1	1	1	1	12
B	15	Environmental specialist	0	10,000															1	1	1	1	1	1	1	1	1	1	1	1	12
B	16	Maintenance specialist	0	10,000																					1	1	1	1	1	1	6
B	17	Traffic safety specialist	0	10,000																											0
		[Total of Pro-A]					**162**												**222**												**384**
		[Total of Pro-B]					**150**												**210**												**360**
		[Total of Pro-A+Pro-B]					312												432												744
		Total Cost of FC for Each Month(Pro-A)					493,938,000												676,878,000												1,170,816,000
		Total Cost of FC for Each Month(Pro-B)					0												0												0
		Total Cost of LC for Each Month(Pro-A)					0												0												0
		Total Cost of LC for Each Month(Pro-B)					1,500,000												2,100,000												3,600,000
		Direct Cost for A					6,710,000												9,290,000												16,000,000
C	1	Secretary	0	10,000			2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	48
C	2	Administrator	0	10,000			2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	48
C	3	CAD operator	0	10,000			6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	144
C	4	Office boy	0	10,000			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	24
C	5	Facility management	0	10,000			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	24
C	6	Driver	0	10,000			5	5	5	5	5	5	5	5	5	5	5	5	6	6	6	6	6	6	6	6	6	6	6	6	132
C	7	Guard man	0	10,000			3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	72
		[Total of Supporting Staff]					**240**												**252**												**492**
		Total Cost of LC for Each Month(SS)					2,400,000												2,520,000												4,920,000
		Total Cost of LC for Each Month(B+C)					3,900,000												4,620,000												8,520,000
		Direct Cost for B+C					1,891,000												2,618,000												4,509,000
		Total					5,791,000												7,238,000												13,029,000
		Escalation			7.440%	6.975%	6.500%												6.500%												
		Total Cost of Escalation for LC					1,081,139												1,909,587												2,990,726
		Total Cost of LC for Each Month(B+C) with Escalation					6,872,139												9,147,587												16,019,726
		Grand Total MM					**552**												**684**												**1,236**
		Grand Total Cost					**777,345,012**												**1,054,124,488**												**1,831,469,500**

Source: JICA Study Team

3.7.2 Strait Crossing Bridge

(1) Covered by Estimated Cost

Estimated cost in this study covered design costs and construction costs. Compensation cost and maintenance cost are not included in this estimated cost.

1) Design Cost

- Detail Design Cost
- Construction Engineering Cost

2) Construction Cost

Based on conceptual design in Clause 3.5.2 and preliminary construction plan in Clause 3.6.2 derived from the conditions in Clause 3.4.2, general specifications of suspension bridge is set as Table 3.7.9.

Table 3.7.9 General Specifications of Suspension Bridge

Item	Data
Center Span	2,023m
Total Length	4,023m
Width	2-(3@3.65m + 2.5m)
Tower Height	308m
Side Span Pier Height (North)	43.2m
Side Span Pier Height (South)	43.2m
Center Clearance	87.3m
Naviation Channel	1,000m x 64m

(2) Not Covered by Estimated Costs

The compensation cost before start of the project and the maintenance cost after completion of the project are not included in this estimated cost.

(3) Conditions of Cost Estimation

Conditions of cost estimation such as term of cost estimation, exchange rate, tax, inflation and interest are the same as those for the Road in Clause 3.8.1.

(4) Preliminary Construction Cost Based on Conceptual Design

Preliminary construction cost for suspension bridge is calculated as Table 3.7.10:

Table 3.7.10 Preliminary Construction Cost for Suspension Bridge

Unit : USD

ITEM	COST
Preparatory Works	45,100,000
Mobilization & Demobilization	228,700,000
Design	78,400,000
Substructure	894,000,000
Suspension System/Superstructure	1,160,000,000
E&M, Auxillary	93,800,000
Total	2,500,000,000

3.7.3 Maintenance Cost

The maintenance, there is routine patrol inspection and large-scale maintenance including re-paving, replacement of the expansion joint and shoes. The maintenance cost was estimated by the actual result of past performance of KGM (Highway Operation Maintenance and Toll Collection Expenditures, 2014). In this document there is described from the 2004 year, and it is shown in Table 3.7.11. In addition, the spending of the Istanbul district where close to the project area was used.

Table 3.7.11 Trends in maintenance costs

(JPY41.24/TRY)

		2,004	2,005	2,006	2,007	2,008	2,009	2,010	2,011	2012	2013	2014	JPY/km
Motorway (Istanbul)	Traffic Services	32,877	38,596	49,316	50,762	57,883	38,744	28,123	21,233	40,283	53,699	61,461	2,535,000
	Snow Fighting	4,981	8,416	9,514	6,779	6,306	4,471	0	0	8,296	9,751	8,379	346,000
	Highway Maintenance	19,839	25,819	30,968	35,521	33,589	31,561	24,220	24,792	49,091	49,856	69,730	2,876,000
	Tall Collection	35,505	37,691	50,909	54,870	56,583	86,012	59,905	54,753	76,510	69,666	73,934	3,049,000
1st Bosporus Bridge	Traffic Services	254,148	395,694	3,048,179	2,762,798	551,032	316,070	28,283	26,504	492,299	1,175,148	616,118	
	Snow Fighting	0	0	0	0	0	0	0	0	0	0	0	
	Highway Maintenance	298,571	519,795	307,872	312,752	340,278	564,891	429,640	519,387	431,245	460,281	519,670	
	Tall Collection	1,590,837	3,629,693	1,066,041	987,499	1,147,260	1,209,111	1,169,612	1,307,568	1,385,775	1,282,605	1,492,808	
2nd Bosporus Bridge	Traffic Services	488,040	934,559	771,067	514,530	1,617,176	522,896	3,141,145	2,525,319	1,422,479	2,392,437	1,030,025	
	Snow Fighting	0	0	0	0	0	237	423	0	0	0	0	
	Highway Maintenance	175,975	700,641	322,386	146,875	270,896	342,372	149,601	121,572	0	12,914	0	
	Tall Collection	1,782,950	4,028,002	2,083,364	2,266,046	1,836,286	7,700,777	4,277,425	4,569,620	5,328,502	4,751,799	4,621,174	
Average of 1st and 2nd Bosporus Bridge	Traffic Services	371,094	665,127	1,909,623	1,638,664	1,084,104	419,483	1,584,714	1,275,912	957,389	1,783,793	823,072	33,943,000
	Snow Fighting	0	0	0	0	0	119	212	0	0	0	0	0
	Highway Maintenance	237,273	610,218	315,129	229,814	305,587	453,632	289,621	320,480	215,623	236,598	259,835	10,716,000
	Tall Collection	1,686,894	3,828,848	1,574,703	1,626,773	1,491,773	4,454,944	2,723,519	2,938,594	3,357,139	3,017,202	3,056,991	126,070,000

Legend

KGS system introduced

Introduction of the Camera system, the traffic management system and the road state information systems (bridge traffic information, congestion information can be viewed by TV and telephone from the application

Change of carrier platform (maintenance and repair work of the main part)

Source: Highway Operation Maintenance and Toll Collection Expenditures, 2014, KGM, June 2015

According to Table 3.7.11,

A) Maintenance costs of motorway section

- ✓ From 2004 to 2014, almost evenly maintenance cost has been recorded. Therefore, the value of 2014 was applied.

B) Maintenance costs of the bridge section

- ✓ The maintenance cost for Snow Fighting, it was determined to be unnecessary from metrological conditions.
- ✓ The maintenance cost for Toll Collection, after the installation of traffic information system (green cell), there is no major changes in the maintenance cost. Therefore, maintenance cost of 2014 was applied.

In addition, large-scale maintenance is included re-pavement of the motorway (reconstruction from base course). The maintenance cost is shown in Table 3.7.12 and the transition of the maintenance costs, shown in Table 3.7.13.

Table 3.7.12 Routine and large scale maintenance cost

		Unit	Maintenance cost (USD)	Remark
Motorway	Traffic Service	/km/year	23,488	
	Snow Fighting	/km/year	3,206	
	Highway Maintenance	/km/year	26,648	
	Toll Collection	/km/year	28,251	
	Total (Regular)	/km/year	81,593	
	Large scale maintenance	/km/year	221,081	Re-pavement, 16^{th}~20^{th} years after construction including regular
Bridge	Traffic Service	/year	5,032,025	
	Snow Fighting	/year	0	
	Highway Maintenance	/year	1,588,642	
	Total (Regular)	/year	6,620,667	
	Medium scale maintenance	/3years	18,120,667	Every 3 years including regular
	Large scale maintenance	/15years	24,620,667	Every 15 years including regular

Source: JICA Study Team

Table 3.7.13 The transition of the maintenance costs

(Unit: xJPY1000)

				per km		2014	2015	2016	2017	2018	2019
	Year										
	Inflation Rate				(xJPY1000)		7.440%	6.975%	6.5%	6.5%	6.5%
Maintenance Cost	Road 184km	Traffic Service	①	(61,461TRY)	2,535	466,440	483,792	518,621	553,521	589,500	627,817
		Snow Fighting	②	(8,379TRY)	346	63,664	66,032	70,786	75,550	80,460	85,690
		Highway Maintenance	③	(69,730TRY)	2,876	529,184	548,870	588,384	627,979	668,798	712,269
		(Large scale repair)	④	(1,894,956TRY)	78,148			15,987,832			
		Toll Collection	⑤	(73,934TRY)	3,049	561,016	581,886	623,777	665,754	709,028	755,115
		Sub-total (xJPY1000)	Regular	①+②+③+⑤	8,806	1,620,304	1,680,580	1,801,568	1,922,804	2,047,786	2,180,891
			Large scale	①+②+③x4/5+④x1/5+⑤	23,860	4,390,314	4,553,634	4,881,458	5,209,955	5,548,602	5,909,260
	Bridge 4km	Traffic Service	①	(823,072TRY)	135,772	543,088	563,291	603,843	644,479	686,370	730,984
		Snow Fighting	②	(0TRY)	0	0	0	0	0	0	0
		Highway Maintenance	③	(259,835TRY)	42,864	171,456	177,834	190,637	203,466	216,691	230,776
		Toll Collection	④	(0TRY)	0	0	0	0	0	0	0
		(Medium scale repair)	⑤					1,380,000			
		(Large scale repair)	⑥					2,160,000			
		Sub-total (xJPY1000)	Regular	①+②+③+④	178,636	714,544	741,125	794,480	847,945	903,061	961,760
			Medium scale	①+②+③+④+⑤				2,174,480			
			Large scale	①+②+③+④+⑥				2,954,480			
	Total (xJPY1000)										
	Cumulative total (xJPY1000)										

				2020	2021	2022	2023	2024	2025
	Year								
	Inflation Rate			6.5%	6.5%	6.5%	6.5%	6.5%	6.5%
Maintenance Cost	Road 184km	Traffic Service		668,626	712,086	758,372	807,666	860,164	916,075
		Snow Fighting		91,260	97,192	103,510	110,238	117,403	125,034
		Highway Maintenance		758,567	807,874	860,386	916,311	975,871	1,039,302
		(Large scale repair)							
		Toll Collection		804,197	856,470	912,140	971,429	1,034,572	1,101,820
		Sub-total (xJPY1000)	Regular maintenance	2,322,650	2,473,622	2,634,408	2,805,644	2,988,010	3,182,231
			Large scale maintenance						
	Bridge 4km	Traffic Service		778,498	829,100	882,992	940,386	1,001,511	1,066,609
		Snow Fighting		0	0	0	0	0	0
		Highway Maintenance		245,776	261,752	278,766	296,885	316,183	336,735
		Toll Collection		0	0	0	0	0	0
		(Medium scale repair)		1,721,147	1,833,022	1,952,168	2,079,059	2,214,198	2,358,121
		(Large scale repair)		2,693,969	2,869,077	3,055,567	3,254,179	3,465,701	3,690,971
		Sub-total (xJPY1000)	Regular maintenance	1,024,274	1,090,852	1,161,758	1,237,271	1,317,694	1,403,344
			Medium scale maintenance						
			Large scale maintenance						
	Total (xJPY1000)							4,305,704	4,585,575
	Cumulative total (xJPY1000)							4,305,704	8,891,279

				2026	2027	2028	2029	2030	2031
	Year								
	Inflation Rate			6.5%	6.5%	6.5%	6.5%	6.5%	6.5%
Maintenance Cost	Road 184km	Traffic Service		975,620	1,039,035	1,106,572	1,178,500	1,255,102	1,336,684
		Snow Fighting		133,162	141,817	151,035	160,852	171,308	182,443
		Highway Maintenance		1,106,857	1,178,803	1,255,425	1,337,028	1,423,934	1,516,490
		(Large scale repair)							
		Toll Collection		1,173,438	1,249,711	1,330,942	1,417,454	1,509,588	1,607,711
		Sub-total (xJPY1000)	Regular maintenance	3,389,077	3,609,366	3,843,974	4,093,834	4,359,932	4,643,328
			Large scale maintenance						
	Bridge 4km	Traffic Service		1,135,939	1,209,775	1,288,410	1,372,157	1,461,347	1,556,335
		Snow Fighting		0	0	0	0	0	0
		Highway Maintenance		358,622	381,933	406,759	433,198	461,356	491,344
		Toll Collection		0	0	0	0	0	0
		(Medium scale repair)		2,511,398	2,674,639	2,848,491	3,033,643	3,230,830	3,440,833
		(Large scale repair)		3,930,884	4,186,392	4,458,507	4,748,310	5,056,951	5,385,652
		Sub-total (xJPY1000)	Regular maintenance	1,494,561	1,591,708	1,695,169	1,805,355	1,922,703	2,047,679
			Medium scale maintenance	4,005,959			4,838,998		
			Large scale maintenance						
	Total (xJPY1000)			8,889,597	5,201,074	5,539,143	11,483,351	6,282,635	6,691,007
	Cumulative total (xJPY1000)			17,780,876	22,981,950	28,521,093	40,004,444	46,287,079	52,978,086

				2032	2033	2034	2035	2036	2037
	Year								
	Inflation Rate			6.5%	6.5%	6.5%	6.5%	6.5%	6.5%
Maintenance Cost	Road 184km	Traffic Service		1,423,568	1,516,100	1,614,647	1,719,599	1,831,373	1,950,412
		Snow Fighting		194,302	206,931	220,382	234,707	249,962	266,210
		Highway Maintenance		1,615,062	1,720,041	1,831,844	1,950,913	2,077,723	2,212,775
		(Large scale repair)							
		Toll Collection		1,712,213	1,823,507	1,942,034	2,068,267	2,202,704	2,345,880
		Sub-total (xJPY1000)	Regular maintenance	4,945,145	5,266,579	5,608,907	5,973,486	6,361,762	6,775,277
			Large scale maintenance						
	Bridge 4km	Traffic Service		1,657,497	1,765,234	1,879,974	2,002,173	2,132,314	2,270,914
		Snow Fighting		0	0	0	0	0	0
		Highway Maintenance		523,281	557,295	593,519	632,097	673,184	716,941
		Toll Collection		0	0	0	0	0	0
		(Medium scale repair)		3,664,488	3,664,488	3,664,488	1,424,850	1,424,850	1,424,850
		(Large scale repair)		5,735,720	5,735,720	5,735,720	2,230,200	2,230,200	2,230,200
		Sub-total (xJPY1000)	Regular maintenance	2,180,778	2,322,529	2,473,493	2,634,270	2,805,498	2,987,855
			Medium scale maintenance	5,845,266			4,059,120		
			Large scale maintenance						
	Total (xJPY1000)			12,971,189	7,589,108	8,082,400	12,666,876	9,167,260	9,763,132
	Cumulative total (xJPY1000)			65,949,275	73,538,383	81,620,783	94,287,659	103,454,919	113,218,051

	Year			2038	2039	2040	2041	2042	2043
	Inflation Rate			6.5%	6.5%	6.5%	6.5%	6.5%	6.5%
	Road	Traffic Service		2,077,188	2,212,206	2,355,999	2,509,139	2,672,233	2,845,928
	184km	Snow Fighting		283,514	301,942	321,568	342,470	364,731	388,438
		Highway Maintenance		2,356,605	2,509,784	2,672,920	2,846,660	3,031,693	3,228,753
		(Large scale repair)			68,197,023	72,629,830	77,350,768	82,378,568	87,733,175
		Toll Collection		2,498,362	2,660,756	2,833,705	3,017,895	3,214,059	3,422,972
		Sub-total (xJPY1000)	Regular maintenance	7,215,669					
			Large scale maintenance		20,822,136	22,175,574	23,616,986	25,152,091	26,786,975
Maintenance Cost	Bridge	Traffic Service		2,418,524	2,575,728	2,743,150	2,921,455	3,111,349	3,313,587
	4km	Snow Fighting		0	0	0	0	0	0
		Highway Maintenance		763,542	813,172	866,028	922,320	982,271	1,046,118
		Toll Collection		0	0	0	0	0	0
		(Medium scale repair)		8,113,832	5,694,565	6,064,711	6,458,917	6,878,747	7,325,866
		(Large scale repair)		3,084,962	8,913,231	9,492,591	10,109,610	10,766,735	11,466,572
		Sub-total (xJPY1000)	Regular maintenance	3,182,066	3,388,900	3,609,178	3,843,775	4,093,620	4,359,705
			Medium scale maintenance	11,295,898			10,302,692		
			Large scale maintenance	6,267,028					
	Total (xJPY1000)			27,960,661	24,211,036	25,784,752	37,763,453	29,245,711	31,146,680
	Cumulative total (xJPY1000)			141,178,712	165,389,748	191,174,500	228,937,953	258,183,664	289,330,344

	Year			2044	2045	2046	2047	2048	2049
	Inflation Rate			6.5%	6.5%	6.5%	6.5%	6.5%	6.5%
	Road	Traffic Service		3,030,914	3,227,923	3,437,738	3,661,191	3,899,168	4,152,614
	184km	Snow Fighting		413,687	440,576	469,214	499,713	532,194	566,787
		Highway Maintenance		3,438,622	3,662,133	3,900,171	4,153,682	4,423,672	4,711,210
		(Large scale repair)							
		Toll Collection		3,645,466	3,882,421	4,134,778	4,403,539	4,689,769	4,994,604
		Sub-total (xJPY1000)	Regular maintenance	10,528,689	11,213,053	11,941,901	12,718,125	13,544,803	14,425,215
			Large scale maintenance						
Maintenance Cost	Bridge	Traffic Service		3,528,970	3,758,353	4,002,646	4,262,818	4,539,901	4,834,995
	4km	Snow Fighting		0	0	0	0	0	0
		Highway Maintenance		1,114,116	1,186,534	1,263,658	1,345,796	1,433,273	1,526,436
		Toll Collection		0	0	0	0	0	0
		(Medium scale repair)		7,802,047	8,309,180	8,849,277	9,424,480	10,037,071	10,689,480
		(Large scale repair)		12,211,899	13,005,673	13,851,042	14,751,359	15,710,198	16,731,361
		Sub-total (xJPY1000)	Regular maintenance	4,643,086	4,944,887	5,266,304	5,608,614	5,973,174	6,361,431
			Medium scale maintenance	12,445,133			15,033,094		
			Large scale maintenance						
	Total (xJPY1000)			27,616,908	16,157,940	17,208,205	33,359,833	19,517,977	20,786,646
	Cumulative total (xJPY1000)			316,947,252	333,105,192	350,313,397			

Red frame:, The project period excluding the construction period

Source: JICA Study Team

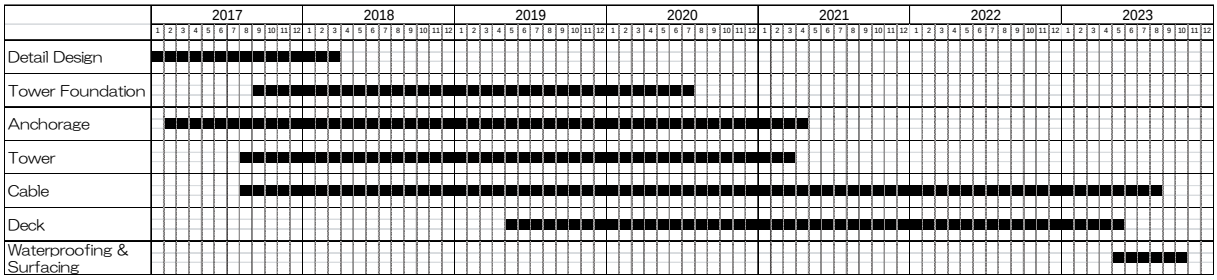
3.8 Project Implementation Schedule

The expected schedule for design and construction of suspension bridge is as Table 3.8.1:

Table 3.8.1 Expected Project Implementation Schedule

Year	1	2	3	4	5	6	7	8	9~
BOT Contract	△								
Finance Close	△								
Planning and design	▬	▬	▬						
Construction of road			▬	▬	▬	▬	▬	▬	
Construction of bridge		▬	▬	▬	▬	▬	▬	▬	
Operation start								△	
Operation and maintenance								▬	▬

Table 3.8.2 Expected Schedule for Design and Construction of Suspension Bridge



Concrete bidding schedule has not been fixed yet.

3.9 Environmental and Social Considerations

3.9.1 Summary of the Project

(1) Name of the Survey

Preparatory Survey on the Project for Construction of Dardanelles Strait Crossing and Motorway

(2) Outline of the Road

- Project Section: Kinali-Shekerkav (app.184km) and Dardanelles Bridge (app. 4km)
- New Construction or Renovation: New construction
- Lanes: 6 lanes

(3) Classification of the Survey

Feasibility Study

(4) Environmental Category

Environmental Category: A

Reason: This project is applicable to sensitive sector (roads and bridges) and sensitive characteristics in JICA Guidelines for Environmental and Social Considerations (April 2010.)

(5) Counterpart of Turkey

Turkish Motorway Authority (KGM)

3.9.2 Outline

(1) Background of the Survey

Turkey is located at the cross point between Asia and Europe, but the road connecting East and West continents is only suspension bridges over Bosporus strait, and sea transportation is only the way to across Marmara sea and Dardanelles strait. In-flow traffic from East Europe through Bulgaria has been increasing, and the number of registered cars in the country increased from 8 million in 2000 to over 16

million in 2012. The increase of traffic demand due to rapid economic growth caused chronical traffic congestion, and it is urgent issue to set up efficient automobile network in the country. Turkey government raised its government program, so called “2023 vision” and in this vision, the government is aiming to enter into one of the top ten economic largest countries in the world by 2023. Turkish Motorway Authority “KGM” also worked out “motorway development programs in order to achieve the government goal. In this development program, KGM is aiming to expand mobility, strengthen the network for automobile roads, increase the more than two lane roads, decrease the mortality due to traffic accident and etc. Besides, similar to Japan, Turkey is a country with frequent earthquakes and the existence of an active fault in Marmara Sea is recognized. Thus, it is urgent issue to establish alternative route by passing Istanbul.

(2) Survey Objectives

The purpose of the survey is to work out the detailed plan for the captioned project (demand forecast, project scope of work, project cost, schedule, way of implementation, project implementation structure, O&M structure, environmental and social impacts of the project, etc.) and to implement necessary survey for application of Overseas Investment and Loans.

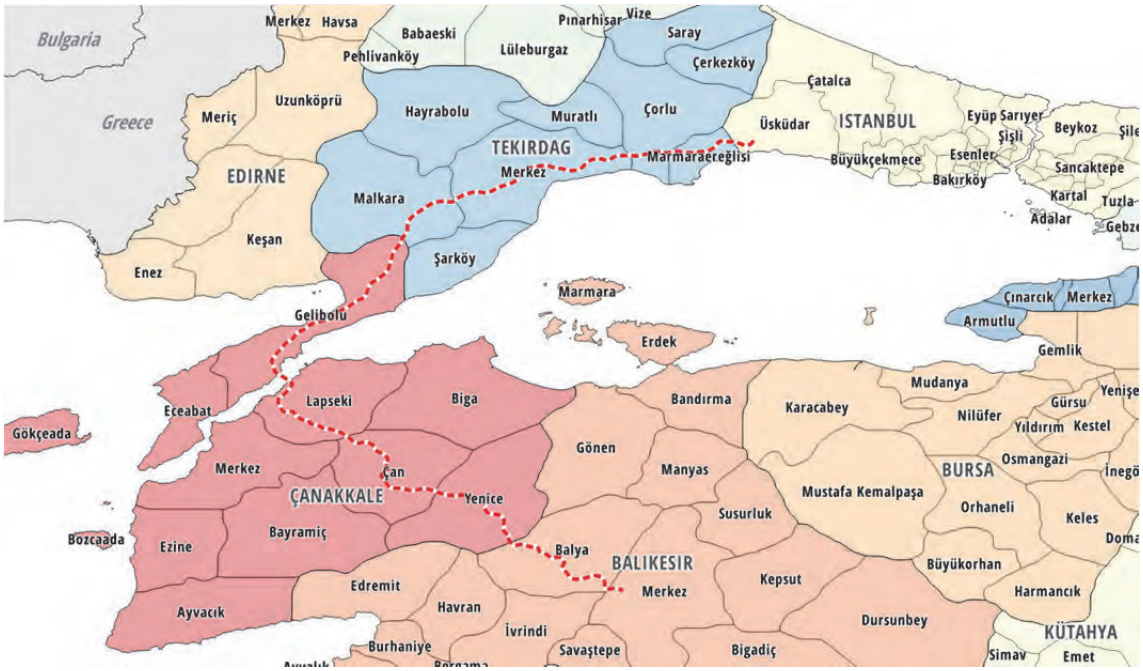
(3) Survey Area

Istanbul Province, Tekirdag Province, and Canakkale Province, in Turkey

Figure 3.9.1 shows the Project location, and Figure 3.9.2 shows provinces around the survey area.

