

## RISK MANAGEMENT FOR URBAN HERITAGE: THE CASE OF IZMIR

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### Abstract

Risk management for cultural heritage is a significant issue in conservation and management studies. The Convention Concerning the Protection of the World Cultural and Natural Heritage states that ensuring a good state of conservation of the property is a requirement for inscription on the World Heritage List. This paper aims to develop a preliminary site-specific methodology for the urban heritage, the case of historic centre of Izmir, which is the management site of the Historical Port City of Izmir in the Tentative List from 2020. Although risks are diversified, the scope of this paper is limited to physical risks affecting the spatial environment. The site-specific methodological approach is constituted based on key sources of ICCROM and UNESCO and adopted for the urban heritage of Izmir.

**Keywords:** Risk Management, Cultural Heritage, Historic Centre, Izmir, Historical Port City of Izmir

### 1. Introduction

“Cultural heritage is always at risk” states Stovel (1998, p.17) in *Risk Preparedness: A Management Manual for World Cultural Heritage*, one of the earliest noted sources in risk management for cultural heritage. Stovel (1998) explains principles including importance of advance and integrated planning not just for buildings but also for associated context and landscapes, adopting preparedness requirements compatible with conservation principles, and inclusion of users in the process of planning. He draws a planning framework as preparedness, response and recovery phases for the risks of fire, earthquakes and related disasters, flooding, armed conflict, and other hazards.

*Managing Cultural World Heritage (2013)* is a significant resource manual, mentioning risk preparedness is one of the key considerations for the management system. In the context of risk management, *Managing Disaster Risks for World Heritage (2010)* is the specific resource manual published by UNESCO. The manual states that disaster risk management (hereafter DRM) should be an integral part of a site management plan and linked to local, regional, and national management systems. DRM plan is designed to eliminate or mitigate negative impacts of disasters on heritage values, which is outlined in statement of Outstanding Universal Value (OUV). The DMR plan is consisted of three phases, namely before, during, and after disasters (Figure 1). For each phase, the manual determines relevant studies to be followed.

With a similar approach, *A Guide to Risk Management of Cultural Heritage* (2016), prepared by ICCROM, Government of Canada, Canadian Institute, provides a scientific model and methodology for risk elimination and assessment for cultural heritage. Risk Management is a future oriented and continuous study, which has six main steps: context, identify, analyse, evaluate, treat, and monitor (Figure 2).

For the case of Izmir, there are several noted sources. *The Provincial Disaster Reduction Plan (called IRAP in Turkish)* is prepared by Izmir Governorship Provincial Disaster and Emergency Directorate in 2021. For the whole province, earthquake and tsunami, landslide and rockfall, flooding, industrial facility accidents and CBRN events, fire, disasters due to meteorological events and climate change, medical geological disasters and pandemic diseases are assessed, evaluated and mitigation strategies are presented.

*The Historical Port City of Izmir Site Management Plan (2022-2027)* defines the heritage sites with diversified values, historical background, social and economic structure, current management system and other relevant plans on the site. The plan with a vision of “The port and trade city of the eastern mediterranean, the beautiful Izmir’s multi-layered cultural heritage created by the effect of co-existence will be conserved, sustained and promoted” introduces guiding policies, sets goals and an action plan. The Goal 5, “Risk management of the historical port city of Izmir will be activated”, describes necessary actions to be taken regarding both physical aspects and social and economic issues in risk management.

The recent project, *Developing Risk Management in the Historical Port City of Izmir*, aims to develop a study methodology specific to the site with the participation of relevant stakeholders. This ongoing study is also in line with this paper, which is constituted based on the research question of *how to develop a methodologic approach for risk management for the historic centre, specifically for the case of urban heritage of Izmir*. Hence, the study focuses on before any disaster event, risk preparedness and mitigation activities that deal with hazards affecting the built environment, which are earthquake, flood, fire, landslide and rockfall. Although, social and economic risks are significant aspects of the Site Management Plan, they are not in the scope of this study.

For this purpose, based on the main steps clarified in the key sources published by UNESCO and ICOMOS, a case study is conducted. Specific data for the case of urban heritage of Izmir are gathered from diverse sources, mainly the key sources mentioned previously. The data are analysed and evaluated with thematic maps prepared via CAD (drawing) software. Afterwards, preliminary strategies for risk identification, reduction, monitoring and revision processes are determined.

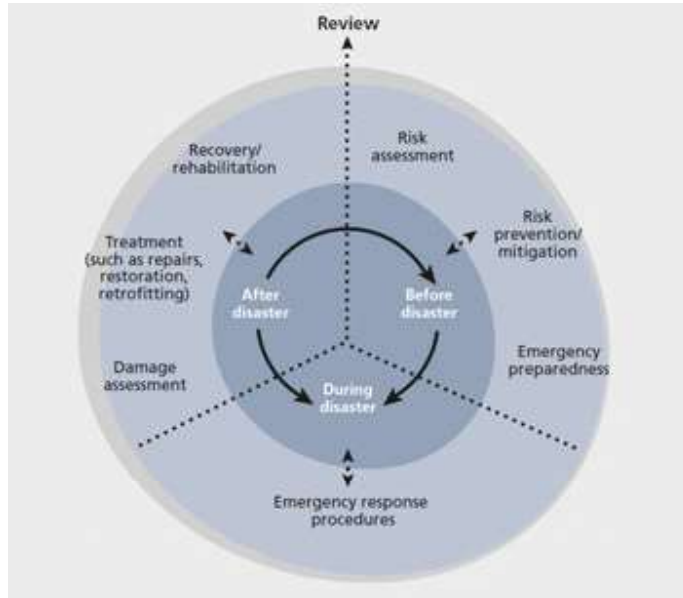


Figure 1: Disaster Risk Management Cycle  
 (Source: Managing Disaster Risks for World Heritage, 2010, p. 13)



Figure 2: Risk Management Cycle  
 (Source: A Guide to Risk Management of Cultural Heritage, 2016; p.15)

## 2. Scope and Context

Izmir, located on the Aegean coastal area of Türkiye has been a significant settlement and cultural hub in the Mediterranean Basin since Neolithic ages. The story of the Historical Port City Izmir is consisting of three different areas and diverse periods of Izmir, one of which are the oldest Izmir established in Yeşilova and Yassitepe mounds from Neolithic period, secondly as Old Smyrna, during the next period called Hellenistic, and the third Izmir as the historic urban centre living around 2500 years (Figure 3).

Cultural significance of the Historical Port City of Izmir mainly based on its location on Bornova plain near to the Gulf of Izmir, interaction with the sea and trading activities in the Mediterranean basin with diversified routes throughout the history. Meles River on the eastern site of the management area, the Gulf of Izmir on the west, and Pagos Hill on the eastern south are natural edges of the historic urban centre.



Figure 3: Historical Port City of Izmir

The site has been conserved and managed based on conservation master plans and the Historic Port City of Izmir Site Management Plan (2022-2027), and faces various hazards such as earthquakes, fires, floods, landslides, and climate change, as well as social and economic risks. Under the Goal 5 of the management plan, specific targets, and actions are determined to eliminate, mitigate, and adopt these risks.

This study is in line with the site management plan but focuses on the historic urban centre and physical risks affecting the spatial environment. To clarify the scope and context of the study, values and cultural characteristics of place, present state of conservation, and stakeholder participation strategy are explained as follows.

## 2.1. Values and Cultural Characteristics

The historic centre of Izmir is a multilayered heritage and continues its formation. The city was established on the layers of Smyrna Ancient City of Hellenistic times, later formed as a traditional Ottoman city with a bazaar, afterwards as a modern city with national architectural elements, and today as a living heritage place with diverse cultural values. The historic urban centre has diverse cultural characteristics and can be conceptualised in different character areas (Figure 4):

1. Coastal Areas: This area gives the main characteristic of a port city, the coastal site as an interaction place of historic city centre and the gulf. The pier was constructed in the Ottoman period and significantly increased trading activities and led to modernization of the city. The rectangular narrow parcels facing to the gulf presents a modern urban layout. A modern port system, a customs house, ferry terminal, bank, commercial and residential buildings give characteristic of the area. Between Pasaport Ferry Terminal and Konak-Pier custom house, the original pier line of the Ottoman times has survived today.
2. Mimar Kemalettin Modern Bazaar: Covering the architectural elements of Ottoman Period, the area is a commercial zone of modernization period. Buildings with corner towers, corner entrances, window layouts changing in each floor, horizontal and vertical window mouldings, tile panels, reliefs and carved ornament motifs, and wide eaves (Aslanoglu, 1980) are typical features of the area. The stock exchange building, old Greek National Bank, Kardiçalı Khan are among characteristic buildings in the place.
3. The Historic Kemeraltı Bazaar: This Ottoman bazaar is one of the biggest bazaars in the world, covering an area approximately 270 hectares. The bazaar was constructed with the infilling process of the ancient inner harbour between 16th and 19th centuries (Beyru, 1992). The urban morphology of the bazaar, composed of commercial parcels and gated khans in the narrow and long streets leading to the pier area, is largely preserved today. The five mosques, which are named as Hisar, Kemeraltı, Şadırvanaltı, Kestane Pazarı and Başdurak are located in Anafartalar Street, which is the main axes presenting shoreline of the ancient harbour.

Trading activity, both from sea and land routes shaped the urban fabric. For instance, fevkani mosques were constructed to accommodate commercial activities, and khans were designed to provide storage, accommodation, also passageways between streets. Unlike the typical foundation-based approach seen in other Ottoman settlements, the khans in the bazaar were erected through a collaborative effort among merchants, reflecting a unique social model in this vibrant trading hub. Public squares, khans, passages, bazaars, and business centres, mosques, synagogues, hotels, hammams, sebils, and shadirvans, are among cultural heritage components of the living bazaar.

4. Public Administrative Facilities: Konak Square is the historic administrative centre of Izmir. The square and coastal shore are located on the infilled area, which was an ancient harbour in the 16th century. The Clock Tower, the Governor's Office, Izmir

Metropolitan Municipality Area<sup>1</sup>, and Yalı Mosque, all together compose the administrative node. Close to the square, Elhamra Cinema and National Library, Gureba-i Muslimin Hospital and Beyler Streets are located, which contributed to public facilities of the area.

