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Transformation of Post Industrial Areas Into Public Open and Green Spaces; Ankara Maltepe Gasworks Example

Post Endüstriyel Alanlarının Kamusal Açık Yeşil Alanlara Dönüştürülmesi; Ankara Maltepe Gazhanesi Örneği

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Abstract

Transforming post-ındustrial areas into public spaces is a common practice in urban areas. Maltepe Gasworks in Ankara, Türkiye, was selected for this study. The research aims to develop a new landscape design that enhances the area's ecological, historical, and economic assets. In this context, the study consists of four stages. In the first stage, literature research was conducted. In the second stage, a SWOT analysis was carried out. Later, a new industrial landscape design proposal was developed for the region, taking into account ecological, historical and economic considerations. Finally, the current situation of the area and the new landscape design are compared. The SWOT analysis and neighborhood analysis used in the study revealed that the region lacks a historical identity and a green connection. With the new landscape design proposed for the area, a landscape design that takes into account ecological, historical identity and economic parameters has been developed. With the study, the area's historical identity, ecological and economic value have been allocated. In addition, the amount of green space is increased and the relationship between other green spaces is further strengthened with the proposed industrial landscape design.

Keywords: Industrial area, public open green space, historical identity, ecological restoration

Özet

Kentsel alanlarda post-endüstriyel alanların kamusal alanlara dönüştürülmesi yaygın bir uygulamadır. Çalışma alanı olarak Türkiye'nin başkenti Ankara'daki Maltepe Gazhanesi seçilmiştir. Araştırma, bölgenin ekolojik, tarihi ve ekonomik değerini geliştiren yeni bir peyzaj tasarımı geliştirmeyi amaçlamaktadır. Bu bağlamda çalışma dört aşamadan oluşmaktadır. İlk aşamada literatür araştırması yapılmıştır. İkinci aşamada SWOT analizi gerçekleştirilmiştir. Daha sonra bölge için ekolojik, tarihi ve ekonomik hususları da göz önünde bulunduran yeni bir endüstriyel peyzaj tasarım önerisi geliştirilmiştir. Son olarak alanın mevcut durumu ile yeni peyzaj tasarımı karşılaştırılmıştır. Çalışmada kullanılan SWOT analizi ve yakın çevre analizleri ile bölgede tarihi bir kimliğin ve yeşil bağın olmadığı görülmüştür. Alan için önerilen yeni peyzaj tasarımı ile ekolojik, tarihi kimlik ve ekonomik parametrelerin dikkate alındığı bir peyzaj tasarımı geliştirilmiştir. Çalışma ile bölgenin tarihi kimliğinin, ekolojik ve ekonomik değerlerinin ortaya çıkarılması amaçlanmıştır. Ayrıca önerilen bu endüstriyel peyzaj tasarımı ile yeşil alan miktarı arttırılırken, diğer yeşil alanlar arasındaki ilişki daha da güçlendirilmiştir.

Anahtar Kelimeler: Endüstriyel alan, kamusal yeşil alan, tarihsel kimlik, ekolojik restorasyon

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1. Introduction

Rapid industrialization has significantly contributed to the economic development of many countries (Fan et al., 2017). Regions like North Rhine-Westphalia in Germany, Yorkshire in England, Nord-Pas-de-Calais in France, and Upper Silesia in southern Poland are considered the birthplaces of the Industrial Revolution. In Türkiye, industrialization began later than in Europe, starting with the Ottoman Empire in the late 19th century and continuing with the establishment of the Republic of Türkiye. In all these countries, industrial activities, especially coal mining, played a crucial role in shaping the post-industrial landscape and left lasting marks on the geography (Pytel et al., 2021). Rapid industrialization has led to the wastage of land and resources in urban areas, the degradation of the city's ecological landscape (Liu and Pan, 2014), and negatively impacted public health (Zeng et al., 2021). However, these once-problematic landscapes are now seen as opportunities. Their location, proximity to infrastructure, and unique forms make them ideal for redevelopment in urban areas (Loures, 2015). Creative interventions in these areas can increase the amount of public space in cities and improve public health and well-being.