Source: JICA Survey

Figure 3.9.1 Project Location Map



Source: JICA Survey

Figure 3.9.2 Province Map around the Survey Area

(4) Survey Contents

Contents of the survey are as follows. (Period of the field work: April, 2015- March, 2016)

1) Preparation work of the survey

2) Current status and agendas of transportation sector in Turkey and necessity of the project

3) Study of the project
   - ① Decision of the project purpose
   - ② Decide the project scope
   - ③ Traffic demand forecast
   - ④ Establishment of design criteria
   - ⑤ Outline design
   - ⑥ Construction plan
   - ⑦ Operation and maintenance plan and organizational framework
   - ⑧ Cost estimation
   - ⑨ Set up the project implementation schedule
   - ⑩ Implementation of survey for environmental and social considerations

4) Consideration of Cash flow analysis, the Project Scheme and Funding of Overseas Investment Project
   - ① Suggestion of the project scheme and comparison of multiple options
   - ② Examination to depend on a most suitable financing plan in the initial investment phase

③ Cash flow analysis and sensitivity analysis
④ Analysis of persons concerned the project
⑤ Confirmation of related laws and regulations

5) Risk analysis and examination of the risk mitigation measures
① Analysis of risks by carrying out this project and consideration of their mitigation measures
② List up of the related contracts that are necessary in carrying out the project and Setting of main terms of contract

6) Confirmation of the Effect of the Project

3.9.3 Outline of the Project Area

(1) Positioning of the Project Area in Turkey

The project area is the four provinces of Istanbul, Tekirdag and Canakkale located in Marmara region (northwestern Turkey), the Republic of Turkey. Turkey western region around Marmara Sea is the center of the industry in Turkey, but its traffic infrastructure is small and weak compared to its importance. The project road will form a large highway network around Marmara Sea with Gebze-Izmir highway (Izmit Bay Bridge) and North Marmara highway (Third Bosporus Bridge included) under construction, and existing Trans-European motorway (TEM).

Figure 3.9.3 Location of the Project area

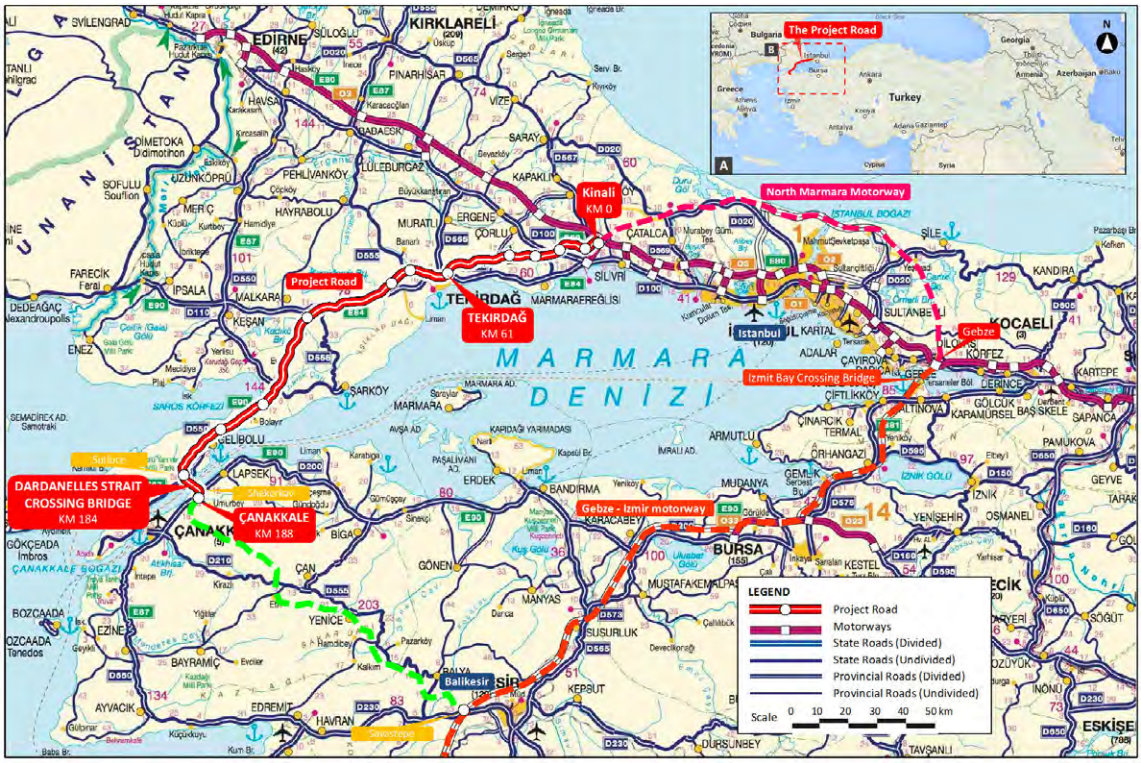
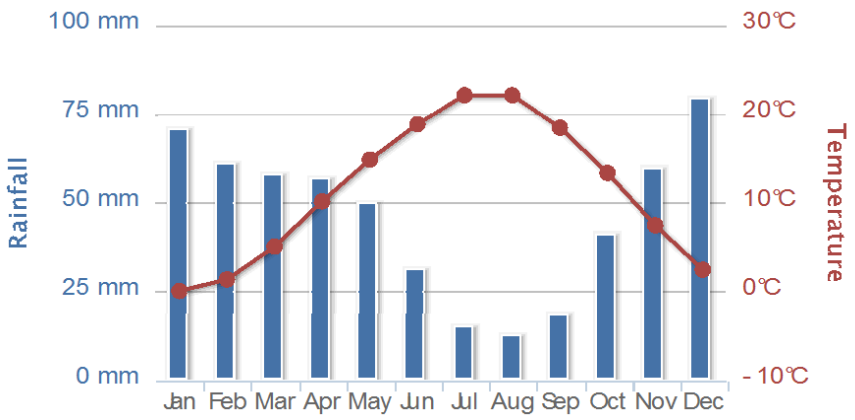


Figure 3.9.4 Location of Kunal- Balikesir Highway and Dardanelles Bridge

(2) Natural Environment

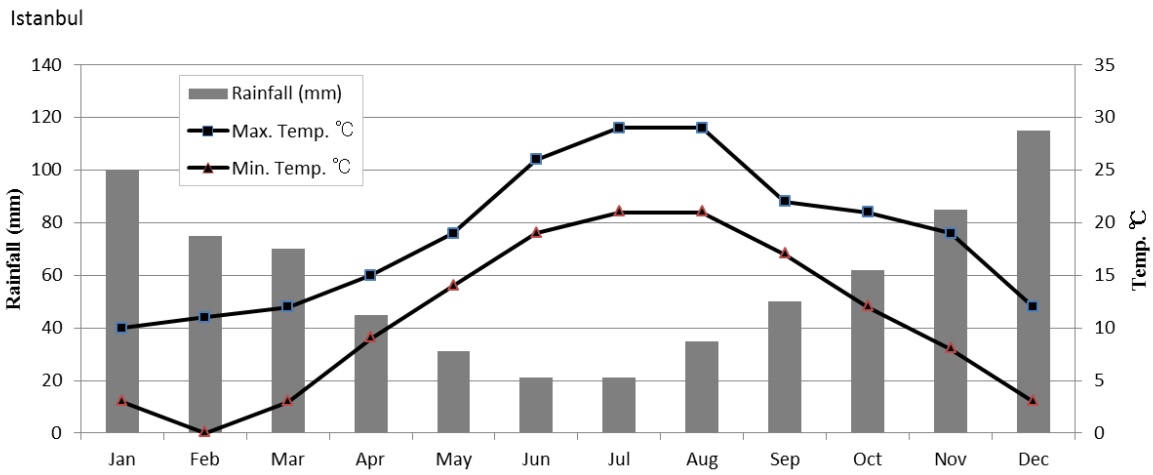
1) Climate

In Turkey, a country is large and has intense difference of climate and precipitation by a district. The European adjacency area such as the region around Marmara Sea of the project area belongs to the middle of the humid subtropical climate. It is cool here in summer and snow piles up in winter. Monthly temperature and precipitation (the mean from 1990 through 2009) in Turkey is shown in Figure 3.9.5. In addition, the monthly maximum and minimum temperatures and precipitation in Istanbul, Tekirdag and Canakkale of the project area are shown below. The annual rainfall in all areas is 600-700mm. The temperature becomes slightly higher as towards the west.



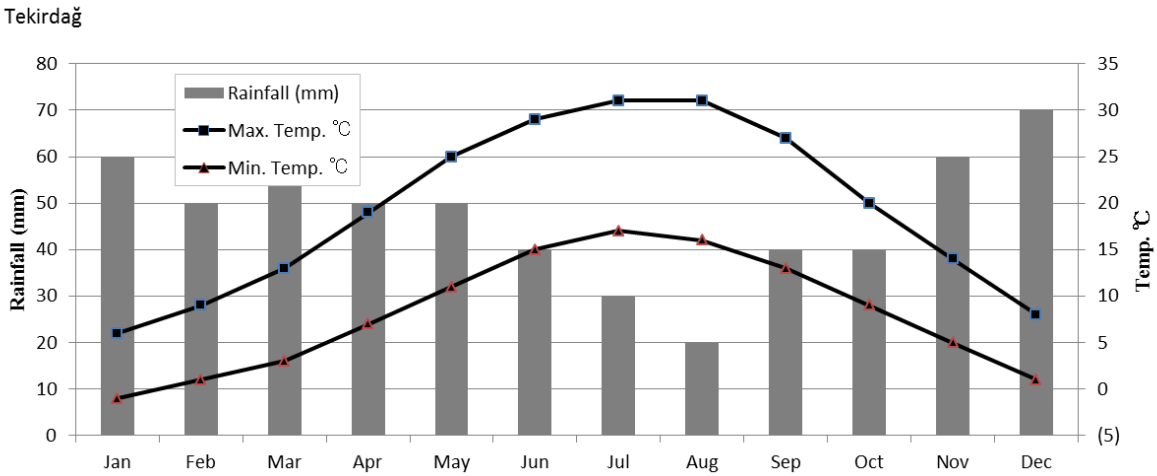
Source: http://sdwebx.worldbank.org/climateportal/index.cfm

Figure 3.9.5 Average Monthly Temperature and Rainfall for Turkey from 1990-2009



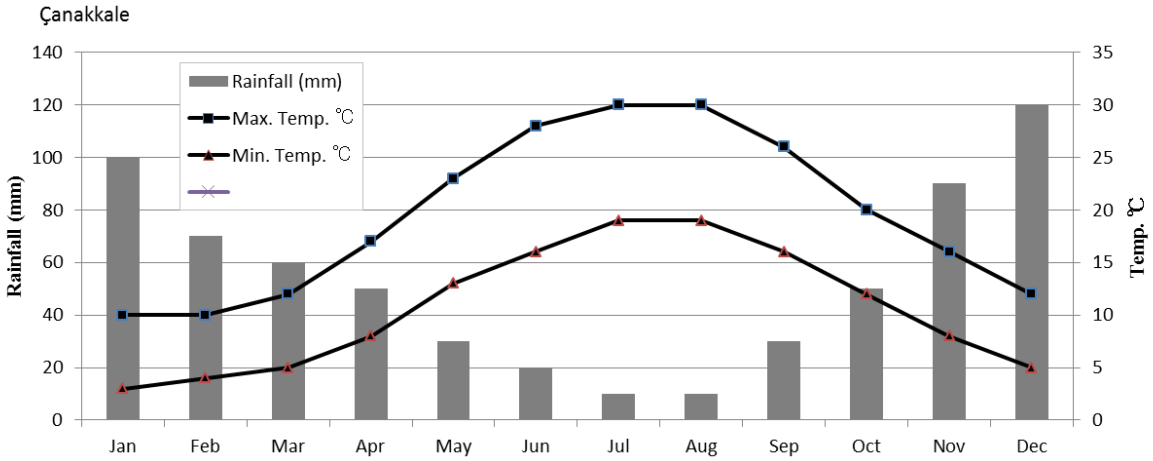
Source: JICA Survey Team

Figure 3.9.6 Average Monthly Temperature and Rainfall for Istanbul from 1990-2009



Source: JICA Survey Team

Figure 3.9.7 Average Monthly Temperature and Rainfall for Tekirdag from 1990-2009



Source: JICA Survey Team

Figure 3.9.8 Average Monthly Temperature and Rainfall for Canakkale from 1990-2009

2) Protected areas

Conservation areas in Turkey are shown in The Environmental Impact Assessment Regulation (2003) as 'Sensitive Area'. Although no protected area such as National Park is observed on the planned alignment, the presence/absence of the areas near the project site will be confirmed by the future survey. The following map shows the location of the planning road and National parks.

The nearest national park is Gelibolu Peninsula Historical National Park (Figure 3.9.9-②) from the project location, however, the park is away more than 30km from the location of Dardanelles Bridge, thus the project does not give any adverse impacts to the park.

Source: http://nationalparksofturkey.com/

Figure 3.9.9 Locations of National Parks around the Project Site

Table 3.9.1 National Parks around the Project Site

No	Name	Location	Distance from Project area
1	Lake Gala National Park	Edirne	App. 60km
2	Gelibolu Peninsula Historical National Park	Canakkale	App. 30km
3	Troya Historical National Park	Canakkale	App. 50km
4	Kazdagi (Mount Ida) National Park	Balikesir	App. 40km
5	Manyas Bird Paradise National Park	Balikesir	App. 40km
6	Uludag National Park	Bursa	App. 150km

Source: http://nationalparksofturkey.com/

3) Cultural Heritage

Location of the major cultural heritages in Turkey such as World Cultural Heritage are shown in Table 3.9.2 and Figure 3.9.10 The nearest cultural heritage is Archaeological Site of Troy which is away

more than 50km from the project location of Dardanelles Bridge, thus the project does not give any impacts. Other relevant affected cultural heritages are not observed from general information, hence, detailed information is clarified based on approved EIA after disclosure of the EIA. In general, the any cultural heritage is identified at the project site, it is reported to Regional Council for Conservation, Ministry of Culture and Tourism in accordance with Las for the Protection of Cultural and Natural Assets (1983) and necessary actions are determined after the survey.

Table 3.9.2 World Heritage Sites by UNESCO in Turkey

No	Name	Property	Inscription	Location
1	Archaeological Site of Troy	Cultural	1998	Province of Canakkale
2	Bursa and Cumalikizik: the Birth of the Ottoman Empire	Cultural	2014	Bursa and Cumalikizik
3	City of Safranbolu	Cultural	1994	District of Safranbolu, Province of Karabuk
4	Great Mosque and Hospital of Divrigi	Cultural	1985	District of Divrigi, Province of Sivas (Eastern Anatolia)
5	Hattusha: the Hittite Capital	Cultural	1986	District of Sungurlu, Province of Corum
6	Historic Areas of Istanbul	Cultural	1985	City of Istanbul
7	Nemrut Dag	Cultural	1987	Province of Adiyaman
8	Neolithic Site of Çatalhoyuk	Cultural	2012	Province of Konya
9	Pergamon and its Multi-Layered Cultural Landscape	Cultural	2014	Province of Bergama
10	Selimiye Mosque and its Social Complex	Cultural	2011	Province of Edirne
11	Xanthos-Letoon	Cultural	1988	Provinces of Mugla and Antalya
12	Goreme National Park and the Rock Sites of Cappadocia	Mixed	1985	Province of Nevşehir (Central Anatolia)
13	Hierapolis-Pamukkale	Mixed	1988	Province of Denizli

Source: website of UNESCO (http://whc.unesco.org/en/statesparties/tr (accessed June, 2015))

Source: website of UNESCO (http://whc.unesco.org/en/statesparties/tr (accessed June, 2015))

Figure 3.9.10 World Heritage Sites by UNESCO in Turkey

4) Ecosystem

According to the IUCN Red List, threated species in Turkey (Europe side) are shown in the following table. In addition to 20 species in the following table, about 337 species of Least Concern (LC) and Data Deficient (DD) are identified.

The project area seems not to be threated species habitats, since the area is mainly agricultural land. However, it is necessary to identify threated species which inhabit in the sea area because piers of Dardanelles Bridge will be constructed at least 2 places in the sea area. In the IUCN website, threated species which habitats correspond to the project area are shown in the following table.

Table 3.9.3 Threatened Species in Turkey (Europe side)

No.	Classification	Scientific Name	English Name	Category	Habitats may locate around the project area
1	Plants	Aldrovanda vesiculosa	Waterwheel	EN	
2	Plants	Amsonia orientalis	Blue star	CR	
3	Plants	Baldellia ranunculoides	Lesser Water-plantain	NT	✓
4	Plants	Cladocora caespitosa	Mediterranean Pillow Coral	EN	✓
5	Plants	Elatine alsinastrum	Elatine Faux Alsine	NT	✓
6	Plants	Galanthus trojanus	-	CR	
7	Plants	Phoenix theophrasti	Theophrastus's Date Palm	NT	
8	Plants	Sideritis scardica	Mountain Tea	NT	✓
9	Insecta	Osmoderma lassallei	-	EN	✓
10	Insecta	Polyommatus guezelmavi	Beautiful Blue	NT	
11	Insecta	Ropalopus insubricus	-	NT	
12	Insecta	Somatochlora borisi	Bulgarian Emerald	VU	
13	Shellfish	Monacha ovularis	-	NT	
14	Shellfish	Monacha venusta	-	NT	
15	Shellfish	Sphaerium rivicola	River Orb Mussel	VU	
16	Shellfish	Unio mancus	-	NT	
17	Crustacea	Palinurus elephas	Common Spiny Lobster	VU	No data
18	Crustacea	Potamon ibericum	-	NT	✓
19	Pisces	Mobula mobular	Giant Devil Ray	EN	
20	Pisces	Raja radula	Rough Ray	EN	✓

Source: IUCN Red List

(3) Basic Information about Socio-Economic

1) Area and Population

Area

Land area of Turkey is 780,576 square kilometers, and is nearly twice as large as Japan. Areas of the target 4 provinces are shown in below.

Table 3.9.4 Land Area of the Target Provinces

Province	Land Area (km^2)	Ratio of the whole country
Turkey	780,576	100.00%
1. Istanbul	5315.33	0.68%
2. Tekirdag	6342.30	0.81%
3. Canakkale	9950.43	1.27%
4. Balikesir	14472.73	1.85%
Total	**36,080.79**	**4.61%**

Source: Turkish Statistical Institute

Population

According to statistical data of 2014, total population of the target provinces is approximately 17 million, and density of each province is 50-150 persons/km^2 without Istanbul as shown below. This low density reflects land use that the area is mainly farmland.

Table 3.9.5 Population and Population Density of the Target Provinces

Province	Population (2014)	Density (pop/km^2)
1. Istanbul	14,377,018	2,767
2. Tekirdag	906,732	144
3. Canakkale	511,790	52
4. Balikesir	1,189,057	83
Total	**16,984,597**	**471**

Source: Turkish Statistical Institute

2) Economy

Economy in the whole Turkey has grown 5-7% since 2002 as a result of structural reforms after economic crisis in 2001. Although it continues to grow with domestic demand from 2010 to 2011, the growth was slowing down in 2012 due to the influence of economic control promoted by the government. In 2013, the economy gradually recovered due to an upsurge in domestic demand, and annual growth rate is around 4.0%. The GDP and the GDP growth rate in Turkey from 2011 to 2013 is shown in Table 3.9.6.

Table 3.9.6 GDP and GDP growth rate in Turkey

(Unit: million TL)

	2011	2012	2013
Nominal GDP	1,297,713	1,416,798	1,565,181
Real GDP growth rate	8.8%	2.1%	4.0%
GDP per capita (US$)	10,476	10,523	10,815

Source: JETRO

Table 3.9.7 shows gross regional domestic product (GRDP) of the target provinces. While data of GRDP has not been updated since 2001 when Turkish Statistical Institute carried out the investigation, income disparity of big cities such as Istanbul and the inland are still pointed out now. In 14 provinces which are colored green in Figure 3.9.11, economic level has reached equal to or more than the developed

countries. On the other hand, 40 provinces colored blue may be heading toward a “middle-income trap” that income does not grow up than 17,000 dollars per person, and the economic level of 27 provinces colored red remains in lower than poverty line.

Table 3.9.7 GDP and GRDP in the Survey area

(Unit: million TL)

Province	GRDP(TL) (2001)	Share	Rate of economic growth
Turkey	178,412	100%	43.2%
1. Istanbul	38,010	21.3%	38%
2. Tekirdag	1,931	1.1%	45.1%
3. Canakkale	1,319	0.7%	30.7%
4. Balikesir	2,628	1.5%	38.3%

Source: Turkish Statistical Institute

Source: JBIC ‘Investment climate in Turkey’ (2014)

Figure 3.9.11 Domestic Economic disparity in Turkey

3) Land use

The current land use of the whole land of Turkey is shown in Figure 3.9.12.

The planning road is mainly passing through agricultural area for wheat and fruit trees. The alignment has been set up with avoiding residential and industrial area. Photographs of the present situation along the planning road are shown in Figure 3.9.13.

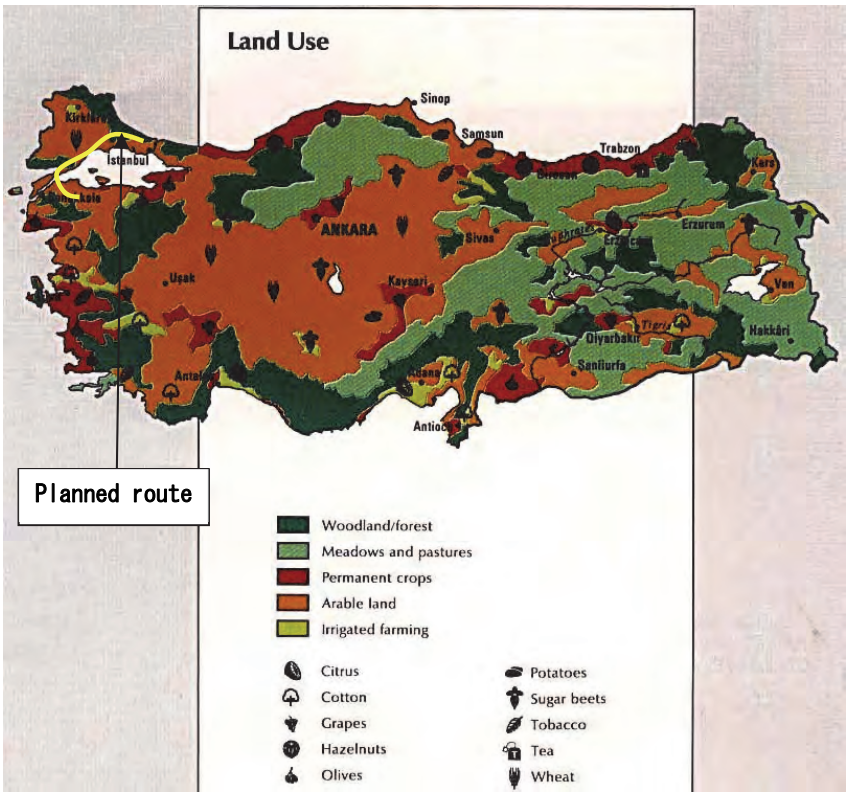
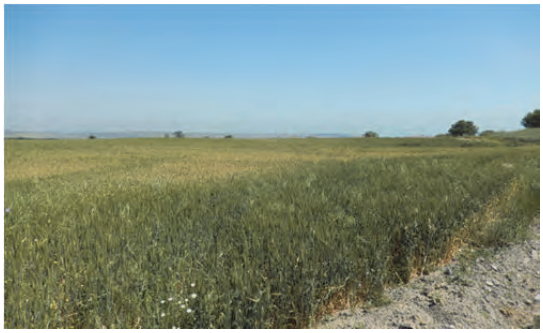


Figure 3.9.12 Land Use of the whole land of Turkey



Present situation along the planning road
(Wheat fields)

Present situation along the planning road
(Fruit trees)

Present situation at a point where the bridge will be constructed: Gelipoli side
(Grassland)

Present situation at a point where the bridge will be constructed: Canakkale side
(Grassland)

Figure 3.9.13 Present land use on the planning road (as of May, 2015)

3.9.4 Legislation for Environmental and Social Considerations in Turkey

(1) Laws and regulations for Environmental and Social Considerations in Turkey

1) Environmental Policy, Strategy and Legal Framework

Environmental policy and strategy in Turkey are shown below;

- Environmental Law (issued in 1983)
- Environmental Impact Assessment Regulation(issued in 1993)
- National Environmental Action Plan (issued in 1998)
- National Environmental Strategy (issued in 2006)

In addition, the government of Turkey has been ratified international treaties and agreements in relation to environmental and social considerations which are listed below ;

- Convention for the Protection of world Cultural and Natural Heritage (ratified in 1983)
- Convention for the conservation of European Wildlife and Natural Habitats, Bern (ratified in 1984)
- Convention on Wetland of International Importance Especially as Waterfowl Habitat (ratified in 1994)
- Rio Declaration (retified in 1996)
- Convention on Biological Diversity (ratified in 1996)
- Convention on International Trade in Endangered Species of Wild fauna and Flora (ratified in 1996)
- European landscape Convention (ratified in 2001)

(2) Turkish Environmental Impact Assessment (EIA) System

1) Procedures of EIA

The foundation of the system of Environmental Impact Assessment in Turkey is Environmental law and Environmental Impact Assessment Regulation has been established based on the Environmental law. In the Environmental Impact Assessment Regulation, it is stipulated that all project carried out in the country requires to be authorized if implementation of EIA is necessary by Ministry of the Environment and Urban Planning.

This project falls under “8c) Construction of motorways expresses roads and public roads” in Annex I. Therefore, KGM is currently conducting EIA procedure.

EIA procedure in Turkey is based on Environmental Impact Assessment Regulation. Its flow is shown in Figure 3.9.14.

The period for EIA approval and acquisition of the project licenses in Turkey is up to approximately 21 months in total through the entire procedure. A breakdown is as follows; 45 days for permission of “the

approval application about EIA implementation" and "decision of EIA scoping", up to 18 months for "EIA report making" and 45 days for examination and permission of "EIA report" in the usual condition.

In this project, EIA has been conducted by KGM. The scope of EIA is the section of 325km between Kinali, Tekirdag, Canakkale and Savaştepe (Balikesir) including bridge section. In the process of EIA, the public hearing was held in May 2015. As of May 2016, through hearing it has confirmed that the EIA report has been submitted and it is in the stage of examination.