5. Trade, Production, and Storage areas of Kestelli: Adjusted to the Historic Kemeraltı Bazaar, the area covers trade, small production, and storage uses. The building typology is also similar to the historic bazaar.
6. Residential Quarter of İsmet İnönü Street: The residential quarter adjusted to historic Kemeraltı Bazaar. Two-storey Izmir houses with a basement, staired street in İsmet İnönü, mansions with decorated façade and interiors are significant features. These residential quarters functioned as houses for those working in Kemeraltı Bazaar. Mosques, churches, synagogues, hammams, sebils, shadrvans, and fountains are components of the residential areas.
7. Residential Quarter of Damlalık: The area is a vista point on the upper elevation. The area has a residential characteristic with limited registered buildings, close to the open green area of Cicipark.
8. Basmane Train Station and Environs: Basmane Train Station and environs is a gateway and transit point, connecting the city with its hinterland and welcoming people coming to the bazaar via railway or caravan in the past. Nearby, there are hotel regions, where Izmir houses were transformed into accommodation facilities. Basmane Train Station, hotels along hotels street, and train station warehouses behind the station gives general characteristics of the area.
9. Residential Quarter of Basmane: Basmane quarter at the east of İki Çeşmelik street is the main residential quarter of the historic city. In the past, mainly the Turkish population and Jewish population were settled in this area. Dead ended street and organic pattern, two storey Izmir houses, and a few conserved *cortijo* houses (shared housing units for collective living, built by Jewish people in the Ottoman time) are characteristic spatial organisation of the area.
10. Components of Smyrna Ancient City: The historic urban centre is a multilayered cultural heritage and Smyrna Ancient City gives the overall ancient layer. Smyrna Acropolis, Smyrna Agora, Smyrna Theatre, Harbour Bath, and the ancient residential area Altınpark are seen in today's living heritage place. Some parts of trade pathways are also still visible. The modern İki Çeşmelik street and the Roman road is the *cardo maximus*, while Anafartalar street is *decumanus maximus* in Roman period. Although the wideness of these street changed in time, the route and several remains have been conserved. Significantly, Caravan Bridge on Meles River has been conserved with its form and still sustains its function.

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<sup>1</sup> Izmir Metropolitan Municipality building was located in this area previously. However, the building was damaged due to the 2020 Aegean Sea earthquake and demolished in 2023. The metropolitan municipality announced plans to build a monumental metropolitan building in this area, based on an architecture project competition. (<https://sehirmeclisleriyarismasi.izmir.bel.tr/yarismanin-amaci.html>, Access in 31.03.2024)

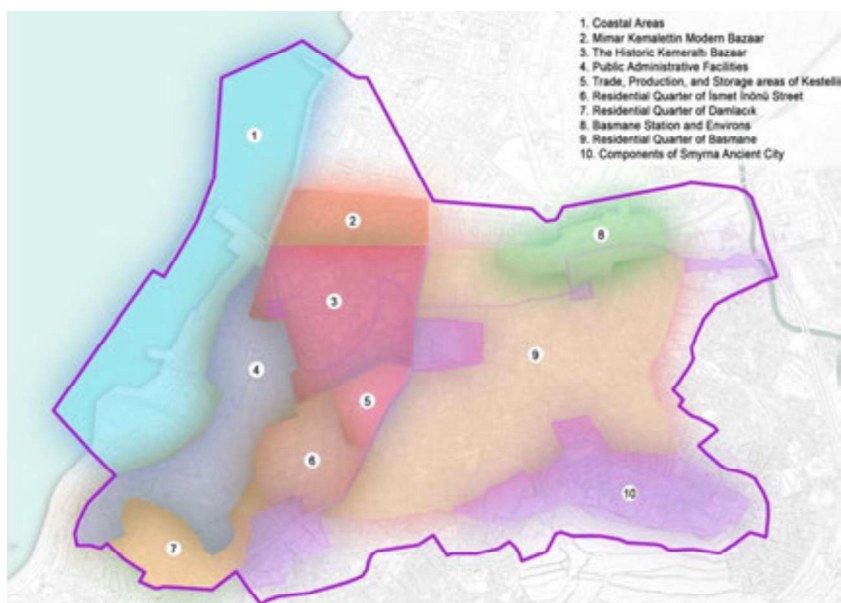


Figure 4: Values and Characteristics of Historic Centre

## 2.2. State of Conservation

The historic centre of Izmir is also determined as a management site in the legal framework. The management site is 372.40 hectares and is composed of diverse categories of conservation areas, which are Urban Conservation Areas, Historical Conservation Areas, Archaeological Sites, Natural Sites and Urban Archaeological Sites. Almost half of the management site is registered as Urban + 3rd Degree Archaeological Conservation Area (Table 1, Figure 5).

Table 1: Conservation Areas in Management Site (prepared based on source: The Historical Port City of Izmir Site Management Plan, 2022, p. 30-31)

Conservation Areas	Size (ha)
Urban + 3 <sup>rd</sup> Degree Archaeological Conservation Area	167.10
Urban Conservation Areas	8.34
Historical Conservation Areas	80.59
Archaeological Conservation Areas	38.86
Natural Conservation Areas	8.98

Besides, there are 1730 registered cultural properties, including 1153 examples of civil architecture, 371 industrial and commercial buildings, 60 religious buildings, 59 cultural buildings, 52 administrative buildings, 13 archaeological remains, 7 water structures, 4 cemeteries, 4 monuments, 3 military buildings, 2 streets, and the Port Bath-Gymnasium structure. Moreover, the Historic Kemeraltı Bazaar covers 13.1 hectares of urban and archaeological conservation sites and includes 403 registered cultural assets.

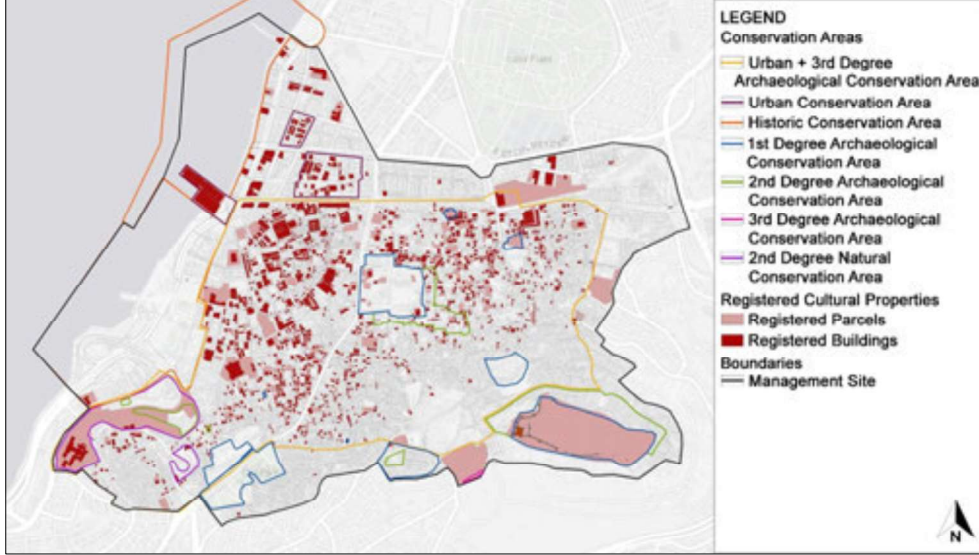


Figure 5: Conservation Areas and Registered Buildings  
(prepared based on source: The Historical Port City of Izmir Site Management Plan, 2022)

### **2.3. Stakeholders**

The stakeholders are categorised as public authorities of central and local governments, universities, professional chambers, NGOs, local community, authorised public-private partnership, and private sectors serving public services.

Public institutions hold the main responsibility in conservation and management. Universities in Izmir province are significant actors to improve knowledge about the site and conduct research on the site. Professional chambers both represent professions' perspective and monitor activities on the site for the public. Non-governmental organisations mainly comprise trade unions and sustain communication among tradesmen, both owners and renters of shops. Authorised public private partnership conducts projects mainly on restoration of buildings with other partners. Several companies provide public service of electricity at local level.

For disaster risk management, public authorities, NGOs, companies providing public services, and authorised public private partnership are determined as stakeholders who are to be worked in collaboration, provide advisory, and required data including statistical information. Universities and professional chambers are defined as stakeholders who provide advisory. Local communities are main users of the site, including headmen, tradesmen, and visitors. All stakeholders are also responsible for informing the public and involve in risk management studies (Table 2).

Table 2: Main Stakeholders in Risk Management and Participation Strategy

Institution		Key Duties	Strategy
Public Authorities	Izmir Governorship	Provincial Civil Supervisor	Collaboration, Advisory and Data
	Izmir Provincial Directorate of Disaster and Emergency	Disaster management planning, general coordination on emergency situations	
	Izmir Provincial Directorate of Environment and Urbanization	Built environment, urbanization	
	Izmir Provincial Directorate of Culture and Tourism	Conservation of cultural heritage	
	Izmir No. 1 Cultural Properties Conservation Regional Board	Conservation of cultural heritage	
	Directorate of Smyrna Ancient City Excavation	Conservation and scientific research	
	Izmir Development Agency	Financial support, local development	
	2 <sup>nd</sup> Regional Directorate of Turkish State Meteorological Service	Weather forecast, notice	
	Izmir Metropolitan Municipality	Provincial public services	
	Izmir Provincial Police Department	Rescue in emergency	
	Provincial Gendarmerie Command	Rescue in emergency	
	Konak Municipality	District public services	
Universities	Dokuz Eylül University	Scientific research	Advisory
	Ege University		
	Izmir Institute of Technology		
	Izmir Katip Çelebi University		
	Izmir Democracy University		
Professional Chambers	UCTEA Izmir Provincial Coordination Board	Public monitoring and information	Advisory
	Chamber of Architects Izmir Branch		
	Chamber of Landscape Architects Izmir Branch		
	Chamber of Geological Engineers Izmir Branch		
NGOs	Union of Chambers of Tradesmen and Craftsmen of Izmir	Trading activities	Advisory and Data
	Izmir Historical Kemeraltı Tradesmen Association		
Public Service Companies	Historical Kemeraltı Construction Investment Trade, Inc. (TARKEM)	Conservation and restoration	Collaboration, Advisory and Data
	GDZ Electricity Distribution Joint Stock Company	Public service	
	Türkiye Electricity Transmission Inc. 3rd Regional Directorate	Public service	
	Türkiye Electricity Distribution Inc. 12th Regional Directorate	Public service	

### 3. Identifying Risks and Presenting Mitigation Actions

The historic centre of Izmir is both susceptible and exposed to the risks of earthquake and tsunami, landslide and rockfall, fire, and flood. To identify risks, statistical data of past disasters and emergency response preparedness on the site at present are analysed. The frequency of disasters is also indicated.

#### 3.1. Earthquake and Tsunami

The Gulf of Izmir and its surroundings are full of intense fault lines; thus this region is identified as “magnificent seismological area” (MTA, 2005). According to Earthquake Hazard Map of Türkiye, prepared by AFAD in 2018, Izmir provincial area is located in the red zones with a high probability of earthquake hazard prevails (Figure 6), experiencing earthquakes with the magnitude of 6, in every ten years (Uluğ, 2017).

The fault lines which potentially affect the centre of Izmir are the Karşıyaka fault line of 35 km (Çiğli-Bostanlı-Karşıyaka Bornova) at the north and the Izmir fault line of 40 km (Güzelbahçe-Narlıdere-Balçova-Izmir centre) at the south. Besides, Gülbahçe (Karaburun fault), Uzunada, Seferihisar (from Gulf of Sığacık to Güzelbahçe) and Tuzla (from west of Kuşadası Bay to Orhanlı-Gaziemir-Izmir centre) fault lines have potentially effects on the city. Each fault line is considered to have a possibility of creating an earthquake with 5-6 magnitude (Izmir Metropolitan Municipality, 2020).