The term "post-industrial" often refers to areas that remain after industrial use, including polluted landscapes and old factory buildings in historic parts of cities (Erdem Kaya, 2022). For example, the Çubuklu Silos, an important part of Istanbul's industrial heritage, is located between Paşabahçe and Kanlıca. Opened in the late 19th century to meet the city's growing energy needs, they have been used for storage by private oil companies since the 1930s. Over time, different silos were built to store various products like food, seeds, minerals, and chemicals. Even though they no longer serve their original purpose, these silos have architectural significance and are now preserved as heritage sites. In 2024, the Istanbul Metropolitan Municipality restored the Çubuklu Silos following universal conservation principles, bringing them back into use (İBB Atatürk Library, 2024). Another example is Bilgi's Santral Campus. Between 1938 and 1952, Turkey's first thermal power plant supplied electricity to Istanbul. Built in the Golden Horn, it reflects the First National Architectural Movement. In 2007, it was converted into a campus and now serves as a space preserving industrial heritage, hosting education, culture, and arts activities (Benli and Banaz, 2024).

Reusing outdated industrial areas that no longer meet contemporary needs is one of the best ways to revitalise vacant spaces affected by urban shrinkage (Smith, 2008; Loures, 2015; Pan and Song, 2017; Otsuka et al., 2021). These old industrial sites, which have lost their production, transportation, and infrastructure functions, as well as brownfields in cities, have great development potential and hold significant historical and cultural values (Erdem Kaya, 2022). However, they often carry negative environmental burdens. Many successful examples of converting urban brownfields and historic industrial complexes into green spaces demonstrate both social benefits and environmental gains (De Sousa, 2014; Langhorst, 2014; Kristiánová et al., 2016). For instance, Gas Works Park in Seattle, Washington, US, designed by Richard Haag Associates, is a former industrial site transformed into a public park through remediation and reclamation. The park has not only cleaned up contaminated land but also serves the public (Way, 2013; Liu and Pan, 2014; Lee, 2019; Erdem Kaya, 2022). Converting old industrial areas and brownfields into green spaces can meet recreational needs, enhance aesthetic appeal, create healthy urban environments, increase property values, provide wildlife habitats, and make cities more resilient to climate change (Kristiánová et al., 2016). However, these benefits are only possible with proper landscape designs. For example, the Seka Paper Factory in Kocaeli, Türkiye, was a comprehensive industrial transformation project. Opened in 1934 and operating until 2005, the factory's land was transferred to the Kocaeli Metropolitan Municipality and turned into an open green area (Oğuz et al., 2010). Another example is the Hasanpaşa Gasworks, which supplied the city's lighting and fuel for 101 years from its establishment in 1892. Production ceased in 1993 due to outdated technology and environmental concerns. After a period of abandonment, public advocacy led to its preservation and extensive restoration. Reopened as Museum Gazhane on 9 July 2021, it now serves as a cultural hub in Istanbul, focusing on arts and culture in a modern "living space" concept (MG, 2022).

Post-industrial landscape design is an inclusive process that involving creative and technical considerations on contaminated sites. Remediation and design are two critical actions to redefine the post-industrial landscape (Erdem Kaya, 2022). Another important focus in industrial landscape design is historical identity. As public open green spaces, industrial landscapes allow the new to connect with history, enabling the rebirth of the past and creating a harmonious landscape with industrial heritage (Liu and Pan, 2014). For example, Westergasfabriek (WGF) is a former gas production factory located west of Amsterdam. The factory was shut down when natural gas resources were discovered in the Netherlands, making gas production unnecessary. Most of its buildings were demolished, and the rest were used as storehouses for years. In 1981, the factory was reconstructed as a recreational area due to increasing interest in reclaiming old industrial areas as historically valuable urban spaces. The various shapes and sizes of the buildings in the area provide opportunities for different activities. The gas holder, for instance, is used for events such as house parties, pop concerts, and other performances (Bonink and Hitters, 2001; Loures and Burley, 2012). As a result, spatial design and planning projects for post-industrial spaces have gained visibility, especially when they include significant public open spaces or green areas (Langhorst, 2014).

This research focuses on transforming Maltepe Gasworks, located in the Maltepe district of Ankara, the capital city of Türkiye, into an ecologically, culturally, and economically open public space. Maltepe Gasworks was chosen as the study area because it was registered as an immovable cultural property by the Ankara Cultural and Natural Heritage Preservation Board on 19 March 1991. However, its status was downgraded and it was demolished in 2006. The research aims to create a new public space in ecological, cultural, and economic terms through the post-industrial landscape design of the Maltepe Gasworks area. Initially, a brief literature review was conducted. Then, a SWOT analysis was performed on the study area. Based on this analysis, a post-industrial landscape design and economic parameters were proposed. The proposed landscape design was then compared with the current situation. The methods and findings of this study, conducted at the old Maltepe Gasworks site, which has been demolished and is now used for various purposes without any upgrades, are unique. The research demonstrates that abandoned industrial areas, both in Türkiye and globally, can be transformed into public spaces that benefit society. This transformation can incorporate ecological, cultural, and economic functions, making it valuable for the community.