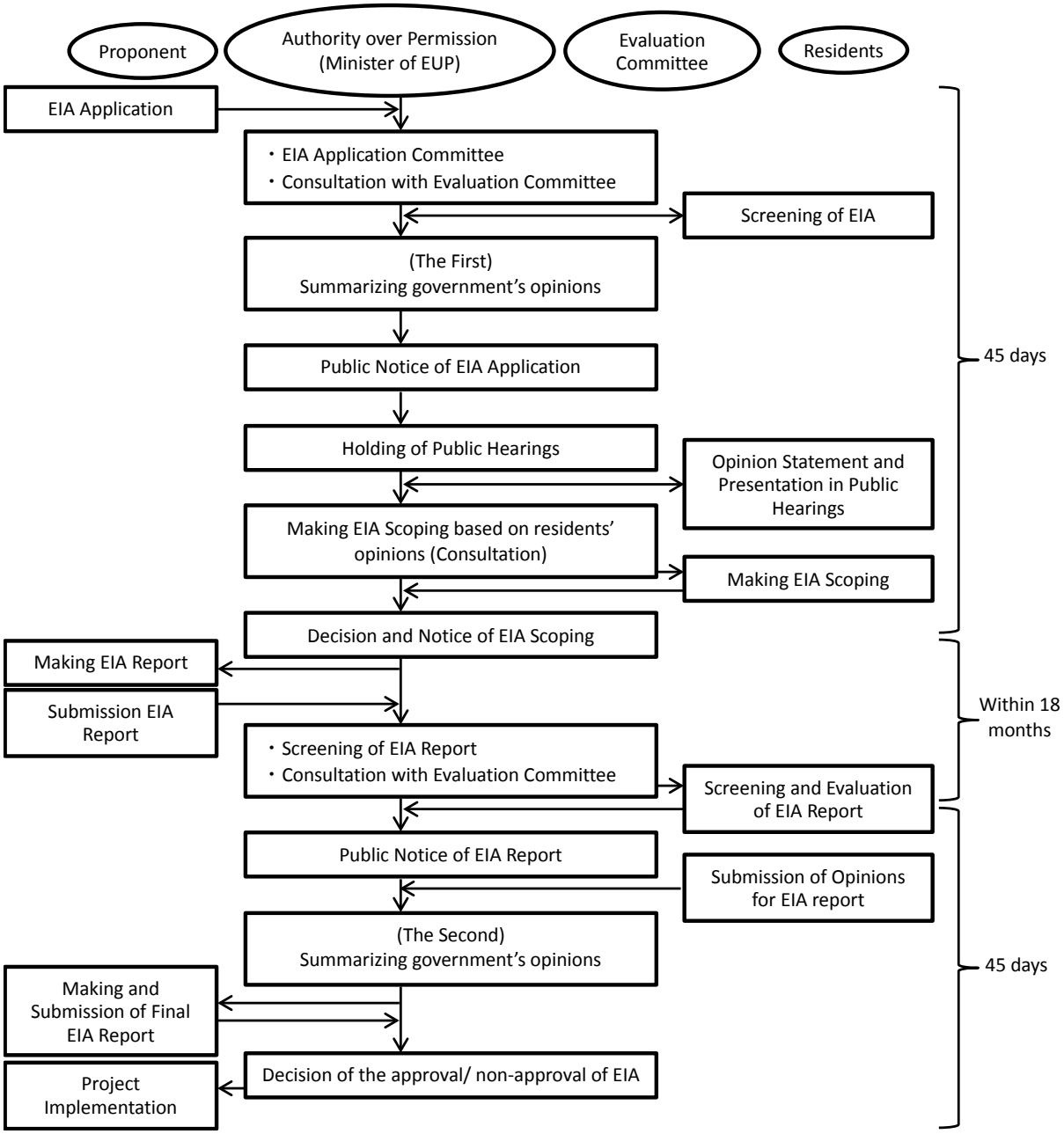


Figure 3.9.14 EIA procedure in Turkey

2) Resettlement and Land Acquisition System in Turkey

Major laws in Turkey regarding resettlement and land acquisition and their summary are shown below;

The Constitution (revised in 2001)

The Constitution protects public and private interests when land is expropriated in Turkey. In land acquisition for the purpose of the public interest, it is demanded that the organization concerned pays compensation equivalent to the asset values to be lost in advance of the project construction.

Public institutions are admitted to expropriate assets temporary/permanently for the purpose of the public interest after carrying out the compensation.

Expropriation Law (No. 2942) (enacted in 1983)

Expropriation Law regulates the proceedings to be carried out for the expropriation of the privately owned real estate by the State and public institutions. Specifically, the law prescribes calculation for the cost of expropriation, registration of the immovable property, return of the unused portion of the immovable property, transfer of the immovable propertied between the administrations, matters regarding reciprocal rights and liabilities, and the settlement procedures and methods of the disputes arising therefrom.

The administration carries out the acquisition procedure within six months after the decision for expropriation is taken. This procedure (negotiations about calculation of land prices and transfer of ownership, compensation payment to the owners, etc.) and preparation of land use must be completed before the construction is started. When there is a doubt in calculated land prices and acquisition itself, the procedure is suspended until the court judges it. A start of the project is enabled when all legal procedures are finished and payments of compensation ware completed. Incidentally, the section for land acquisition can be divided since the area of this project is large. However, the method of determining the plot is not described in the legislation in Turkey. A resettlement action plan (RAP) of other project in Turkey explains that the section for land acquisition is determined in consideration of the construction plan for each project.

Market interest rate is added to the compensation value. Ownerships are also accepted for the customary and traditional owner. The administration bears the costs required for the land acquisition and the compensation procedures.

Transit Law (No.4586), and Pasture Law (No.4342)

Transition Law regulates acquisition of the state-owned land. Unregistered land rights will transfer the rights after registered. Unregistered land and forest land under the management of the state and pastures defined in Pasture Law are registered based on requirements from the administration.

Communications Law (No.7201)

For land owner and private owner of real estate whose addresses are not identified, it is admitted that the

appropriate notification are carried out with information by official and private administrations and police authorities as needed. In addition, the notices with newspaper advertisements and posters are possible.

Resettlement Law (No.2510) (enacted in 1934)

Resettlement Law is prescribed about relocation that the state decided. The contents are the relocation of households who engage in agriculture in the area for rural areas and relocation of households who engage in work other than agriculture for urban areas. Resettled residents receive services free until it is possible for production activity in a new address. Specifically, means of transportation to the new address, lodging, meals, fuel, medical care and clothes for the poor (one-off) are provided. By the resettlement, residents are supplied assets instead of the things which they held conventionally such as land, houses, livestock, agricultural equipment, seeds and seedlings. Residents who lived in the land more than three years are possible to receive the same relocation procedures as landowners.

Although compensations are paid for all individuals having real estates, the government supports due to the relocation are provided for almost every household.

The procedure of land acquisition is shown in the following. Legal activities of land acquisition in the following are basically started around the timing of a bid after F/S was approved by High Planning Commission (HPC).

Procedure of Land Acquisition

(1) Application of the presence/absence of land acquisition to the relevant administration by the project proponent
(2) Collection of cadastral map from each local government and Identification for the land acquisition range and affected targets such as buildings by the project proponent
(3) Identification of owners of the affected land based on the cadastral map
(4) Decision of the start of the land acquisition (Ministry of Transportation MOT)
(5) Establishment of an evaluations committee of the land acquisition (members: from organizations concerned such as Ministry of Agriculture and the local governments)
(6) Investigation and Evaluation of land prices by the evaluation committee
(7) Explanation and Negotiation for the landowners

Gaps between JICA Guidelines for Environmental and Social Considerations and the legislation related resettlement and land acquisition are reviewed in Table 3.9.8.

Table 3.9.8 Comparisons between Laws in Turkey and JICA Guidelines (Draft)

No	JICA Guidelines	Laws and Guidelines in Turkey	Gap relative to JICA GL	Project Policy
1	Involuntary resettlement and loss of means of livelihood are to be avoided when feasible by exploring all viable alternatives.	Not applicable	There is no regulation which mentions or requests to avoid or minimize involuntary resettlement and loss of livelihood means.	The project examines alternatives to avoid or minimize resettlement impact.
2	When, population displacement is unavoidable, effective measures to minimize impact and to compensate for losses should be taken.	Not applicable	There is no regulation which mentions or requests to avoid or minimize involuntary resettlement and loss of livelihood means.	The project takes effective measures to minimize the impacts and to compensate for the loss.
3	People who must be resettled involuntarily and people whose means of livelihood will be hindered or lost must be sufficiently compensated and supported, so that they can improve or at least restore their standard of living, income opportunities and production levels to pre-project levels.	Not applicable	Settlement Law describes that the provision of services such as transportation to the resettlement site, accommodation, food, fuel and medical care is provided. More detail will be confirmed in the future survey.	The project considers the assistance to improve or restore the livelihood.
4	Compensation must be based on the full replacement cost as much as possible.	Cost of compensation will be decided by valuation commission. With regard to the cost of compensation for building, depreciation shall be deducted.	With regard to the cost of compensation, it is determined by the experts in the valuation commission considering the various elements. However, payment in replacement cost is not mentioned, therefore it is expected that cost for compensation will be lower than full replacement cost.	Replacement cost is adopted for compensation.
5	Compensation and other kinds of assistance must be provided prior to displacement.	Compensation must be paid in advance.	There is no significant difference.	Compensation and other kinds of assistance are provided prior to displacement.
6	For projects that entail large-scale involuntary resettlement, resettlement action plans must be prepared and made available to the public.	Not applicable	There is no regulation requesting to prepare resettlement action plan.	The project prepares resettlement action plan and make available to the public.
7	In preparing a resettlement action plan, consultations must be held with the affected people and their communities based on sufficient information made available to them in advance.	Not applicable	There is no regulation requesting to organize consultations with PAPs.	The project holds the consultations with the affected people and their communities on sufficient information made available to them in advance.
8	When consultations are held, explanations must be given in a form, manner, and language that are understandable to the affected people.	Not applicable	There is no regulation requesting to organize consultations with PAPs.	The project considers appropriate explanation when consultations are holds.

No	JICA Guidelines	Laws and Guidelines in Turkey	Gap relative to JICA GL	Project Policy
9	Appropriate participation of affected people must be promoted in planning, implementation, and monitoring of resettlement action plans.	Not applicable	There is no regulation requesting participation of PAPs into planning, implementation, and monitoring of resettlement action plans.	The project considers the appropriate participation of affected people.
10	Appropriate and accessible grievance mechanisms must be established for the affected people and their communities.	The agreement is not made, implementation agency apply for the Court for resolution.	There is no significant difference.	Appropriate grievant redress mechanism shall be established and implemented.
11	Affected people are to be identified and recorded as early as possible in order to establish their eligibility through an initial baseline survey (including population census that serves as an eligibility cut-off date, asset inventory, and socioeconomic survey), preferably at the project identification stage, to prevent a subsequent influx of encroachers of others who wish to take advance of such benefits.	The identification of affected people and survey on asset inventory etc. in the baseline survey will be done by implementation agency or designated experts.	Socioeconomic survey is not included in the baseline survey. In addition, there is no specific description of cut-off date.	The project identifies and records the affected people at the project identification stage. Baseline survey includes identification of affected people, cut-off date, asset inventory, and socioeconomic survey.
12	Eligibility of benefits includes, the PAPs who have formal legal rights to land (including customary and traditional land rights recognized under law), the PAPs who don't have formal legal rights to land at the time of census but have a claim to such land or assets and the PAPs who have no recognizable legal right to the land they are occupying.	PAPs who have formal legal rights are eligible for compensation. Although those are not legal title holder, customary owner and traditional owner are also entitled to some compensation.	Although those are not legal title holder, customary and traditional owner are also entitled to some compensation. In addition, it is mentioned that those who settled the affected location more than three years are eligible for compensation. Consequently, there is no difference expected. However, more detail confirmation is required.	The project considers eligibility for assistance to all households who lives in the area before cut-off date and whose income sources or assets are confirmed as affected due to project implementation. However, those who have previously received compensation for land and houses but sell or rent them, occupants of the land secured as a re-settlement and intruders are not subject to compensation.
13	Preference should be given to land-based resettlement strategies for displaced persons whose livelihoods are land-based.	Not applicable	In the settlement law, provisions of items required for livelihood such as sufficient land, farm animals, tools and instrument is mentioned. Therefore, further confirmation in the next stage is required.	The project considers the land-based resettlement strategies.
14	Provide support for the transition period (between displacement and livelihood restoration).	Not applicable	There is no regulation stipulating to provide support for the transition period.	The project considers the support for the transition period.
15	Particular attention must be paid to the needs of the vulnerable groups among those displaced, especially those below the poverty line, landless, elderly, women and children, ethnic minorities etc.	Not applicable	There is no regulation stipulating to provide particular attention to the vulnerable groups.	The project pays particular attention to vulnerable groups.

3.9.5 Analysis of Alternatives

(1) Alternative Analysis

With regard to alternative analysis, the alternative analysis on EIA should be reviewed in accordance with JICA Guidelines for Environmental and Social Considerations after disclosing of EIA by KGM.

(2) Impacts when the project is not carried out

Although relatively positive impacts on resettlement and land acquisition are expected when the project is not carried out, the following negative impacts will increase in the future. It is judged that the project is desirable to be carried out from the general standpoint.

Negative Impacts

In case of not implementing the project, it is expected that chronic traffic congestion in Istanbul become more serious because of not only increase in traffic demand with the progress of rapid economic growth of Turkey but also increase in inflow traffic from neighboring countries. Therefore great economic loss is assumed. In addition, further air pollution by increase in exhaust gas due to the congestion is concerned.

3.9.6 Impact Items (Draft Scoping)

(1) Draft Scoping

This draft scoping based on the environmental preliminary survey in 25-27 May 2015. The results of the scoping and the reason are shown in the following table. Impact items are created in consideration of JICA Guidelines for Environmental and Social Considerations since the EIA implemented in Turkey is not available.

Table 3.9.9 Scoping Matrix（Draft）

	No	Affected Activities / Impact Items (J ICA Guideline)	(Turkey Guideline) Unidentified as of May 2015	Rating for Pre/During Construction Phase	Pre/During Construction Phase: Land acquisition and Change of Land use plan, Control of various activities by regulations for the construction	Reclamation of Wetland, etc.	Deforestation	Alteration to ground by cut land, filling, drilling, etc.	Operation of Construction Equipment and Vehicles	Construction of Roads, tollgates, parking lots, Access roads for bridges and other related facilities	Traffic Restriction in construction area	Influx of construction workers, construction of base camp	Rating for Operation Phase	Operation Phase: Increase of through traffic and traveling speed	Appearance/occupancy of roads and related building structures including tunnel and embankment	Increasing influx of settlers
Pollution	1	Air Pollution		**B**	D	D	D	D	B	D	D	D	**B**	B	D	D
	2	Water Pollution		**B**	D	D	D	B	D	D	D	B	**D**	D	D	D
	3	Waste		**B**	D	D	B	B	D	D	D	B	**B**	D	B	D
	4	Soil contamination		**C**	D	D	D	C	D	D	D	D	**D**	D	D	D
	5	Noise and Vibration		**B**	D	D	D	D	B	D	D	D	**B**	B	D	D
	6	Ground Subsidence		**D**	D	D	D	D	D	D	D	D	**D**	D	D	D
	7	Odor		**D**	D	D	D	D	D	D	D	D	**D**	D	D	D
	8	Sediment quality		**D**	D	D	D	D	D	D	D	D	**D**	D	D	D
Natural Environment	9	Protected Area		**C**	D	C	C	C	C	C	D	D	**C**	C	D	D
	10	Ecosystem		**C**	D	C	C	C	C	C	D	D	**C**	C	D	D
	11	Hydrology		**B**	D	D	D	B	D	D	D	D	**B**	D	B	D
	12	Topography and geology		**B**	D	D	D	B	D	D	D	D	**B**	D	B	D
Social Environment	13	Involuntary resettlement and land acquisition		**C**	C	D	D	D	D	D	D	D	**D**	D	D	D
	14	The poor		**C**	C	D	D	D	D	D	D	D	**D**	D	D	D
	15	Indigenous and ethnic people		**C**	C	D	D	D	D	D	D	D	**D**	D	D	D
	16	Local economy such as employment and livelihood		**B**	B	D	D	D	D	D	D	D	**D**	D	D	D
	17	Land use and utilization of local resources		**B**	B	D	B	D	D	D	D	D	**B**	D	D	D
	18	Water Usage		**B**	D	D	D	B	D	D	D	D	**B**	D	B	B
	19	Existing social infrastructures and services		**C**	C	D	D	D	D	D	D	D	**D**	D	D	D
Social Environment	20	Social institutions such as local decision making institutions		**D**	D	D	D	D	D	D	D	D	**D**	D	D	D
	21	Misdistribution of benefit and damage		**C**	C	D	D	D	D	D	D	D	**C**	C	D	D
	22	Local conflict of interests		**B**	D	D	D	D	D	D	D	B	**D**	D	D	D
	23	Cultural Heritage		**C**	C	D	D	C	D	D	D	D	**D**	D	D	D
	24	Landscape		**D**	D	D	D	D	D	D	D	D	**C**	D	C	D
	25	Gender		**D**	D	D	D	D	D	D	D	D	**D**	D	D	D
	26	Right of Children		**C**	D	D	D	D	D	D	D	C	**D**	D	D	D
	27	Infectious diseases such as HIV/AIDS		**B**	D	D	D	D	D	D	D	B	**D**	D	D	D
	28	Labor environment (including work safety)		**C**	D	D	D	D	D	D	D	C	**D**	D	D	D

	No	Affected Activities / Impact Items (J ICA Guideline)	(Turkey Guideline) Unidentified as of May 2015	Rating for Pre/During Construction Phase	Pre/During Construction Phase: Land acquisition and Change of Land use plan, Control of various activities by regulations for the construction	Reclamation of Wetland, etc.	Deforestation	Alteration to ground by cut land, filling, drilling, etc.	Operation of Construction Equipment and Vehicles	Construction of Roads, tollgates, parking lots, Access roads for bridges and other related facilities	Traffic Restriction in construction area	Influx of construction workers, construction of base camp	Rating for Operation Phase	Operation Phase: Increase of through traffic and traveling speed	Appearance/occupancy of roads and related building structures including tunnel and embankment	Increasing influx of settlers
Other	29	Accidents		**B**	D	D	D	D	B	D	B	D	**B**	B	D	D
	30	Cross Boundary impacts and climate change		**B**	D	D	D	D	B	D	D	D	**D**	D	D	D

Note) Rating:

A: Serious impact is expected. B: Some impact is expected. C: Extent of impact is unknown (serious impact is not expected, but survey and analysis shall be done.) D: Few impacts are expected. Detailed quantitative survey is not necessary.

Source: JICA Survey

Table 3.9.10 Reasons for Scoping

Category	№	Impact Item (Items on Turkey guideline are unidentified as of May 2015)	Rating: Pre/During Construction	Rating: Operation Phase	Reasons of the Rating
Pollution	1	Air pollution	B	B	**During Construction:** Temporary negative impacts are expected due to machines and equipment for construction. **Operation phase:** Negative impact is expected due to traveling of vehicles on the new road.
	2	Water pollution	B	D	**During Construction:** Turbid water may be generated by earth works and excavation for such as bridge construction. Additionally Organic polluted water may be discharged from base camps. **Operation phase:** No serious impacts are expected.
	3	Waste	B	B	**During Construction:** Construction waste such as waste soil and cutting trees are expected. Additionally domestic waste and night soil may be generated from base camps. **Operation phase:** Domestic waste and night soil may be generated from the Service Area.
	4	Soil contamination	C	D	**During Construction:** It is necessary to confirm land use history of the modified area. **Operation phase:** No serious impacts are expected.
	5	Noise and vibration	B	B	**During Construction:** Noise generation is expected due to works of machines and equipment for construction. **Operation phase:** Noise generation is expected due to traveling of vehicles on the new road.
	6	Ground subsidence	D	D	No impacts are expected since activities which cause ground subsidence are not expected and there is no soft ground.
	7	Odor	D	D	No impacts are expected since activities which cause odor are not expected.
	8	Sediment quality	C	D	**During Construction:** It is necessary to confirm the land use history of the modified area. **Operation phase:** No serious impacts are expected.

Category	№	Impact Item (Items on Turkey guideline are unidentified as of May 2015)	Rating		Reasons of the Rating
			Pre/During Construction	Operation Phase	
Natural environment	9	Protected area	C	C	**During Construction and Operation phase:** No serious impacts are expected because the alignment is planning to avoid the protected areas based on the existing documents. However, it is necessary to confirm the presence/absence of impacts by the future survey.
	10	Ecosystem	C	C	**During Construction and Operation phase:** Although any designated protected areas and considerable species habitats have not been identified in the project area, impacts will be assessed based on the future survey. Especially impacts for fishes and benthos in the water where bridge piers are constructed should be surveyed and analyzed.
	11	Hydrology	B	B	**During Construction and Operation phase:** Construction of bridges may change hydrological situation of rivers.
	12	Topography and geology	B	B	**During Construction and Operation phase:** Considerable topography and geological sites are not located in the project area. Alteration to ground by cut land and filling may provoke landslide.
Social environment	13	Involuntary resettlement and land acquisition	C	D	The concrete number of resettlers is unidentified at the present phase. Although few impacts are expected, the impacts will be assessed based on the future survey by the government of Turkey. **Operation phase:** No serious impacts are expected.
	14	The poor	C	D	**Pre-Construction and During Construction:** Impacts are unknown at the present phase. Impacts will be assessed based on the survey in conjunction with resettlement. **Operation phase:** No serious impacts are expected.
	15	Indigenous and ethnic people	C	D	**Pre-Construction and During Construction:** Locations of indigenous and ethnic people are unknown at the present phase. Impacts will be assessed based on the future survey. **Operation phase:** No serious impacts are expected.
	16	Local economy such as employment and livelihood	B	D	**Pre-Construction and During Construction:** Livelihood of residents and farmers may be affected. Impacts will be assessed based on the survey in conjunction with resettlement. **Operation phase:** No serious impacts are expected.
	17	Land use and utilization of local resources	B	B	**Pre-Construction and During Construction:** Impacts are expected since the alignment is mainly passing through agricultural areas to cultivate wheat. **Operation phase:** The road side may be developed disorderly as commercial and industrial areas. Impacts on the appropriate land use and farmland are expected.
	18	Water usage	B	B	**During Construction:** Impacts on spring water and well water around the construction site are expected since alteration to ground by cut land and drilling will have impacts on aquifer. **Operation phase:** Tunnel may give impact to surrounding wells.
	19	Existing social infrastructures and services	C	D	**Pre-Construction and During Construction:** Some schools or meeting places may be affected by land acquisition. Impacts will be assessed based on the survey in conjunction with resettlement. **Operation phase:** No impacts are expected.
	20	Social institutions such as local decision making institutions	D	D	Road construction and relevant activities do not give adverse impacts on social institutions.

Category	№	Impact Item (Items on Turkey guideline are unidentified as of May 2015)	Rating		Reasons of the Rating
			Pre/During Construction	Operation Phase	
Social environment	21	Misdistribution of benefit and damage	C	C	**Pre-Construction and During Construction:** Land acquisition may give adverse impacts on misdistribution of benefit and damage **Operation phase:** Relevant employees and workers may lose their job and working opportunities after construction of the Dardanelles bridge.
	22	Local conflict of interests	B	D	**During Construction:** Local inhabitants and local authorities may request to ensure job opportunities as construction workers. **Operation phase:** No impacts are expected.
	23	Cultural heritage	C	D	**Pre-Construction and During Construction:** Impacts on cultural heritage and monuments may be expected. Impacts will be assessed based on the survey in conjunction with resettlement. **Operation phase:** No impacts are expected.
	24	Landscape	D	C	**During Construction:** No impacts are expected. **Operation phase:** Landscape from recreation sites such as cultural heritages and natural parks may change.
	25	Gender	D	D	The activities in this road project do not give adverse impacts in terms of gender due to local culture and behaviors.
	26	Right of children	C	D	**During Construction:**Child labor is not observed in the construction site during environmental reconnaissance. Thus it is not likely to give few impacts. But the status needs to be confirmed in the future. **Operation phase:** No impacts are expected.
	27	Infectious diseases such as HIV/AIDS	B	D	**During Construction:** Infectious diseases are possible to be spread due to inflow of construction workers. **Operation phase:** No impacts are expected.
	28	Labor environment	C	D	**During Construction:** Although relevant labor laws and regulations in Turkey are applicable for the project, other cases should be confirmed. **Operation phase:** No impacts are expected.
Others	29	Accidents	B	B	**During Construction:** The number of traffic accident may increase due to traveling of construction vehicles. **Operation phase:** Risks of traffic accidents on the new road are expected.
	30	Cross boundary impacts and climate change	B	D	**During Construction:** Although significant deforestation is not expected on this project, greenhouse gas will generated by construction of the road. **Operation phase:** Although greenhouse gas will increase at an area where the new road is constructed, greenhouse gas is controlled in the whole survey area by the improvement of traffic congestion. Thus few impacts are expected.

Note) Rating:

A: Serious impact is expected. B: Some impact is expected. C: Extent of impact is unknown (serious impact is not expected, but survey and analysis shall be done.) D: Few impacts are expected. Detailed quantitative survey is not necessary.

Source: JICA Survey

3.9.7 TOR of EIA Studies

(1) Study Area

The study area is a section where new motor way will be constructed. The motor way starts from Kinali, which is European side of Istanbul, via Dardanelles straits-bridge (west north of Canakkale city) through Tekirdag province, and reaches to Savastepe city of Balikesir province.

(2) Survey and Analysis Components

TOR of the EIA studies is decided according to a scoping result by Ministry of Environment and Urban Planning. Although it seems that there is not the big difference with JICA Guidelines for Environmental and Social Considerations, the following field surveys and quantitative analysis are necessary to be conducted.