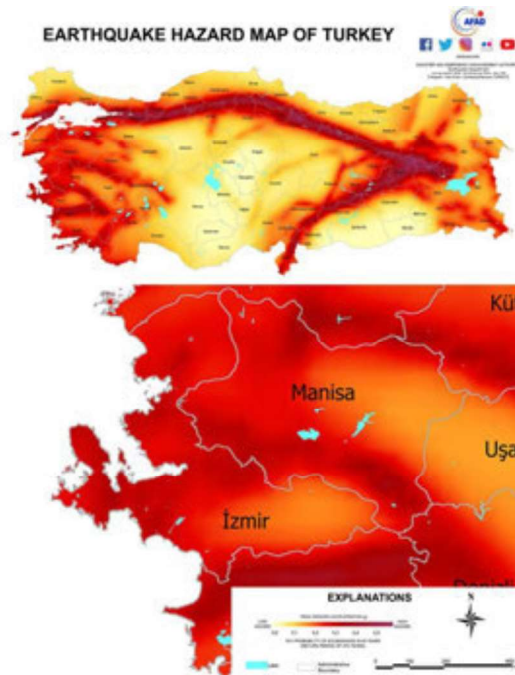


Figure 6: Earthquake Hazard Map of Türkiye and Detail of Izmir (illustrated based on the source: AFAD, 2018)

The ground condition is also significant for settlements where earthquake seismic waves can be felt and highly affected. Depending on the general tectonic structure of the Aegean Region, the Gulf of Izmir and its surroundings are located in a depression zone where the opening regime still continues. Hence, the region is under the influence of faults, some of which that cannot be monitored from the surface may cause earthquakes. The coastal areas, where mostly settled, are composed of young sedimentary alluviums (İzmir Metropolitan Municipality, 2018).

The Historic Kemeraltı Bazaar and environs were formed with the filling of the inner harbour of ancient times, which was a process spanning 400 years (Beyru, 2011). Different periods infilling processes with alluviums, from antiquity to the 19<sup>th</sup> century not only changed the urban morphology but also cause more vulnerable ground conditions.

The carrying capacity of these areas is quite weak, magnifying seismic waves several times above normal. More critically, the ground might have high liquefaction probability, creating very adverse conditions for the settlements (Uluğ, 2017). Earthquakes trigger soil layers, causing to softening and loss of strength. Similarly, liquefaction is the loss of the bearing feature of the ground due to dynamic effects. Liquefaction events in soil are mostly observed in water-saturated coarse-grained soils, such as coastal areas (İzmir Metropolitan Municipality, 2018).

Although detailed surveys are needed to identify ground conditions, assessments based on previous studies (İzmir Metropolitan Municipality, 2018) shows that the historic city centre of Izmir is located on risky ground, and high and middle probability of liquefaction (Figure 7).

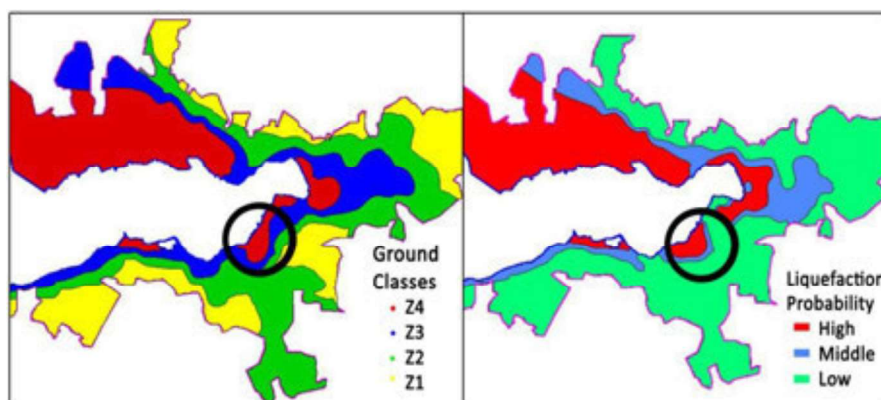


Figure 7: Ground Classes and Liquefaction Probability  
(illustrated based on source: İzmir Metropolitan Municipality, 2018)

The major earthquake events that occurred since the 1900s and affected Izmir are analysed (Table 3). It is seen that earthquake events occurred around Aegean Sea, Karaburun-Chios, Lesbos-Doğanbey-Sisam affect Izmir. When the magnitude of the earthquake was around 5, buildings were damaged. While the magnitude is around 6, it causes mainly casualties and the collapse of buildings. Also, tsunami events occurred as secondary hazards when the magnitude was higher than 6.5, around the coastal areas of rivers or Aegean Sea in 1955 and 2020 (MTA, 2005; MTA, 2020; İzmir Governorship Provincial Disaster and Emergency Directorate, 2021; AFAD, 2024).

It is also known that settlements at the coastal zone of Aegean Sea and Eastern Mediterranean Sea are located at the riskiest areas regarding tsunami, mainly due to Hellenic and Cyprus subduction zones. For instance, the 2020 dated Aegean Sea Earthquake was followed by a tsunami at south of Izmir, reaching 200 meters distance according to witnesses. Historically, a tsunami with magnitude of 5 occurred on the coast of Izmir. Tsunami waves up to 5 metres high may reach to the southern part of Türkiye, which also affects Izmir (Izmir Governorship Provincial Disaster and Emergency Directorate, 2021).

Since, there are 44 earthquake monitoring stations in Izmir (Izmir Governorship Provincial Disaster and Emergency Directorate, 2021). Seismic Microzonation studies are ongoing by the Izmir Metropolitan Municipality to determine exact locations of fault lines (Izmir Metropolitan Municipality, 2023).

Table 3: Major Earthquake Events in and around Izmir in last hundred years  
(prepared by the authors based on MTA 2005 and 2020; Izmir Governorship Provincial Disaster and Emergency Directorate, 2021; AFAD, 2024)

Date	Time (UT)	Latitude (N)	Longitude (E)	Depth (km)	Intensity (Io)	Magnitude (M)	Note
19/01/1909	04.57	38	26.5	60	IX	6	<b>Foça Earthquake</b> Centre: Around Güzelhisar, Menemen and Foça districts Casualties: 8 people died. Collapse of 700 houses, damage to 1000 houses
31/01/1928	00.29	38.18	27.8	10	VIII	6.5	<b>Torbali Earthquake</b> Centre: Junction of Little Meander and Izmir K-G hole Casualties: 50 people died, may injured. Collapse of 2000 houses, and huge damage on buildings, collapse on the top of Clock Tower, some seaside areas had slid into the sea by 20 meters.
22/09/1939	00.36	39.07	26.94	10	VIII IX	6.6	<b>Dikili Earthquake</b> Centre: Between Dikili and Lesbos Casualties: 41 people died, 88 injured. Collapse of 1000 houses.
23/07/1949	15.03	38.57	26.29	10	VIII VII X	6.6	<b>Karaburun Earthquake</b> Casualties: 7 people died. Collapse or damage of 2200 houses in Karaburun-Çeşme peninsula

(Table 3 continues)

Date	Time (UT)	Latitude (N)	Longitude (E)	Depth (km)	Intensity (Io)	Magnitude (M)	Note
02/05/1953	05.41	38.48	26.57	40	VII VIII	5	<b>Karaburun Earthquake</b> Centre: North of Karaburun peninsula Casualties: Damage on around 300 houses
16/07/1955	07.07	37.65	27.26	40	VIII	6.8	<b>Söke-Balat Earthquake</b> Centre: Aegean Sea Casualties: 2 people died. Collapse of 300 houses, damage on many buildings and minarets of mosques in Izmir Secondary hazard: Overflows in the Gediz and Büyük Menderes rivers.
19/06/1966	17.55	38.55	27.35	9	VI	4.8	<b>Menemen Earthquake</b> Casualties: Damage around 100 houses
06/04/1969	03.49	38.47	26.41	16	VIII VII	5.9	<b>Karaburun Earthquake</b> Centre: Sea near to Karaburun Casualties: Damage to 443 buildings in Çesme and Chios
01/02/1974	00.01	38.55	27.22	24	VII	5.3	<b>Izmir Earthquake</b> Centre: 15 km away from Izmir Casualties: 2 people died, 7 injured. Huge damage on 47 houses in city centre, Karşıyaka and Alsancak
16/12/1977	07.37	38.41	27.19	24	VIII	5.5	<b>Izmir Earthquake</b> Casualties: 20 people injured. Collapse of several buildings in Izmir, damage on several buildings in Buca, Alsancak, Hatay, Karşıyaka, Bornova, Gültepe and Tepecik districts
14/06/1979	11.44	38.79	26.57	15	VII	5.7	<b>Karaburun Earthquake</b> Centre: Aegean Sea Casualties: 1 people injured. Collapse of 2 houses, damage on several buildings in Alsancak.
06/11/1992	22.08	38.16	26.99	17	VII	5.7	<b>Doğanbey Earthquake</b> Centre: Around Doğanbey district. Casualties: Damage to 60 buildings
28/01/1994	18.45	38.69	27.49	5	VII	5.2	<b>Manisa Earthquake</b> Casualties: Damage to 60 buildings.
24/05/1994	05.05	38.66	26.54	17	VII	5	<b>Karaburun Earthquake</b> Casualties: Damage to 10 buildings.

(Table 3 continues)

Date	Time (UT)	Latitude (N)	Longitude (E)	Depth (km)	Intensity (Io)	Magnitude (M)	Note
10/04/2003	03:40	38.26	26.83	16	VII	5.6	<b>Urla Earthquake</b> Centre: Between Urla and Seferihisar Casualties: Damage to several buildings
17/10/2005	5:45				VII	5.7	<b>Urla-Seferihisar Earthquake</b>
	09:48			5.9			
	12:55			5.6			
20/10/2005	21:40				-	5.9	<b>Urla-Seferihisar Earthquake</b>
11/11/2010	21:08				-	5	<b>Selçuk Earthquake</b>
12/06/2017	15:28				VI	6.2	<b>Aegean Sea Earthquake</b>
17/06/2017	19:50				-	5.3	<b>Aegean Sea Earthquake</b>
22/06/2017	02:48				-	5	<b>Aegean Sea Earthquake</b>
30/10/2020	14:51	37.88	26.77	6-15	V VI	6.6	<b>Aegean Sea Earthquake</b> Centre: 8 km north of Sisam Island Casualties: 114 people died, 1035 people injured. Collapse of 16 buildings in Bayraklı district, damage to 973 buildings. Secondary hazards: Tsunami in coastal areas of Gulf of Sığacık (Seferihisar-Izmir) and Samos Island.
01/02/2021	08:48				IV	5.1	<b>Aegean Sea, Karaburun Earthquake</b>
14/08/2021	03:24	37.96	27.17	6.47		5	<b>Aegean Sea, Kuşadası Earthquake</b>
31/08/2022	13:10	26.80	37.58	7.03		5.1	<b>Aegean Sea, Söke Earthquake</b>
01/02/2021	08:46	26.11	38.98	20.69		5.1	<b>Aegean Sea, Karaburun Earthquake</b>
	11:35	26.07	38.94	17.62			
30/11/2021	07:00	26.14	37.72	3.97		5.1	<b>Aegean Sea, Çeşme Earthquake</b>

### 3.2. Landslide and Rockfall

Landslide hazard is seen around the southern part of Kadifekale's slopes, and rockfall is seen northwest of management area boundaries in Kocakapı district. Landslide and rockfall risks are related to geological formation of soil, geological features, and also effects of water, flooding and earthquakes.