2. Literature review

The presence of derelict, underutilized, outdated, and often abandoned post-industrial structures in the landscape today is primarily the result of past and present human land use (Loures, 2015). Post-industrial landscapes, including old factories, ports, train stations, mines, and other unused, abandoned, and neglected places, are often associated with "visible places" (Sandberg, 2014). For example, Elmhurst Park in New York was once an industrial storage facility used to store gas. The factory was abandoned in the 1980s due to investments in new storage and distribution technologies. Construction of the $20 million park, led by former Mayor Michael Bloomberg, began in 2007. Elmhurst Park was opened on May 24, 2011, on the former site of the gas tanks (Mulvaney, 2017). During field analysis, it was found that the entire area was contaminated with lead. It was necessary to remove 18,000 tons of soil from the site. The renovation's first phase proposed planting 500 trees, adding 1,219 m^3 of clean filling material, and installing rainwater management systems. The two phases of reconstruction focused on building the playground and recreational facilities of the park (De Sousa, 2014). Another example is the Thames Barrier Park on the River Thames in London, England, which was once a chemical industrial factory (Zhang et al., 2022). After many years of industrial use, the area was transformed into a green space. Before the factory site was converted, a 2-meter layer of crushed concrete was poured over the contaminated soil. The park now includes fountains, playgrounds, picnic areas, and more. However, the most striking feature is the 49-meter-long 'Green Dock', which was built to remind visitors of the old port area (Villella et al., 2006). The Rahmi Koç Industrial Museum, one of Türkiye first private-sector regeneration projects, features two historic buildings: the 18th-century Ottoman Navy anchor foundry (Lengerhane) and the Hasköy Dockyard. Restored in 1994, the museum showcases transport, industrial, and communication history. It is the first industrial museum in Istanbul and is dedicated to the history of transportation, industry and communication. It exhibits the first products of the Koç Group as well as various industrial artifacts from all over the world. In addition to its museum function, the complex also includes a restaurant, pub, museum store and seminar hall (Gunay and Dokmeci, 2012).

Land is often contaminated with potentially hazardous substances and materials during use for industry, commerce, and waste disposal. These can harm humans, ecological systems, the aquatic environment, structures, and sometimes other groups (Smith, 2008). However, these problems can be addressed with landscape designs. For example, the Olympic Sculpture Park in Seattle was once an industrial site that transferred and distributed petroleum products between 1900 and 1975 (Coates, 2009; Erdem Kaya, 2022). Rehabilitation began in 1988 for the area contaminated with gasoline, diesel oil, lubricating and heating oils, and petroleum-based solvents due to heavy industry use. Initially, approximately 65,000 tons of oil-contaminated soil were removed. The rehabilitation included adding a new soil layer, placing a reduced permeable layer within the clean fill layer, installing stormwater drainage lines, and implementing erosion control measures to stabilize the site (Huber, 2008; Erdem Kaya, 2022). Another example is Freshkills Park, an area in New York that used to be a landfill. The site was used as a landfill for 53 years and became the largest landfill in the world (Heesche et al., 2022). Garbage collection stopped in 2001 due to increasing public pressure regarding environmental, health, and aesthetic concerns. An international design competition and collective outreach process was initiated in 2001 to transform it into a park (Klenosky et al., 2017). Developed by James Corner Field

Operations in 2001, the New York Parks and Recreation Department took over the project in 2006. The project began in October 2008 and will continue gradually for at least 30 years. When completed, it will be the second-largest park in New York City after Pelham Bay Park in the Bronx. Ecological strategies were used to rehabilitate the area at Freshkills Park (Klenosky et al., 2017; Erdem Kaya, 2022; Heesche et al., 2022). Another example is the Emscher Park project, which rehabilitates an industrially polluted area. Green corridors on the north-south axis, connecting 17 cities, have been proposed by using the existing waterways and open green areas. The park, covering an area of approximately 300 km², connects regions with gardens, pedestrian paths, and bicycle paths (Loures and Burley, 2012). Various industrial landscapes have been created along the green corridor, including the Nord Landscape Park in Duisburg. In this area, biological cleaning processes were carried out using suitable plant species to eliminate water pollution. One of the most prominent features of the project is the integration of existing old industrial buildings with plant designs (Shaw, 2002; Stilgenbauer, 2005; Loures and Burley, 2012; Pytel et al., 2021).