Table 3.9.11 Analysis Components and Investigation Methods

Category	№	Impacted Item (Items on Turkey guideline are Unidentified as of May 2015)	Rating		Analysis Methodology	
			Pre/During construction	Operation Phase	Baseline Survey	Forecast Analysis
Pollution	1	Air Pollution	B	B	- Site measurement CO, CO_2, NO_2, SO_2, TPM - Literature survey	**During Construction:** Quantitative analysis **Operation Phase:** Quantitative analysis or Comparison analysis with other cases
	2	Water pollution	B	D	- Site measurement River (in fine and wet weather) Groundwater - Items: BOD, pH, SS, temperature - Literature survey	**During Construction:** Quantitative analysis or Comparison analysis with other cases
	3	Waste	B	B	- Review based on design, construction plan and multiplication documents	**During Construction:** Quantitative analysis of volume of cutting trees, excavated or drilling soil and muck
	4	Soil contamination	C	D	- Review based on design, construction plan and multiplication documents - Literature survey (confirmation of land use history)	**During Construction:** Quantitative analysis of volume of muck
	5	Noise and Vibration	B	B	Noise - Site measurement $L_{Aeq, 10min}$ 24hr/weekday, traffic volume and speed - Literature survey	**During Construction:** Quantitative analysis based on construction machines on standard formation. **Operation Phase:** Quantitative analysis by Japanese model or Comparison analysis with other cases
	8	Bottom Sedimentation	C	D	- Literature survey (confirm of land use history)	**During Construction:** Qualitative analysis based on the literature survey

Category	№	Impacted Item (Items on Turkey guideline are Unidentified as of May 2015)	Rating		Analysis Methodology	
			Pre/During construction	Operation Phase	Baseline Survey	Forecast Analysis
Natural Environment	9	Protected Area	C	C	Literature survey (location of protected area)	**During Construction and Operation Phase:** Qualitative analysis based on the literature survey
	10	Ecosystem	C	C	Literature survey (vegetation, fauna and flora, considerable species list)	**During Construction and Operation Phase:** Qualitative analysis based on the literature survey, construction plan and traffic volume in the future
	11	Hydrology	B	B	Literature survey and hydrographic survey	**During Construction and Operation Phase:** Quantitative analysis base on the hydrographic analysis
	12	Topography and geology	B	B	Literature survey and topographic survey	**During Construction and Operation Phase:** Quantitative analysis by slope stability calculation
Social Environment	13	Involuntary resettlement and land acquisition	C	D	Literature survey and a series of RAP surveys (Inventory of loss assets, census, social economic survey and replacement cost study: refer to Table 3.9.14)	**During Construction:** Quantitative analysis based on RAP surveys
	14	The poor	C	D	Literature survey and a series of RAP surveys	**During Construction:** Quantitative analysis based on RAP surveys
	15	Indigenous and ethnic people	C	D	Literature survey and a series of RAP surveys	**During Construction:** Quantitative analysis based on RAP surveys
	16	Local economy such as employment and livelihood	B	D	Literature survey and a series of RAP surveys	**During Construction:** Quantitative analysis based on RAP surveys
	17	Land use and utilization of local resources	B	B	Literature survey and a series of RAP surveys	**During Construction:** Quantitative analysis based on RAP surveys
	18	Waste Usage	B	B	Literature survey and water usage survey based on construction plan and geological survey (identification of springs and wells around tunnel and cutting land areas)	**During Construction and Operation Phase:** Qualitative analysis base on construction plan and the baseline survey
	19	Existing social infrastructures and services	C	D	Literature survey and a series of RAP surveys	**During Construction:** Quantitative analysis based on RAP surveys
	21	Misdistribution of benefit and damage	C	C	A series of RAP survey and collection of information and opinions in stakeholder meeting(s)	**During Construction:** Qualitative analysis
	22	Local conflict of interests	B	D	A series of RAP survey and collection of information and opinions in stakeholder meeting(s)	**During Construction:** Qualitative analysis
	23	Cultural Heritage	C	D	A series of RAP survey and collection of local information through stakeholder meeting(s)	**During Construction:** Quantitative analysis based on RAP surveys
	24	Landscape	D	C	Literature survey and site survey (Confirmation of landscape at recreation sites and parks near project area)	**Operation Phase:** Qualitative analysis and /or preparation of photo montage

Category	№	Impacted Item (Items on Turkey guideline are Unidentified as of May 2015)	Rating		Analysis Methodology	
			Pre/During construction	Operation Phase	Baseline Survey	Forecast Analysis
Social Environment	27	Infectious diseases such as HIV/AIDS	B	D	Literature survey and collection of local information through stakeholder meeting(s) regarding infection disease such as HIV/AIDS	**During Construction:** Qualitative analysis
	28	Labor environment	C	D	Confirmation of relevant labor laws and regulations in Turkey and current status	**During Construction:** Qualitative analysis
Others	29	Accidents	B	B	Collection of traffic accident data	**During Construction and Operation Phase:** Qualitative analysis
	30	Cross Boundary impacts and climate change	C	C	Identification of kinds of trees by Satellite photograph and a series of RAP surveys	**During Construction and Operation Phase:** Quantitative analysis by estimation of generated greenhouse gas (CO_2) from traffic

Note) Rating:

A: Serious impact is expected. B: Some impact is expected. C: Extent of impact is unknown (serious impact is not expected, but survey and analysis shall be done.) D: Few impacts are expected. Detailed quantitative survey is not necessary.

In areas targeted the EIA studies, surveys for RAP making are implemented. Items of the field surveys are shown in the following table.

Table 3.9.12 TOR of Resettlement Action Plan(RAP) survey

Item	Summary
1. population census	- As for all owner of land in the project area, to identify the number of people who will receive compensation of each category. - To identify the number of socially vulnerable groups who need special supports (the poor, people who do not own the land, the elderly people, people with disabilities, women, children, indigenous and ethnic people, and others who are not protected on the basis of domestic laws.)
2. Property and land survey	- To identify all of the assets which will relocate physically or economically and the quantity (land, residence, shops, public institution, trees and so on.) - Land: To identify the scale (area) of land acquisition, current owner and current land use (agricultural, residential, commercial, vacant, etc.) - Residence and Shops: After clarifying the legal/illegal, to identify the number of affected buildings and the number of residents, respectively. - To identify loss assets that are assumed in addition to and loss assets involved in livelihood (farmland, products before the harvest, etc.)
3. Household and life survey	- To identify standard features of the households who receive compensation, basic information about the livelihood, etc. (production system, work, household composition, income obtained from formal/informal economic activity, living standards, social and cultural features, etc.)

Preparation of RAP in accordance with JICA Guidelines for Environmental and Social Considerations 2010 and World Bank Guidelines OP4.12 is required based on data obtained from the field surveys.

(3) Environmental Mitigation Measures (Draft)

As a result of the scoping at the present phase, the following environmental mitigation measures are expected.

Table 3.9.13 Summary of Analysis Components and Mitigation Measures (Draft)

Category	№	Item (Items on Turkey guideline are Unidentified as of May 2015)	Rating on the Scoping		Mitigation Measures (Draft)	
			Pre/ During Construction	Operation Phase	Pre/ During Construction	Operation Phase
Pollution	1	Air pollution	B	B	- Dust Water sprinkling near residential area.	Secure sufficient distance from boundary of the road to residential area after construction of the road on land use plan along the road.
	2	Water pollution	B	D	- Turbid water Installation of sedimentation ponds	-
	3	Waste	B	B	- Construction waste (trees and waste soil) After considering the possibility of reuse, construction waste is disposed at designated disposal site - Muck soil from tunnel section Reuse or disposed at designated disposal site after treatment - Garbage from base camp Garbage at workers camp and waste oil shall be properly treated and disposed. - Night soil Temporary sanitation facility such as septic tank shall be introduced to the workers camp.	Generated waste and night soil at SA (Service Area) shall be properly treated and disposed.
	4	Soil contamination	C	D	If the soil contamination is observed, it shall be appropriately treated and disposed.	-
	5	Noise and Vibration	B	B	- Construction noise near residential area Installing noise barrier and selecting low-noise equipment. - Avoiding works of heavy equipment during night time. - Informing the construction schedule to surrounding communities to obtain their consensus.	- Traffic noise Secure sufficient distance from boundary of the road to residential area after construction of the road on land use plan along the road
	8	Sediment quality	C	D	If the soil contamination is observed, it shall be appropriately treated and disposed.	-
Natural Environment	9	Protected Area	C	C	Consideration of the alignment	-
	10	Ecosystem	C	C	Planting trees as a compensation measure of cutting trees	Appropriate land use management along the road
	11	Hydrology	B	B	Designing of bridges with sufficient capacity	-
	12	Topography and geology	B	B	Installation of slope protection measures	-
Social Environment	13	Involuntary resettlement and land acquisition	C	D	Appropriate compensation and social assistance in accordance with RAP	-
	14	The poor	C	D	Appropriate compensation and social assistance in accordance with RAP	-

Category	№	Item (Items on Turkey guideline are Unidentified as of May 2015)	Rating on the Scoping		Mitigation Measures (Draft)	
			Pre/ During Construction	Operation Phase	Pre/ During Construction	Operation Phase
Social Environment	15	Indigenous and ethnic people	C	D	Appropriate compensation and social assistance in accordance with RAP	-
	16	Local economy such as employment and livelihood	B	D	Appropriate compensation and social assistance in accordance with RAP	-
	17	Land use and utilization of local resources	B	B	Appropriate compensation and social assistance in accordance with RAP	Management of appropriate land use
	18	Water usage	B	D	Installation of alternative water distribution system when unexpected situation such as reduction of spring water and water level of wells	-
	19	Existing social infrastructures and services	C	D	Appropriate compensation and social assistance in accordance with RAP	-
	21	Misdistribution of benefit and damage	C	C	Appropriate compensation and social assistance in accordance with RAP	
	22	Local conflict of interests	B	D	Local workforce is prioritized for construction of the road.	-
	23	Cultural Heritage	C	D	Appropriate compensation and social assistance in accordance with RAP	-
	24	Landscape	D	C	-	Adoption of earth color not to affect surrounding landscape
	27	Infectious diseases such as HIV/AIDS	B	D	In order to prevent spread of infectious diseases, enlightenment activities for construction workers and local residents are carried out.	-
	28	Labor Environment	C	D	Compliance with relevant labor laws and regulations in Turkey	
Others	29	Accidents	B	B	- Controlling entry to construction area. - Deploying flagman at the gate and crossing points of the construction vehicles. - Installing fence around the construction site to keep out local people. - Restricting mobilization speed in the construction site. - Safety training for the workers - Safety patrol at the construction site. - Monthly safety meeting	- Installation of sign board for speed limit. - Enforcement of traffic controls
	30	Cross Boundary impacts and climate change	B	D	Replanting natural native trees and other agricultural trees such as coconuts	-

Note) Rating:

A: Serious impact is expected. B: Some impact is expected. C: Extent of impact is unknown (serious impact is not expected, but survey and analysis shall be done.) D: Few impacts are expected. Detailed quantitative survey is not necessary.

-: Not required

Source: JICA Survey

(4) Environmental Management Plan

In an environmental management plan, mitigation measures based on the baseline surveys, the forecasts and the assessments are suggested. An environmental monitoring plan is planned along the environmental management plan. The schedule (include the period, the frequency, etc.), the costs and the implementation system (responsible person) are included in the mitigation measures and the environmental monitoring plan.

(5) Making Schedule of EIA and RAP

According to Turkish government, approval of the EIA is expected to be obtained from Ministry of Environment and Urban Planning (MOEUP) during 2015-2016. After that, the bid of BOT project proponents is going to be carried out. This project is expected to be completed in 2023.

The current status on EIA process and expected activities to be conducted by the JICA Study Team is shown in Figure 3.9.15.

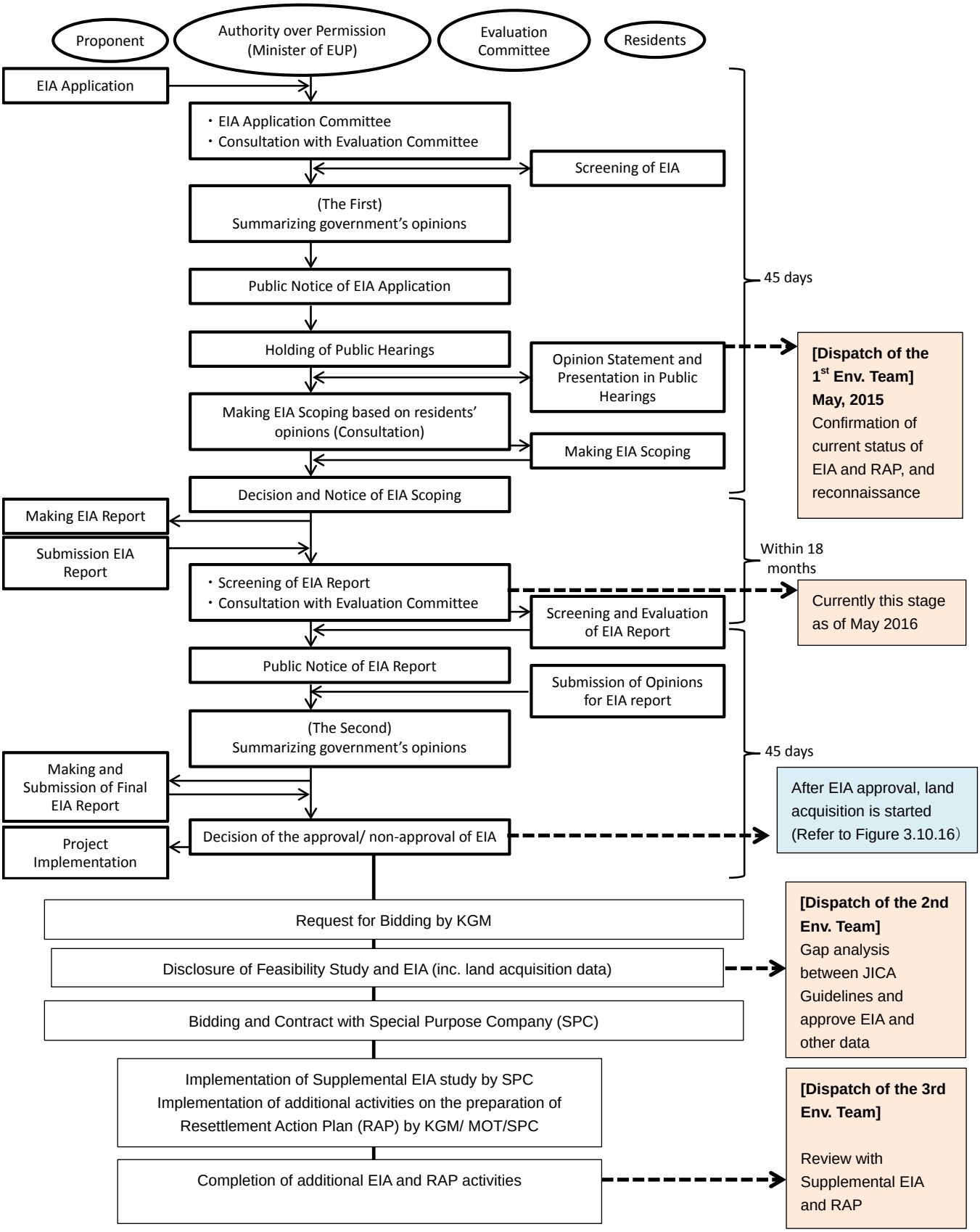


Figure 3.9.15 EIA procedure in Turkey

(6) Public Hearing under Turkey EIA Process

During the survey, a public hearing has been held once. The holding of the meeting was publicized 2 weeks before the date of the meeting. The summary of the meeting is shown in the following table.

Table 3.9.14 Summary of the Stakeholder Meetings within the Survey

Date	Place	Object	Content	Main Participant
26th-29th May, 2015	5 places (Istanbul, Tekirdag, Canakkale, Balikesir)	Explanation of the project summary and Announcement about the implementation of EIA	Explanation of the project summary and Questions and Answers	• Section in charge , city of Tekirdag, • Ministry of the Environment, • KGM

Source: JICA Survey Team

Table 3.9.15 Major Questions and Answers on the Meeting in Tekirdag

No	Questioner	Questions	Answers
1	Citizen	There is a main road in neighborhood. Why is new highway necessary?	In the traffic demand forecasting, traffic congestion will be generated in the existing main road and economical losses will produce in the future. The new road is necessary from the viewpoint of accident prevention.
2	Citizen	During construction, will dust come flying from the construction site and may the dust influence vegetables around the site?	This proposal is BOT project. In such a case, a project proponent pays compensation depending on an objection.
3	Citizen	What are mitigation measures of impacts by cutting down trees?	In the forest-related laws, planting ten trees is necessary when they fell one tree. Such measures will mitigate the impacts.

Source: JICA Survey Team

Although local stakeholder meetings on the law about EIA will not be held, the meetings for project affected people on resettlement and land acquisition will be held. In future when the surveys for land acquisition procedure are carried out and land owners are identified, the information of the compensation policy is planned to be disclosed.

(7) Necessary Study for Environmental and Social Considerations based on JICA Guideline

The study for Environmental and social considerations in this preparatory survey was planned to conduct review and gap analysis of approved EIA and SIA prepared by Turkey, to implement supplemental survey to fill the gap by the fund of SPC and to finalize the result. However, the EIA and SIA was not disclosed during the preparatory survey, the following supplemental survey needs to be conducted when the utilization of JICA fund is considered.

- Review and gap analysis of JICA guideline and approved EIA (including alternative analysis)/SIA
- Analysis and survey to fill the recognized gaps

The followings are the expected gaps at this moment.

- Quantitative forecast of EIA items such as air quality, noise, vibration, water quality etc.
- Series of survey on land acquisition and resettlement and consideration of compensation policy

4. Conclusion and Recommendation

4.1 Conclusion

This survey is carried out in order to verify the feasibility of the project of Dardanelles strait crossing bridge and Kinali~Canakkale motorway under application of private sector investment, by implementing the design of bridges and road section, traffic demand forecast of the project area, financial structure analysis, risk analysis, and the study of technical, environmental and social considerations, with the aim to propose the optimal BOT scheme.

The results obtained from the study of the technical and investment aspects are shown as follows.

Traffic Demand Forecast

(Undisclosed)

Road design and cost estimation

The preliminary design of the target motorway has been completed by KGM. However, the F/S report done by KGM is not available. Therefore, the JICA Survey basically reviewed the designated corridor which is disclosed to public. Based on the examination of design standard in Turkey and the disclosed route map at public hearing, validity of the KGM motorway design was confirmed in F/S level. Target motorway length is approx. 188 km (including Strait Bridge of 4 km in length). Major facilities are 7,900 m total length of bridges, 2,000 m total length of tunnel, 15 interchanges and 7 service areas.

Based on the above design, the project cost of motorway section excluding the Strait Bridge of 4 km in length is estimated at approximately USD 1,786,666,000 (approximately 214 billion JPY) including construction cost, engineering cost, administration cost, interest and escalation.

Bridge across the Strait

The study confirms that the bridge crossing the Dardanelles strait is feasible from the technical point of view. The suspension bridge is considered appropriate as the optimal solution mainly considering the span length, water depth, navigation clearance, impact on environment and frequent vessel traffic.

The geophysical and geotechnical studies reveal that the water depths along the proposed bridge location are approximately 40m at the tower foundation and 90m at the deepest (mostly centre). The possible bed rock can be seen in 30-50m depth, however the liquefiable soil with 20-30m thickness exists at the European anchorage area and the similar condition is expected at the tower foundations. In addition to the typical issues for the design and the construction of suspension bridge in Turkey, i.e. aerodynamic stability and seismic design, the soil improvement and foundation design will also be one of the governing parameters.

Though the detailed investigation is required to have much clear conclusion for the schedule and the cost, the initial study based on the past study and the available information so far estimates 2.5 billion USD of construction cost and 7 years of the construction period including the design, respectively.

O&M Plan and Organization Framework

The plan of O&M suggested in this study is based on the O&M Manual regulated by KGM. Regarding the items which are not specified in KGM O&M manual, this study is made with reference to the manual of Japanese Expressway Company.

As for Organization Framework of O&M in this study, the operation center and, the operation and maintenance offices shall be established. The operation center manages 2 operation and maintenance offices and the traffic control center.

O&M Cost

Based on the past achievements for maintenance works done by KGM, regular maintenance costs are estimated at 81,593 USD/km for motorway and 6,620,667 USD for the Strait Bridge (cost in Year 2016 with assumed escalation). A large-scale maintenance cost for motorway including regular maintenance is estimated at 221,081 USD/km, based on the assumption that overlay works will be conducted from 16th to 20th years after service. The periodic maintenance costs for the Strait Bridge including regular maintenance are estimated at 18,120,667 USD every 3 years as a middle-scale maintenance and 24,620,667 USD every 15 years as a large-scale maintenance in reference with the other large-scale bridges (cost in Year 2016 with assumed escalation).

Environmental and Social Considerations

For this project, the EIA has been conducted by Turkey, but the approval has not been obtained. In addition, implementation of Social Impact Assessment (SIA) is not stipulated in relevant laws in Turkey, thus the SIA has not been implemented.

4.2 Recommendation

Traffic Demand Forecast

(Undisclosed)

Road design and cost estimation

With regard to the road design for this project, preliminary motorway design conducted by KGM shall be obtained and the contents shall be reviewed in detail. In the detailed design, motorway alignment and structural type needs to be reconsidered in accordance with the result of detailed topographical, geological and hydrological survey. To apply motorway alignment in consideration with soil volume balance, transport cost from the borrow pit or to the disposal site and its land also can be minimized. Consequently, the construction cost can be reduced.

Bridge across the Strait

To evaluate the construction period of the bridge across the Dardanelles strait as much as precise is one of the most important issues for this BOT project and only the way to minimize the risk of overestimation/underestimation. Because of the liquefiable soil with 20-30m thick at European anchorage and mostly at the tower foundation locations, the soil improvement at those locations will be required. The impact of those structures including the soil improvement shall be carefully taken into consideration in the schedule and the cost evaluations.

O&M Plan and Organization Framework

Regarding the toll collection method, because the law which is applied to the KGM is different from that of BOT operator, it is found that automatic/unmanned collection which is commonly adapted in Turkey is difficult.

However, from the point of view of safety and economic effect, automatic/unmanned collection is quite effective. Therefore consideration including the fact of other BOT project must be given to decide the toll collection method.

O&M Cost

For this survey, the maintenance costs were estimated in reference with past achievements by KGM. However, based on the quantities calculated by design of facilities and systems of operation and maintenance in the detailed design stage, the maintenance cost should be estimated.

Environmental and Social considerations

In case of considering the investment and loans from international donors as the implementation of the project, conducting of EIA and SIA at international standards and obtaining approval should be considered.

