AYGM

HALKALI-ISPARTAKULE-CERKEZKOY RAILWAY LINE

Environmental and Social Impact Assessment



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16

MAJOR ACCIDENTS AND DISASTERS

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16.1 INTRODUCTION

16.1.1. This chapter provides consideration and high-level assessment of likely significant adverse effects of the Project on the environment, deriving from the vulnerability of the Project to risks of relevant major accidents and/or disasters related to natural hazards or manmade hazards (including operational failure) (hereafter referred to as major events). The Chapter takes into consideration both external and internal factors, during the operation and construction phases, namely:

- The vulnerability of the Project to major events; and/or
- The Project's potential to cause major events.

16.1.2. Based on professional judgement, major events are events or scenarios that have the potential to affect the Project causing immediate or delayed serious damage to one or more of the following:

- Human health;
- Property; and the
- Environment.

16.1.3. This chapter has been completed in accordance with paragraph 15 of EU Directive 2014/52/EU and the Turkish Regulation on Environmental Impact Assessment (the EIA Regulation) 2014.

16.1.4. This assessment is based on the information available within other relevant technical chapters, such as receptors, potential significant effects and appropriate mitigation measures. This Chapter is intended to be read as part of the wider ESIA, with particular reference to the following chapters: **Chapter 6: Air Quality, Chapter 11: Surface Water Environment, Chapter 12: Geology and Hydrogeology** and **Chapter 14: Climate Change**.

16.1.5. The potential major events to which the Project may be at risk of vulnerability during construction and operation phases considered in this chapter are listed in **Table 16-1**.

Table 16-1 - Major Event Categories and Types

Term	Type
Natural	Geophysical
	Hydrological
	Climatological and Metrological
	Space
	Biological
Technological or Manmade Hazards	Societal
	Industrial and Urban Accidents
	Transport Accidents

Term	Type
	Pollution Accidents
	Utility Failures
	Malicious Attacks
	Engineering Accidents and Failures

16.1.6. This Chapter describes the assessment methodology and the baseline conditions relevant to the assessment and a summary of the likely significant effects resulting from the vulnerability of the Project to major events. Where appropriate, this chapter includes the further mitigation measures required to prevent, reduce or offset any significant adverse effects, the preparedness for and proposed response to emergencies, and the expected residual effects after these mitigation measures have been employed.

16.2 GLOSSARY

The definition of key terms used in this Chapter are provided in **Table 16-2**. These definitions have been developed by reference to the definitions used in EU and Turkish legislation and guidance relevant to major accidents or disasters as well as professional judgement based on knowledge and experience of similar projects in the context of the Project.

Table 16-2 - Key Terms

Term	Definition
Consultation Zone	The Ministry of Environment and Urbanization (MoEU) sets a Consultation Distance (CD) around major hazard sites and major accident hazard installations and pipelines after assessing the risks and likely effects of major accidents at the major hazard. The area enclosed within the CD is referred to as the consultation zone. The Planning Authority is notified of this CD and has a statutory duty to consult the regulatory agency on certain Projects within the zone the CD forms.
(Natural) Disaster	In the context of the Project, a naturally occurring phenomenon such as an extreme weather event (for example storm, flood, temperature) or ground-related hazard events (for example subsidence, landslide, earthquake) with the potential to cause an event or situation that meets the definition of a Major Accident as defined below.

Term	Definition
External Influencing Factor	A factor which occurs beyond the Project that may present a risk to the Project, e.g. If an external disaster occurred (e.g. earthquake, BEKRA[291] site major accident) it would increase the risk of serious damage to an environmental receptor associated with the Project.
Hazard	Anything with the potential to cause harm, including ill-health and injury, damage to property or the environment; or a combination of these.
Internal Influencing Factor	A factor which occurs within the Project that may present a risk to the Project itself.
Major Accident	In the context of the Project, an event that threatens immediate or delayed serious damage to human health, welfare or the environment, and requires the use of resources beyond those of the Applicant or its contractors to respond to the event. Serious damage includes the loss of life or permanent injury and/or permanent or long-lasting damage to an environmental receptor that cannot be restored through minor clean-up and restoration efforts. The significance of this effect takes into account the extent, severity and duration of harm and the sensitivity of the receptor.
Major Event	A term used to encompass both the term Major Accident and the term Natural Disaster.
Risk	The likelihood of an impact occurring combined with effect or consequence(s) of the impact on a receptor if it does occur.
Risk Event	An identified, unplanned event, which is considered relevant to the Project and has the potential to be a Major Accident or Disaster subject to assessment of its potential to result in a significant adverse effect on an environmental receptor.
Vulnerability	In the context of the EU Directive 2014/52/EU, the term refers to the 'exposure and resilience' of the Project to the risk of a major accident or disaster. Vulnerability is influenced by sensitivity, adaptive capacity and magnitude of impact.

16.3 ABBREVIATIONS

16.3.1. The abbreviations used in this Chapter are provided in **Table 16-3**.

[291] BEKRA (Büyük Endüstriyel Kaza Risklerinin Azaltılması) sites are establishments where industrial processes involving hazardous substances are carried out.

Table 16-3 - Abbreviations

Abbreviation	Description
ALARP	As Low as Reasonably Practicable
BEKRA	Turkish By-Law regarding Major Industrial Accident Risks
ESIA	Environmental Social Impact Assessment
EMS	Environmental Management System
MoEU	Ministry of Environment and Urbanization

16.4 LEGISLATIVE FRAMEWORK, POLICY AND GUIDANCE

16.4.1. This section outlines the international and national legislation, policy and guidance, including EBRD performance requirements, considered as part of the assessment.

INTERNATIONAL LEGISLATION, POLICY AND GUIDANCE

16.4.2. Paragraph 15 of EU Directive 2014/52/EU states:

"In order to ensure a high level of protection of the environment, precautionary actions need to be taken for certain projects which, because of their vulnerability to major accidents, and/or natural disasters (such as flooding, sea level rise, or earthquakes) are likely to have significant adverse effects on the environment. For such projects, it is important to consider their vulnerability (exposure and resilience) to major accidents and/or disasters, the risk of those accidents and/or disasters occurring and the implications for the likelihood of significant adverse effects on the environment."

16.4.3. There is currently no published guidance for the application of the legal requirements to major events. However, following guidance for risk assessment methodology is provides relevant guidelines:

- The International Standards Organization's ISO 31000:2009 Risk Management - Principles and Guidelines[292].

16.4.4. The EBRDs Environmental and Social Policy[293] focuses on 10 performance requirements that must be met to ensure appropriate operation and construction of any Project. The Environmental and Social Policy (2014), Performance Requirement (PR) 4, titled 'Health and Safety', outlines a project-level approach to occupational health and safety, community health and safety and specific requirements for health and safety in relation to:

- Infrastructure, building and equipment design and safety;
- Hazardous materials safety;

[292] International Standards Organization (2009). ISO 31000: 2009 Risk Management – Principles and Guidelines.
[293] EBRD (2014). Environmental and Social Policy.

- Product safety;
- Services safety;
- Traffic and road safety;
- Natural hazards;
- Exposure to disease; and
- Emergency preparedness and response.

16.4.5. All the above health and safety requirements in PR4 are relevant and can contribute to the occurrence of a major event.

16.4.6. Additionally, the following international sources have been consulted to support the identification of potential major events:

- The International Federation of Red Cross & Red Crescent Societies (2008), Early Warning, Early Action[294]. This guidance looks to other countries including those in warmer climates, thereby identifying risks that Turkey may encounter in the future in light of climate change and global warming.
- The International Disaster Database[295]. This online source contains data covering over 22,000 mass disasters in the world since 1900 to the present day and aims to "*rationalise decision making for disaster preparedness, as well as provide an objective base for vulnerability assessment and priority setting*".

NATIONAL LEGISLATION

16.4.7. The applicable EIA legislative framework surrounding major events is the Turkish Regulation on Environmental Impact Assessment (the EIA Regulation) 2014.