Eastern part of Meles River is covered with clayey marl and tuff, and Neogene limestone on the top, and slopes of Pagos hill is covered with andesite (Figures 8, 9, and 11). Gecekondu buildings are located in these areas in general. The steep slope is also damaged due to water from surrounding houses. Thus, Kadifekale and its surroundings were declared as "Disaster Exposure Area" due to landslide risk and should be afforested with the decisions of the Council of Ministers in 1977, 1981, 1998, 2003, and 2013 in order to prevent the landslide risk (Figure 10) (Izmir Governorship Provincial Disaster and Emergency Directorate, 2022).

The area in Kocakapı district is andesite, and rockfall event occurred at nearby outcropped clay schist, where rainwater causes degradation of clay shales and steep cliffs to slide. This area was declared as a “Disaster Exposure Area” due to rockfall with the decisions of the Council of Ministers in 1981 (Figure 10) (Izmir Governorship Provincial Disaster and Emergency Directorate, 2018).

The landslide hazard is driven by earthquakes or rainfall. The landslide susceptibility shows that southwest of the historic urban centre is under moderate and high degree of landslide susceptibility, while Kadifekale and its southern part are under susceptibility degree (Figure 8).

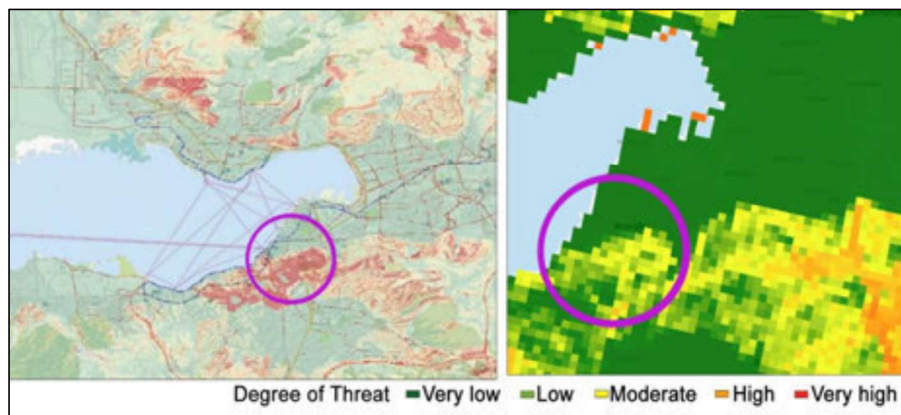


Figure 8: Resilience to Landslide (illustrated based on sources at left: Izmir Governorship Provincial Disaster and Emergency Directorate, 2021,p. 137; at right Ministry of Environment, Urbanization, and Climate Change, 2023)

According to Izmir Metropolitan Municipality Fire Department statistics, emergency rescue studies for landslide events were conducted in Sakarya neighbourhood in 2023, and Ülkü and Sakarya neighbourhoods in 2021 for the years between 2019 and 2023.

For mitigation, Kadifekale Urban Renewal Project was conducted in the Disaster Exposure Area of 42 hectares, at southern slopes part of Kadifekale, in the early 2000s. With the decision of the Izmir Metropolitan Municipality Council dated 20/07/2006, expropriation studies were conducted, and buildings were demolished. Then this area was afforested (Mutlu Kılıç & Göksu, 2018). Public engagement and social studies are still ongoing, conducted by the municipality.

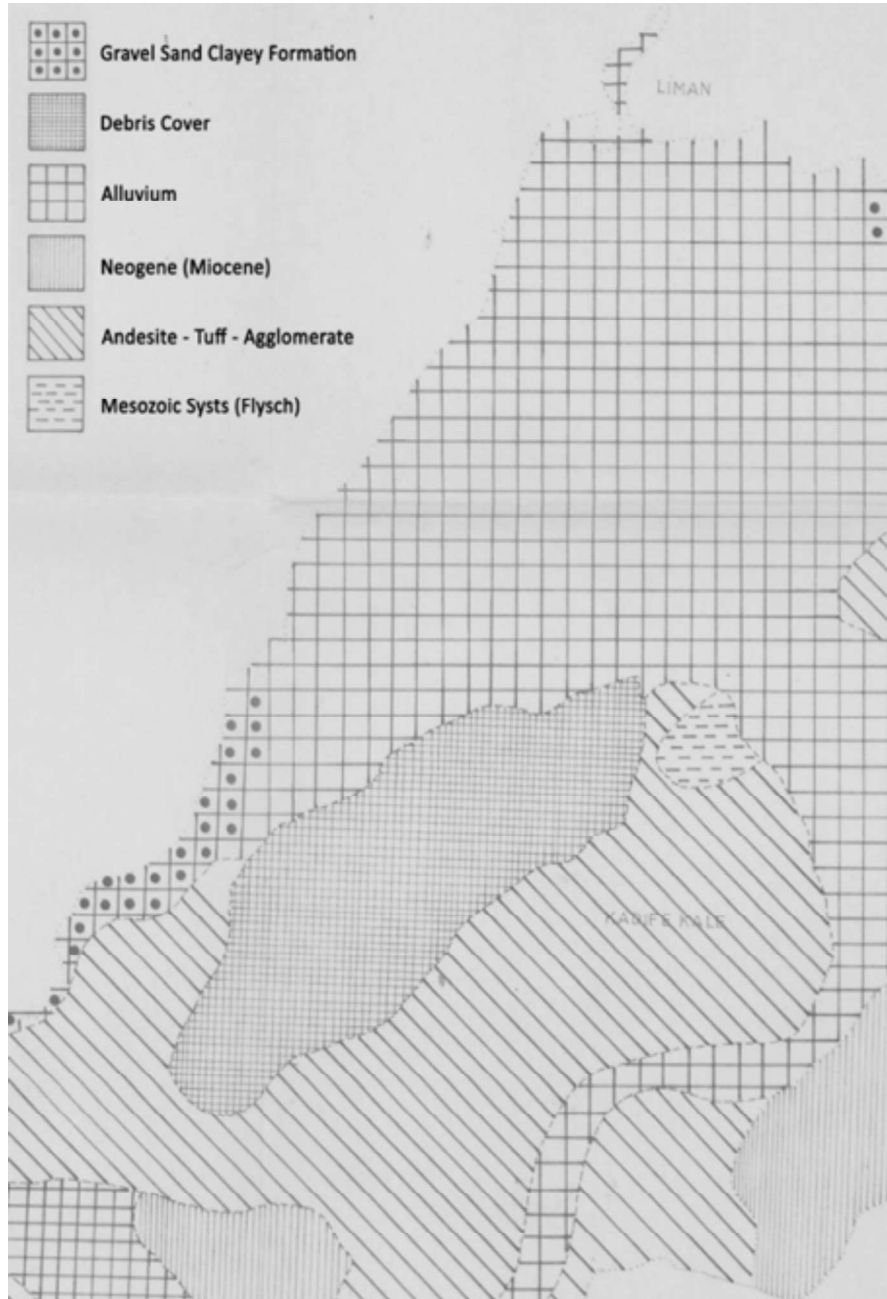


Figure 9: Geological Structure (scaled 1/20000) (edited by authors based on the source Geologist Mehmet Taşdemiroğlu Report, Izmir Metropolitan Municipality Archives, 1962)

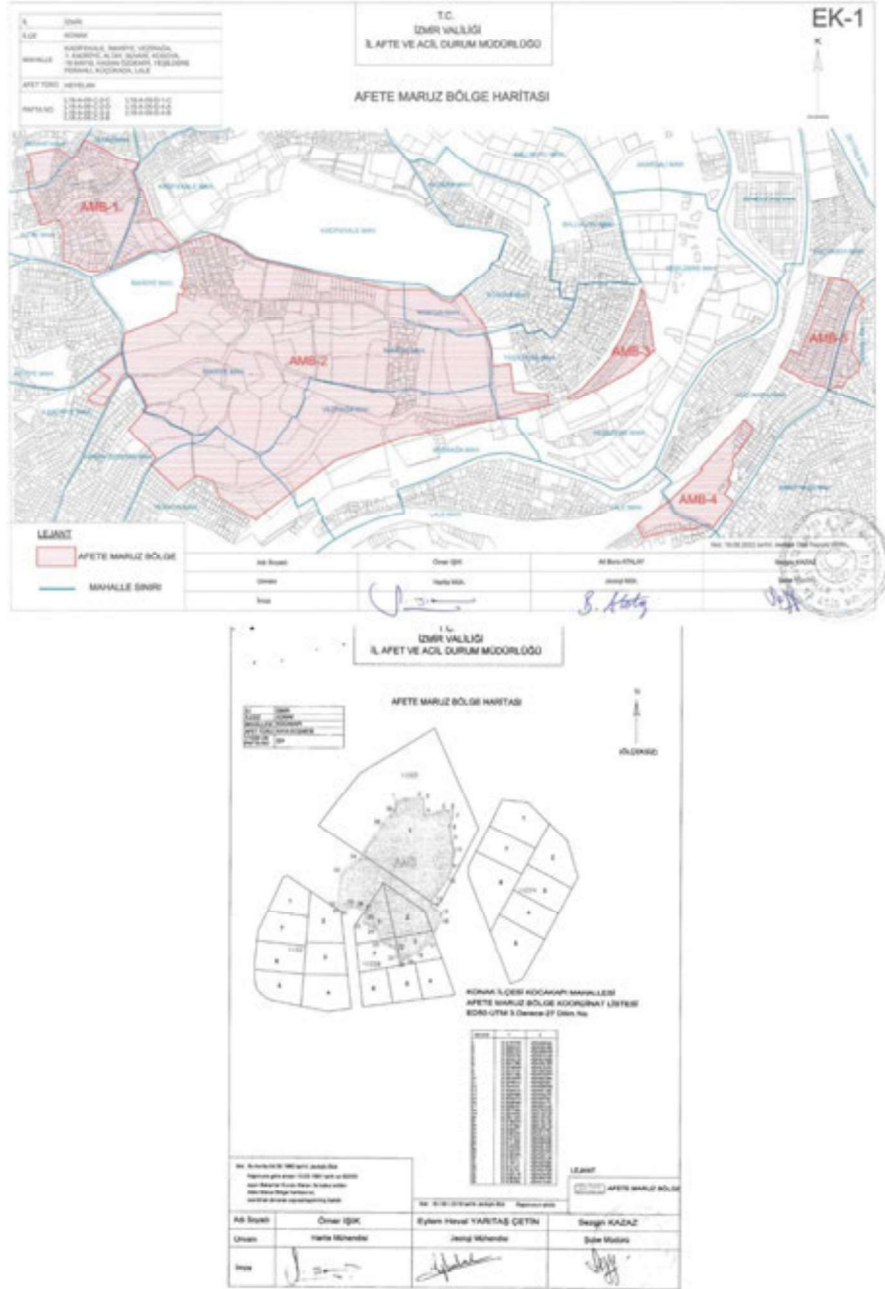


Figure 10: Disaster Exposure Areas in Kadifekale (above) and Kocakapı (below) (Source: Izmir Governorship Provincial Disaster and Emergency Directorate, 2018, p.22; 2022, p.12)