The issue of environmental gentrification is rarely addressed in the post-industrial landscape ecological restoration literature, and when it is, it is seldom the main focus (Sandberg, 2014). Emscher Landschaftspark is a public green space north of Duisburg, Germany. Designed by Peter Latz in 1991, the park was previously used as farmland and later converted into a coal and steel production factory. The formerly polluted industrial area has been transformed into a public green space through landscape design. The planting improvement method was applied to the contaminated areas of the factory (Stilgenbauer, 2005; Hemmings and Kagel, 2010; Langhorst, 2014). This project is an example of effective post-industrial landscape practice, combining remediation approaches and spatial design with a strong emphasis on heritage value and the adaptive reuse of existing structures (Erdem Kaya, 2022). Hudson River Park in New York is another example of regenerating and developing coastal industrial districts using an open space model. The park is a key part of New York City's park system and the core area of the city's greenway system. As part of the city's green infrastructure, it connects many blocks and landmarks, integrating the urban open space on the west side of Manhattan Island into a cohesive green area (Carr, 2008). The park features various themed entertainment venues, including grass fields, water piers, airfields, small restaurants, pet parks, recreational sports facilities, and children's playgrounds (Zhang et al., 2022). It offers several programs for children and adults, many focusing on Hudson River ecology. The park's programs often relate to marine science and aim to educate the public about the estuary and its ecology (Hutcheson et al., 2018).

3. Material and Method

3.1. Study area

The study area constitutes the main material of the research. In this context, Maltepe Gasworks, located in Ankara, the capital of Türkiye, has been determined as the study area (Figure 1). Located in an urban area, Maltepe Gasworks covers 66,815 m^2. Built in 1929, it was one of the first industrial buildings in Ankara, designed to provide heating and lighting for the city's residential and industrial areas (Karayaman, 2014). The factory included various structures such as gasometers, power plants, water towers, gas furnace rooms, fuel tanks, warehouses, silos, and workshops, reflecting the architectural style of the time (Cihanger, 2012). From its opening until the 1960s, many other industrial buildings were developed around the factory, following the Jansen Urban Plan. The Maltepe region continued to grow industrially with factories, warehouses, and workers' residences until the 1960s. However, Maltepe Gasworks ceased operations because it became obsolete with the shift from air gas to natural gas. Additionally, pollution from nearby riverbeds and the raw materials used in the factory contributed to air and water pollution, leading to discussions about the factory's demolition in 1990 (Cihanger, 2012). However, the Union of Chambers of Turkish Engineers and Architects (UCTEA) Chamber of Architects in Ankara applied to the Ankara Cultural and Natural Heritage Preservation Board. They succeeded in registering some of the factory’s industrial structures as immovable cultural assets (Saner, 2012). Additionally, on March 19, 1991, decision number 1679, the 'guest house' located southeast of the site and facing Toros Street, was designated as an immovable cultural property that must be preserved. This decision marked the first official use of the term "industrial area" in Türkiye, although it is not included in the conservation legislation (Aslan, 2019).

Figure 1. The surroundings of the study area and its location in Türkiye (Original).

The building, which had been neglected for about 15 years, became a focal point once again due to expert opinions supporting its demolition. Engineering assessments and reports highlighted the building's poor physical condition and potential environmental hazards, which strengthened the case for its demolition. Most of the registered industrial structures had their status downgraded and were demolished on June 13, 2006 (Figure 2) (Cihanger, 2012). However, Article 9 of the "Regulation on the Detection and Registration of Immovable Cultural Properties and Sites to be Protected," published in the Official Gazette on March 13, 2012, number 28232, includes a provision stating that "Removal of registration records for immovable cultural properties that need to be protected shall be conducted according to the principles of this Regulation."

Figure 2. Images of Maltepe Gasworks before and during its demolition in 2006 (Chamber of Architects, 2023).