16.4.8. The applicable legislative framework covering the design, construction and operation of the Project is listed as follows:

- Occupational Health and Safety Law No. 6331, Official Gazette Date/Number: 30.06.2012/28339 (last amended 28.11.2017);
- Regulation on Health and Safety in Construction Works (2013), Official Gazette Date/Number: 05.10.2013/28786; and
- Regulation on Prevention of Major Industrial Accidents and Minimisation of their Impacts, Official Gazette Date/Number: 30.12.2013/28867 (last amended 18.07.2017).
- Regulation About Buildings to be Made at Disaster Areas, Official Gazette Date/Number: 03.05.2007/26511.
- Law About Aids to be Made with Actions to be Taken Because of Disasters Effective to Public Life, Official Gazette Number: 1959/7269.
- Regulation About Building to be Made at Earthquake Regions, Official Gazette Date/Number: 06.03.2007/ 26454.
- Turkey Earthquake Building Regulations, Official Gazette Date/Number: 18.03.2018/30364.

[294] International Federation of Red Cross and Red Crescent Societies (2008). Early Warning, Early Action.
[295] Centre for Research on the Epidemiology of Disasters (2020). The International Disaster Database. Available at: http://www.emdat.be/ (Accessed 26/06/20).

16.4.9. There are no applicable policy or guidance documents for major events at the time of writing.

16.5 ASSESSMENT METHODOLOGY

16.5.1. The assessment takes account of current and emerging EIA good practice[296,297, 298 & 299] which also refers to other relevant documentation, including 'Early Warning, Early Action' and the International Disaster Database.

16.5.2. The assessment of major events has been achieved through a review of available documentation. The assessment does not involve assessment from 'first principles', because it is recognised that existing legislation and health and safety requirements already identify risks and help to protect human beings and the environment.

16.5.3. The study area for major events has been developed based on professional judgement as there is no specific regulatory guidance nor significant precedent or standardised methodology. The following factors and associated distances were adopted for setting the study area in order to capture internal and external influencing factors which may have high adverse consequences on the Project:

- Manmade features:
  - Airports and airfields within 13km;
  - Major Industrial Accident Risks facilities (i.e. BEKRA establishments) within 3km;
  - Major Accident Hazard pipelines within 1km, such as dangerous gases, fuel and chemical pipeline systems;
  - Fuel retail sites (including Liquified Natural Gas, Liquified Petroleum Gas) within 1km;
  - Rail infrastructure within 500m; and
  - Transmission (gas, electrical, oil/fuels) crossing the Project.
- Natural features with the potential to create risks within:
  - 3km (chiefly hydrological and geological, for example dam failure and seismic activity respectively); and
  - 1km (chiefly hydrological and geological, for example flood risk and unstable ground conditions respectively).

16.5.4. **Figure 16-1** depicts the study area for major events.

16.5.5. An initial long list of all possible major event types was reviewed to rule out any potential accidents and disasters that are considered highly unlikely to occur due to the location of the Project, based on information provided by the Project Team and use of information sources related to accidents and

[296] IEMA (2020) Major Accidents and Disasters in EIA: A Primer
[297] IEMA (2017). EIA Quality Mark Webinar: Major Accidents and Natural Disasters in EIA.
[298] IEMA (2017). EIA Quality Mark Article: What is this MADness?
[299] Institute of Environmental Management and Assessment (IEMA) (2016). EIA Quality Mark Article: Assessing Risks of Major Accidents / Disasters in EIA.

disasters. Those major events that could not be screened out, formed the major events that were scoped in for further assessment (referred to as the short list).



THIS DRAWING MAY BE USED ONLY FOR THE PURPOSE INTENDED AND ONLY WRITTEN DIMENSIONS SHALL BE USED

Legend

- Railway Station
- Proposed Railway Route
- 500m Buffer for Rail Infrastructure
- 1Km Buffer for Major Accident Hazard Pipelines
- 3Km Buffer for Major Industrial Accident Risks Facilities
- 13Km Buffer for Airports and Airfields



Note:

Drawing Status: FINAL

Job Title: HALKALI-ISPARTAKULE-CERKEZKOY RAILWAY LINE

Drawing Title: Figure 16-1 - Study Area for Major Events

Scale at A4: 1:400,000

Drawn			
DG			
Stage 1 check	Stage 2 check	Originated	Date
LW	JW	DG	22/02/2021

0 1.25 2.5 5 7.5 10
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Drawing Number: Figure 16-1

Path: \\uk.wspgroup.com\central data\Projects\70069878xx\70069878 - IPPF - Turkey TCDD Halkali - Cerkezkoy High Speed Railway\03 WIP\GIS\Mxd\Figure 16-1 - Study Area.mxd

SIGNIFICANCE CRITERIA

16.5.6. By definition, a major event would have a major adverse effect on human health, property or the environment. Accordingly, any risks that could result in a major event without suitable mitigation, management or regulatory controls in place will be assessed as significant.

16.6 BASELINE CONDITIONS

EXISTING BASELINE

16.6.1. Major event risks relevant to the baseline in the absence of the Project include extreme weather events and associated flooding. Baseline 'without Project' conditions are described in detail in the Technical Chapters: **Chapter 6: Air Quality**, **Chapter 8: Ecology**, **Chapter 9: Cultural Heritage**, **Chapter 11: Surface Water Environment**, **Chapter 12: Geology and Hydrogeology**, **Chapter 14: Climate Change** and **Chapter 15: Social**. Those aspects of most relevance to this assessment are summarised below.

16.6.2. In line with Paragraph 15 of EU Directive 2014/52/EU, the following sensitive receptors were considered in relation to major events:

- Members of the public and local communities;
- Infrastructure and the built environment;
- The natural environment, including ecosystems, land and soil quality, air quality, surface and groundwater resources and landscape;
- The historic environment, including archaeology and built heritage; and
- The interaction between the factors above.

16.6.3. The specific potential receptors of effects resulting from a major event are all reported in the relevant topic chapter. However, the baseline features important to the Project are shown in **Table 16-4**.

Table 16-4 - Major Event Baseline Features

Feature	Type	Description	Approximate Distance and Direction from Project and/or Chainage
Büyükçekmece Lake (Figure 8-5)	Important Bird Area (IBA) – International Union for the Conservation of Nature (IUCN) Category IV	A freshwater lake situated west of Istanbul where the Karasu stream reaches the Marmara Sea. This site is important for wintering and passage waterbird species and also supports a range of breeding waterbirds.	A feeder channel (Camasir Creek and surrounding agricultural fields) to the north of the lake is crossed by the Project (underpass).
Küçükçekmece Basin (Figure 8-5)	IBA - IUCN Category IV	A natural brackish lagoon situated to the west of Istanbul on the Sea of Marmara that supports	The Project passes under the site in a tunnel.

Feature	Type	Description	Approximate Distance and Direction from Project and/or Chainage
		significant numbers of wintering waterbirds.	
Terkos Basin (Figure 8-5)	Key Biodiversity Area (KBA) (encompassing 4 nationally designated areas as described in **Chapter 8: Ecology**)	A large area comprising a complex of habitats including coastal, aquatic, swamp, grassland, heath and coppice forests. These habitats support a wide range of flora and fauna including a number of IUCN Red List species.	Crossed by the Project.
Büyükçekmece Dam	Potable Water Supply	Büyükçekmece Dam is an earth-fill embankment dam located at Lake Büyükçekmece (located downstream of the Project). It was opened in 1988 to provide a drinking water supply to Istanbul.	2km south of the Project.
Sazlidere Dam	Potable Water Supply	The Sazlıdere Dam was constructed along the alignment of the Sazli Stream in 1996 to provide drinking water to the western side of Istanbul (located upstream of the Project). The Project will not be located within the drainage catchment of the Dam.	4km east of the Project (outside study area but included due to the intervening topography).
Marmara Basin	Surface Irrigation, Potable and Industrial Water Provision	Groundwater Management Reserve groundwater management reserve of 205 million m^3 of water per year.	The Project is located within the Marmara Basin.
Cultural Heritage Assets (shown on Figures 9-3 to 9-18)	National Importance	Küçükçekmece 1st Degree Archaeological Site	3+350 – 5+000
		Küçükçekmece 3rd Degree Archaeological Site	5+000 – 6+000
		Ispartakule Train Station and Surrounds	9+400, adjacent to the Project.