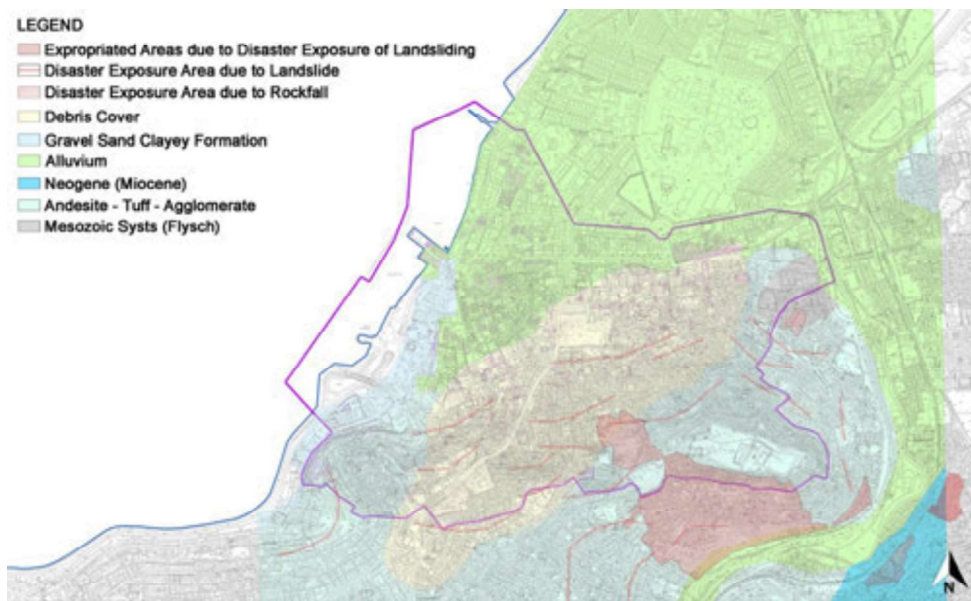


Figure 11: Geological Structure and Disaster Exposure Areas

### 3.3. Fire

Historic city centre of Izmir has suffered fire events in its history many times. One of the most significant fire events occurred in 1922, which caused around 300 hectares of the city to burn.

According to Izmir Metropolitan Municipality Fire Department statistics, around a thousand fire events in total were fought in the management site between 2018 and 2023 (Figures 12 and 13). Fire events mostly occurred in buildings, garbage areas, workplaces, transformers, and electrical infrastructure respectively. The fire events occurred in buildings, mostly housing units and abandoned buildings. It is also known from the site observations that old and inadequate electrical infrastructure in the buildings causes fire events.

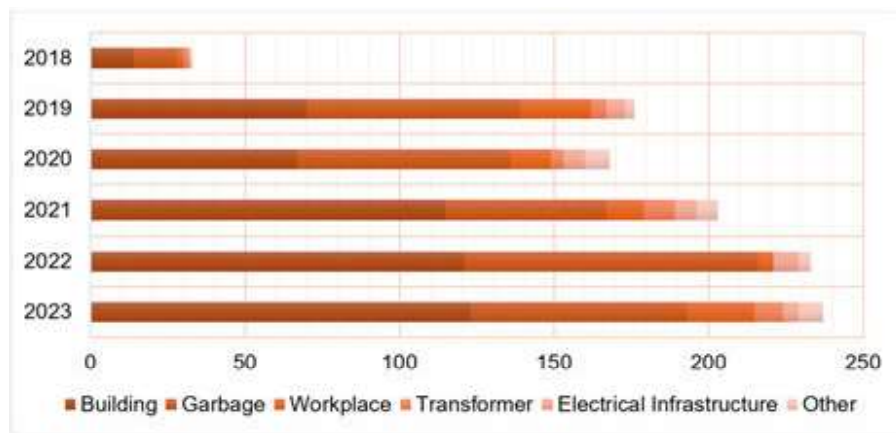


Figure 12: Fire Events in the Historic City centre of Izmir Between 2018 and 2023 (produced based on the source National Smart City Open Data System, 2024)

Izmir Metropolitan Municipality Fire Department statistics show that there are 57 hydrants, and 9 of them are also near to the fire cabinet. Most of the hydrant and fire cabinets are around the Historic Kemeralı Bazaar, Mimar Kemalettin Modern Bazaar, and public buildings. It is seen that there are limited hydrants, especially in the Basmane residential area.

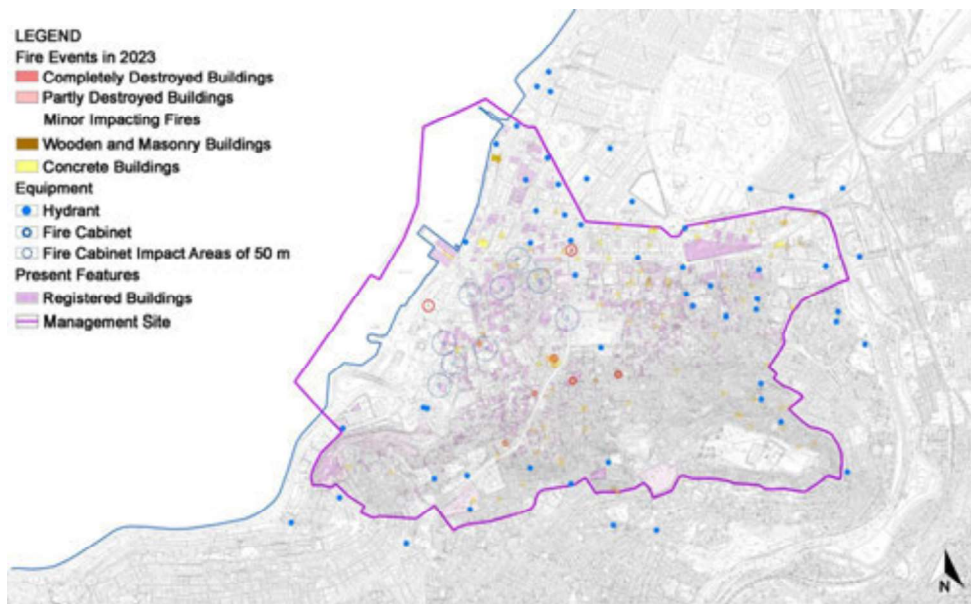


Figure 13: Fire Events and Response Equipment

### 3.4. Flood

Enclosing the historic city centre, Meles River is located in Küçük Menderes River Basin. It is known that especially the Meles River has overflowed since antiquity. Heavy rain with the effects of climate change, hydrogeological features, uneven urbanisation, land cover change with impermeable surfaces and damages on natural vegetation are several causes of flooding (Ministry of Agriculture and Forestry, 2019).

Küçük Menderes River Basin Flood Management Plan identifies that Meles River is risky and determines 500-, 100-, and 50-years recurrent flooding models. In the Q 500 model, the historic city centre would be partly affected. In total 3.855 people, which is 3% of the district population, would be affected including Alsancak region for 2018. It is projected that the population would increase to 4.150 by 2025. Also, economic damage would be around 10-225.000 TL around the historic city centre. The plan also determines six vulnerability factors for cultural heritage and flooding risk (Table 4).

Table 4: Disaster Vulnerability Factors for Cultural Heritage at Flooding Risk (Source: Küçük Menderes River Basin Flood Management Plan, 2019, p.323)

Vulnerability Factors	Details
Topography	<ul style="list-style-type: none"> <li>• Current altitude (Altitude)</li> <li>• Surface water flow paths</li> </ul>
Slope	<ul style="list-style-type: none"> <li>• Upstream source of flood</li> <li>• flood susceptibility</li> </ul>
Building Density	<ul style="list-style-type: none"> <li>• Land value per tread (ground surface)</li> <li>• Land use</li> </ul>
Distance from Riverbed	<ul style="list-style-type: none"> <li>• Distance of the area at risk of flood from the riverbed</li> </ul>
Drainage System and Soil Type	<ul style="list-style-type: none"> <li>• Vulnerable population and critical infrastructure facilities</li> <li>• Soil drainage</li> <li>• Soil moisture</li> <li>• Soil appearance within fragile ecosystem balance</li> <li>• Soil composition</li> </ul>
Distance from Road	<ul style="list-style-type: none"> <li>• Distance of cultural property from the road</li> </ul>

Konak district with the Meles River is considered risky since flood impact areas may affect low lands and ground floors of several buildings. According to models Q10, Q50, Q100, and Q500, the Meles River overflowed three times in 1976, 2000, and 2011 between 1962 and 2010 (Izmir Governorship Provincial Disaster and Emergency Directorate, 2021). Hence, overflowing occurred three times in 50 years.

Besides, it is known that periodic heavy rains cause floods on several scales especially in the Historic Kemeraltı Bazaar. According to Izmir Metropolitan Municipality Fire Department statistics, 433 flooding events and water withdrawal interventions were conducted in the management site between the middle of 2019 and 2023. In total, 275 flooding events were intervened, while 124 small scale, 29 larger scale, and 5 middle scale water withdrawal interventions were conducted in the time period (Figure 14 and 15). The highest interventions to flooding events occurred in different times, mostly in September in 2020, in January and February in 2021, in October in 2022, and in October and December in 2023.

The past flooding event in the figure 14 indicates that flooding events occurred in line with dry stream beds. Besides, land cover is mostly impermeable concrete materials that make

infiltration of rainwater difficult in the historic centre, except from open green areas and Mimar Kemalettin Modern Bazaar. The change of land cover in time, from permeable surface to impermeable ones such as asphalt or concrete, drove the impacts of flooding.

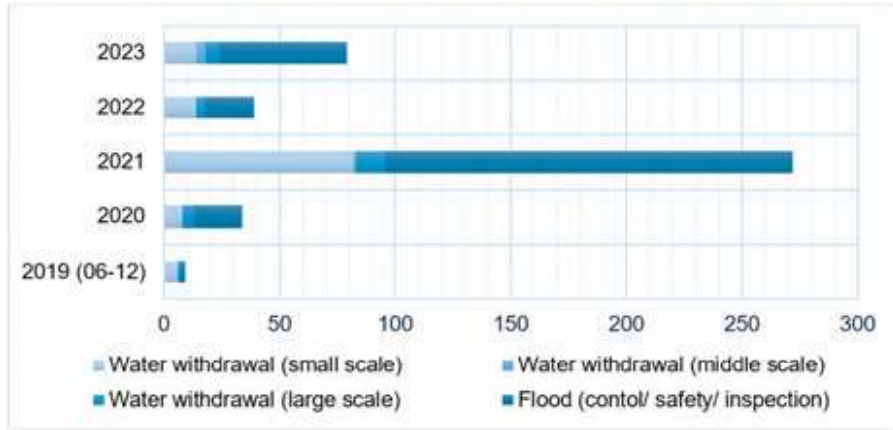


Figure 14: Fire Events in the Historic City centre of Izmir Between 2019 and 2023 (produced based on the source Izmir Metropolitan Municipality Fire Department statistics, 2024)

Today, effective studies are carried out on the risk of flooding and inundation. In order to prevent flood disasters in the area, Early Warning Meteorology Radars and Automatic Meteorology Measurement Stations were established in the city. The Enclosure Infrastructure Project carried out by the Izmir Metropolitan Municipality regarding this risk element is considered as an essential step to eliminate the risk.