Appendices

Appendix 1 Borehole Logs

Fugro Onshore Geotechnical Logs Legend:

ID Tests / Unit weight

- Unit weight derived from water content
- Unit weight derived from volume mass calculation
- Water content
- Water content derived from test on remoulded soil
- Plastic limit
- Liquid limit
- PI — Plasticity index (= displayed as number above connection line)
- Percentage fines
- Carbonate content
- Organic content
- Relative density derived from CPT

Coring rate / Recovery / RQD / Blow count

- Coring rate
- Recovery
- RQD

Undrained shear strength / UCS / Fracture densitiy

- Pocket penetrometer
- Torvane
- Fallcone
- Laboratory vane
- UU-triaxial
- CU-triaxial
- Direct simple shear
- In-situ vane shear test
- Undrained shear strength derived from CPT
- Slashed symbol refers to test on remoulded soil
- Unconfined compressive strength derived from point load test
- Unconfined compressive strength
- Fracture density

Cone resistance / Sleeve friction

- Cone resistance
- Sleeve friction

Friction ratio / Porewater pressure

- Friction ratio

PS-wave velocity

- P-wave velocity
- S-wave velocity

Caliper

- Caliper

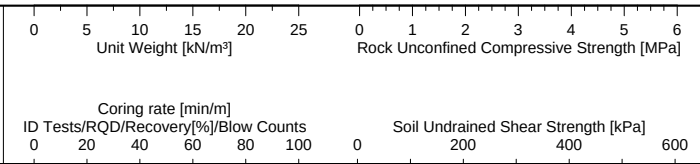
- Lean CLAY
- Fat CLAY
- SILT
- Elastic SILT
- SAND
- GRAVEL
- CLAYSTONE
- SILTSTONE
- SANDSTONE
- SHEAR ZONE
- CONGLOMERATE
- MUDSTONE
- LIMESTONE
- LIMESTONE, dolomitic
- PEAT
- DEBRIS
- Shell DEBRIS
- SHALE
- MADE GROUND

- CPT — Cone Penetration Test
- LS — Liner Sample
- PUS — Push Sample
- CR — Rock Core
- SPT — Standard Penetration Test
- Groundwater level

PROJECT NO:	P2015.0028	**START DATE:**	10/02/2015	**DRILLING COMPANY:**	Fugro
BORING:	AAN-1	**COMPLETION DATE:**	10/05/2015	**DRILLING METHOD:**	Rotary borehole drilling, sampling and testing

Coordinates: E471140.0 N4464476.0
UTM Zone 35N, WGS 84, Meters
Elevation: +1.00 m

Elevation [m]	Depth [m]	Soil / Rock Type	Sampler / Name	Blow Count	Material description	Stratum
0	0		SPT1	2/3/3	0.0 m to 0.1 m - MADE GROUND 0.1 m to 0.4 m - Medium SAND (SP), loose, pale brown, calcareous silica - with roots and rootlets	
			PUS1		0.4 m to 1.2 m - Sandy Fat CLAY (CH), soft, olive grey, calcareous - with traces of shell fragments - with roots and rootlets - clay with sand to 0.7 m	
0			SPT2	2/5/8		
			CR1		1.2 m to 2.3 m - Fine to Medium SAND with clay (SP-SC), greenish grey, calcareous silica - with few shell fragments - with roots and rootlets - with gravel below 2.2 m	
2			SPT3	1/1/3	2.3 m to 3.9 m - Silty Fine SAND (SM), very loose, dark greenish grey, silica - with roots and rootlets	
			CR2			
-2			SPT4	1/1/2	- with many shells and shell fragments below 3.8 m	
4			PUS2		3.9 m to 6.0 m - Fat CLAY (CH), hard, dark greenish grey, calcareous - with few shells and shell fragments	
			PUS3			
-4			CR3			
			PUS4			
6			CR4		6.0 m to 10.6 m - Fat CLAY (CH), very hard, dark greenish grey, laminated	
			SPT5	8/13/16		
-6			CR5			
8			PUS5			
			CR6		- with 45° laminations, 8.3 m to 8.5 m	
			PUS6			
-8			CR7		- with sand lenses below 9.4 m	
10			PUS7		- calcareous below 10.1 m	
			CR8		10.6 m to 11.1 m - Fat CLAY (CH), very hard, greenish grey, calcareous, carbonate, moderately cemented - with few shells and shell fragments - 30°, undulating, smooth, contact at 10.6 m	
-10			CR9		11.1 m to 11.9 m - Fat CLAY (CH), hard, dark greenish grey - fine sand with 30° laminations, 11.5 m to 11.6 m - with few carbonate concretion at 11.7 m	
12			PUS8		11.9 m to 13.8 m - Fat CLAY (CH), hard, reddish brown, light olive brown - with traces of organic matter	
			PUS9			
-12			CR10		13.8 m to 15.4 m - Fat CLAY (CH), hard, dark greenish grey, calcareous	
14			PUS10			
-14			SPT6	10/23/29	15.4 m to 17.6 m - Clayey Fine SAND (SC), very dense, dark greenish grey, calcareous silica	
16			CR11			



GEOTECHNICAL LOG

LOCATION AAN-1

P2015.0028

PROJECT NO:	P2015.0028	**START DATE:**	10/02/2015	**DRILLING COMPANY:**	Fugro
BORING:	AAN-1	**COMPLETION DATE:**	10/05/2015	**DRILLING METHOD:**	Rotary borehole drilling, sampling and testing

Coordinates: E471140.0 N4464476.0
UTM Zone 35N, WGS 84, Meters
Elevation: +1.00 m

Elevation [m] / Depth [m]	Soil / Rock Type	Sampler / Name	Blow Count	Material description	Stratum
16 / 15		SPT7	13/26/28	15.4 m to 17.6 m - Clayey Fine SAND (SC), very dense, dark greenish grey, calcareous silica	
-16 / 17		CR12		- with few gravel below 17.3 m	
18 / 18		PUS11		17.6 m to 22.0 m - Fat CLAY (CH), hard, greenish black - very dark greenish grey to 17.7 m	
				- with traces of organic matter at 18.6 m	
-18 / 19		CR13		- clayey fine sand, 19.3 m to 19.4 m	
20 / 20		CR14			
				- clayey fine sand with subvertical laminations, 20.5 m to 20.7 m - calcareous below 20.7 m - dark greenish grey below 20.7 m	
-20 / 21		PUS12			
22 / 22		CR15		- well cemented with shells and shell fragments below 21.9 m	
		CR16		22.0 m to 24.8 m - Sandy Fat CLAY (CH), hard, greenish grey	
-22 / 23		PUS13			
24 / 24		CR17			
		CR18			
-24 / 25		PUS14		24.8 m to 29.5 m - Fat CLAY (CH), hard, greenish grey, fissured - with traces of sand to gravel size carbonate concretions	
26 / 26		CR19			
		PUS15			
-26 / 27		CR20			
28 / 28		PUS16		- very hard below 27.8 m	
		CR21			
-28 / 29		PUS17			
30 / 30		CR22		29.5 m to 30.6 m - Fat CLAY (CH), hard, very dark grey - with organic matter	
				30.6 m to 33.8 m - Fat CLAY (CH), hard, greenish grey, fissured - with traces of carbonate concretions	
-30 / 31		CR23			
32 / 32				- with cemented clay nodules, 31.7 m to 31.9 m	

Unit Weight [kN/m³]: 0 5 10 15 20 25
Rock Unconfined Compressive Strength [MPa]: 0 1 2 3 4 5 6
Coring rate [min/m]
ID Tests/RQD/Recovery[%]/Blow Counts: 0 20 40 60 80 100
Soil Undrained Shear Strength [kPa]: 0 200 400 600

GEOTECHNICAL LOG

LOCATION AAN-1

P2015.0028

PROJECT NO:	P2015.0028	**START DATE:**	10/02/2015	**DRILLING COMPANY:**	Fugro
BORING:	AAN-1	**COMPLETION DATE:**	10/05/2015	**DRILLING METHOD:**	Rotary borehole drilling, sampling and testing

Coordinates: E471140.0 N4464476.0
UTM Zone 35N, WGS 84, Meters
Elevation: +1.00 m

Unit Weight [kN/m³]: 0 5 10 15 20 25
Rock Unconfined Compressive Strength [MPa]: 0 1 2 3 4 5 6
Coring rate [min/m]
ID Tests/RQD/Recovery[%]/Blow Counts: 0 20 40 60 80 100
Soil Undrained Shear Strength [kPa]: 0 200 400 600

Elevation [m]	Depth [m]	Soil / Rock Type	Sampler / Name	Blow Count	Material description	Stratum
-32	32		CR23		30.6 m to 33.8 m - Fat CLAY (CH), hard, greenish grey, fissured - with traces of carbonate concretions	
			PUS18			
			CR24			
-34	34		CR25		33.8 m to 40.3 m - Fat CLAY (CH), hard, greenish grey, laminated - with extremely closely spaced irregular sand laminations - clayey sand, 34.2 m to 34.4 m - 40°-50°, undulating, smooth, intersection fissures at 34.4 m - subvertical, undulating, smooth fissures, 34.7 m to 34.8 m - subvertical, undulating, smooth fissures, 34.9 m to 35.2 m - 60°, undulating, smooth, extremely closely to very close spaced fissures, 35.2 m to 35.3 m - 60°, undulating, closed, extremely closely to very closed spaced fissures, 35.8 m to 36.0 m	
			PUS19			
-36	36		CR26			
			CR27			
-38	38		PUS20		- calcareous, 37.4 m to 38.9 m - with horizontal sand laminations at 38.2 m	
			CR28			
					- dark greyish brown, 38.9 m to 40.3 m - fine sand, 39.6 m to 39.8 m	
-40	40		CR29		40.3 m to 41.3 m - MUDSTONE, extremely weak, fresh, greenish grey, laminated - calcareous - with sand pockets	
			CR30		41.3 m to 43.6 m - SANDSTONE, fine-grained, extremely weak, fresh, dark greenish grey, laminated, slightly cemented - with mica crystals - with extremely closely spaced clay laminations - with few subrounded to subangular gravel to 41.8 m	
-42	42		CR31		- with few shells and shell fragments below 43.5 m	
	44		PUS21		43.6 m to 45.0 m - MUDSTONE, extremely weak, fresh, greenish grey - calcareous - with shells and shell fragments - with few pockets of sand	
-44			CR32		- with few subrounded, subangular gravel below 44.9 m 45.0 m to 51.1 m - SANDSTONE, fine-grained to medium-grained, extremely weak, fresh, dark greenish grey, slightly cemented - with mica crystals - with occasionally laminations of clay	
	46		CR33			
-46			SPT8	R		
	48		CR34			

GEOTECHNICAL LOG
LOCATION AAN-1
P2015.0028

PROJECT NO:	P2015.0028	**START DATE:**	10/02/2015	**DRILLING COMPANY:**	Fugro
BORING:	AAN-1	**COMPLETION DATE:**	10/05/2015	**DRILLING METHOD:**	Rotary borehole drilling, sampling and testing

Coordinates: E471140.0 N4464476.0
UTM Zone 35N, WGS 84, Meters

Elevation: +1.00 m

Unit Weight [kN/m³]: 0 5 10 15 20 25

Rock Unconfined Compressive Strength [MPa]: 0 1 2 3 4 5 6

Coring rate [min/m]
ID Tests/RQD/Recovery[%]/Blow Counts: 0 20 40 60 80 100

Soil Undrained Shear Strength [kPa]: 0 200 400 600

Elevation [m]	Depth [m]	Soil / Rock Type	Sampler / Name	Blow Count	Material description	Stratum
	48		CR34		45.0 m to 51.1 m - SANDSTONE, fine-grained to medium-grained, extremely weak, fresh, dark greenish grey, slightly cemented - with mica crystals - with occasionally laminations of clay	
-48			CR35			
	50		SPT9	R		
-50			CR36			
					51.1 m to 54.4 m - MUDSTONE, extremely weak, fresh, dark greenish grey - calcareous - with few shells and shell fragments at 51.3 m	
	52		CR37			
-52					- laminated fine sand with mica crystals, 52.8 m to 53.0 m	
	54		CR38		- fine sand, laminated at 54.2 m	
					54.4 m to 63.3 m - SANDSTONE, fine-grained to medium-grained, extremely weak, fresh, dark greenish grey, laminated, slightly cemented - with mica crystals - with organic matter coating at lamination surfaces	
-54			CR39		- clay at 55.7 m	
	56					
-56			CR40			
	58					
			CR41			
-58						
	60		CR42			
					- slightly cemented at 60.8 m	
-60			CR43			
	62				- with shells and shell fragments below 61.4 m - 45°, undulating, rough to smooth, fissure with clay infilling at 61.6 m - moderately strong, 61.6 m to 61.8 m - moderately strong, with organic matter coating at discontinuity surfaces, 62.8 m to 63.2 m	
			CR44			
-62					63.3 m to 63.8 m - SANDSTONE, fine-grained, extremely weak, fresh, greenish grey, laminated, slightly cemented - with extremely closely spaced clay laminations - End of Borehole at 63.8 m	
			CR45			
	64					

GEOTECHNICAL LOG

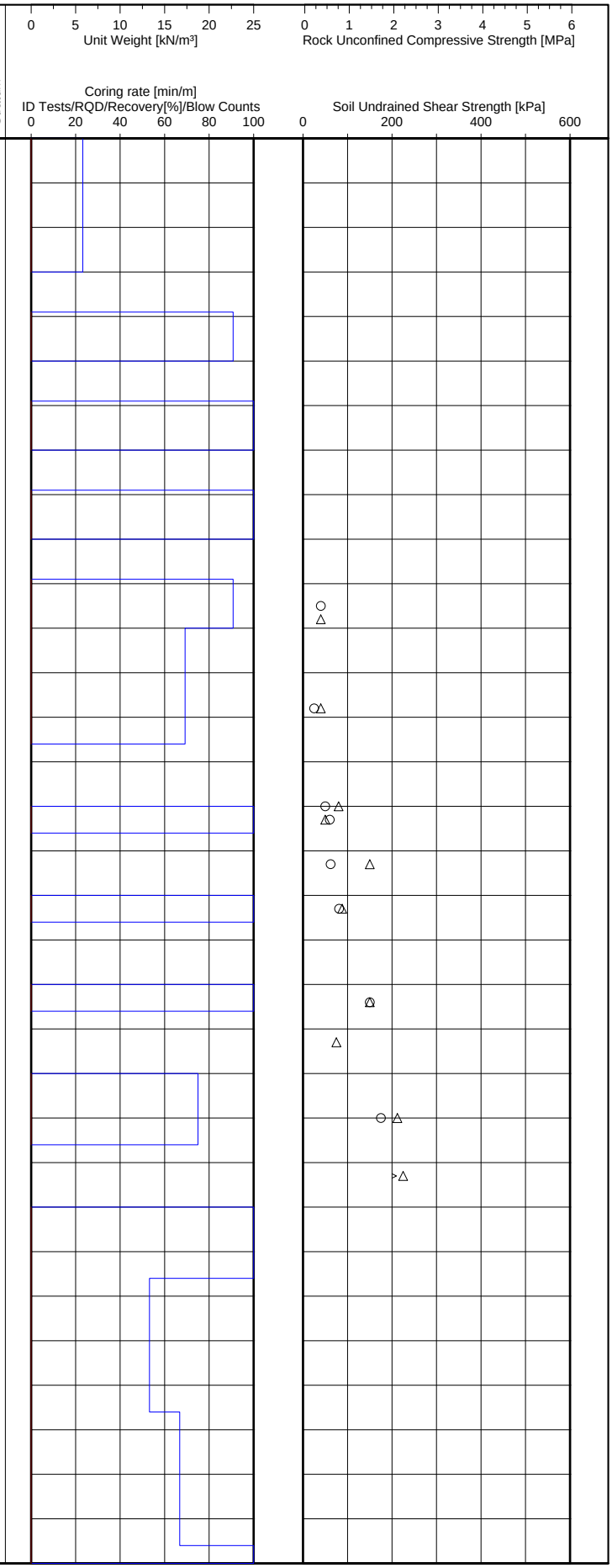
LOCATION AAN-1

P2015.0028

PROJECT NO:	P2015.0028	**START DATE:**	10/06/2015	**DRILLING COMPANY:**	Fugro
BORING:	AAN-1A	**COMPLETION DATE:**	10/10/2015	**DRILLING METHOD:**	Rotary borehole drilling, sampling and testing

Coordinates: E471091.0 N4464510.0
UTM Zone 35N, WGS 84, Meters
Elevation: +0.50 m

Elevation [m]	Depth [m]	Soil / Rock Type	Sampler / Name	Blow Count	Material description	Stratum
0	0		CR1		0.0 m to 0.6 m - MADE GROUND	
					0.6 m to 2.5 m - Fine to Medium SAND (SP), loose, greenish grey, calcareous silica	
					- with roots and rootlets to 2.0 m	
	2		SPT1	3/4/6		
-2			CR2			
			SPT2	1/0/8	2.5 m to 4.3 m - Silty Fine SAND (SM), loose, dark greenish grey, silica	
			CR3		- with odour	
					- silt content is increasing with depth	
			SPT3	1/1/1	- with shells and shell fragments, 3.5 m to 3.8 m	
	4				- with many shells and shell fragments, 3.8 m to 4.0 m	
-4			CR4			
					4.3 m to 4.8 m - Coarse SAND (SP), loose, greenish grey	
			SPT4	2/2/0	- with many shells and shell fragments	
					4.8 m to 7.8 m - Fat CLAY (CH), firm, dark greenish grey, greenish grey	
			CR5			
					- calcareous to 6.8 m	
	6		CR6			
-6						
			PUS1			
			CR7			
	8		PUS2		7.8 m to 11.3 m - Fat CLAY (CH), very stiff, greenish grey, calcareous	
-8					- with shells and shell fragments	
			CR8			
			PUS3			
			CR9			
	10		PUS4		- with pockets of sand, 9.7 m to 9.8 m	
-10					- with coal pieces at 10.2 m	
			CR10		- organic clay, 10.6 m to 10.7 m	
					- with coal pieces at 10.6 m	
			PUS5		11.3 m to 13.1 m - Fat CLAY (CH), hard, greenish grey, calcareous	
	12				- with few shells and shell fragments and gravel sized carbonate concretions	
-12			CR11		- with pockets of fine sand	
			CR12		13.1 m to 13.4 m - Fat CLAY (CH), hard, dark greenish grey, fissured, laminated	
					- reddish brown at 13.1 m	
					13.4 m to 16.2 m - Fat CLAY (CH), very hard to hard, mottled greenish grey to olive, fissured, laminated	
	14				- fissures are irregular	
-14			CR13		- laminations are horizontal	
	16		CR14			



GEOTECHNICAL LOG

LOCATION AAN-1A

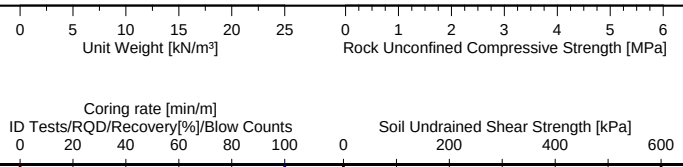
P2015.0028

PROJECT NO:	P2015.0028	**START DATE:**	10/06/2015	**DRILLING COMPANY:**	Fugro
BORING:	AAN-1A	**COMPLETION DATE:**	10/10/2015	**DRILLING METHOD:**	Rotary borehole drilling, sampling and testing

Coordinates: E471091.0 N4464510.0
UTM Zone 35N, WGS 84, Meters

Elevation: +0.50 m

Elevation [m] / Depth [m]	Soil / Rock Type	Sampler / Name	Blow Count	Material description	Stratum
16		CR14		13.4 m to 16.2 m - Fat CLAY (CH), very hard to hard, mottled greenish grey to olive, fissured, laminated - fissures are irregular - laminations are horizontal	
-16		CR15			
		CR16		16.2 m to 17.1 m - Fat CLAY with gravel (CH), hard to very hard, greenish grey - moderately cemented, 16.3 m to 16.4 m	
		CR17		17.1 m to 24.2 m - Fat CLAY (CH), very hard to hard, dark greenish grey to greenish black, fissured - fissures are irregular	
18					
-18		CR18			
		CR19			
				- mottled with olive, 19.5 m to 20.0 m	
20		CR20			
-20					
		CR21			
22				- with few pockets of sand below 20.1 m - organic clay, 21.6 m to 22.7 m	
-22		CR22			
				- with shells and shell fragments below 21.6 m	
				- moderately cemented, 23.7 m to 23.8 m	
24		CR23			
-24				24.2 m to 25.8 m - Fat CLAY (CH), hard, greenish grey - with horizontal, very closely spaced fine sand laminations - moderately cemented, 24.6 m to 24.7 m	
		CR24			
26				25.8 m to 26.4 m - Fat CLAY (CH), hard, dark greenish grey, calcareous, fissured, laminated - with shells and shell fragments	
-26		CR25		26.4 m to 28.3 m - Fat CLAY (CH), very hard, greenish grey - with few shells and shell fragments - with pockets of fine sand - sand at 26.4 m	
		CR26			
28				- calcareous below 27.5 m - carbonate, well cemented, 27.8 m to 27.9 m	
-28				28.3 m to 29.6 m - Fine to Medium SAND (SW), very dense, greenish grey, silica, laminated - with mica crystals - with laminations of clay - clay, 28.5 m to 28.6 m	
		CR27		- clay with laminations of sand, 29.2 m to 29.4 m	
				29.6 m to 32.2 m - Fat CLAY (CH), hard to very hard, greenish grey, laminated - with extremely closely spaced of fine sand laminaes - fine to medium sand, 30.0 m to 30.3 m - with organic matter at 30.5 m	
30					
-30		CR28		- mottled with olive, 30.7 m to 31.3 m	
		CR29			
32				- calcareous, 31.8 m to 32.0 m	



GEOTECHNICAL LOG

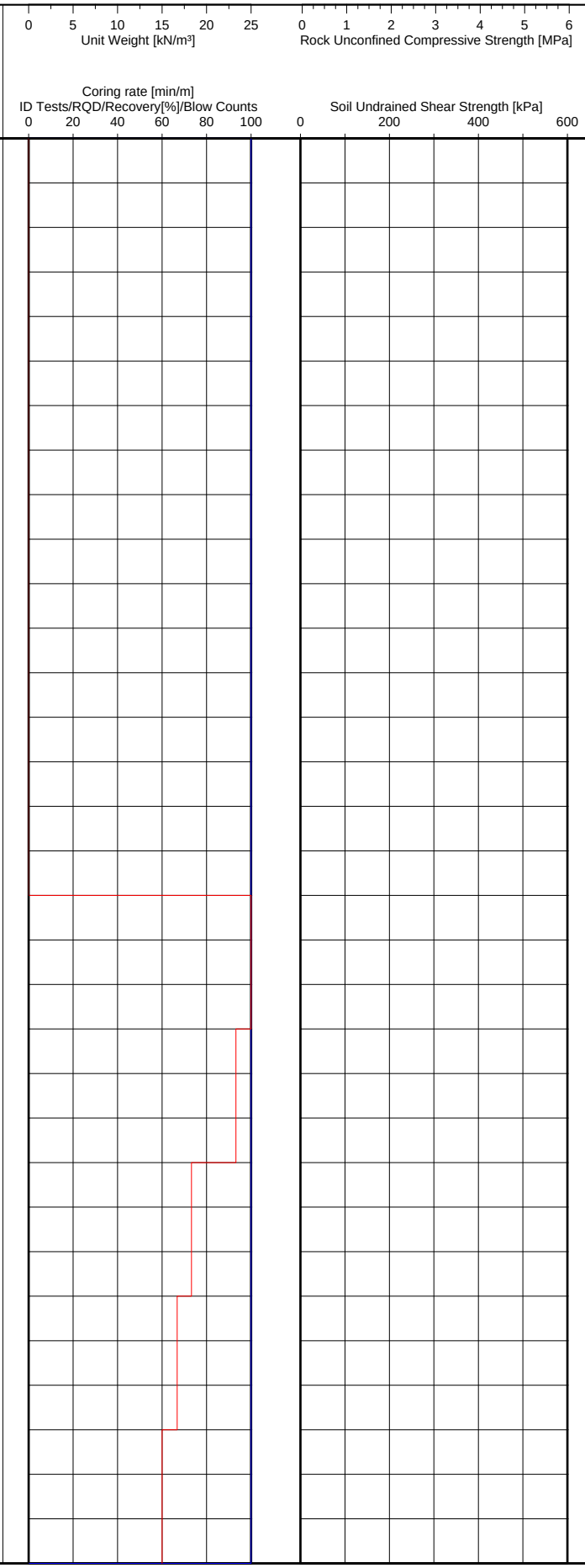
LOCATION AAN-1A

P2015.0028

PROJECT NO:	P2015.0028	**START DATE:**	10/06/2015	**DRILLING COMPANY:**	Fugro
BORING:	AAN-1A	**COMPLETION DATE:**	10/10/2015	**DRILLING METHOD:**	Rotary borehole drilling, sampling and testing

Coordinates: E471091.0 N4464510.0
UTM Zone 35N, WGS 84, Meters
Elevation: +0.50 m

Elevation [m]	Depth [m]	Soil / Rock Type	Sampler / Name	Blow Count	Material description	Stratum
32					29.6 m to 32.2 m - Fat CLAY (CH), hard to very hard, greenish grey, laminated - with extremely closely spaced of fine sand laminaes - with organic matter below 32.0 m	
-32			CR29			
					32.2 m to 32.9 m - Fat CLAY (CH), hard to very hard, dark grey, calcareous - with shells and shell fragments - mottled with dark greenish grey to 32.4 m - organic clay below 32.7 m	
			CR30		32.9 m to 34.9 m - Fat CLAY (CH), very hard, greenish grey, calcareous, laminated - with few shells and shell fragments - dark greenish grey, fissured to 33.2 m - slightly cemented, 34.0 m to 34.1 m - 10º, undulating, fissure at 34.3 m	
34						
-34						
			CR31		34.9 m to 37.6 m - Fat CLAY (CH), very hard, greenish grey, calcareous, laminated - with closely to moderately spaced very thin to thin interlayers of fine to medium sand	
36						
-36			CR32			
					37.6 m to 39.0 m - Fat CLAY (CH), very hard, greenish grey, fissured, laminated	
38			CR33		- mottled with olive, 38.0 m to 38.5 m	
-38					- dark greenish grey, slightly cemented below 38.5 m - organic matter at 38.5 m	
					39.0 m to 39.7 m - Fine to Medium SAND (SP), very dense, greenish grey, silica - silty below 39.4 m	
			CR34		39.7 m to 40.5 m - Fat CLAY (CH), very hard, greenish grey - organic clay, 39.8 m to 40.0 m	
40					- with few shells and shell fragments below 40.4 m	
-40					40.5 m to 44.2 m - MUDSTONE, extremely weak, fresh, greenish grey, weak red - with few carbonate concretions	
			CR35			
42					- fissured, fissures have polished surfaces at 41.9 m - extremely closely spaced fissures, 42.0 m to 42.3 m	
-42			CR36			
					- calcareous below 42.3 m - 50º, planar-undulating, closed fissure at 42.5 m - 50º, undulating, slickensided fissure with 50º striations at 43.0 m - 30º, planar-undulating, slickensided fissure at 43.4 m	
44			CR37		- sub-vertical, planar-undulating, slickensided fissure with vertical striations at 43.4 m - 50º, undulating, closed fissure at 43.9 m	
-44					44.2 m to 44.6 m - Fine to Medium SAND (SP), very dense, greenish grey, silica	
					44.6 m to 45.1 m - SANDSTONE, extremely weak, fresh, dark bluish grey, laminated, slightly cemented - mudstone, 44.6 m to 44.8 m	
			CR38			
46					45.1 m to 46.0 m - MUDSTONE, extremely weak, fresh, dark greenish grey - with shell and shell fragments	
-46					46.0 m to 47.1 m - Fine to Medium SAND (SP), dense, greenish grey, laminated - slightly cemented sandstone, 46.4 m to 46.5 m	
			CR39		47.1 m to 48.6 m - MUDSTONE, extremely weak, fresh, dark bluish grey, laminated	
48						



GEOTECHNICAL LOG

LOCATION AAN-1A

P2015.0028

PROJECT NO:	P2015.0028	**START DATE:**	10/06/2015	**DRILLING COMPANY:**	Fugro
BORING:	AAN-1A	**COMPLETION DATE:**	10/10/2015	**DRILLING METHOD:**	Rotary borehole drilling, sampling and testing