Feature	Type	Description	Approximate Distance and Direction from Project and/or Chainage
		Old Yoğurthane Building (Historic Building)	9+450, adjacent to Project.
		Historical Civil Architecture Sample, Traditional House in Omerli	17+460, 10m to the south of the Project.
		Korugan Old Military Bunker, 2.5km west of Yesilbayir	22+700, adjacent to or possibly within the Project (Bunker 2).
		Bahşayış Bastion and Protection Zone, 1.4km north-west of Bahşayış	24+750 – 24+800, partly on the Project.
		Çatalca Station Buildings, 2km north-east of Çatalca	31+900, within the Project.
		Kaleiçi Historical Bridge (Çatalca – Kaleiçi), 2km north-east of Çatalca	32+700, 45m south-west of Project.
		Kabakca Station Buildings, 1.4km south of Kabakca	32+700, 45m north-east of the Project.
		Anastasuis's Wall, 2.8km north of Kurfalli	53+300 – 53+400, partly within the Project.
		Çayırdere Station Building, 3km south-west of Çayırdere	68+200, 275m south of Project.

Earthquakes

16.6.4. Based upon earthquake mapping from United States Geological Survey, no earthquakes have been recorded along the route of the Project between 1900-2015[300]. **Chapter 12: Geology and Hydrogeology** provides further details. However, other data sources indicate that on August 17th, 1999, there was an earthquake that struck Izmit measuring 7.4 on the Richter scale at 3:00 am that devastated the Marmara region of Turkey. Over 17,000 lives[301] were lost and there was extensive damage to Turkey's industrial heartland. Although the epicentre of the earthquake was approximately 100km east of Istanbul, it caused widespread fatalities and building destruction in Istanbul[302].

16.6.5. There is no fault line mapped along the length of the Project although a major fault line, North Anatolian, is known to be present within the Marmara Sea. This fault line is the nearest to the Project. and the North Anatolian Fault Line is 1,400km long east-west trending, and located approximately 20km south of the Project at the closest point as shown in **Figure 16-2**.

[300] USGS (2020). Earthquake. Available at: https://earthquake.usgs.gov/earthquakes/eventpage/us60007ewc/map (Accessed 29/07/20).
[301] World Bank (1999). Technical Annex for an Emergency Earthquake Recovery Loan in the Amount of US$252.53 Million to the Republic of Turkey.
[302] https://www.britannica.com/event/Izmit-earthquake-of-1999.

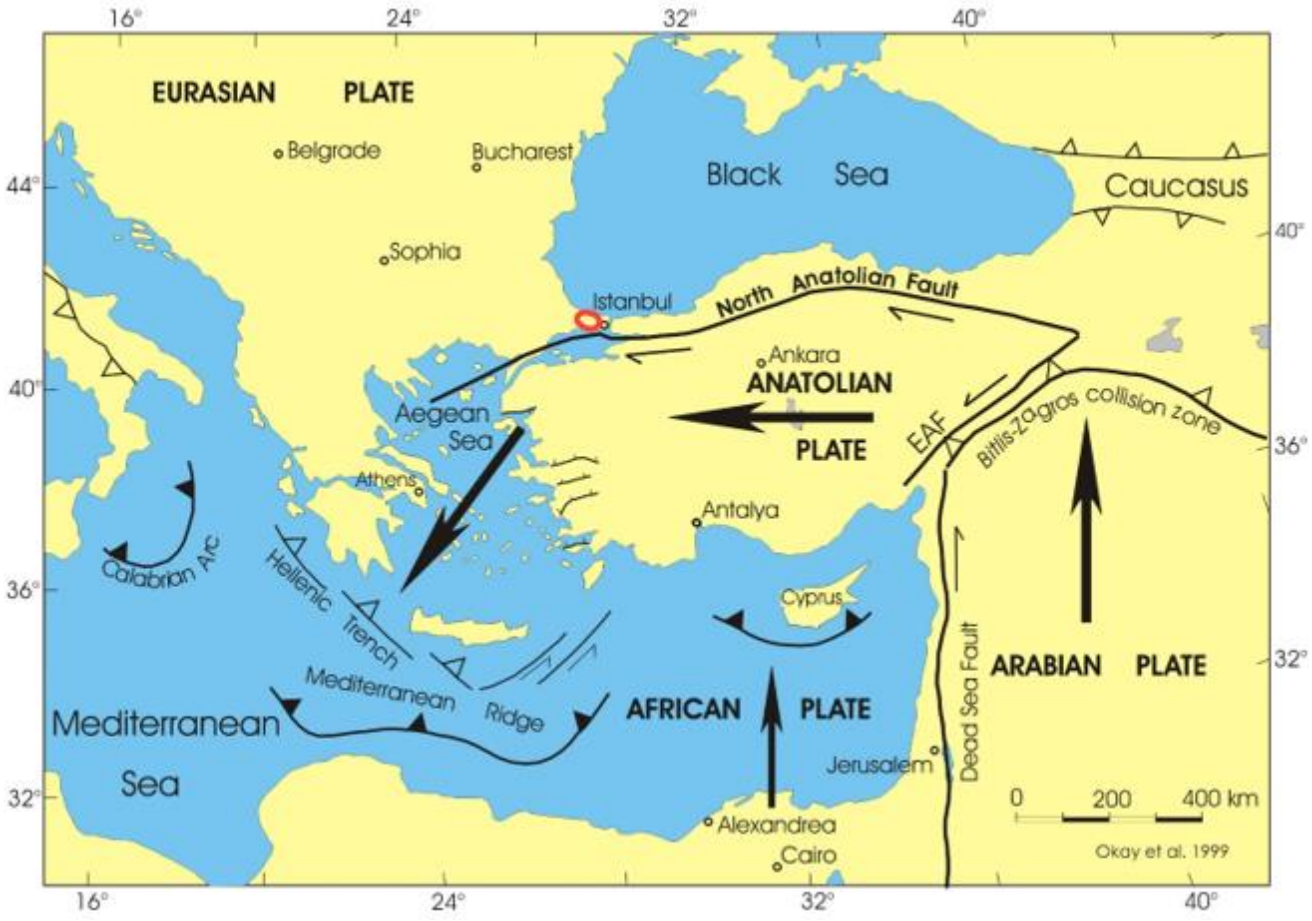


Figure 16-2 - Route of the North Anatolian Fault

16.6.6. As described in **Chapter 12: Geology Hydrogeology**, an updated Turkey Earthquake Hazard Map came into force on 1st January 2019 and shows the largest ground acceleration values rather than earthquake zones. Ground acceleration values replaces the 'earthquake zone' concept in Turkey. The Project is within an area with moderate to high probability of Peak Ground Acceleration (PGA) levels exceeding 10% within the next 50 years. Further details are provided in **Chapter 12: Geology Hydrogeology.**

Landslides

16.6.7. The Project passes through several areas which have a risk from landslides, in particular chainages 42+000 and 51+000 pass through areas which contain old and active landslides. The Project involves the formation of deep cuts / high embankments.

Unexploded Ordnance

16.6.8. Publicly available information from the Ministry of National Defence confirms that the Project does not pass through areas with the potential for Unexploded Ordnance (UXO) to be present[303]. Areas with the potential for UXO to be present are located in the east, south and central areas of Turkey.

Surface Water Features

16.6.9. The majority of the Project is located within the Marmara River Basin, with the very west of the Project passing into the Meriç Ergene River Basin on the approach to Çerkezköy.