With the project, it is aimed to improve the drinking water and wastewater infrastructure network in the region. The First Stage Belt Infrastructure Project aims to discharge rainwater that causes flooding in Kemeraltı area from high elevations during heavy rains, and a pumping station is also being built. Within the scope of these works, it is aimed to renew the drinking water and wastewater network in Fevzipaşa Boulevard, Gaziosmanpaşa Boulevard and Eşrefpaşa Street and to strengthen the existing infrastructure in the region (as cited in Nizamoğlu et al., 2022).

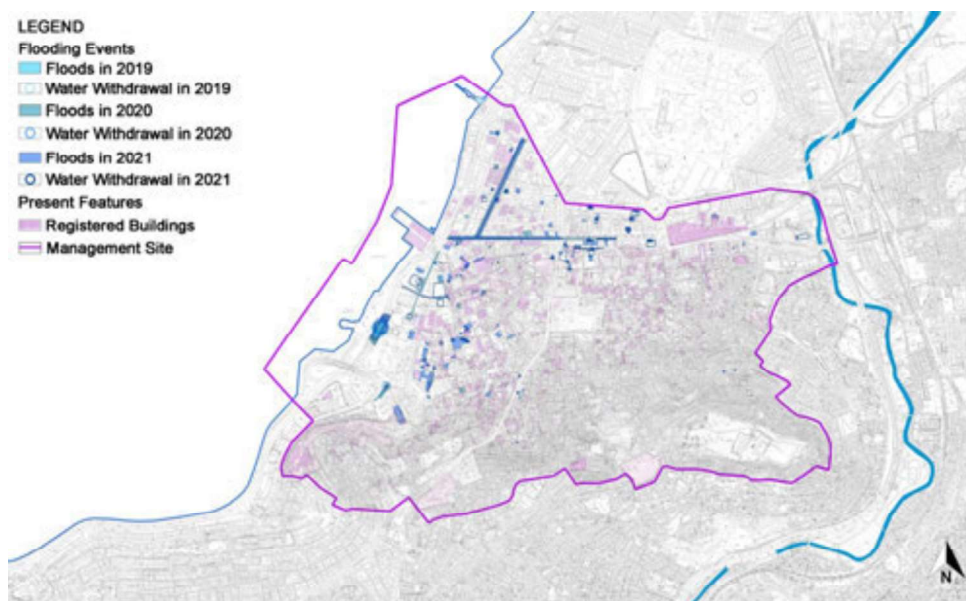


Figure 15: Flood Events and Water Withdrawal Interventions

#### 4. Risk Analysis and Evaluation

The main steps for analysis and evaluation determined in *A Guide to Risk Management of Cultural Heritage* (2016) are followed regarding the risks affecting the built environment.

The analysing step is conducted based on a matrix that shows expected occurrence about how often these hazards may occur, and impact about loss of value (Table 5). In the ABC scales, letter A represents the frequency of the disaster event or rate of occurrence of a damaging process, letter B shows expected loss of value in each item of a heritage asset, and letter C indicates how much the heritage asset value is affected; in other words, how significant is the part of heritage asset affected by the risk. And the combination of the letters A, B, and C is the magnitude of risk (Pedersoli Jr. & Antomarchi, 2016).

Table 5: ABC Method Table (Source: Pedersoli Jr. & Antomarchi, 2016; p. 64, 65, 70)

A-Score	How often does the event occur? (years)	B-Score	Fraction of value lost in each item	Word guidelines	C-Score	% of the value of the heritage asset	World guidelines
5	~ 1	5	100 %	Total or almost total loss of value in each affected item	5	100 %	All or most of the heritage asset value is affected
4.5	~ 3	4.5	30 %		4.5	30 %	
4	~ 10	4	10 %	Large	4	10 %	Large fraction
3.5	~ 30	3.5	3 %		3.5	3 %	
3	~ 100	3	1 %	Small	3	1 %	Small fraction
2.5	~ 300	2.5	0.3 %		2.5	0.3 %	
2	~ 1000	2	0.1 %	Tiny	2	0.1 %	Tiny fraction
1.5	~ 3000	1.5	0.03 %		1.5	0.03 %	
1	~ 10000	1	0.01 %	Trace	1	0.01 %	Trace fraction
0.5	~ 30000	0.5	0.003 %		0.5	0.003 %	

The occurrence is categorised as rare events, which occur less often than about once every 100 years, common events, which occur many times per century, and cumulative process, which occur continuously and frequently. Besides, level of priority and magnitude (level) of risk (hereafter MR) are determined for evaluation. The scale of MR values classified based on the priority, which is catastrophic ( $13.5 \leq MR \leq 15$ ), extreme ( $13 \leq MR \leq 11.5$ ), high ( $11 \leq MR \leq 9.5$ ), medium ( $9 \leq MR \leq 7.5$ ), and low priority ( $7 \leq MR \leq 5$ ).

For the case of urban heritage of Izmir, risk analysis and evaluation are conducted based on present features of the site and past disasters (Table 6). For earthquake risk, it is known that 157 earthquake events with a magnitude higher than 3.5 occurred in Izmir and surroundings from 1900 to 2015 April. A total of 38 earthquakes with magnitudes around 4-5, 15

earthquakes with magnitudes around 5-6, and 3 earthquakes with magnitudes above 6 occurred in the region (İzmir Governorship Provincial Disaster and Emergency Directorate, 2021). Earthquakes occur frequently, while earthquakes with magnitudes higher than 6 likely occur every 38 years. Earthquakes can be determined as common events and A score is given as 3.5.

Although the exact route of the fault lines is not known due to Seismic Microzonation studies are not finished yet, present maps of AFAD illustrate that the Izmir fault line is crossing through the management site. The effect of an earthquake would be diversified according to distance from the fault line. Hence, potential effects for three zones are hypothetically drawn, which are the first affected zone in 150 meters from the fault line, the second zone in 500 meters distance, and the third zone in 1000 meters distance (Figure 16).

The liquefaction risk is illustrated (Figure 17) based on infilling interventions throughout history. The oldest infilled area is considered as having less risks since the area would be more stabilised when compared to the recent infilled areas. Hence, ground stabilities are ranked from safest to the most liquefaction risk as, not intervened areas as the most stabilised, followed by the first infilled areas of Kemeraltı Bazaar, then second period infilled areas in the years between 1400-1850, the third period infilled areas between 1850-1905, and lastly infilled areas between 1905-1997. The third and fourth periods infilled areas are having the most liquefaction risk in coastal areas.

In this sense, a possible earthquake would affect almost all of the site, while coastal areas are more vulnerable due to liquefaction risk. Besides, the historic earthquakes shows that earthquakes in Izmir and environs affects the site. Thus, the B scale is given as 5. Since almost all parts of the heritage would be negatively and directly affected by the earthquake, C score is also determined 5. As a result, MR of earthquake is 13.5, which is a catastrophic priority.

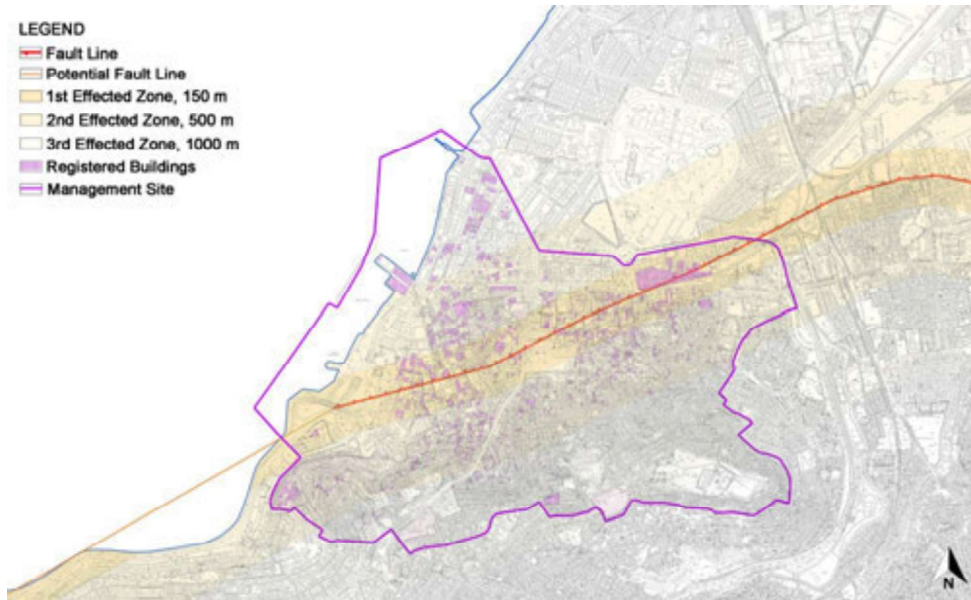


Figure 16: Active Fault Lines in Izmir and Environs

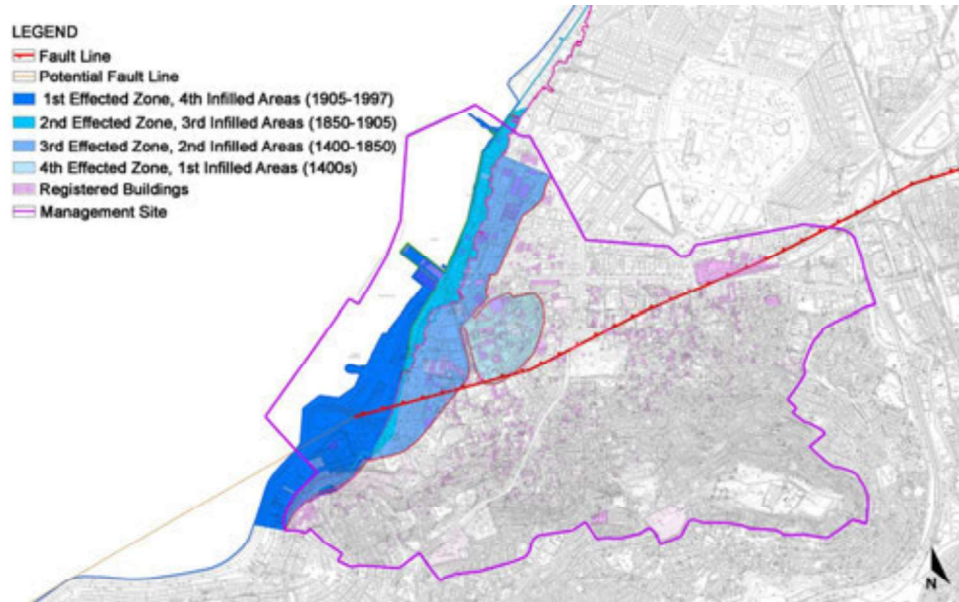


Figure 17: Ground Classes and Liquefaction Probability

Tsunami events rarely occurred after earthquakes, most at the southern part of Izmir, not ever occurring around the historic urban centre. Hence, the frequency of tsunami around the historic centre is considered as once in every 300 years and A score as 2.5. Although, Disaster Risk Reduction Plan for the Izmir Province (2021) perceives that 500 meters from the coastal area could be affected by tsunami, a hypothetical map is drawn to show maximum reaching areas of sea level rise (Figure 18).