Following the annulment of their decision on the same day, the Ankara Metropolitan Municipality began demolition work on a 10,300 m² portion of the factory area, which was part of the Ankara Electricity and Gas Operations (EGO). This demolition removed coal gas production facilities, sulfur treatment facilities, coal storage areas, decovil lines, and crane structures. The chimneys of the BEDAŞ (Boğaziçi Electricity Distribution) power plant have not yet been demolished (Aslan, 2019). After demolishing the EGO General Directorate area, which included the Gasworks and its associated units, the 16402 block of 5 parcels was leased out. In this area, a clothing and electronic equipment market, Maltepe Bazaar, was built using single-story prefabricated units. This development was deemed unsuitable for the historical identity and character of the place. Later, Çankaya Municipality and İller Bankası constructed a shopping mall on the former site of Maltepe Bazaar (Aslan, 2019). The current amount of green space in the area is 3,700 m².

In summary, a registered cultural property was intentionally left in disrepair, eventually labeled as environmentally hazardous and in poor condition to facilitate its leasing. The Maltepe Gasworks area has been involved in numerous legal disputes throughout this process. Currently, the area includes the Başkent Electricity Distribution General Directorate, Maltepe Transformer Center, Maltepe Bazaar, EGO Mosque, EGO Sports Club, and technical services. The land is divided into four parcels: Parcel No. 29228/3 (31,139 m²) and Parcel No. 29228/4 (1,246 m²) belong to EGO, while the Ankara Metropolitan Municipality owns parcels totaling 10,247 m². Figure 3 shows the satellite image of Maltepe Gasworks before and after the demolition.

Figure 3. Satellite images of Maltepe Gasworks before it was demolished in 2002 and after it was demolished in 2022 (Original).

According to the calculations made in Google Earth Pro, the current status of the study area is 6,000 m^2 green area, 30,000 m^2 hard ground (generally used as a parking lot), 12,000 m^2 soil surface and the remaining areas are buildings. In the current state, approximately 27% of the area is permeable surface, and the remaining 63% is impermeable surface. The area currently contains *Ailanthus altissima, Aesculus hippocastanum, Robinia pseudoacacia* and *Acer* sp. species. When examined structurally, the impermeable flooring material is generally asphalt. Although the area can be entered from different points, these entrances are not clearly defined. In addition, security vulnerabilities resulting from inadequate lighting are noted in the field observations.

3.2. Method

The study consists of four phases. Firstly, literature research was conducted, and the current situation was revealed. In addition, at this phase, the natural data of the area, such as soil, hydrology, slope, green space use and elevation, and transportation status in its structural components, were examined in the survey (transportation and green areas), zoning plan, ArcGIS 10.7.1 (soil and hydrology), and Google Earth Pro (elevation and slope). Topography, soil structure, hydrology, and transportation in the area were examined as they will guide the landscape design. The area's history is important in reshaping the industrial heritage in landscape design. Open green areas were examined for green connectivity. Additionally, the vegetation status of the study area and its surroundings over the years were analyzed using NDVI. Secondly, within the scope of the literature data examined, a SWOT analysis was performed in the study area. In the third phase, a new industrial landscape design proposal was developed for the study area, considering the area's natural and structural components and the SWOT analysis. This landscape design, made in the last stage, was discussed by comparing it with the current situation. The general flow diagram of the study is shown in Figure 4.