16.6.10. The Project passes through 5 main watershed catchments as described and illustrated in **Chapter 11: Surface Water Environment**, including:

- Küçükçekmece Lake – catchment that includes the Sazli Stream and Hadımköy Stream / Eşkinoz Creek.
- Büyükçekmece Lake – catchment that includes Karasu Stream.
- Durugöl Lake – catchment that includes Kumluca / Karacaköy / Binkiliç Creek that extends to the north of the Project.
- Kinikli Creek – catchment that extends to the south of the Project.
- Corlu Creek – catchment that encompasses Çerkezköy to the west of the Project.

16.6.11. The Project crosses or is located in close proximity to several key watercourses. The Project also crosses approximately 70 smaller tributaries and overland flow routes that drain to these key watercourses. A summary of these is provided in **Chapter 11: Surface Water Environment.**

Flood Risk

16.6.12. The Flood Surge Map provided in Figure II-15 of the National EIA for the Project (2017)[304] indicates that the Project is not located in an area that is at risk of flooding from 'flood surge'. It is interpreted that 'flood surge' refers to flooding that may arise during extreme river and sea / wave events. Refer to **Chapter 11: Surface Water Environment for further details**.

16.6.13. The groundwater level is very close to the surface the starting point of the Project near Küçükçekmece Lake creating wetland habitats.

Cyclones, Hurricanes, Typhoons, Storms and Gales

16.6.14. The Project is located in regions, in which the Marmara Transition Climate and Trakya Continental Climate are dominant.

16.6.15. The maximum amount of rainfall that is expected on the Project, during the standard recurrent time of 100 years, is 114 - 151mm.

16.6.16. **Table 16-5** presents the observation logs for annual average stormy days and strong-windy days from each of the Meteorological Stations located close to the Project.

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[303] Ministry of National Defence (2020). Frequently Asked Questions. Available at: https://mafam.msb.gov.tr/en-US/MAFAM/Content/frequently-asked-questions (Accessed 14/04/21).
[304] Sweco Mühendislik Müşavirlik ve Tasarım Ltd. Şti.(2017). Halkali – Kapikule Railway Project EIA Report.

Table 16-5 - Observation Logs: Stormy Days and Strong-Windy Days

Meteorological Station	Stormy Days (Annual Average)	Strong-Windy Days (Annual Average)	Thunder-Stormy Days (Annual Average)
Florya Meteorological Station (closest station to Halkali)	2.6	47.4	13.8
Lüleburgaz Meteorological Station	2.8	14.1	24.1
Tekirdağ Meteorological Station (closest station to Cerkezkoy)	9.5	76.5	30.1

Extreme Temperatures: Heatwaves, Low (sub-zero) Temperatures and Heavy Snow

16.6.17. Turkey is located between the mid-latitude and subtropical climate zones and experiences a number of climate variables due to its differing topographical characteristics.

- Marmara climate: The average temperature of cold month January is 4.9°C, the average temperature of hot month July is 23.7°C, yearly average temperature is 14.0°C. Average yearly total rainfall is 595.2mm and most of the rainfall occurs in winter. The share of summer rainfalls within yearly total amount is 11.7%. In November 2020, it was reported that the Sazlıdere dam level was at a 10 year low, however it is reported by the authorities that water supply is not exclusively provided by dams and water levels were sufficient to meet a 120-day demand for Istanbul despite the lack of precipitation[305]. Yearly average relative humidity is 73%.
- Trakya Climate: The average temperature of cold month January is 2.8°C, the average temperature of hot month July is 23.9°C, yearly average temperature is 13.2°C. Average yearly total rainfall is 559.7mm and most of the rainfall occurs in winter. Even though it is less, rainfall occurs in summer in the region. The share of summer rainfalls within yearly total amount is 17.6%. Yearly average relative humidity is 69.6%.

16.6.18. Data provided by the observation logs from the meteorological stations close to the Project is presented in **Table 16-6**.

[305] Daily News (2020). Istanbul Dams Record Lowest Water Level in Decade. Available at: https://www.hurriyetdailynews.com/istanbul-dams-record-lowest-water-level-in-decade-160300 (Accessed: 27/01/20).

Table 16-6 - Extreme Temperature Data from Meteorological Station Observation Logs

Meteorological Station	Snowy Days (Annual Average)	Snow-covered Days (Annual Average)	Hail Stormy Days (Annual Average)	Frosty Days (Annual Average)	Max Snow Thickness (Annual, cm)
Florya	12.5	6.6	0.6	12.3	60 (March)
Lüleburgaz	7.7	7.7	0.5	45.1	47 (December)
Tekirdağ	12.6	6.9	0.7	16.1	44 (February)

Wildfires: Forest Fire, Bush/Brush, Pasture

16.6.19. The Project is located in areas with a 1st and 2nd degrees of risk of fire, based on the Turkish Fire Hazard Map shown in **Figure 16-3**.

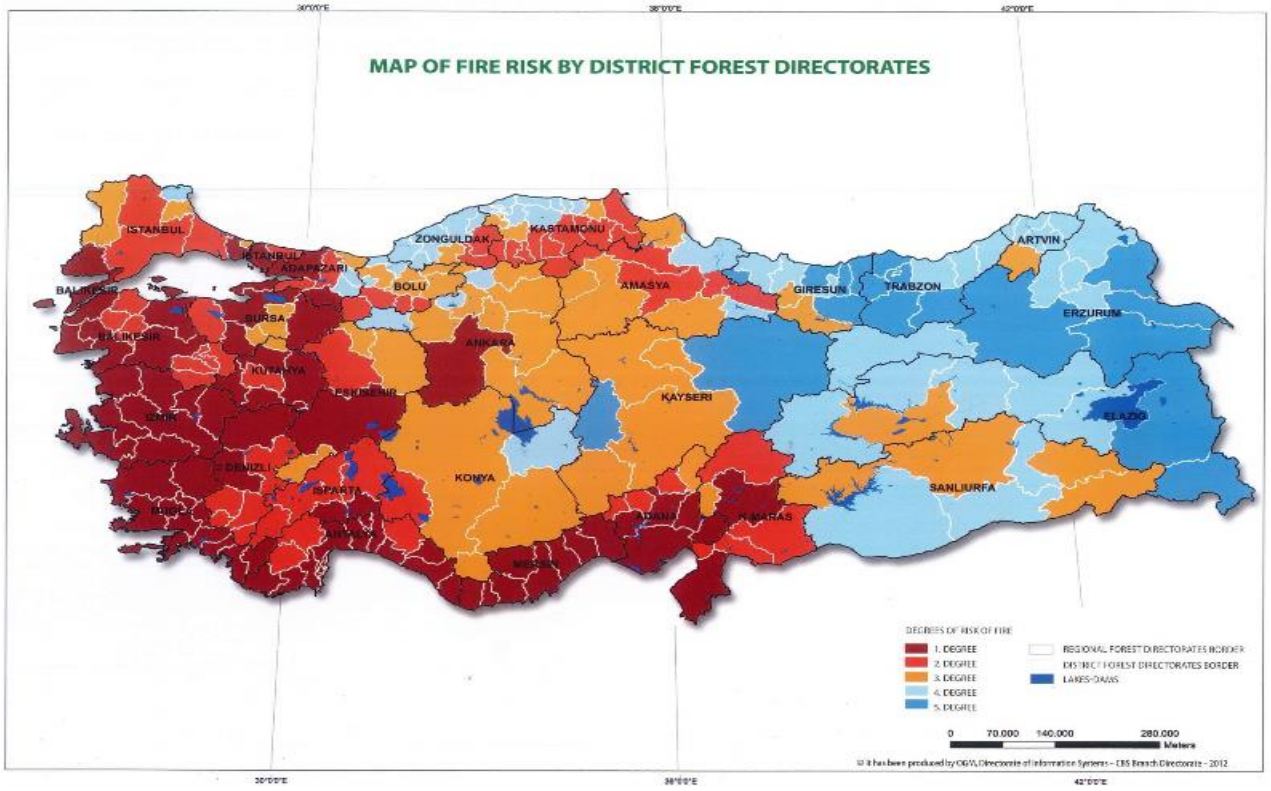


Figure 16-3 - Turkey Fire Risk Map[306]

[306] General Directorate of Forestry (OGM) (2013). Forest Atlas.