For this, both infilled areas and topographic conditions are taken into consideration. It is perceived that higher slopes and high-rise buildings at coastal areas would limit the sea to reach inner parts, while Kemeraltı Bazaar area and its northern part would be more affected. The damage would be in between small and large. B score is given as 3.5. Mostly Kemeraltı Bazaar and coastal zones would be affected, which is a small but valuable part of the whole site. And the C score is given as 3. In total, MR value is 9, which is a medium priority to response.

Although there is limited data available for landslides and rockfalls, three landslides were responded to by the Fire Department of the municipality in five years. With this data, the occurrence frequency of landslide and rockfall events can be thought as once or twice a year. Hence, landslide and rockfall for the site are cumulative processes and A score is 3.5. Landslide and rockfall may affect a small part of a heritage item, and B score is to be 3. Also, a tiny fraction of the historic city would be affected, and C score would be 2. In total, the MR of landslide would be 8.5, which is a medium priority.

Both fires and floods occur several times every year. Fire and flood are thought as cumulative processes, and A scores for both are 5. Since fires are more destructive than floods, causing irreversible damage to heritage items, B score of fire is given as 4. The fraction of loss in flooding would be in between large and small, and B score is given 3.5. Hence, MR score for fire is 13 and for flood is 12.5, having extreme priority.

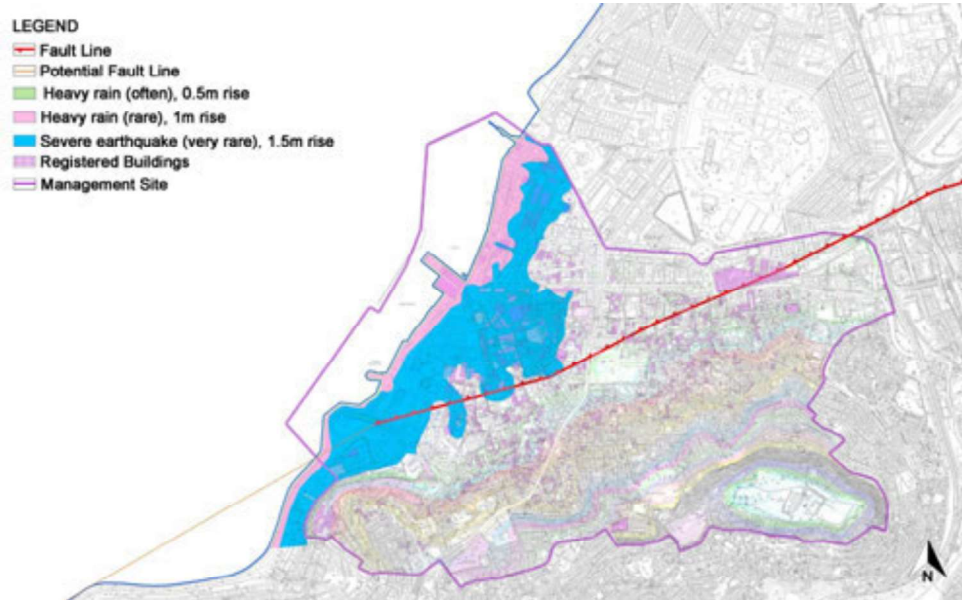


Figure 18: Probability of Sea Level Rise

Table 6: Evaluation of Risks for the case on Urban Heritage of Izmir

	A (How often does the event occur?)	B (fraction of value lost in each effected item)	C (% of value of the heritage asset)	MR (A+B+C)	Level of priority
Earthquake (M ~ 6)	3.5	5	5	13.5	Catastrophic priority
Tsunami	2.5	3.5	3	9	Medium priority
Landslide and Rockfall	3.5	3	2	8.5	Medium priority
Fire	5	4	4	13	Extreme priority
Flood	5	3.5	4	12.5	Extreme priority

The scenario can also be varied according to uncertainty of the event. For this sense, magnitude of the risk can be presented in three values, regarding most likely, low estimate, and high estimate of the relevant scores.

Scenarios for possible disasters:

- Most Likely Scenario: The earthquake with a magnitude of over 6, caused by the Izmir fault, caused to collapse of high-rise buildings and unauthorised structures in Kemeraltı Bazaar and its surroundings, and the destruction of some of the cultural assets and the permanent damage of some of them due to both the earthquake and the destruction of other structures.
- High Estimate Scenario: The fire, which occurred due to a leak in a registered building with an outdated electrical infrastructure in the historic Kemeraltı bazaar, caused the roof to burn and the adjacent buildings to be damaged.
- High Estimate Scenario: After the severe earthquake, fire incidents occurred as a result of the collapse of high-rise buildings and buildings with excessive air conditioning and irregular power lines in the Historical Kemeraltı Bazaar, the closure of roads made the intervention difficult, and the roofs and interiors of registered buildings were permanently damaged.
- High Estimate Scenario: Extreme weather events and sudden rains driven by climate change caused the Gulf of Izmir to overflow, damage on the Clock Tower and its surroundings, submergence of the ground floors of shops, fires due to electricity leakage in some buildings, and permanent damage in some buildings.
- Low Estimate Scenario: After the severe earthquake, the sea overflowed, causing the buildings in the historical city centre to collapse and get damaged, Konak Square and its surroundings were flooded, and the Izmir Clock Tower and the coastline got damaged.
- Low Estimate Scenario: The sea flooding that occurred after the severe earthquake, combined with the irregular electrical infrastructure problem, caused fires to break out

in Kemeraltı Bazaar, high-rise buildings collapsed, and cultural assets got damaged, and coastal buildings suffered permanent damage as a result of floods and fires.

A specific vulnerability analysis methodologic framework for the urban heritage of Izmir is defined based on vulnerability criteria and analyses for identified risks (Table 7 and Figure 19). The vulnerability criteria are determined for all risks, earthquake, tsunami, landslide, fire, and flood. Based on value and cultural characteristics of determined zones, a matrix is drawn for evaluation.

Accordingly, (3) the historic Kemeraltı Bazaar is the most vulnerable place regarding overall risks, which is followed by (4) public administrative facilities, (5) trade, production, and storage areas of Kestelli, (1) coastal are, and (9) residential quarter of Basmane.

Regarding vulnerability criteria for all risks, (9) residential quarter of Basmane is the most vulnerable place which has low accessibility of roads, less open green areas, and limited emergency response equipment. The zones of (1) coastal areas and (4) public administration facilities are the most vulnerable to earthquake risk, which are followed by (3) the Historic Kemeraltı Bazaar and (2) Mimar Kemalettin Modern Bazaar. These places are vulnerable due to spatial pattern, building density, liquefaction risk, ground condition with some effects of infilling interventions as well as proximity to fault line and ground condition.

Tsunami is mainly a risk for (1) coastal areas, while landslides threaten mostly (10) components of Smyrna Ancient City, which is Kadifekale and surroundings. Fire risk is high in (3) the historic Kemeraltı Bazaar, and (5) trade, production, and storage areas of Kestelli. These places are close to uses that drive fire risk, such as small workshops or easily flammable products. Due to the uses of shops, streets are problematic for accessibility. Moreover, the lighting system is mostly improper with disorganised cables and lamps.

Flooding is a most widespread threat for the historic centre, affecting most of the zones. Only, (10) components of Smyrna Ancient City and (2) Mimar Kemalettin Modern Bazaar are more resilient compared to other zones. Since the characteristic zones are mostly covered by concrete materials, infrastructural and spatial organisational problems are driven by proximity to coastal line and height from sea level, flooding becomes a more and more significant risk for the historic centre.

Table 7: Vulnerability Analyses for the Case of Urban Heritage of Izmir

	1. Coastal Areas	2. Mimar Kemalettin Modern Bazaar	3. The Historic Kameraltti Bazaar	4. Public Administrative Facilities	5. Trade, Production, and Storage areas of Kestelli	6. Residential Quarter of Ismet Inonu Street	7. Residential Quarter of Damlibak	8. Basmane Station and Environs	9. Residential Quarter of Basmane	10. Components of Smyrna Ancient City
<b>For All Risks</b>										
Accessibility of Roads (Culde sacs, Narrow Roads, Steets with stairs: 3, Parking & Occupation: 2, Open&Traffic problems: 1)	1	1	3	2	2	3	2	1	3	2
Proximity to Main Roads (Far: 3, Moderate: 2, Close: 1)	1	1	1	1	1	1	1	1	2	2
Proximity to Open Green Areas (Gathering Areas) (Far: 3, Moderate: 2, Close: 1)	1	2	1	1	3	2	1	1	3	1
Density of Users (High: 3, Moderate: 2, Low: 1)	3	3	3	3	2	1	2	3	2	1
Proximity to Emergency Response Equipment (Far: 3, Moderate: 2, Close: 1)	2	1	1	1	2	3	2	1	3	1
Heritage Information and Documentation (Not available: 3, Partly available: 2, Available: 1)	1	2	2	2	2	2	1	2	2	1
<b>Total</b>	<b>9</b>	<b>10</b>	<b>11</b>	<b>10</b>	<b>12</b>	<b>12</b>	<b>9</b>	<b>9</b>	<b>15</b>	<b>8</b>
<b>Earthquake</b>										
Spatial pattern (Adjoining: 3, Composition of adjoining & discrete orders: 2, Discrete: 1)	3	3	3	3	3	3	2	2	3	1
Building Density (High: 3, Moderate: 2, Low: 1)	3	2	2	3	2	2	2	3	2	1
Proximity to Fault Line (Close: 3, Moderate: 2, Far: 1)	2	2	3	3	2	2	2	3	1	1
Liquefaction Risk (High: 3, Moderate: 2, Low: 1, Not: 0)	3	2	1	2	0	0	0	0	0	0
Ground Condition (Alluvium/ Infilled/Gravel sand Clayey Formation: 3, Debris Cover: 2, Andesite-Tuff-Agglomerate: 1).	3	2.5	3	3	2	2	1.5	2.5	1.5	1.5
<b>Total</b>	<b>14</b>	<b>11.5</b>	<b>12</b>	<b>14</b>	<b>9</b>	<b>9</b>	<b>7.5</b>	<b>10.5</b>	<b>7.5</b>	<b>4.5</b>
<b>Tsunami</b>										
Proximity to sea & Topographic Features	3	0	2	1	0	0	0	0	0	0