Coordinates: E471091.0 N4464510.0
UTM Zone 35N, WGS 84, Meters

Elevation: +0.50 m

Unit Weight [kN/m³]: 0 5 10 15 20 25

Rock Unconfined Compressive Strength [MPa]: 0 1 2 3 4 5 6

Coring rate [min/m]
ID Tests/RQD/Recovery[%]/Blow Counts: 0 20 40 60 80 100

Soil Undrained Shear Strength [kPa]: 0 200 400 600

Elevation [m]	Depth [m]	Material description	Stratum	Soil / Rock Type	Sampler / Name	Blow Count
48		47.1 m to 48.6 m - MUDSTONE, extremely weak, fresh, dark bluish grey, laminated			CR40	
-48		48.6 m to 50.1 m - SANDSTONE, extremely weak, fresh, dark greenish grey - silica			CR41	
	50	50.1 m to 50.7 m - MUDSTONE, extremely weak, fresh, dark bluish grey - with few sand pockets				
-50		50.7 m to 56.5 m - Fine to Medium SAND (SP), dense, dark greenish grey, calcareous silica, laminated - with shells and shell fragments			CR42	
	52				CR43	
-52		- with clay laminations, 52.9 m to 53.4 m				
	54	- medium dense, 53.4 m to 54.6 m			CR44	
-54						
					CR45	
	56					
-56		56.5 m to 60.1 m - MUDSTONE, extremely weak, fresh, dark bluish grey - with horizontal sand laminations - with traces of shells and shell fragments - mottled with brown, 56.5 m to 57.1 m			CR46	
	58	- laminated sand, 58.1 m to 58.2 m				
-58					CR47	
		- laminated sand at 59.1 m				
		- fine sand, 59.5 m to 59.8 m				
	60				CR48	
-60		60.1 m to 69.0 m - SANDSTONE, fine-grained to medium-grained, extremely weak, fresh, bluish grey, laminated, slightly cemented - well cemented carbonate cemented nodule, 60.2 m to 60.5 m				
		- with clay laminations, 61.1 m to 61.9 m			CR49	
	62					
-62						
					CR50	
	64				CR51	

GEOTECHNICAL LOG

LOCATION AAN-1A

P2015.0028

PROJECT NO:	P2015.0028	**START DATE:**	10/06/2015	**DRILLING COMPANY:**	Fugro
BORING:	AAN-1A	**COMPLETION DATE:**	10/10/2015	**DRILLING METHOD:**	Rotary borehole drilling, sampling and testing

Coordinates: E471091.0 N4464510.0
UTM Zone 35N, WGS 84, Meters
Elevation: +0.50 m

Unit Weight [kN/m³]: 0 5 10 15 20 25
Rock Unconfined Compressive Strength [MPa]: 0 1 2 3 4 5 6
Coring rate [min/m]
ID Tests/RQD/Recovery[%]/Blow Counts: 0 20 40 60 80 100
Soil Undrained Shear Strength [kPa]: 0 200 400 600

Elevation [m] / Depth [m]	Material description	Sampler / Name	Blow Count	Stratum
64 / -64	60.1 m to 69.0 m - SANDSTONE, fine-grained to medium-grained, extremely weak, fresh, bluish grey, laminated, slightly cemented	CR51		
	- with clay laminations below 62.3 m			
66 / -66		CR52		
		CR53		
68 / -68	- with many shell and shell fragments, 68.4 m to 68.8 m			
		CR54		
	69.0 m to 69.8 m - MUDSTONE, extremely weak, fresh, very dark greenish grey - with horizontal sand laminations			
70 / -70	69.8 m to 70.3 m - SANDSTONE, fine-grained to medium-grained, extremely weak, fresh, bluish grey, laminated, slightly cemented	CR55		
	70.3 m to 70.9 m - MUDSTONE, extremely weak, fresh, very dark greenish grey - with horizontal sand laminations			
	70.9 m to 71.5 m - SILTSTONE, extremely to very weak, fresh, bluish grey, laminated			
	71.5 m to 71.7 m - MUDSTONE, extremely weak, fresh, bluish grey, laminated			
72 / -72	71.7 m to 72.1 m - SANDSTONE, fine-grained to medium-grained, extremely weak, fresh, bluish grey, laminated, slightly cemented - with many shells and shell fragments at 72.1 m	CR56		
	72.1 m to 72.6 m - MUDSTONE, extremely weak, fresh, bluish grey, laminated - with many shells and shell fragments at 72.1 m			
	72.6 m to 75.5 m - MUDSTONE, extremely weak, fresh, greenish black-greenish grey - with few sand pockets - greenish black, 73.0 m to 73.1 m - light yellowish brown, 73.1 m to 73.2 m - grey, 73.2 m to 73.4 m - with many shells and shell fragments, 73.4 m to 74.6 m	CR57		
74 / -74				
	- with charcoal pieces, 74.8 m to 75.3 m - 10-20°, undulating, slickensided fissure at 75.1 m	CR58		
	75.5 m to 76.2 m - SANDSTONE, fine-grained, extremely weak, fresh, light greenish grey, slightly cemented			
76 / -76	76.2 m to 76.7 m - MUDSTONE, extremely weak-very weak, fresh, greenish grey	CR59		
	76.7 m to 80.3 m - SANDSTONE, fine-grained to medium-grained, extremely weak, fresh, greenish grey, laminated, slightly cemented - with clay laminaes - with mica crystals			
78 / -78	- slightly cemented, 77.3 m to 78.2 m	CR60		
	- well carbonate cemented nodule, 78.6 m to 78.8 m			
		CR61		
80	- with clay pockets, 79.5 m to 79.7 m - laminaes are irregular at 79.5 m			

GEOTECHNICAL LOG

LOCATION AAN-1A

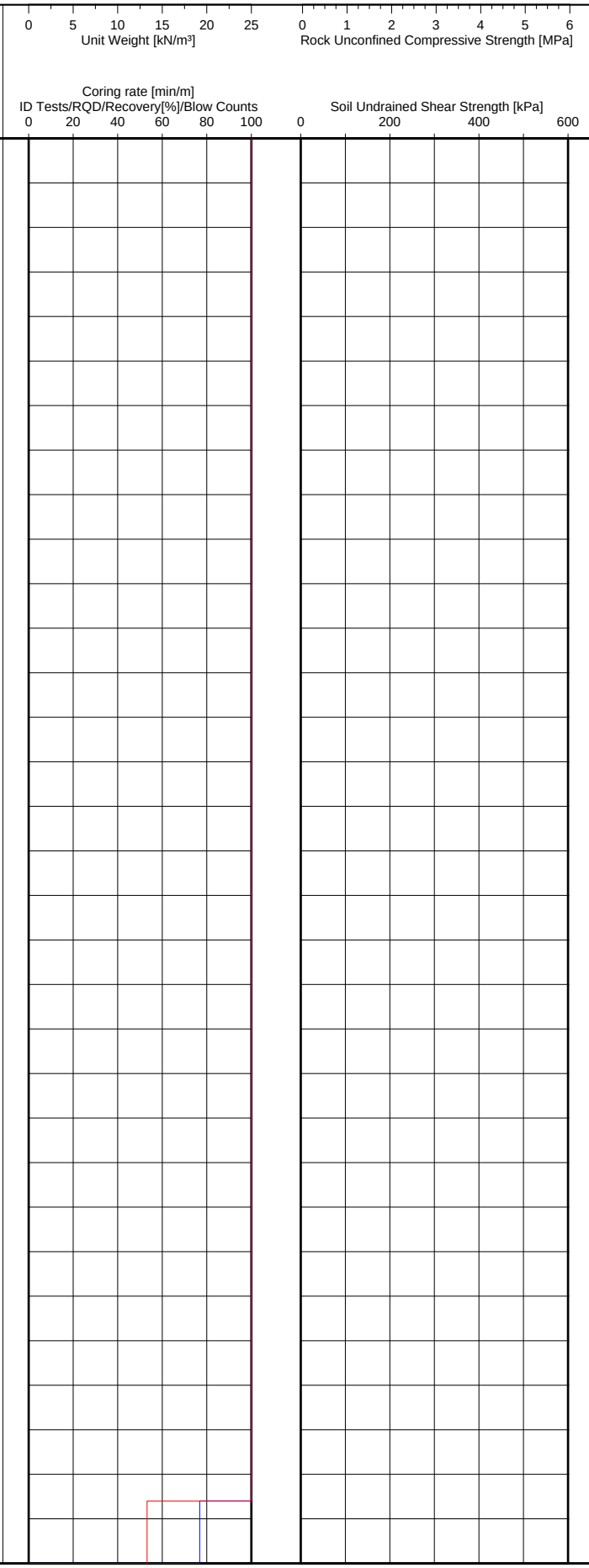
P2015.0028

PROJECT NO:	P2015.0028	**START DATE:**	10/06/2015	**DRILLING COMPANY:**	Fugro
BORING:	AAN-1A	**COMPLETION DATE:**	10/10/2015	**DRILLING METHOD:**	Rotary borehole drilling, sampling and testing

Coordinates: E471091.0 N4464510.0
UTM Zone 35N, WGS 84, Meters

Elevation: +0.50 m

Elevation [m] / Depth [m]	Soil / Rock Type	Sampler / Name	Blow Count	Material description	Stratum
80 / -80		CR61		76.7 m to 80.3 m - SANDSTONE, fine-grained to medium-grained, extremely weak, fresh, greenish grey, laminated, slightly cemented - with clay laminaes - with mica crystals	
		CR62		80.3 m to 81.0 m - SANDSTONE, medium-grained, extremely weak, fresh, greenish grey, slightly cemented - with shells and shell fragments	
82 / -82		CR63		81.0 m to 83.6 m - SANDSTONE, fine-grained to medium-grained, extremely weak, fresh, greenish grey, laminated, slightly cemented - with organic matter coating at laminae surfaces - laminaes are undulating, 82.0 m to 82.6 m - with clay pockets and few shell fragments, 82.6 m to 82.9 m - with charcoal at 82.6 m	
84 / -84		CR64		83.6 m to 85.6 m - SANDSTONE, medium-grained, extremely weak, fresh, greenish grey, slightly cemented - with shells and shell fragments - with clay pockets - laminated, 85.0 m to 85.5 m	
		CR65		- with many shells and shell fragments below 85.3 m	
86 / -86				85.6 m to 94.4 m - MUDSTONE, extremely weak to very weak, fresh, dark greenish grey - sub-vertical, extremely closely spaced, undulating, rough, joint, 85.7 m to 86.1 m - moderately-well carbonate cemented, 85.7 m to 86.1 m	
		CR66			
88 / -88		CR67			
90 / -90		CR68		- calcareous below 85.7 m - 45º, extremely closely spaced, undulating, slickensided joint at 86.0 m - laminated with sand laminaes, 86.1 m to 89.3 m - clay with organic content at 86.6 m - with sand pockets, 86.8 m to 87.0 m - 30º, planar-undulating, slickensided, fissure with horizontal striations at 88.1 m	
		CR69		- very weak, 89.3 m to 89.8 m - laminated without sand below 89.3 m - extremely weak, 89.8 m to 90.4 m	
92 / -92		CR70		- 30º, undulating, slickensided, fissure with 45º striation at 93.9 m - 30º, planar, slickensided, closed fissure with 45º striation at 94.0 m - 50º, undulating, slickensided, closed fissure with 45º striation at 94.2 m	
94 / -94		CR71		94.4 m to 94.6 m - SHEAR ZONE; - consisting of Mudstone and Sandstone fragments - with 30º, slickensided shear planes	
		CR72		94.6 m to 101.0 m - SANDSTONE, medium-grained, extremely weak, fresh, greenish grey, slightly cemented - with shells and shell fragments - extremely weak, 95.0 m to 95.3 m - well carbonate cemented nodule at 95.0 m - mudstone, 95.6 m to 96.0 m	
96					



GEOTECHNICAL LOG

LOCATION AAN-1A

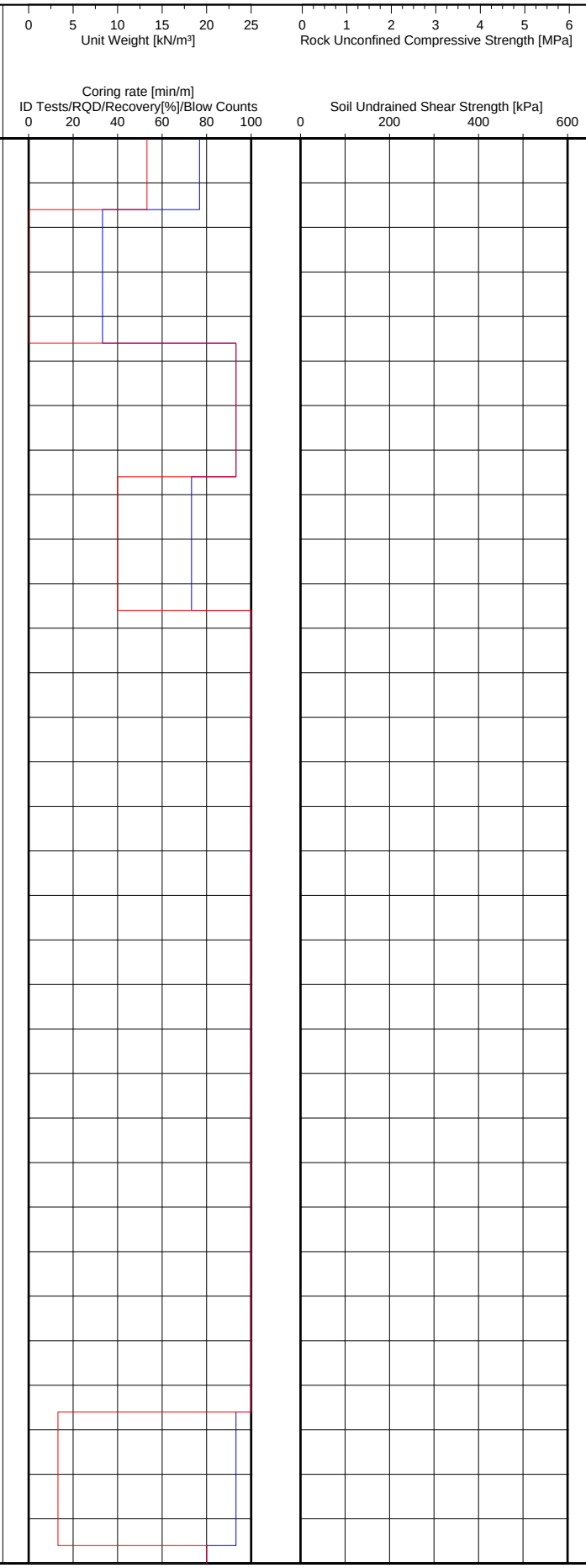
P2015.0028

PROJECT NO:	P2015.0028	**START DATE:**	10/06/2015	**DRILLING COMPANY:**	Fugro
BORING:	AAN-1A	**COMPLETION DATE:**	10/10/2015	**DRILLING METHOD:**	Rotary borehole drilling, sampling and testing

Coordinates: E471091.0 N4464510.0
UTM Zone 35N, WGS 84, Meters

Elevation: +0.50 m

Elevation [m] / Depth [m]	Soil / Rock Type	Sampler / Name	Blow Count	Material description	Stratum
96 / -96		CR72		94.6 m to 101.0 m - SANDSTONE, medium-grained, extremely weak, fresh, greenish grey, slightly cemented - with shells and shell fragments - weak-moderately strong, occasionally well cemented, 96.3 m to 96.8 m	
		CR73		- medium-coarse, 96.8 m to 98.3 m - weak-moderately strong, occasionally well cemented at 97.2	
98 / -98		CR74			
100 / -100		CR75			
				101.0 m to 102.1 m - SANDSTONE, fine-grained to coarse-grained, weak to moderately strong, fresh, grey, well cemented	
102 / -102		CR76		102.1 m to 102.8 m - MUDSTONE, very weak, fresh, dark greenish grey - with sand laminations - very weak-weak, 102.5 m to 102.6 m	
		CR77		102.8 m to 103.3 m - SANDSTONE, fine-grained, very weak, fresh, greenish grey, thinly laminated, moderately cemented - with very closely spaced clay laminations 103.3 m to 103.7 m - MUDSTONE, very weak, fresh, dark greenish grey - with sand laminations	
104 / -104		CR78		103.7 m to 104.3 m - SANDSTONE, fine-grained, very weak, fresh, greenish grey, thinly laminated, slightly to moderately cemented - with very closely spaced clay laminations 104.3 m to 105.0 m - SILTSTONE, very weak, fresh, thinly laminated, greenish grey - calcareous - laminations are 5º - with few shells and shell fragments	
106 / -106		CR79		105.0 m to 106.3 m - MUDSTONE, very weak, fresh, thinly laminated, dark greenish grey - calcareous - laminations are 5º - with few shell fragments 106.3 m to 108.8 m - SILTSTONE, very weak, fresh, greenish grey - calcareous - with sand pockets - 60º, undulating, slickensided, polished fissure at 107.2 m	
108 / -108		CR80		- weak to moderately strong, 107.3 m to 108.6 m	
		CR81		108.8 m to 118.6 m - SANDSTONE, fine-grained, very weak, fresh, greenish grey, thinly laminated, slightly to moderately cemented - with very closely spaced thinly clay laminations	
110 / -110		CR82			
112		CR83			



GEOTECHNICAL LOG

LOCATION AAN-1A

P2015.0028

PROJECT NO:	P2015.0028	**START DATE:**	10/06/2015	**DRILLING COMPANY:**	Fugro
BORING:	AAN-1A	**COMPLETION DATE:**	10/10/2015	**DRILLING METHOD:**	Rotary borehole drilling, sampling and testing

Coordinates: E471091.0 N4464510.0
UTM Zone 35N, WGS 84, Meters
Elevation: +0.50 m

Unit Weight [kN/m³]: 0 5 10 15 20 25
Rock Unconfined Compressive Strength [MPa]: 0 1 2 3 4 5 6
Coring rate [min/m]
ID Tests/RQD/Recovery[%]/Blow Counts: 0 20 40 60 80 100
Soil Undrained Shear Strength [kPa]: 0 200 400 600

Elevation [m] / Depth [m]	Soil / Rock Type	Sampler / Name	Blow Count	Material description	Stratum
112 / -112		CR83		108.8 m to 118.6 m - SANDSTONE, fine-grained, very weak, fresh, greenish grey, thinly laminated, slightly to moderately cemented - with very closely spaced thinly clay laminations - extremely weak, 110.3 m to 115.0 m	
114 / -114		CR84		- with many shells and shell fragments, 113.7 m to 113.8 m	
116 / -116		CR85			
118 / -118		CR86			
		CR87			
		CR88		118.6 m to 119.9 m - MUDSTONE, very weak, fresh, greenish grey - calcareous - with few shell and shell fragments - with carbonate nodules	
120 / -120		CR89		119.9 m to 123.4 m - MUDSTONE, extremely weak, fresh, weak red, olive brown, mottled greenish grey, laminated, fissured - fissures are extremely closely spaced irregular, polished	
122 / -122		CR90		- slightly cemented, 121.8 m to 122.3 m - mottled with dark greenish grey, fissures have polished-slickensided surfaces below 122.3 m - 15-20º, undulating, polished-slickensided, closely spaced fissures, 122.3 m to 122.9 m	
124 / -124		CR91		123.4 m to 126.3 m - SILTSTONE, very weak-weak, fresh, greenish grey, weak red, moderately cemented - with carbonate nodules - mudstone, extremely weak to very weak, 124.0 m to 124.2 m - mudstone, extremely weak to very weak, 124.5 m to 124.6 m - sandstone, extremely weak, 125.1 m to 125.3 m - mudstone, very weak to weak, 125.4 m to 125.7 m - sandstone, extremely weak, 125.9 m to 126.0 m	
126 / -126		CR92		126.3 m to 127.4 m - MUDSTONE, very weak-weak, fresh, weak red, moderately cemented - 30º, planar, slickensided, fissure with vertical striation at 126.3 m - shearzone with irregular, slickensided, extremely closely spaced shearplanes, 127.0 m to 127.1 m - siltstone below 127.3 m	
128		CR93		127.4 m to 128.0 m - SANDSTONE, fine-grained, extremely weak, fresh, greenish grey, slightly cemented - slightly cemented to 127.7 m 128.0 m to 129.8 m - MUDSTONE, very weak-weak, weak red, moderately cemented	

GEOTECHNICAL LOG

LOCATION AAN-1A

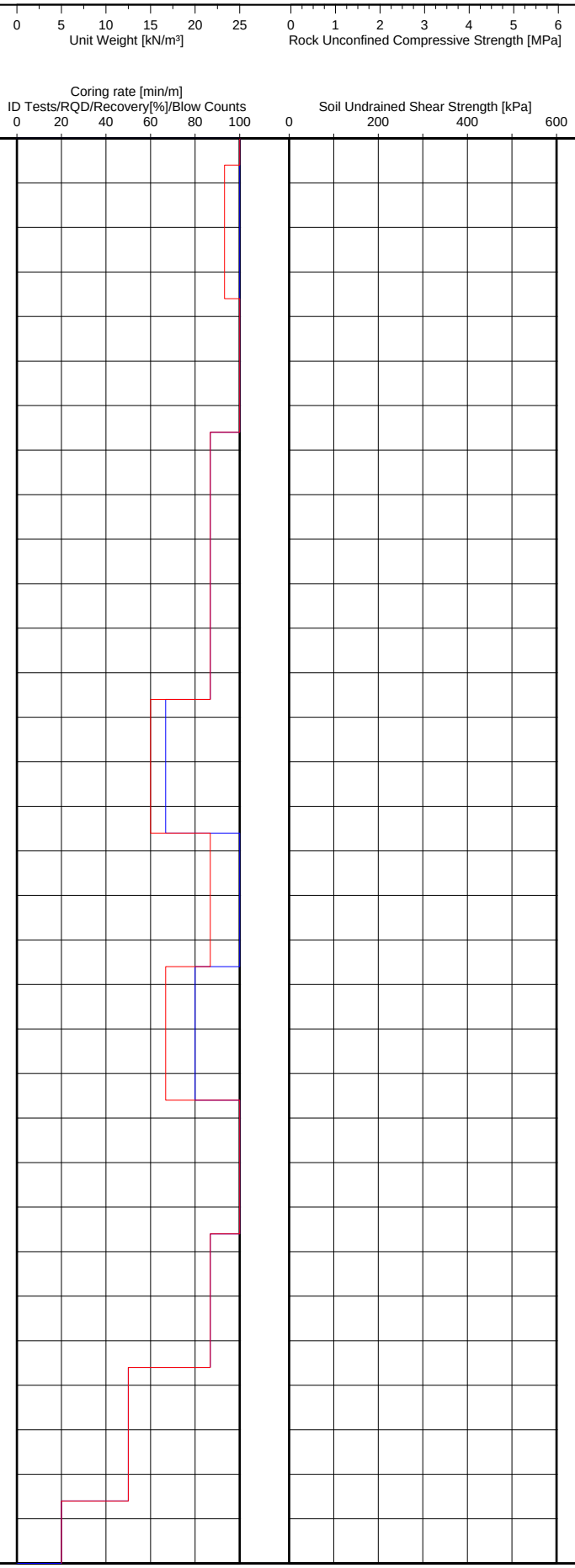
P2015.0028

PROJECT NO:	P2015.0028	**START DATE:**	10/06/2015	**DRILLING COMPANY:**	Fugro
BORING:	AAN-1A	**COMPLETION DATE:**	10/10/2015	**DRILLING METHOD:**	Rotary borehole drilling, sampling and testing

Coordinates: E471091.0 N4464510.0
UTM Zone 35N, WGS 84, Meters

Elevation: +0.50 m

Elevation [m] / Depth [m]	Soil / Rock Type	Sampler / Name	Blow Count	Material description	Stratum
128 / -128		CR93		128.0 m to 129.8 m - MUDSTONE, very weak-weak, weak red, moderately cemented - sandstone, extremely weak, 128.2 m to 128.3 m - siltstone, very weak to weak, 128.4 m to 128.8 m	
		CR94		- 45º, planar, slickensided, fissure with vertical striations at 129.2 m - extremely weak, with irregular slickensided fissures, 129.4 m to 129.7 m	
130 / -130		CR95		129.8 m to 134.5 m - SANDSTONE, fine-grained to medium-grained, extremely weak, fresh, greenish grey, laminated, slightly cemented - with mica crystals - very weak to weak, moderately cemented, 129.8 m to 130.0 m - siltstone, very weak, moderately cemented, 130.2 m to 130.6 m - 45º, planar, slickensided, fissure with vertical striation at 130.2 m - coarse grained, 131.4 m to 131.7 m	
132 / -132		CR96		- organic content at 132.5 m	
		CR97			
134 / -134		CR98		134.5 m to 135.3 m - SILTSTONE, very weak, fresh, greenish grey - with few shells and shell fragments	
				135.3 m to 137.7 m - CONGLOMERATE, very weak-weak, fresh, greenish grey-grey - with shell and shell fragments	
136 / -136		CR99			
138 / -138		CR100		137.7 m to 139.8 m - SILTSTONE, very weak, fresh, greenish grey	
		CR101		- 25º and 50º, undulating, slickensided, intersecting fissures with vertical striations at 138.9 m - fine sand at 139.1 m - 25º, stepped, polished fissure at 139.6 m	
140 / -140		CR102		139.8 m to 147.90 m - SANDSTONE, extremely weak, fresh, greenish grey, laminated, slightly cemented - with mica crystals - laminaes are 5º-10º - mudstone at 140.8 m	
142 / -142		CR103			
		CR104		- weak to moderately strong, 143.5 m to 143.6 m - sub-vertical, planar, smooth, closed, joint with calcite infilling, 143.5 m to 143.6 m	
144					



GEOTECHNICAL LOG

LOCATION AAN-1A

P2015.0028

PROJECT NO:	P2015.0028	**START DATE:**	10/06/2015	**DRILLING COMPANY:**	Fugro
BORING:	AAN-1A	**COMPLETION DATE:**	10/10/2015	**DRILLING METHOD:**	Rotary borehole drilling, sampling and testing

Coordinates: E471091.0 N4464510.0
UTM Zone 35N, WGS 84, Meters
Elevation: +0.50 m

Unit Weight [kN/m³]: 0 5 10 15 20 25
Rock Unconfined Compressive Strength [MPa]: 0 1 2 3 4 5 6
Coring rate [min/m]
ID Tests/RQD/Recovery[%]/Blow Counts: 0 20 40 60 80 100
Soil Undrained Shear Strength [kPa]: 0 200 400 600