16.6.20. Parts of the Project (approximately 21km) would be located in, and be surrounded by, areas of forest (approximately 105ha) that could be at risk of wildfire events due to external factors during hot, dry periods, and/or fires due to the Project, accidentally initiated by construction related activities.

Air Quality

16.6.21. The prevailing wind direction for the Project is from the north east, therefore receptors located to south west of the Project are more likely to be affected by dust and particulate matter emitted and re-suspended during the construction phase. As detailed within **Chapter 6: Air Quality** within a 350m study area surrounding the Project and construction compounds there are:

- 4,284 high sensitivity receptors (dwellings, hospitals or places where an individual will spend more than 8 hours); and
- 431 medium sensitivity receptors (schools, places of work, commercial buildings where individuals spend up to 8 hours).

16.6.22. In addition, mainly-wetland Important Bird Areas (IBA) are directly crossed by the Project, and they trigger the IAQM criterion for a high-risk area, i.e. a highly sensitive ecological receptor located within 20m of the Project.

Invasive Plants

16.6.23. There are not currently considered to be any significant invasive plant outbreaks within the ecological zone of influence and no notable such communities were identified during baseline ecological surveys, as detailed within **Chapter 8: Ecology**.

Major Accident Hazard Chemical Sites, Hazard Pipelines and Nuclear Facilities

16.6.24. There are a number of licensed natural gas wells close to the Project, and the Project also passes through 4 Organised Industrial Zones[307].

16.6.25. The Project intersects a North Atlantic Treaty Organisation (NATO) pipeline at approximately chainage 8+700, the content of which is not available in the public domain.

16.6.26. Çekmece Nuclear Research and Training Centre (ÇNAEM) is situated by Küçükçekmece Lake approximately 400m west of Halkali Station, and 700m south-west from the start of the Project to the centre point of this site. The land occupied by ÇNAEM was expropriated, and the TR-1 Research reactor was constructed between years 1959-1962 and started operation on the 27th May 1962 with 1 MW nominal power. The purpose of the ÇNAEM was for research, development, application and training in the nuclear field. The TR-1 Research Reactor ceased operation in September 1977 with the development of the 5MW output TR-2 Research Reactor, which commenced operations in December 1981.[308]

[307] Land Use Planning Economic Zones with good infrastructure and social facilities to encourage national and international investment.
[308] Tenmak (2021). Home Page. Available at: https://www.taek.gov.tr/en/institutional/affiliates/cekmece-nuclear-research-and-training-center.html (Accessed: 27/01/20).

FUTURE BASELINE

16.6.27. The future baseline is not anticipated to differ significantly from the current baseline with regards major events.

16.6.28. The predicted changes in climate due to climate change between now and the operational year (2023) are not considered significant in relation to their potential to influence major accidents.

16.7 POTENTIAL MAJOR EVENTS

16.7.1. The Risk Events whose impact on a human health, property or environmental sensitive receptor has the potential to be a major event, during either the construction or operation phases, are listed in **Table 16-7**. The justification for the inclusion of each potential major events in the short list, has been provided to support the decision.

16.7.2. Should a short list major event occur, then this is likely to result in a significant major adverse effect. Key management and mitigation measures to reduce the effect are described in **Section 16.8.**

Table 16-7 - Potential Major Event Types (Short List)

Major Event Type	Phases which exacerbate vulnerability	Potential Sensitive Receptors	Justification for Inclusion in the Short List
Earthquakes	Construction Operation	Workers Rail Users Public and Local Community	The Project is within an area with moderate to high probability of PGA levels exceeding 10% within the next 50 years. Activities will be executed by adapting to provisions of "Regulation About Buildings To Be Made At Disaster Areas" entered into force by being published at 03.05.2007 dated and 26511 numbered Official Gazette and by adapting to 7269 numbered "Law About Aids To Be Made With Actions To Be Taken Because of Disasters Effective To Public Life" and by adapting to provisions of Regulation issued referring to this law. All the structures designed for the Project will be designed to be resistant to earthquake. During the design the compatibility to provisions of “Regulation About Building To Be Made At Earthquake Regions”, which entered into force at 06.03.2007 dated and 26454 numbered Official Gazette, should be observed. TCDD and AYGM have confirmed that all the civil engineering designs are compliant with Turkish civil, structural, environmental and earthquake engineering standards. AYGM reports that data from geological surveys, seismic primary wave and Multi-channel Analysis of Surface Waves measurements, Ground Penetrating Radar (GPR) measurements, geophysical measurements and seismic evaluation charts were used to inform the Project design.
Landslides	Construction Operation	Workers Rail Users Public and Local Community	The Project passes through several areas which have a risk from landslides, in particular chainages 42+000 and 51+000 pass through areas which contain old and active landslides. The Project involves the formation of deep cuts/high embankments. This is recognised as being a fundamental part of the Project’s design-development. The Project will be constructed on hard ground and drainage installed in order to provide surface flows during the construction phase. Cutting depths along the Project are up to 20m. Cut and cover tunnel excavation depths vary between 31 and 56m. Embankments are designed with heights up to 10m. Construction Phase: The ground stability of the Project area, particularly around bridges, viaducts, tunnels, overpasses, underpasses cutting, and embankments, reportedly, has been subject to detailed geotechnical investigation and geotechnical engineering design as part of the design-development within the scope of the soil surveys performed along the Project. Soil survey geotechnical report is reported to have been prepared in order to determine the engineering parameters which constitute basis of the geotechnical and static design. Operation Phase: If necessary ongoing routine inspections and potentially ground movement monitoring will form part of the overall landslide and erosion risk management regime for the Project.
Groundwater Flooding	Construction Operation	Workers Rail Users	The Project is not located in a region that is at risk of floods. The design of rain collection and drainage systems has taken into account rainfall data. Groundwater seepage in tunnels will require further consideration in the design, where underground tunnels are being proposed, e.g. – where the Project will cross underneath the proposed Kanal Istanbul project.
Cyclones Hurricanes Typhoons Storms Gales	Construction Operation	Properties Workers Rail Users Public and Local Community	The Project passes from the regions, in which Marmara Transition Climate and Trakya Continental Climate are dominant. Refer to Section 16.6 for baseline information. A fatal serious rail accident happened in 2018 (Corlu train derailment: a passenger train derailment occurred) due to heavy rainfall which affected the rail and railway sleepers related to a culvert, which resulted in 25 fatality on 8 July 2018 in the Corlu district of Tekirdag Province.
Thunderstorms	Construction Operation	Workers Rail Users	The Project is located in regions, in which Marmara Transition Climate and Trakya Continental Climate are dominant. Refer to Section 16.6 for baseline information.