(Table 7 continues)

	1. Coastal Areas	2. Mimar Kemalettin Modern Bazaar	3. The Historic Kemeraltı Bazaar	4. Public Administrative	5. Trade, Production, and Storage areas of	6. Residential Quarter of İsmet	7. Residential Quarter of Damlaçk	8. Basmane Station and Environs	9. Residential Quarter of Basmane	10. Components of Smyrna Ancient City
<b>Landslide</b>										
Proximity to Disaster Exposure Area (Close:3,Moderate:2,Far:1,NA:0)	0	0	0	0	0	0	0	0	1	3
<b>Fire</b>										
Proximity to fire risk uses (Close: 3, Moderate: 2, Far: 1)	0	2	3	2	3	2	1	2	1	1
Obstacles for Responses on Street (High:3, Moderate:2, Low:1, NA:0)	1	1	3	2	2	0	0	0	0	0
Proximity to hydrant/ fire cabinet (Close: 1, Moderate: 2, Far: 3)	2	1	1	1	2	3	2	1	3	1
Oder of Lightening System (Improper:3, Partly p.: 2, Proper: 1)	1	1	3	2	2	1	2	1	1	1
<b>Total</b>	<b>4</b>	<b>5</b>	<b>10</b>	<b>7</b>	<b>9</b>	<b>6</b>	<b>5</b>	<b>4</b>	<b>5</b>	<b>3</b>
<b>Flood</b>										
Spatial organization (Problematic: 3, Moderate: 2, Organized: 1, NA:0 - regarding building entrance below street, concrete & open areas, adjoining & discrete)	1	1	3	2	3	1	2	2	2	0
Land Cover (Concrete: 3, Permeable Surface: 2, Green: 1)	1	2	3	3	3	3	3	3	3	2
Road (Tunnels & Underground passes: 3, Partly asphalt: 2, pedestrian pathways: 1, Natural: 0)	3	1	2	2	2	1	3	2	2	1
Infrastructure (Old: 3, Moderate: 2, Renewed:1, Not Required: 0)	1	1	1	1	2	3	2	2	3	0
Ground Condition (Alluvium/ Infilled/Gravel sand Clayey Formation: 3, Debris Cover: 2, Andesite-Tuff-Agglomerate: 1).	3	2.5	3	3	2	2	1.5	2.5	1.5	1.5
Proximity to Coastal Line (Close: 3, Moderate: 2, Far: 1)	3	2	2	2	3	3	3	3	3	2
Height Above Sea Level (Low:3,Moderate:2,Higher slopes:1)	3	2	3	3	2	2	1	1	1	2
<b>Total</b>	<b>15</b>	<b>11.5</b>	<b>17</b>	<b>16</b>	<b>17</b>	<b>15</b>	<b>15.5</b>	<b>15.5</b>	<b>15.5</b>	<b>8.5</b>
<b>Grand Total</b>	<b>45</b>	<b>38</b>	<b>52</b>	<b>48</b>	<b>47</b>	<b>42</b>	<b>37</b>	<b>39</b>	<b>44</b>	<b>27</b>

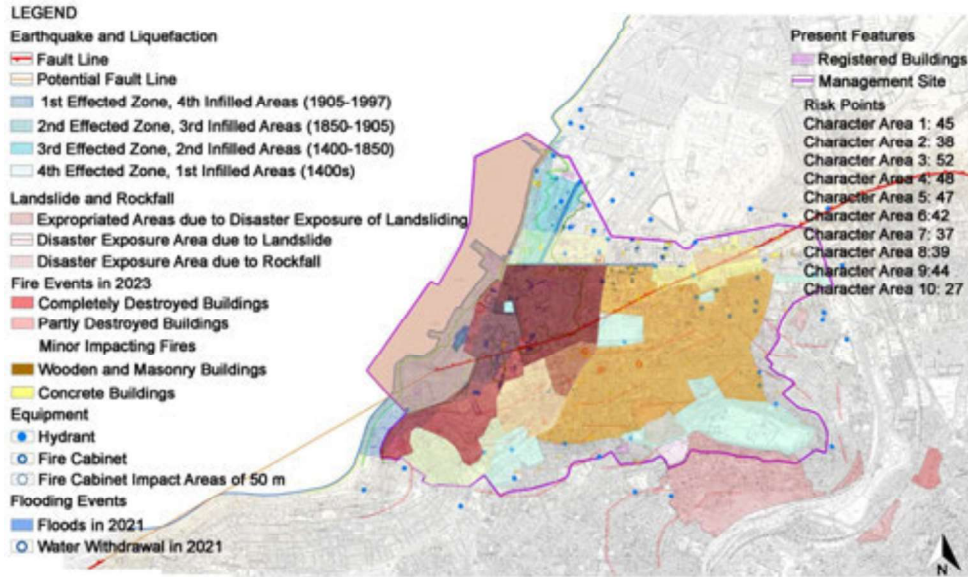


Figure 19: Synthesis of Risk Analyses

## 5. Proposals for Improvement of Risk Treatment Strategies

According to analyses and evaluations, preliminary strategies for elimination, adaptation or mitigation risks are determined in regard to cultural values of the site.

For all risks:

- To increase accessibility within the historic centre, parking problems and occupation of small shops in the streets are to be prevented in the historic Kemeraltı Bazaar.
- Small compatible vehicles and transportation facilities are to be utilised for residential quarters of İsmet İnönü Street and Basmane.
- Emergency response equipment including early warning system, emergency buttons, and monitoring cameras sensitive to heat, as well as hydrants and fire cabinets are to be increased in number and upgraded in technologic quality.
- Emergency gathering areas are to be developed. Several buildings are to be functioned as emergency gathering points, especially in trade, production, and storage areas of Kestelli and residential quarter of Basmane.
- As determined in the Site Management Plan, heritage information and documentation must be sustained, detailed inventory of buildings and cultural characteristic zones are to be regularly updated and data is to be secured.
- Specified studies to increase public awareness on precautions before disasters, behaviours during disasters, and recovery processes after disasters are to be conducted.
- Periodical training is to be organised for capacity building of public authorities on how to respond during and after disaster events.

For earthquake and tsunami risk:

- Prevention and mitigation strategies are to be developed and reviewed based on seismic microzonation studies.
- Spatial plans including conservation plans and master plans are executed fully. Building densities must be audited by relevant public authorities to be appropriate with the plan decisions.
- Emergency monitoring systems are to be placed in the coastal areas to monitor sea level rise, gather data periodically and sustain information for future estimations and planning studies.

Landslide and Rock Fall:

- Specific interventions must be taken in the Disaster Exposure Areas around Kadifekale. Housing areas are to be expropriated and afforestation studies are to be conducted by the public authorities in cooperation with relevant stakeholders. Since these are radical interventions, public participation and involvement of locals and residents should be ensured. Spatial interventions should sustain social and economic empowerment strategies, in this manner, social inclusion policies should be determined and implemented sensitively regarding diversified cultural backgrounds of locals.
- Kocakapı neighbourhood and other areas close to Meles River should be monitored regarding rockfall risks. Similar interventions like expropriation and public participation in Kadifekale should be taken for the disaster exposure area due to rockfall.

Fire:

- Trade of fireproof products in the historic Kemeraltı Bazaar is to be encouraged.

- Small shops and workshops in the historic Kemeraltı Bazaar and trade, production, and storage areas of Kestelli are to be regularly audited by the relevant authorities.
- Street shelters are to be designed with an appropriate height from the street, fireproof materials, and compatible with the cultural heritage.
- More hydrants are to be placed in residential quarters of İsmet İnönü Street and Basmane.
- Lightening systems in the historic Kemeraltı Bazaar, public administrative facilities, trade, production, and storage areas of Kestelli, and residential quarter of Damlacık are to be reviewed. Besides, old electricity infrastructure of the buildings is to be detected and renewed in the historic centre.

Flood:

- Küçük Menderes River Basin Flood Management Plan determines measures for Meles River as pre-disaster period, which are building a canal with retaining walls (masonry and concrete materials) and improvement of bridges and transition structures on the river between 2020-2024. For the basin scale several measures are determined, such as introducing green roof, plant rain ditch, permeable pavement, permeable asphalt, rain tank, bioretention and infiltration ponds. These measures are to be evaluated and adopted for the historic centre in regard of compatibility to cultural heritage values.
- Since land cover change significantly drives flooding risk, permeable surfaces are to be used in the historic centre, concrete surfaces can be preferred only in main roads.
- Some buildings have remained below street level due to infrastructure studies. These inappropriate interventions must be reversed.
- Old infrastructure facilities such as water collection channels in residential quarters of İsmet İnönü Street and Basmane are to be renewed. The cultural layers of the past must be taken into account in the renewal studies.
- Intervention including expropriation can be taken to create open green axes according to dry stream beds. Continuity of open green areas should be sustained within the historic centre.

## 6. Proposals for Monitoring and Revision Processes

The main responsible stakeholders for implementation, monitoring, and revision of risk treatment strategies are public authorities. The whole process of risk management is to be conducted with collaboration of universities, professional chambers, NGOs, PPP, and public service companies. Main strategies for monitoring and revision processes are determined:

- A database to collect data about risk management strategies is to be established by the relevant public authorities. This database is also utilised to collect data and documentation of past disasters.
- A risk management working group consisting of experts from public authorities, academics from universities, representatives of professional chambers, NGOs, PPP, and public service companies is to be constituted.
- Main duty of the risk management working group is periodically collecting actual data and monitoring processes within their corresponding authority.
- A risk management monitoring board is to be constituted with involvement of senior representatives of the whole stakeholders.
- The working group and monitoring board together would evaluate the progress and obstacles faced during the processes of implementation and monitoring. Also, new emerging threats either due to risk management strategies or unpredicted events are to

be discussed. Required regulatory actions are to be taken with consolidations of stakeholders.

## **7. Conclusion**

This study presents an example of a preliminarily risk management process for urban heritage sites, suggesting a methodology to open new discussions for further studies. This paper is an attempt to encourage conducting an integrated risk management plan with participation of the stakeholders, based on detailed surveys to identify risks, including specified parts such as action programmes with responsible authorities and allocated resources, monitoring indicators, and evaluation forms.

Risk identification, analyses, and evaluation, as well as strategies for risk reduction, monitoring, and evaluation are determined in a general perspective which should be further studied and expanded. Studies not just in the scale of area but also in the building scale should be conducted. The impacts of different hazards influencing one another and threats occur due to the dynamics of the place, such as adjacent order, adjoint electricity infrastructure, narrow roads with low accessibility, should be taken into consideration. Based on more detailed analysis, more specified strategies for mitigation and adaptation should be determined.

Cultural heritage places are threatened by many factors, either due to human induced factors or natural factors. It is significant to take actions effectively and comprehensively regarding human, technical, and financial resources. Pre-disaster risk studies are fundamental to eliminate risks on cultural heritage and decrease costs of recovery and rehabilitation after disasters. The overall aim is to be the conservation of urban heritage, which are significant to humanity, as of public interest for today's and future generations and beyond.

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