Elevation [m]	Depth [m]	Material description	Stratum	Soil / Rock Type	Sampler / Name	Blow Count
144	-144	139.8 m to 147.90 m - SANDSTONE, extremely weak, fresh, greenish grey, laminated, slightly cemented - with mica crystals - laminaes are 5º-10º			CR105	
146	-146	- 45º, planar, smooth, slickensided fissure at 146.5 m			CR106	
148	-148	147.9 m to 149.0 m - SILTSTONE, very weak, fresh, greenish grey - with few shells and shell fragments - 45º, planar, slickensided fissure at 148.0 m - 45º, planar, slickensided fissure at 148.2 m			CR107	
		149.0 m to 150.0 m - MUDSTONE, very weak, fresh, mottled greenish grey, brown - with few shells and shell fragments - fissured, greenish black below 149.3 m - 45º, planar, slickensided fissure at 149.6 m - 45º, planar, slickensided fissure at 149.9 m - End of Borehole at 150.0 m - End of Borehole at 150.0 m			CR108	
150	-150					
152	-152					
154	-154					
156	-156					
158	-158					
160						

GEOTECHNICAL LOG

LOCATION AAN-1A

P2015.0028

PROJECT NO:	P2015.0028	**START DATE:**	10/14/2015	**DRILLING COMPANY:**	Fugro
BORING:	EAN-1	**COMPLETION DATE:**	10/19/2015	**DRILLING METHOD:**	Rotary borehole drilling, sampling and testing

Coordinates: E467944.0 N4467032.0
UTM Zone 35N, WGS 84, Meters
Elevation: +1.28 m

Elevation [m]	Depth [m]	Soil / Rock Type	Sampler / Name	Blow Count	Material description	Stratum
1	0		PUS1		0.0 m to 0.2 m - TOPSOIL	
					0.2 m to 1.7 m - Fat CLAY (CH), firm, olive brown, grey, calcareous - with roots and rootlets	
			PUS2			
0			PUS3			
	2		SPT1	9/7/5	1.7 m to 3.0 m - Gravelly Medium to Coarse SAND with silt (SW-SM), medium dense, very dark greenish grey, subrounded particles, calcareous silica	
			CR1			
-2			SPT2	4/5/7	3.0 m to 5.8 m - Silty Fine SAND (SM), medium dense, dark greenish grey, calcareous silica - with traces of mica crystals	
	4		CR2		- with many shells and shell fragments at 3.9 m	
			SPT3	4/5/9		
			CR3		- with few shells and shell fragments below 4.5 m	
-4			SPT4	1/6/7		
	6		CR4		5.8 m to 7.6 m - Silty Fine to Coarse SAND (SM), very loose to loose, dark greenish grey, calcareous silica - with very closely spaced clay lenses - occasionally with gravel	
			SPT5	1/0/3		
			CR5			
-6			SPT6	3/3/3		
	8		CR6		7.6 m to 12.0 m - Silty Fine SAND (SM), loose to medium dense, dark greenish grey, calcareous silica - with few shells and shell fragments - with extremely closely spaced clay lenses	
			SPT7	1/2/9		
			CR7			
-8			SPT8	3/4/6	- medium to coarse sand with gravel, 9.0 m to 9.4 m	
			CR8			
	10		SPT9	11/17/15	- medium to coarse sand with gravel, 10.1 m to 10.6 m	
			CR9			
-10						
	12		PUS4			
			SPT10	1/0/1	12.0 m to 14.5 m - Silty Fine SAND (SM), very loose, very dark greenish grey, calcareous silica - with few shells and shell fragments - clay, 12.5 m to 12.6 m - clay at 12.9 m	
-12			CR10			
	14		SPT11	0/0/0		
			CR11		14.5 m to 15.7 m - Sandy SILT (ML), soft, very dark greenish grey, calcareous	
-14						
			PUS5			
	16				15.7 m to 16.9 m - Fat CLAY (CH), soft to firm, very dark greenish grey, calcareous	

Unit Weight [kN/m³]: 0 5 10 15 20 25
Rock Unconfined Compressive Strength [MPa]: 0 1 2 3 4 5 6
Coring rate [min/m]
ID Tests/RQD/Recovery[%]/Blow Counts: 0 20 40 60 80 100
Soil Undrained Shear Strength [kPa]: 0 200 400 600

GEOTECHNICAL LOG

LOCATION EAN-1

P2015.0028

PROJECT NO:	P2015.0028	**START DATE:**	10/14/2015	**DRILLING COMPANY:**	Fugro
BORING:	EAN-1	**COMPLETION DATE:**	10/19/2015	**DRILLING METHOD:**	Rotary borehole drilling, sampling and testing

Coordinates: E467944.0 N4467032.0
UTM Zone 35N, WGS 84, Meters
Elevation: +1.28 m

Elevation [m] / Depth [m]	Soil / Rock Type	Sampler / Name	Blow Count	Material description	Stratum
16		CR12		15.7 m to 16.9 m - Fat CLAY (CH), soft to firm, very dark greenish grey, calcareous	
-16		PUS6		16.9 m to 17.7 m - Silty Fine SAND (SM), very loose, very dark greenish grey, calcareous silica - with traces of shells and shell fragments	
		SPT12	0/0/0		
18				17.7 m to 19.6 m - Silty CLAY (CL-ML), soft, very dark greenish grey, calcareous	
		CR13			
-18		PUS7			
20		SPT13	0/3/7	19.6 m to 20.0 m - Silty SAND (SM), loose to medium dense, very dark greenish grey, calcareous silica	
				20.0 m to 23.0 m - Clayey SAND (SC), loose to medium dense, very dark greenish grey, calcareous silica	
		CR14			
-20		SPT14	0/5/7		
22		CR15		- clay with thin sand laminations, 22.1 m to 22.5 m	
		SPT15	6/8/8		
-22		PUS8		23.0 m to 23.8 m - Fat CLAY (CH), firm, very dark greenish grey, calcareous - with thin sand laminations	
24		CR16		23.8 m to 24.8 m - Fine SAND (SP), loose, very dark greenish grey, calcareous silica	
		SPT16	0/1/1	24.8 m to 25.5 m - Fat CLAY (CH), soft, very dark greenish grey, calcareous	
-24		CR17		25.5 m to 26.2 m - Gravelly SAND with silt (SW-SM), very dark greenish grey, calcareous silica - with shells and shell fragments	
26				26.2 m to 28.2 m - Fat CLAY (CH), firm, very dark greenish grey, calcareous - with shells and shell fragments - with traces of sand pockets	
		PUS9			
-26		CR18		- with many shells and shell fragments, 27.1 m to 27.2 m	
28		PUS10			
		SPT17	0/5/11	28.2 m to 29.2 m - Fine SAND (SP), medium dense, very dark greenish grey, calcareous silica - with many shells and shell fragments	
-28		CR19			
		CR20		29.2 m to 33.5 m - Clayey Fine to Coarse GRAVEL (GC), yellowish brown, olive brown, grey, subrounded particles, calcareous silica - gravels are sandstone, limestone originated - cores are generally recovered as gravels with clay matrix washed away	
30					
		CR21			
-30					
32					

Unit Weight [kN/m³]: 0 5 10 15 20 25

Rock Unconfined Compressive Strength [MPa]: 0 1 2 3 4 5 6

Coring rate [min/m]
ID Tests/RQD/Recovery[%]/Blow Counts: 0 20 40 60 80 100

Soil Undrained Shear Strength [kPa]: 0 200 400 600

GEOTECHNICAL LOG

LOCATION EAN-1

P2015.0028

PROJECT NO:	P2015.0028	**START DATE:**	10/14/2015	**DRILLING COMPANY:**	Fugro
BORING:	EAN-1	**COMPLETION DATE:**	10/19/2015	**DRILLING METHOD:**	Rotary borehole drilling, sampling and testing

Coordinates: E467944.0 N4467032.0
UTM Zone 35N, WGS 84, Meters

Elevation: +1.28 m

Unit Weight [kN/m³]: 0 5 10 15 20 25

Rock Unconfined Compressive Strength [MPa]: 0 1 2 3 4 5 6

Coring rate [min/m]
ID Tests/RQD/Recovery[%]/Blow Counts: 0 20 40 60 80 100

Soil Undrained Shear Strength [kPa]: 0 200 400 600

Elevation [m]	Depth [m]	Soil / Rock Type	Sampler / Name	Blow Count	Material description	Stratum
32			CR22		29.2 m to 33.5 m - Clayey Fine to Coarse GRAVEL (GC), yellowish brown, olive brown, grey, subrounded particles, calcareous silica - gravels are sandstone, limestone originated - cores are generally recovered as gravels with clay matrix washed away	
-32						
	34		CR23		33.5 m to 35.3 m - Fat CLAY (CH), stiff to very stiff, olive brown, light greenish grey, calcareous - with oxidated sand pockets	
-34						
			CR24		35.3 m to 37.4 m - Gravelly Fat CLAY (CH), stiff to very stiff, yellowish brown, olive brown, greenish grey, calcareous - gravels are fine to coarse, subrounded	
	36		CR25			
			CR26			
-36						
					37.4 m to 38.5 m - Silty Fine SAND (SM), medium dense to dense, olive brown, calcareous silica - with coarse sand pockets with shell fragments	
	38		CR27			
					38.5 m to 39.2 m - Gravelly Fat CLAY (CH), stiff to very stiff, olive brown, calcareous	
-38			CR28			
					39.2 m to 47.1 m - SANDSTONE, fine to medium grained, extremely weak, fresh, olive brown, olive yellow, thickly laminated to very thinly bedded, slightly cemented - with coarse gravel to cobble sized, well carbonate cemented nodules - with mica crystals - bedding planes are 5°-15° and occasionally oxidated - fine grained to 39.9 m	
	40		SPT18	R		
			CR29			
-40			CR30			
	42		CR31			
			CR32			
-42					- well carbonate cemented nodule, 43.2 m to 43.4 m	
	44		CR33			
-44			CR34			
	46		CR35			
					47.1 m to 94.7 m - SANDSTONE, fine to medium-grained, extremely weak, fresh, grey, thickly laminated to very thinly bedded, slightly cemented - with coarse gravel to cobble sized, well carbonate cemented nodules - with mica crystals - bedding planes are 5°-15°	
-46			CR36			
	48					

GEOTECHNICAL LOG

LOCATION EAN-1

P2015.0028

PROJECT NO:	P2015.0028	**START DATE:**	10/14/2015	**DRILLING COMPANY:**	Fugro
BORING:	EAN-1	**COMPLETION DATE:**	10/19/2015	**DRILLING METHOD:**	Rotary borehole drilling, sampling and testing

Coordinates: E467944.0 N4467032.0
UTM Zone 35N, WGS 84, Meters
Elevation: +1.28 m

Unit Weight [kN/m³]: 0 5 10 15 20 25
Rock Unconfined Compressive Strength [MPa]: 0 1 2 3 4 5 6
Coring rate [min/m]
ID Tests/RQD/Recovery[%]/Blow Counts: 0 20 40 60 80 100
Soil Undrained Shear Strength [kPa]: 0 200 400 600

Elevation [m]	Depth [m]	Soil / Rock Type	Sampler / Name	Blow Count	Material description	Stratum
	48		CR36		47.1 m to 94.7 m - SANDSTONE, fine to medium-grained, extremely weak, fresh, grey, thickly laminated to very thinly bedded, slightly cemented - with coarse gravel to cobble sized, well carbonate cemented nodules - with mica crystals - bedding planes are 5°-15° - well carbonate cemented nodule, 47.9 m to 48.1 m	
-48			CR37			
	50					
			CR38		- bedding planes are 15°-20°, 50.7 m to 51.3 m	
-50						
	52		CR39			
-52						
	54		CR40		- well carbonate cemented nodule, 53.8 m to 54.0 m	
			CR41			
-54						
	56					
			CR42		- medium to coarse grained, 56.3 m to 57.3 m - well carbonate cemented nodule, 56.9 m to 57.0 m	
-56						
	58		CR43			
-58						
	60		CR44		- well carbonate cemented nodule at 59.8 m	
-60						
			CR45			
	62					
			CR46		- well carbonate cemented nodule at 62.9 m	
-62						
	64		CR47			

GEOTECHNICAL LOG

LOCATION EAN-1

P2015.0028

PROJECT NO:	P2015.0028	**START DATE:**	10/14/2015	**DRILLING COMPANY:**	Fugro
BORING:	EAN-1	**COMPLETION DATE:**	10/19/2015	**DRILLING METHOD:**	Rotary borehole drilling, sampling and testing

Coordinates: E467944.0 N4467032.0
UTM Zone 35N, WGS 84, Meters
Elevation: +1.28 m

Unit Weight [kN/m³]: 0 5 10 15 20 25
Rock Unconfined Compressive Strength [MPa]: 0 1 2 3 4 5 6
Coring rate [min/m]
ID Tests/RQD/Recovery[%]/Blow Counts: 0 20 40 60 80 100
Soil Undrained Shear Strength [kPa]: 0 200 400 600

Elevation [m]	Depth [m]	Soil / Rock Type	Sampler / Name	Blow Count	Material description	Stratum
	64				47.1 m to 94.7 m - SANDSTONE, fine to medium-grained, extremely weak, fresh, grey, thickly laminated to very thinly bedded, slightly cemented - with coarse gravel to cobble sized, well carbonate cemented nodules - with mica crystals - bedding planes are 5°-15° - well carbonate cemented nodule, 63.8 m to 64.3 m - well carbonate cemented nodule, 65.5 m to 65.7 m	
-64			CR48			
	66		CR49			
-66			CR50			
	68					
-68			CR51			
	70		CR52			
-70						
	72		CR53			
-72			CR54		- 30°, undulating, rough fissure at 73.4 m - 45°, undulating, rough fissure at 73.6 m	
	74				- well carbonate cemented nodule, 74.3 m to 74.5 m	
-74			CR55			
	76		CR56		- 45°, undulating, rough fissure at 76.0 m - mudstone with irregular calcite veins, 76.4 m to 76.5 m	
-76			CR57		- mudstone, 77.7 m to 77.8 m	
	78		CR58		- mudstone at 78.5 m	
-78			CR59		- well carbonate cemented nodule, 79.1 m to 79.2 m	
	80				- well carbonate cemented nodule at 80.0 m	

GEOTECHNICAL LOG

LOCATION EAN-1

P2015.0028

PROJECT NO:	P2015.0028	**START DATE:**	10/14/2015	**DRILLING COMPANY:**	Fugro
BORING:	EAN-1	**COMPLETION DATE:**	10/19/2015	**DRILLING METHOD:**	Rotary borehole drilling, sampling and testing

Coordinates: E467944.0 N4467032.0
UTM Zone 35N, WGS 84, Meters
Elevation: +1.28 m

Unit Weight [kN/m³]: 0 5 10 15 20 25
Rock Unconfined Compressive Strength [MPa]: 0 1 2 3 4 5 6
Coring rate [min/m]
ID Tests/RQD/Recovery[%]/Blow Counts: 0 20 40 60 80 100
Soil Undrained Shear Strength [kPa]: 0 200 400 600

Elevation [m] / Depth [m]	Soil / Rock Type	Sampler / Name	Blow Count	Material description	Stratum
80		CR59		47.1 m to 94.7 m - SANDSTONE, fine to medium-grained, extremely weak, fresh, grey, thickly laminated to very thinly bedded, slightly cemented - with coarse gravel to cobble sized, well carbonate cemented nodules - with mica crystals - bedding planes are 5°-15°	
-80		CR60			
82				- well carbonate cemented nodule, 81.9 m to 82.0 m - with 5°-10° clay laminations, 82.0 m to 82.8 m	
-82		CR61			
84		CR62		- mudstone, 83.7 m to 83.8 m - 45°, planar, smooth fissure at 84.1 m	
-84		CR63		- well cemented sandstone with vertical, undulating, rough, very closely spaced joints with calcite infilling, 84.8 m to 85.0 m	
86				- vertical, undulating, rough fissure, 86.3 m to 86.5 m	
-86		CR64		- 45°, undulating, rough fissure at 87.1 m	
88				- subvertical, undulating, rough fissure, 87.4 m to 87.8 m - well carbonate cemented nodule at 87.7 m	
-88		CR65			
90		CR66		- fine to coarse grained below 90.8 m	
-90		CR67		- well carbonate cemented nodule at 91.3 m	
92				- well carbonate cemented nodule at 91.9 m	
-92		CR68		- with mudstone seams, 92.9 m to 93.5 m	
94		CR69		- conglomeratic sandstone at 94.0 m - well cemented, 94.2 m to 94.3 m	
-94		CR70		94.7 m to 97.0 m - MUDSTONE, very weak, fresh, greenish grey, weak red - 60°, undulating, closed fissure with 5-mm thick calcite, 94.7 m to 95.0 m - 10°-20°, planar, smooth, closely spaced fissures, 95.3 m to 96.0 m	
96					

GEOTECHNICAL LOG

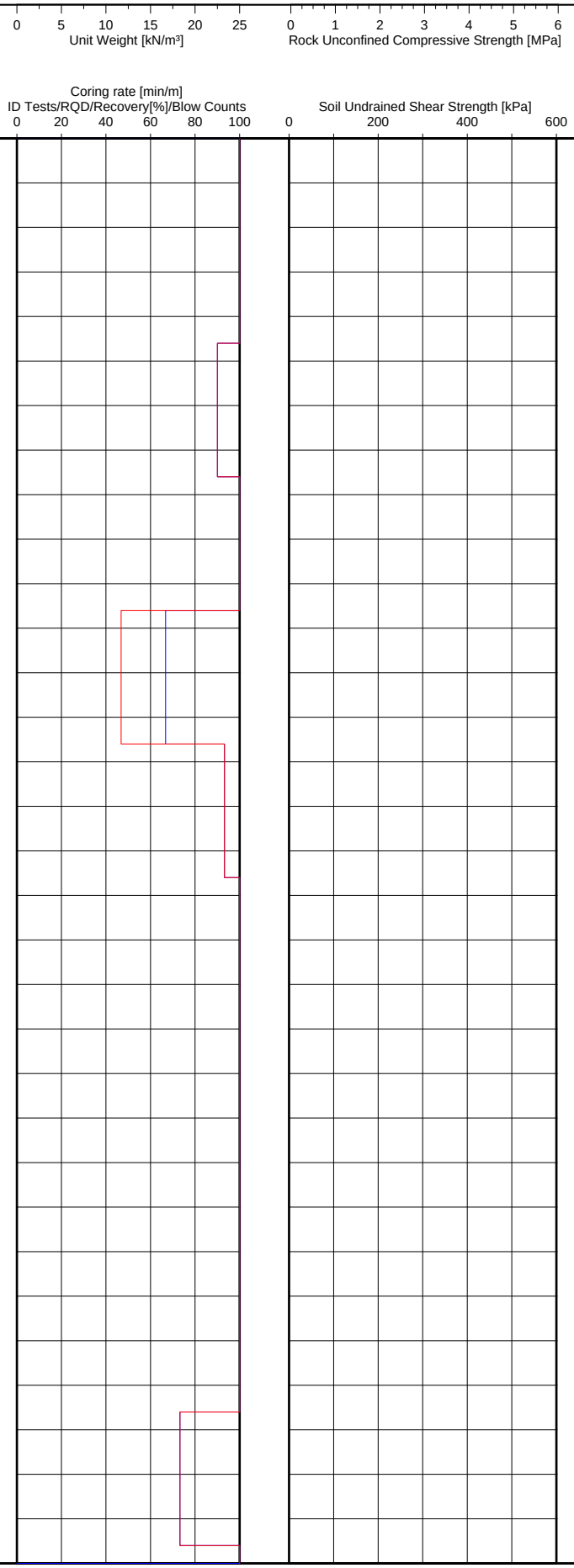
LOCATION EAN-1

P2015.0028

PROJECT NO:	P2015.0028	**START DATE:**	10/14/2015	**DRILLING COMPANY:**	Fugro
BORING:	EAN-1	**COMPLETION DATE:**	10/19/2015	**DRILLING METHOD:**	Rotary borehole drilling, sampling and testing

Coordinates: E467944.0 N4467032.0
UTM Zone 35N, WGS 84, Meters
Elevation: +1.28 m

Elevation [m]	Depth [m]	Soil / Rock Type	Sampler / Name	Blow Count	Material description	Stratum
	96		CR70		94.7 m to 97.0 m - MUDSTONE, very weak, fresh, greenish grey, weak red - 45°, planar, smooth, medium spaced fissures, 95.3 m to 96.8 m - siltstone, extremely weak, 96.0 m to 96.2 m	
-96			CR71		97.0 m to 97.9 m - SANDSTONE, extremely weak, fresh, greenish grey, laminated, slightly cemented - mudstone at 97.8 m - well carbonate cemented nodule at 97.9 m	
	98		CR72		97.9 m to 99.0 m - MUDSTONE, very weak, fresh, greenish grey - sandstone, extremely weak, laminated, 98.2 m to 98.5 m - beddings are 30° below 98.2 m - 45°-55°, undulating, slickensided, closely spaced fissures with subhorizontal striations, 98.5 m to 98.8 m - sandstone, extremely weak, below 98.8 m	
-98						
	100		CR73		99.0 m to 99.5 m - BRECCIATED MUDSTONE, extremely weak, greenish grey, weak red - gravel sized mudstone fragments cemented in matrix - with irregular, extremely closely spaced slickensided surfaces	
-100			CR74		99.5 m to 100.5 m - SANDSTONE, extremely weak, fresh, dark greenish grey, laminated, slightly cemented - with coarse gravel to cobble sized, well carbonate cemented nodules - bedding planes are 10°-15° - 70°, planar, rough to smooth, closely spaced, occasionally closed fissures, 99.8 m to 100.0 m	
	102				100.5 m to 116.5 m - SANDSTONE, fine to medium-grained, extremely weak, fresh, grey, greenish grey, laminated, slightly cemented - with coarse gravel to cobble sized, well carbonate cemented nodules - bedding planes are 10°-15° - conglomeratic sandstone, 101.0 m to 101.3 m - well carbonate cemented nodule at 101.5 m - well carbonate cemented nodule at 102.0 m	
-102			CR75			
	104				- beddings are horizontal below 104.0 m	
-104			CR76			
	106				- 50°, planar, rough, fissure at 106.3 m	
-106			CR77			
	108		CR78		- well carbonate cemented nodule at 108.3 m	
-108			CR79		- 40°, planar, rough, fissure at 109.7 m	
	110				- well carbonate cemented nodule at 110.3 m	
-110			CR80			
	112		CR81		- well carbonate cemented nodule at 111.9 m	



GEOTECHNICAL LOG

LOCATION EAN-1

P2015.0028

PROJECT NO:	P2015.0028	**START DATE:**	10/14/2015	**DRILLING COMPANY:**	Fugro
BORING:	EAN-1	**COMPLETION DATE:**	10/19/2015	**DRILLING METHOD:**	Rotary borehole drilling, sampling and testing

Coordinates: E467944.0 N4467032.0
UTM Zone 35N, WGS 84, Meters
Elevation: +1.28 m

Elevation [m] / Depth [m]	Soil / Rock Type	Sampler / Name	Blow Count	Material description	Stratum
112		CR81		100.5 m to 116.5 m - SANDSTONE, fine to medium-grained, extremely weak, fresh, grey, greenish grey, laminated, slightly cemented - with coarse gravel to cobble sized, well carbonate cemented nodules - bedding planes are 10°-15° - well carbonate cemented nodule at 112.4 m - well carbonate cemented nodule at 112.8 m	
		CR82			
-112					
		CR83			
114				- well carbonate cemented nodule at 114.1 m	
-114					
		CR84			
116				- conglomeratic sandstone below 116.3 m	
				116.5 m to 117.1 m - BRECCIA, extremely weak, very dark greenish grey - subvertical, undulating, slickensided, very closely spaced shear planes with subhorizontal striations - 60°, stepped, slickensided fissure at 116.9 m	
		CR85			
-116					
				117.1 m to 123.8 m - SANDSTONE, fine to medium-grained, extremely weak, fresh, grey, greenish grey, laminated, slightly cemented - with coarse gravel to cobble sized, well carbonate cemented nodules - bedding planes are 10°-15° - well carbonate cemented nodule at 117.3 m to 117.5 m - well carbonate cemented nodule at 117.6 m to 117.8 m - well carbonate cemented nodule at 117.9 m - well carbonate cemented nodule at 118.3 m to 118.4 m	
118		CR86			
-118					
120		CR87		- well carbonate cemented nodule at 120.0 m to 120.1 m	
-120					
		CR88		- well carbonate cemented nodule at 121.4 m	
122					
				- well carbonate cemented nodule at 122.1 m to 122.2 m	
		CR89			
-122					
				- brecciated below 123.6 m	
124				123.8 m to 124.5 m - BRECCIATED MUDSTONE, extremely to very weak, greenish grey, weak red - gravel sized mudstone fragments cemented in matrix - with irregular, extremely closely spaced slickensided surfaces - 45°-50°, planar, slickensided, very closely spaced, occasionally closed shear surfaces	
		CR90			
-124				124.5 m to 125.8 m - SILTSTONE, very weak to weak, fresh, grey	
126		CR91		125.8 m to 127.3 m - SILTSTONE, very weak to weak, fresh, grey, laminated - with Sandstone laminations	
-126					
		CR92		127.3 m to 130.5 m - SANDSTONE, extremely weak, fresh, grey, laminated, slightly cemented - with gravel to cobble sized well carbonate cemented nodules	
128					

Unit Weight [kN/m³]: 0 5 10 15 20 25
Rock Unconfined Compressive Strength [MPa]: 0 1 2 3 4 5 6
Coring rate [min/m]
ID Tests/RQD/Recovery[%]/Blow Counts: 0 20 40 60 80 100
Soil Undrained Shear Strength [kPa]: 0 200 400 600

GEOTECHNICAL LOG

LOCATION EAN-1

P2015.0028

PROJECT NO:	P2015.0028	**START DATE:**	10/14/2015	**DRILLING COMPANY:**	Fugro
BORING:	EAN-1	**COMPLETION DATE:**	10/19/2015	**DRILLING METHOD:**	Rotary borehole drilling, sampling and testing

Coordinates: E467944.0 N4467032.0
UTM Zone 35N, WGS 84, Meters
Elevation: +1.28 m