Major Event Type	Phases which exacerbate vulnerability	Potential Sensitive Receptors	Justification for Inclusion in the Short List
			Construction: This type of event could result in lightning strikes to temporary elevated structures during construction (e.g. tower cranes) and new elevated structures (such as bridges, viaducts, overpasses) introduced as part of the Project; however, the risk is no different to similar railways and roads in the locality. Operation: During operation a lightning strike could disable an electric unit within the rolling stock. However, lightning rods will be established along the overhead line system that will be used by the Project to reduce the risk of damage to the rail track and rolling stock from lightning, as stated in the Technical Specification (for signalling and telecommunication works and signalling systems).
Extreme Temperatures: Heatwaves, Low (sub-zero) Temperatures and Heavy Snow	Construction Operation	Workers Rail Users Public and Local Community	The Project area experiences both a Mediterranean and humid subtropical climate. Summers are hot, humid and moderately dry whereas winters are cold and wet and sometimes snowy. Refer to Section 16.6 for baseline information. Section II.14 of the National EIA for the Project (2017) states that the Project will not be affected from the natural disasters that may occur due to meteorological reasons, which would cause severe consequences in construction and operation phase. There is a risk that railway constructs can fails to operate due to the negative impacts associated with the transition of the climate, which can change from very cold to very hot. For such situations, the route will be constantly monitored, and necessary renewals will be made. In case of stormy weather, signalling systems will be installed for the situations, such as loss of connection in the overhead line system for the railway.
Severe Space Weather: Solar Flares	Operation	Rail Users	Solar flare events are known to interrupt radio and other electronic communications. Records from solar storms in 1921 and 1960 describe widespread radio disruption and impacts on railway signalling and switching systems.
Wildfires: Forest fire, Bush/brush, pasture	Construction	Ecological Receptors Properties Workers Road users	Refer to Section 16.6 for baseline information. Parts of the Project (approximately 21km) would be located in, and be surrounded by, areas of forest (approximately 105ha) that could be at risk of wildfire events during hot, dry periods and/or fires initiated by construction related activities. During construction, dense forest cover increases the likelihood of fire and makes construction work more difficult. Control measures will be implemented by the appointed contractor to manage the risk of fire, as specified in the **Construction Environmental and Social Management Plan** (CESMP).
Poor Air Quality	Construction	Ecological Receptors Public and Local Communities Workers Road Users	Construction effects would be temporary for the duration of the construction phase. Increased dust emissions from construction activities and traffic could lead to potential loss of amenity at sensitive receptors. Traffic management measures would be required to reduce the potential for these effects.
Biological: Plants	Construction	Ecological Receptors Public and Local Communities Workers	The risk remains that the Project may serve as a conduit to facilitate the establishment of new invasive species communities across the ecological zone of influence. Ozaslan et al. (2016) concluded '…that railways have notable contribution to plant invasion in Turkey'.
Major Accident Hazard Chemical sites	Construction	Rail Users Public and Local Communities	Letter no. 15590 dated 08/09/2015 of TPAO General Directorate specifies the distances to Natural Gas production wells from the Project: ▪ Within AR/TPO/I/4775 License Area: 520m distance to Kuleli-1 Well, 410m distance to Babaesli-2 Well, 240m distance to Babaesli-1 Well. ▪ Within D.Adatepe Operation License Area: 1,280m distance to D.Adatepe-5 Well. ▪ Within AR/TPO/I/4655 License Area: 1,110m distance to Kömürcüyolu-1 Well, 810m distance to Danamandıra-2 Well.

Major Event Type	Phases which exacerbate vulnerability	Potential Sensitive Receptors	Justification for Inclusion in the Short List
			The line passes through 4 Organised Industrial Zones (Tekirdağ Çerkezköy OIZ , Tekirdağ Ergene-1 OIZ, Tekirdağ Kapaklı OIZ, Kırklareli Evrensekiz Islah OIZ), which may include BEKRA establishments. Additional information provided by Ministry of Environment and Urbanisation on 26 November 2020 indicates 3 BEKRA establishments: ▪ İPRAGAZ A. Ş. HADIMKÖY ŞUBESİ located approximately 250m north of the northern emergency side passage for the first NATM tunnel (Tunnel 4)at approximate chainage 17+810 (approximately 500m to the north of the tunnel itself); ▪ ARGON KİMYA SAN. VE TİC.A.Ş.(ÇERKEZKÖY ŞUBESİ) situated approximately 5.9km west of the expropriation corridor at chainage 76+000; and ▪ BSH EV ALETLERI SANAYI VE TICARET A.Ş. situated approximately 4.7km west of the expropriation corridor at chainage 76+000. The distance of the installations provided above is the distance of the installation (based on its address and grid co-ordinates provided by the Ministry of Environment and Urbanisation). No information has been provided as to the safety/consultation zones for these installations. In addition, the reason for BEKRA classification for these installations is unknown at this stage. It should be noted that the existing railway passes closer to the İPRAGAZ A. Ş. HADIMKÖY ŞUBESİ installation than the Project which is located in a tunnel to the south of this installation and as such the proximity of this installation does not pose a greater risk of a major event than to the existing railway. The remaining two BEKRA installations identified above located a significant distance from the Project and as such do not pose a greater risk of a major event.
Major Accident Hazard Pipelines	Construction	Rail Users Public and Local Communities	The Project intersects with a NATO pipeline at chainage 8+700.
Dam breaches	Construction Operation Maintenance	Ecological Receptors Public and Local Communities Properties Workers Road Users	The Project is in close proximity to 2 dams which provide reservoirs used for drinking water. Büyükçekmece Lake is fed by the Karasu Stream and is used as a drinking water source for Istanbul. At its closest point the Project will pass approximately 1.4km to north of Büyükçekmece Lake. The Lake was deepened by the General Directorate of State Hydraulic Works (DSi) in 1988. The lake has a surface area of approximately 28km^2 and the annual capacity of the dam is 82 hm^3. The National EIA for the Project (2017) states that the Project is within the maximum water level of the Büyükçekmece Lake and also located within the 'absolute, short, medium and long-distance protected areas' of the Lake. The Project will be in parallel with existing line between Halkalı-Çerkezköy . The construction works here will be designed depending on the Büyükçekmece Dam Maximum water-level value. The Project is to the north of Büyükçekmece Lake, and Büyükçekmece Dam itself is at the southern end of the lake. The blasting works will be mainly associated with the NATM tunnels, and although there are 2 NATM tunnels as part of the Project to the north of the lake, they are over 11km from the dam itself. Furthermore, as outlined in the ESMP a detailed assessment of vibration will be completed when details of blasting activities are known, including location, the size and frequency of events. The Sazlıdere Dam is located approximately 4km east of the Project within the boundary of Istanbul Province, Ambarlıdere-1 Regulator is within 2,800m of the Project within Istanbul Province boundaries, Ambarlıdere-2 Regulator is within 5,000m of the Project within Tekirdağ boundaries. Sazlıdere Dam was constructed along the alignment of the Sazli Stream in 1996 to provide drinking water to the western side of Istanbul. The annual capacity of the dam is 55 m^3[309]. The Project will not be located within the drainage catchment of the Dam. The failure of the Sazlidere Dam could pose risk to downstream receptors between the Dam and Küçükçekmece Lake, following the alignment of the Sazli Stream. This is unlikely to affect the Project as it will be located in tunnel at this location.

[309] https://www.researchgate.net/figure/The-map-of-Sazlidere-Dam-and-sampling-stations-6_fig1_328679363

Major Event Type	Phases which exacerbate vulnerability	Potential Sensitive Receptors	Justification for Inclusion in the Short List
			There is a NATM tunnel along the Project to the east of Sazlidere Reservoir, which will require blasting during construction, however Sazlidere Dam itself is over 5km from the tunnel. Furthermore, as outlined in the **ESMP** a detailed assessment of vibration will be completed when details of blasting activities are known, including location, the size and frequency of events.
Mines and storage caverns	Construction Operation	Road Users Workers	According to the opinion dated 29/01/2016 and numbered 403677 taken from the General Directorate of Mining Affairs regarding the Project; as a result of the examinations made on 25/11/2015, it is stated that 4 operating licenses, 3 exploration license sites, 2 detail exploration license sites and 1 pre-exploration period license site have been found. As a result of the inspection carried out by the technical staff of the General Directorate of Mining Affairs in the Project area between 04-07 /12/2015; It has been decided that there will be no adverse effect on the activities to be performed in the areas licensed by the General Directorate, provided that the Project is constructed within the stated parameters (3.427,84 ha) and that it will not cause loss of resources.
Fires	Construction	Cultural Heritage Assets Public and Local Communities Road Users	Fires could be initiated by construction related activities which could impact areas adjacent to the construction activities. During construction, standard control measures would be implemented by the appointed contractor to manage the risk of fire, as detailed in the **CESMP**. The Project area is located in the 2nd and 3rd risk zones in terms of risk of fire. Measures to be taken against fires are given in the **CESMP**.
Road Transport Accidents	Construction Operation	Ecological Receptors Properties Workers Road Users	Currently TCDD is undertaking the following improvement works to the existing railway: the cross points of level crossings used by on-road vehicles; renewal of warning signs; and equipping the level crossings, which have high vehicle traffic and limited sight area, with safety systems such as automatic barrier, flange, camera and bell. Reportedly, there have been installations of 632 signboards, 133 rubber material coatings, improvement works on 342 level crossings (arrangement of sight distance and access road, sign completion) and activities to draw warning lines for slowdown on 292 crossings were carried on 2018. During construction the Contractor will use many operational vehicles and earthmoving heavy vehicles during the groundwork, earth removal activities, drainage and bridge construction activities.
Rail Transport Accidents	Construction Operation	Ecological Receptors Properties Workers Road Users	There are existing railways within the Project area, however they have low train numbers and lower speeds than the Project. There is a high risk of accidents in the rail sector in Turkey, as demonstrated by the number of accidents which have occurred in the past few years. TCDD Transport published Annual Report 2014-18[310] provides safety statistics for Turkish railways. The report shows an average of 1.3 fatalities per million train km. This report does not include fatalities or injuries to operational workers not caused by train accidents. In 2018 there was a total of 118 recorded accidents on the TCDD Transport railways[311]. Across Turkey, according to Railway News, there were train accidents in Tekirdağ Çorlu and Ankara in 2018[312]. As a result of the accident in Tekirdağ Çorlu there were 25 fatalities, as a result of a technical failure. As a result of several accidents in Ankara there were 348 injuries and 3 fatalities, largely due to the lack of signalling systems[312]. The number of rail accidents in Turkey is approximately three times the world average[312]. It is understood that the use of conventional lines and technical problems with the high-speed service, Yüksek Hızlı Tren (YHT) which became operation in 2003, is a major cause of accidents in Turkey.

[310] Annual Statistics (2014-2018). General Directorate of Turkish State Railways 2019.
[311] ACE (2020). Environmental and Social Gap Analysis of TCDD Halkali–Kapikule Railway Project Gap Analysis Report.
[312] Railway news (2020). Available at: https://www.raillynews.com/2020/07/positive-train-accident-in-Turkey-three-times-the-world-average/.

Major Event Type	Phases which exacerbate vulnerability	Potential Sensitive Receptors	Justification for Inclusion in the Short List
			The existing railway is fairly typical of Turkish railways and is expected to have about the average level of safety. Using the existing railway passenger movements, as shown in **Chapter 2: Description of the Project,** and assuming operation every day of the year, the estimated total distance for passenger travel is approximately 388,000 km. Using the existing railway freight movements, as shown in **Chapter 2: Description of the Project,** and assuming operation every day of the year, gives the estimated total freight travel distance of approximately 165,000 km. In total, the estimated total distance of 553,000km correlates to approximately 0.72 fatalities per year if the safety of the existing railway is assumed to be the same as the average for Turkish railways (1.3 fatalities per million km).
Waterways	Construction Operation	Workers Waterway Users Rail Users	Based on the available information there are no waterways located in the study area, that are used for substantial transport by water. The Project will cross beneath the proposed Kanal Istanbul project which has been approved immediately upstream of Küçükçekmece Lake. The Project is proposed to be in tunnel (TBM-twin bore) at this crossing point. The highest risk will be during the construction phase (of each project) when construction of each could impact the other - depends on timeline of the projects.
Air Pollution accidents	Construction	Public and Local Communities Road Users	Construction activities may cause dust emissions which may contribute to poor air quality albeit on a temporary basis. Use of fossil fuelled mobile plant and equipment during the construction phase. However, emissions from mobile plant and equipment covered under health, safety and environmental legislation and will be managed via measures in the **CESMP**.
Land Pollution Accidents	Construction	Ecological Receptors Cultural Heritage Assets Public and Local Community	During construction there may increase the risk of leaks and spillages of hazardous materials associated with the construction activities. During construction, standard control measures would be implemented by the appointed contractor to manage the risk of spillages and leaks, as set out in the **CESMP**.
Water Pollution Accidents	Construction Operation	Public and Local Community Water Environment	During construction there may increase the risk of leaks and spillages of hazardous materials associated with the construction activities. During construction, standard control measures would be implemented by the appointed contractor to manage the risk of spillages and leaks, as set out in the **CESMP**.
Electricity Utilities Failure	Construction Operation	Public and Local Community Workers Rail Users	Instances of electricity failure (also referred to as power loss or blackout) can be caused by a several scenarios, such as severe weather (e.g. very strong winds, lightning and flooding) which damage the distribution network. These tend to mainly occur at specific places, local (e.g. metropolitan area) and less frequently regional as a result of severe winter storms and consequent damage to the distribution overhead line network. Signalling systems and overhead line systems will be designed to avoid the loss of connection and power to the railway with the provision of failsafe systems, so that major accident events are avoided. Underground and above-ground electrical transmission lines are present across the Project, the responsibilities of which lie with the relevant local operator or company should this infrastructure fail. The potential risk of construction-related incidents when undertaking diversion works as part of the Project would be covered by existing legislation provisions of “Regulation on Current Faculties with Electric Power” entered into force after publication on Official Gazette issue 24246 dated 31.11.2000 in terms of safety of life and property on overhead lines.
Malicious Cyber Attacks	Operation	Property Public and local Community Rail Users Workers	Cyber-attacks occur almost constantly on key national and commercial electronic information, control systems and digital industries. The increasing reliance on rail technology (such as the control systems, the traction scada system, signalling system, etc) could render the Project more vulnerable to a cyber-attack. As technology is proposed to be installed as part of the Project to control train movements and signalling systems. Notwithstanding this, it is not considered to be more vulnerable to attack than similar infrastructure installed and running elsewhere on the strategic rail network. However, it should be noted that there are no signalling systems on the existing railway line that are located near the

Major Event Type	Phases which exacerbate vulnerability	Potential Sensitive Receptors	Justification for Inclusion in the Short List
			Project. The installed signalling system for the Project will be equipped with national signalling systems, with Automatic Train Stop (ATS) train protection systems.
Property or bridge demolition accidents	Construction	Public and local Community Road Users Workers	The Project involves demolition works to a small number of buildings and structures. The risks of accidents occurring during these works would be taken into account by the appointed contractor and considered as part of their detailed methodology and risk assessments in advance of these works. Surveys would be undertaken prior to the demolition of properties and structures to confirm whether any potentially harmful substances (e.g. asbestos) are present, and to determine the risk to people.
Tunnel failure/fire	Construction Operation	Workers Rail Users	The Project includes: ▪ 8 tunnel structures of various lengths that will pass under the Kanal Istanbul project, agricultural fields, existing road infrastructure, commercial / industrial areas, residential areas and through hilly areas towards Cerkezkoy; and ▪ 26 underpasses that will pass under existing road and rail infrastructure, forest areas and agricultural fields. The tunnels will be constructed using Tunnel Boring Machine (twin bore), cut and cover tunnel and NATM tunnel. In case of tunnel blasting, it is predicted that nearby settlements could potentially be negatively affected from impacts such as vibration, noise, flying rocks due to blasting. The Project will pass under the Kanal Istanbul project in a 6km twin-bore tunnel (Tunnel 1). The width of the Kanal Istanbul project will vary between 360m and 1,050m (the width will be approximately 300m at the location where the Project will pass under it). The Kanal Istanbul project will have a depth of 25m below sea level (BSL). Tunnel 1 will pass beneath it at a depth of 40m BSL, an allowance of 15m between the 2 structures.

ASSESSMENT ASSUMPTIONS AND LIMITATIONS

16.7.8. Key assumptions for this assessment are that:

- The Project is being designed and its implementation guided by good practice industry standards and codes, many of which are mandatory. These require infrastructure and systems to be designed so that risks to people and the environment are either eliminated or reduced to levels that are ALARP.
- The construction stage(s) of the Project will be managed through the implementation of the **Construction Phase Health and Safety Plan** (required under the Regulation on Health and Safety in Construction Works 2003) and a **CESMP**.
- Environmental effects associated with unplanned events that do not meet the definition of a major event e.g. minor leaks and spills that may be contained within the construction sites are addressed in other relevant ESIA chapters, and measures in the **Environmental and Social Management Plan** (ESMP), which contains the CESMP and the Operational **Environmental and Social Management Plan** (OESMP).
- It is recognised that the management framework for the Project is not fully defined at this stage; however, a presumption of standard practice and regulatory compliance within the adopted management framework has been assumed and will be developed following the appointment of the Principal Contractor.
- The design, installation, commissioning, operation and maintenance of plant, drainage systems, equipment and machinery, including associated systems, will take into account Good Engineering Practice.