Unit Weight [kN/m³]: 0 5 10 15 20 25
Rock Unconfined Compressive Strength [MPa]: 0 1 2 3 4 5 6
Coring rate [min/m]
ID Tests/RQD/Recovery[%]/Blow Counts: 0 20 40 60 80 100
Soil Undrained Shear Strength [kPa]: 0 200 400 600

Elevation [m]	Depth [m]	Soil / Rock Type	Sampler / Name	Blow Count	Material description	Stratum
128			CR92		127.3 m to 130.5 m - SANDSTONE, extremely weak, fresh, grey, laminated, slightly cemented - with gravel to cobble sized well carbonate cemented nodules	
	-128		CR93			
130			CR94		- well carbonate cemented nodule, 130.4 m to 130.5 m 130.5 m to 131.0 m - BRECCIATED MUDSTONE, extremely weak, dark greenish grey - with gravel sized carbonate concressions - with irregular, extremely closely spaced slickensided surfaces	
	-130					
132			CR95		131.0 m to 133.7 m - MUDSTONE, very weak, fresh, mottled greenish grey, olive brown and weak red - subvertical, undulating, slickensided, incipient fissures below 132.8 m - 60°, planar to undulating, smooth fissure at 133.0 m	
	-132		CR96			
134					133.7 m to 135.2 m - CONGLOMERATE, very weak, fresh, greenish grey - 20°, planar, closed beddings - sandstone, very weak, 134.2 m to 134.5 m - sandstone, extremely weak, 134.7 m to 134.8 m	
	-134		CR97		135.2 m to 139.1 m - SANDSTONE, extremely weak, fresh, greenish grey, slightly cemented - with gravel to cobble sized, well carbonate cemented nodules - siltstone to 135.4 m	
136			CR98			
	-136					
138			CR99		- 60°, undulating, rough fissure at 138.3 m	
	-138		CR100		139.1 m to 141.3 m - MUDSTONE, very weak to weak, fresh, mottled greenish grey and reddish brown - with many carbonate nodules - subvertical, undulating, slickensided, very closely spaced fissures with subvertical striations, 139.1 m to 139.6 m - extremely weak with 30°, planar, closed fissures, 139.6 m to 139.8 m	
140			CR101			
	-140				141.3 m to 142.6 m - SILTSTONE, very weak to weak, fresh, greenish grey - with carbonate nodules	
142			CR102		142.6 m to 143.2 m - SANDSTONE, fine grained, extremely weak, fresh, greenish grey, laminated to very thinly bedded, slightly cemented - beddings are 20° - 30°-40°, undulating, slickensided, closely spaced fissures with horizontal striations	
	-142		CR103		143.2 m to 146.3 m - SANDSTONE, medium to coarse grained, extremely weak, fresh, greenish grey to grey, laminated to very thinly bedded, slightly cemented - with gravel sized well carbonate cemented nodules	
144						

GEOTECHNICAL LOG

LOCATION EAN-1

P2015.0028

PROJECT NO:	P2015.0028	**START DATE:**	10/14/2015	**DRILLING COMPANY:**	Fugro
BORING:	EAN-1	**COMPLETION DATE:**	10/19/2015	**DRILLING METHOD:**	Rotary borehole drilling, sampling and testing

Coordinates: E467944.0 N4467032.0
UTM Zone 35N, WGS 84, Meters

Elevation: +1.28 m

Elevation [m] / Depth [m]	Soil / Rock Type	Sampler / Name	Blow Count	Material description	Stratum
144		CR103		143.2 m to 146.3 m - SANDSTONE, medium to coarse grained, extremely weak, fresh, greenish grey to grey, laminated to very thinly bedded, slightly cemented - with gravel sized well carbonate cemented nodules	
-144		CR104			
146				146.3 m to 146.6 m - SILTSTONE, very weak, fresh, greenish grey - with carbonate nodules	
				146.6 m to 147.1 m - MUDSTONE, very weak, fresh, mottled greenish grey and weak red - with many carbonate nodules - 10°-20°, undulating closed fissure with clay infilling at 146.6 m	
		CR105			
-146				147.1 m to 147.4 m - SILTSTONE, very weak, fresh, greenish grey - with carbonate nodules	
148				147.4 m to 148.5 m - SANDSTONE, fine grained, extremely weak, fresh, greenish grey, laminated to very thinly bedded, slightly cemented - beddings are 10°-20° - 50°-60°, planar, extremely to very closely spaced, closed fissures 147.7 m to 148.0 m - shear zone, 148.1 m to 148.3 m	
		CR106			
-148				148.5 m to 150.0 m - SANDSTONE, medium grained, extremely weak, fresh, greenish grey, slightly cemented - subvertical, undulating, closed fissure below 149.3 m - End of Borehole at 150.0 m	
		CR107			
150					
-150					
152					
-152					
154					
-154					
156					
-156					
158					
-158					
160					

Unit Weight [kN/m³]: 0 5 10 15 20 25

Rock Unconfined Compressive Strength [MPa]: 0 1 2 3 4 5 6

Coring rate [min/m]
ID Tests/RQD/Recovery[%]/Blow Counts: 0 20 40 60 80 100

Soil Undrained Shear Strength [kPa]: 0 200 400 600

GEOTECHNICAL LOG

LOCATION EAN-1

P2015.0028

Appendix 2 Drawings

TEKIRDAG
KM 19.3 - 123.5 (104.2 km)

ISTANBUL
KM 0 - 19.3 (19.3 km)

CANAKKALE
KM 123.5 - 188.0 (64.5 km)

BEG. OF PROJECT
STA. 0+000

END OF PROJECT
STA. 188+000

Kinali-2 IC
Kinali-3 IC
Canta IC
Marmara IC
Corlu IC
Karatepe IC
Hayrabolu IC
Tekirdag West IC
Tekirdag East IC
Tekirdag IC
Malkara IC
Bolayir Evrese IC
Gelibolu North IC
Dardanelles Bridge
Gelibolu South IC
Canakkale IC

Corlu
Tekirdag
Canakkale
Eceabat
Istanbul

KIRKLARELI
TEKIRDAG
EDIRNE
ISTANBUL
CANAKKALE
BALIKESIR
YALOVA

Bulgaria
Georgia
Armenia
Turkey
Syria
Lebanon
Cyprus

0 100 300 500 km
SCALE 1 : 16,000,000 (A3)

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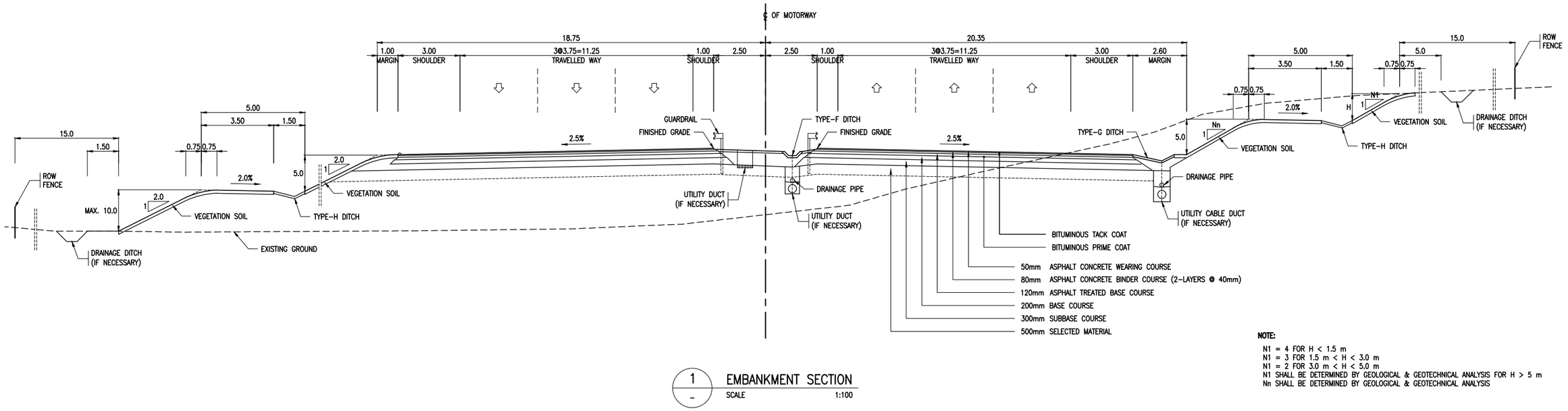
LOCATION MAP

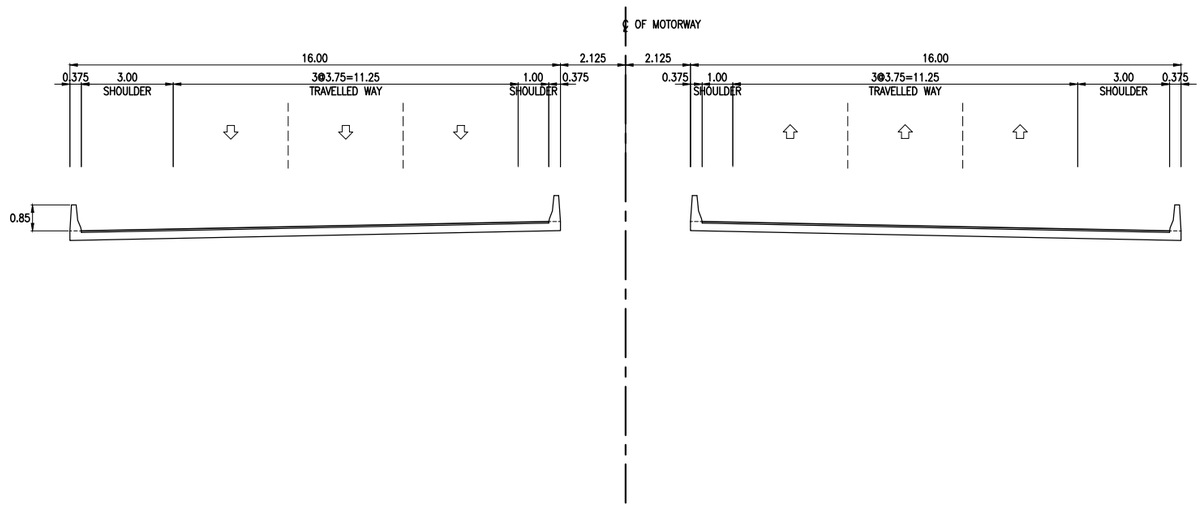
0 10 20 30 km
SCALE 1 : 600,000 (A3)



1 / - EMBANKMENT SECTION
SCALE 1:100

NOTE:

N1 = 4 FOR H < 1.5 m
N1 = 3 FOR 1.5 m < H < 3.0 m
N1 = 2 FOR 3.0 m < H < 5.0 m
N1 SHALL BE DETERMINED BY GEOLOGICAL & GEOTECHNICAL ANALYSIS FOR H > 5 m
Nn SHALL BE DETERMINED BY GEOLOGICAL & GEOTECHNICAL ANALYSIS



2 / - BRIDGE SECTION (SHORT-MEDIUM LENGTH)
SCALE 1:100

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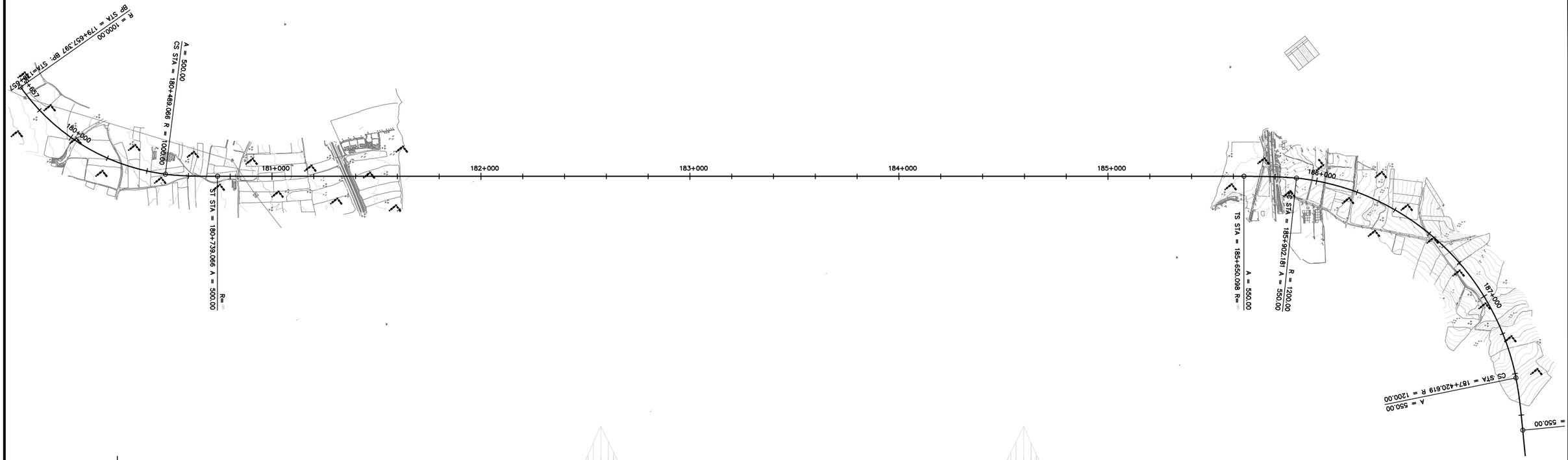
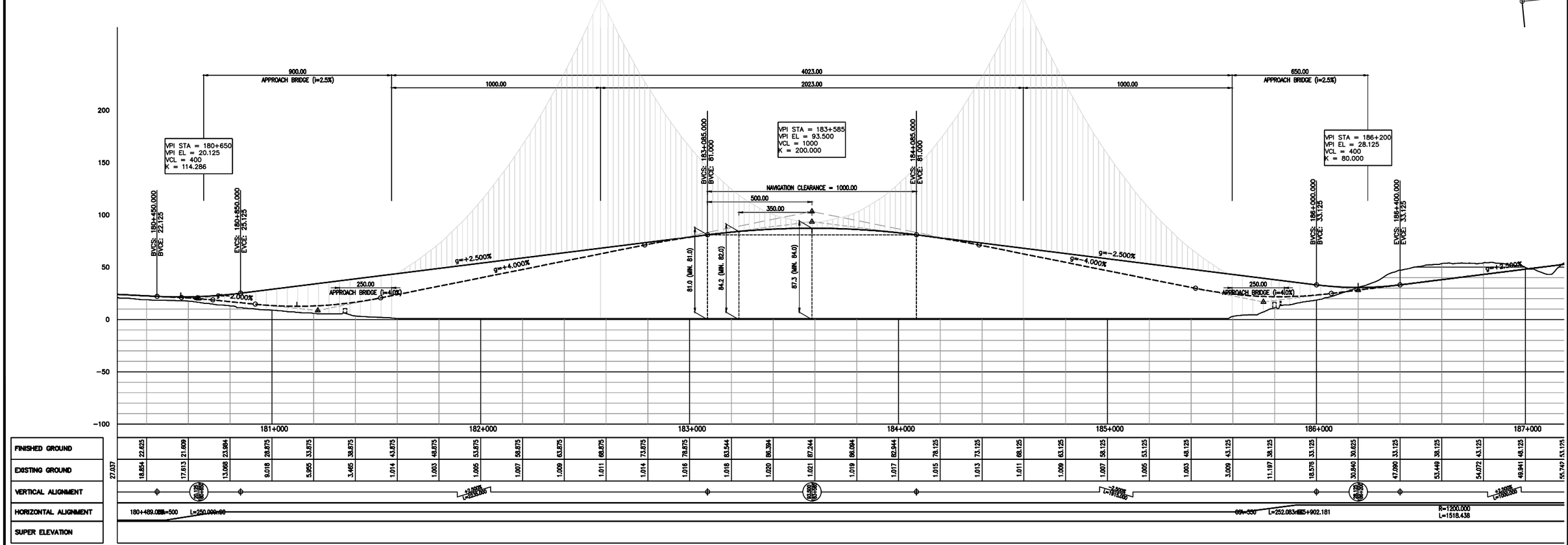
TYPICAL CROSS SECTION

SCALE 1 : 200 (A3)





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DARDANELLES STRAIT BRIDGE

SCALE 1 : 160,000 (A3)

KINALI-1 INTERCHANGE
STA. -1+000

BEG. OF PROJECT
STA. 0+000

KINALI-3 INTERCHANGE
STA. 3+700

TOLL PLAZA
STA. 4+200

CANTA INTERCHANGE
STA. 14+000

SERVICE AREA
STA. 18+200

MARMARA INTERCHANGE
STA. 22+400

CORLU INTERCHANGE
STA. 26+000

SERVICE AREA
STA. 31+600

LEGEND
- UNDERPASS BRIDGE
- RIVER BRIDGE
- OVERPASS BRIDGE
- BOX CULVERT
- TUNNEL

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ALIGNMENT LAYOUT PLAN
(01 / 05)

SCALE 1 : 50,000 (A3)

KARATEPE INTERCHANGE
STA. 40+600

SERVICE AREA
STA. 47+500

TEKIRDAG EAST INTERCHANGE
STA. 55+200

TEKIRDAG INTERCHANGE
STA. 61+400

HAYRABOLU INTERCHANGE
STA. 68+000

SERVICE AREA
STA. 70+500

TEKIRDAG WEST INTERCHANGE
STA. 75+000

LEGEND
- UNDERPASS BRIDGE
- RIVER BRIDGE
- OVERPASS BRIDGE
- BOX CULVERT
- TUNNEL

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ALIGNMENT LAYOUT PLAN
(02 / 05)

0 1 2 3 km
SCALE 1 : 50,000 (A3)

SERVICE AREA
STA. 99+400

TAKIRDAG IPSALA ROAD

SERVICE AREA
STA. 112+500

MALKARA INTERCHANGE
STA. 108+000

TANYRDAG IPSALA ROAD

LEGEND
- UNDERPASS BRIDGE
- RIVER BRIDGE
- OVERPASS BRIDGE
- BOX CULVERT
- TUNNEL

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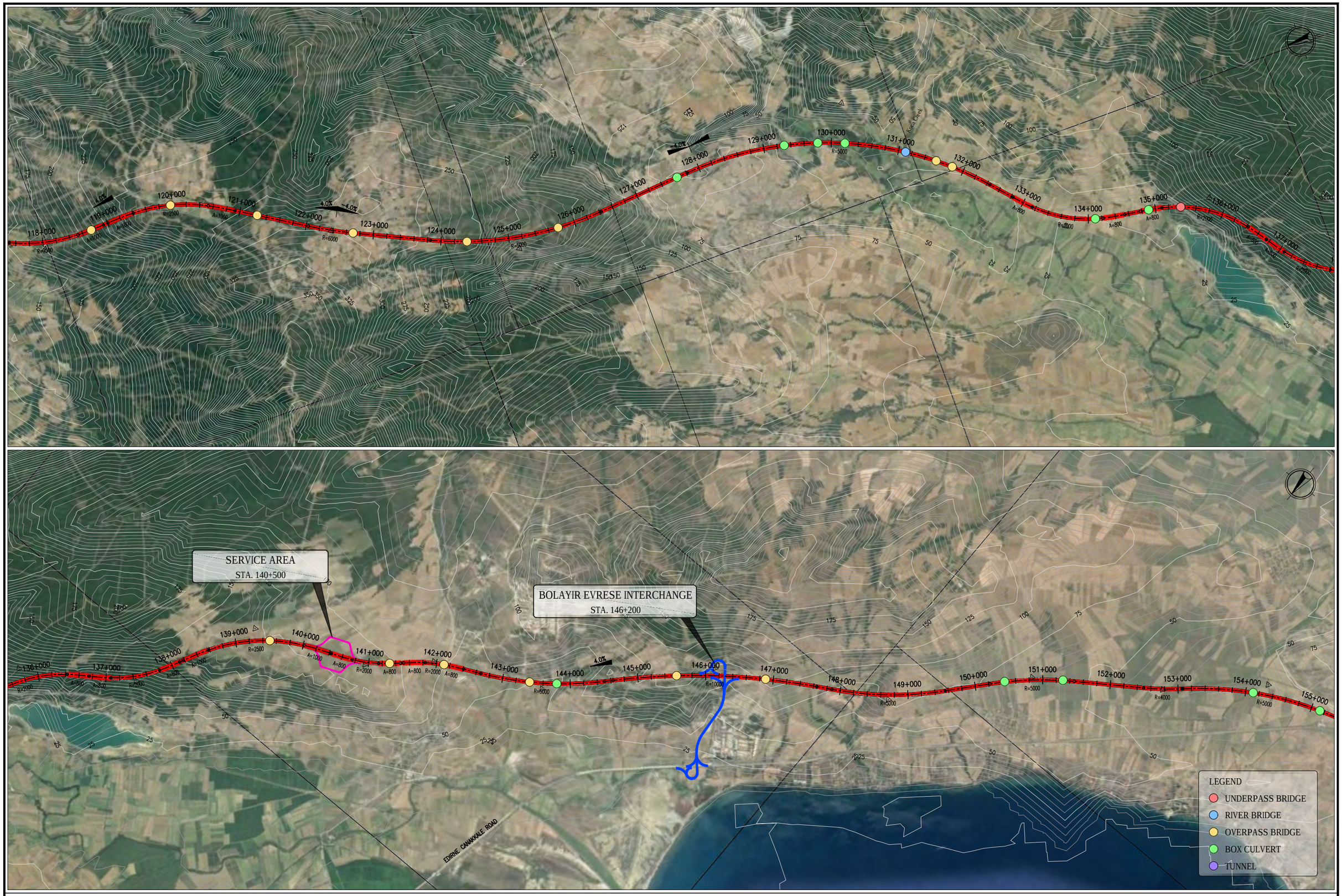
ALIGNMENT LAYOUT PLAN
(03 / 05)

0 1 2 3 km

SCALE 1 : 50,000 (A3)



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ALIGNMENT LAYOUT PLAN
(04 / 05)

0 1 2 3 km

SCALE 1 : 50,000 (A3)

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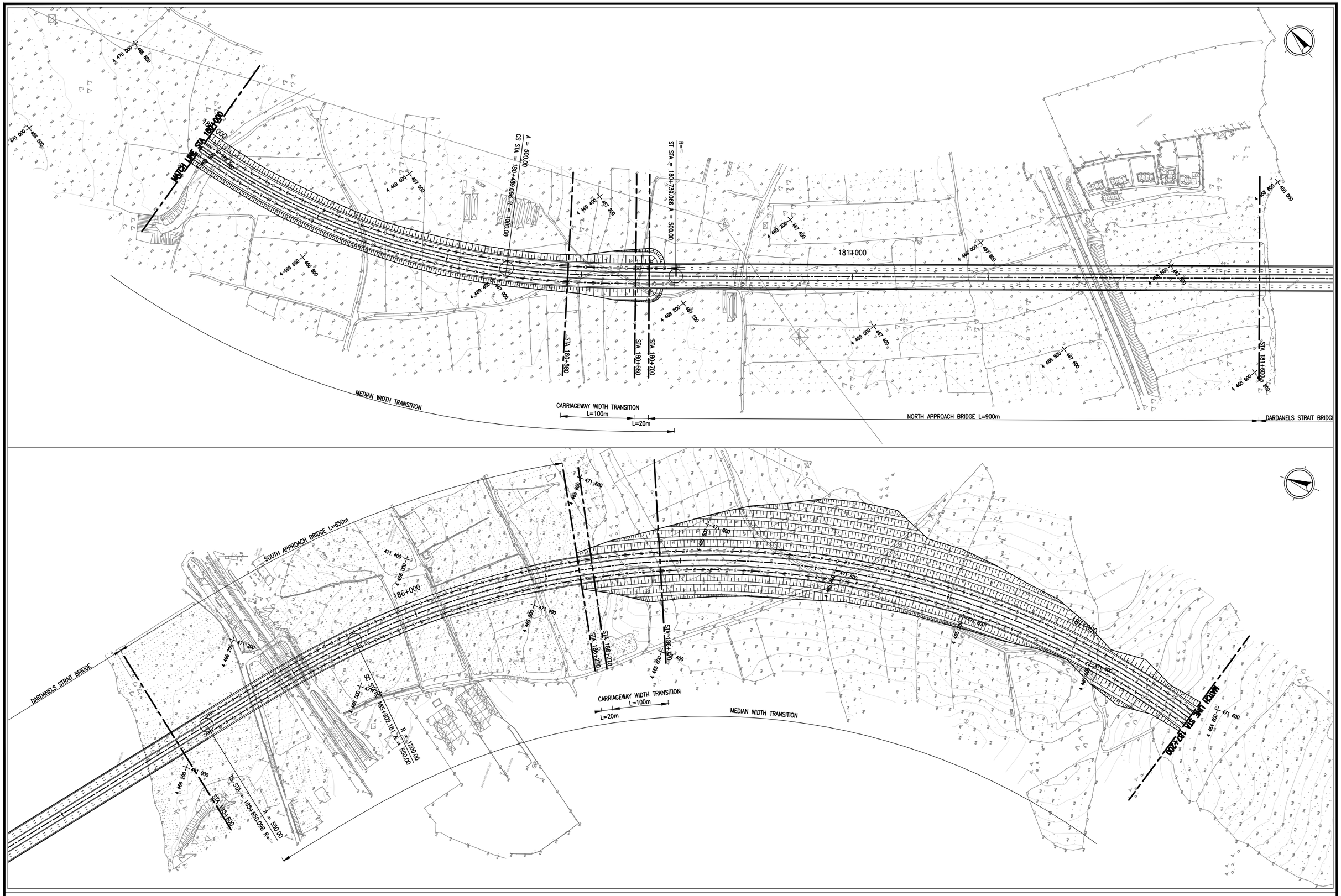
ALIGNMENT LAYOUT PLAN
(05 / 05)

0 1 2 3 km

SCALE 1 : 50,000 (A3)



PREPARATORY SURVEY ON THE PROJECT FOR
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STRAIT BRIDGE APPROACH
PLAN

0 10 20 300 m

SCALE 1 : 5,000 (A3)