16.8 MITIGATION AND ENHANCEMENT MEASURES

16.8.1. Based on current information available, it is not considered that the identified major event types could be currently managed to be 'As Low as Reasonably Practicable' (ALARP). For all major events, compliance with the legal and regulatory requirements described in this section to manage risks to be ALARP must be demonstrated, including the requirement to:

- Consider the principles of protection from risks when making decisions regarding architectural, technical and organizational issues in order to plan the different elements and stages of the construction work that occur simultaneously or one after another (required under the Regulation on Health and Safety in Construction Works 2003). This will be achieved through the development of a construction and design **Risk Register** for the Project as part of the detailed design stage. This will then be followed by a review of the short list major events (as identified in Table 16-7), and appropriate mitigation measures embedded into the detailed design of the Project so that the risk of a major event is as low as reasonably practicable.
- Manage all construction risks in accordance with the **CESMP (including Dust Management Plan, Construction Travel Plan, Construction Logistics Plan), Construction Plans and Method Statements** (required under the Regulation on Health and Safety in Construction Works 2003);
- Develop and implement **Emergency Response Framework (including Spill Management Plan)** and emergency response plans that considers risks associated with the potential major event categories identified in Table 16-7 during construction and operation;

- Comply with design standards, this will include designing to appropriate environmental parameters (flood, wind, lightning, ground stability), including climate change. Design standards apply to controls and systems and civil infrastructure;
- The Contractor will be required to use the Project **Hazard Log** that identifies rail safety requirements and show how hazards are being managed;
- A **Rail Safety Plan** will be produced by AYGM that mandates all the activities the Contractor will need to undertake in order to manage safety according to the CSM-RA.
- Manage all operational risks in accordance with the **OESMP**, **Health and Safety Plan, Operational Maintenance Plan** and **System Safety Plan**; and
- Co-ordination between AYGM and their construction contractor, and during operation phase TCDD Transport and their maintenance contractors (included in **Contractor Management Plan, Health and Safety Plan, Operation Maintenance Plan** and **System Safety Plan**).

16.8.2. The development of the construction and design **Risk Register**, **CESMP** and method statements, **Emergency Response Framework** and emergency response plan for the Project will need to consider the risk of construction of the Project and the Kanal Istanbul project impacting each other. This will require a combined approach between the 2 projects to ensure all health and safety construction and operational risks are identified and assessed with appropriate control measures implemented minimise the potential occurrence of a major event. This will be facilitated by AYGM, who is responsible for the construction of both projects, and it will be delivered via contractual requirements for their contractors, and measures in the **CESMP**, for both projects.

16.8.3. **Table 16-8** summarises the additional mitigation measures and enhancement measures for the construction and operational phases of the Project (in addition to those identified in the bullets above) required in order to manage major event risks to be ALARP.

Table 16-8 - Additional Mitigation and Enhancements Specific to Potential Major Event Risks

Major Event Type	Phases which exacerbate vulnerability	Mitigation and Enhancement Measures
Landslides	Construction Operation	Mitigation measures associated with landslide risks during the construction and operation phases of the Project are described in Tables 12.2 and 12.3 respectively in **Chapter 12: Geology and Hydrogeology** of the ESIA.
Groundwater Flooding	Construction Operation Maintenance	Groundwater seepage into the tunnel under Kanal Istanbul (Tunnel 1) need to be considered and included in the design **Risk Register** so appropriate mitigation measures (such as waterproofing) are incorporated into the final design of the Project to avoid/minimise groundwater flooding.
Cyclones, Hurricanes, Typhoons, Storms and Gales	Construction Operation	Mitigation measures associated with the risk of storms and gales during the construction and operation phases of the Project as described in Tables 14.7 and 14.8 respectively in **Chapter 14: Climate Change** of the ESIA.

Major Event Type	Phases which exacerbate vulnerability	Mitigation and Enhancement Measures
Thunderstorms	Construction Operation	Construction: When the use of temporary elevated structures is required during construction, working at height during storms will be ceased. As detailed in the **CESMP**. Operation: A Lightning rod line will be established along with the overhead line system that will be used by the Project during operation.
Extreme Temperatures: Heatwaves Low (sub-zero) Temperatures and Heavy Snow	Construction Operation	Mitigation measures associated with the risk of extreme weather temperatures during the construction and operation phases of the Project as described in Tables 14.7 and 14.8 respectively in **Chapter 14: Climate Change** of the ESIA.
Wildfires: Forest fire, Bush/Brush, Pasture	Construction	Mitigation measures associated with the risk of wildfires during the construction and operation phases of the Project as described in Tables 14.7 and 14.8 respectively in **Chapter 14: Climate Change** of the ESIA.
Poor Air Quality	Construction	Mitigation measures associated with the risk of increased poor local air quality during the construction and operation phases of the Project as described in Section 6.6 in **Chapter 6: Air Quality** of the ESIA.
Plants	Construction	Mitigation measures associated with the risk of substantial invasive plant outbreaks during the construction phase are described in Section 6.6 in **Chapter 8: Ecology** of the ESIA. These include the development and implementation of a **Biodiversity Action Plan** and **Invasive Species Management Plan**, as set out in the **CESMP**.
Major Accident Hazard Chemical sites	Construction	Prior to construction, further details of the BEKRA sites needs to be obtained, including the distance from the Project to the installation located within 1 km either side of the Project and details of the consultation/safety zones around the installations that are subject to the BEKRA notification system. The impact of the Project on these installations and the impact of the installation on the Project needs to be evaluated and considered as part of the final design prior to construction. A **Traffic Management Plan** will be developed and implemented, as set out in the **CESMP**. This will ensure that emergency response units are able to get to site within the guideline response times.

Major Event Type	Phases which exacerbate vulnerability	Mitigation and Enhancement Measures
Fires	Construction	The **Emergency Response Framework** specifies the need for equipment for reducing risk of fire, including evacuation strategy. Liaison with emergency services. Mandate use of fire reduction/ safety facilities.
Road Transport Accidents	Construction Operation	A **Traffic Management Plan** should be developed and implemented during construction.
Rail Transport Accidents	Construction Operation	Mitigation measures associated with the risk of train accidents during the operation phase of the Project as described in **Chapter 15: Social** of the ESIA.
Land Pollution Accidents	Construction	Mitigation measures associated with the risk of pollution incidents to land during the construction of the Project as described in Table 12.2 in **Chapter 12: Geology and Hydrogeology** and section 8.5 in **Chapter 8: Ecology** of the ESIA.
Water Pollution Accidents	Construction Operation	Mitigation measures associated with the risk of pollution incidents to land during the construction and operation of the Project as described in Tables 11.12 and 11.13 respectively in **Chapter 11: Surface Water** of the ESIA.
Electricity Utilities Failure	Construction Operation	Mitigation measures associated with the risk of train accidents during the operation phase of the Project as **Chapter 15: Social** of the ESIA.
Tunnel Failure/Fire	Construction Operation	Mitigation measures associated with the risk of train accidents during the operation phase of the Project as described in **Chapter 15: Social** of the ESIA.

16.9 SUMMARY

16.9.1. The high-level assessment undertaken in this chapter has identified potential categories of major events deriving from the vulnerability of the Project to risks of relevant major accidents and/or disasters. Following the incorporation of the mitigation measures described in Section 16.8 into the detailed design, in particular, the development of a construction and design risk register for the Project and the review of this against specific major events, then the risks would be anticipated to be as low as reasonably practicable.