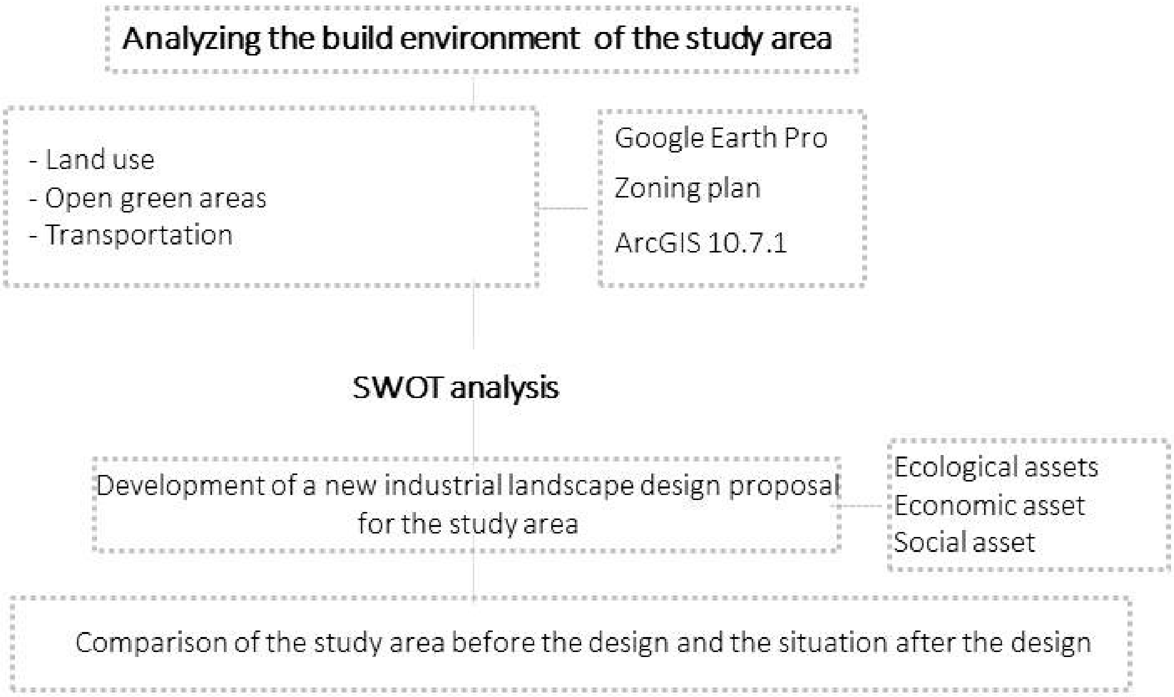

Figure 4. General flow diagram of the study (Original).

3.2.1. NDVI analysis

The green areas within the study area and its immediate surroundings were analyzed using NDVI for different years (Figure 5). Images from 26 July 1990 and 16 July 1998 were processed using data from the Landsat 5 satellite, applying Equation 1. The image from 21 June 2024 was processed using data from the Landsat 8 OLI satellite, applying Equation 2.

$$NDVI = \left(\frac{Bant4 - Bant\ 3}{Bant\ 4 + Bant3}\right)$$

(1)

$$NDVI = \left(\frac{Bant5 - Bant\ 4}{Bant\ 5 + Bant4}\right)$$

(2)

The NDVI analysis represents 0-0,1 water surface, 0,1-0,2 barren rocks, sand, or snow, 0,2-0,5 shrubs and grasslands or senescing crops 0,5≤ dense vegetation or tropical rainforest.

3.2.2. SWOT analysis in the study area

SWOT analysis is a method used to assess an organization's resources and environment by examining four key areas: Strengths, Weaknesses, Opportunities, and Threats (Namugenyi et al., 2019; Phadermrod et al., 2019). It has been in use since the 1960s due to its simplicity and ease of application (Phadermrod et al., 2019). Strengths refer to internal factors that help an organization succeed, while weaknesses are internal factors that hinder success. Opportunities are external factors that can aid an organization in achieving its goals, including positive environmental aspects and chances to address gaps or start new activities. On the other hand, threats are external challenges that could impede the organization's objectives (Benzaghta et al., 2021). In this study, SWOT analysis was applied to facilitate decision-making. It was conducted at Maltepe Gasworks, the focus area of the study, and the landscape design was developed based on the results. The SWOT analysis identified the strengths, weaknesses, opportunities, and threats relevant to the landscape design of Maltepe Gasworks. SWOT is chosen for this study due to its simplicity, flexibility, and ease of understanding. The primary goal of using SWOT was to provide clear guidance for future landscape design.

4. Results

The natural and structural data of the Maltepe Gasworks area were collected and analyzed through area surveys, zoning plans, ArcGIS 10.7.1, and Google Earth Pro. The elevation of the area ranges from 849 to 878 meters. The slope in the area varies from 0 to 19%. However, the addition of the gasworks' structural units has flattened the land. Approximately 3.5 km to the northwest of the site is the Ankara Stream, and the İmrahor Stream is located to the southeast. According to the Türkiye soil map, the soil beneath the structural materials in the area has been affected by settlement (TSA, 2023). This information is crucial for guiding future planting design proposals for the site.

In the study, NDVI analysis was conducted to identify green infrastructure deficiencies and develop landscape design recommendations that will strengthen ecological connections. When the NDVI analysis of the Maltepe Gasworks and its immediate surroundings (the study area) is reviewed, it shows an increase in vegetation over the years.

This trend can be attributed to the natural growth of vegetation and the addition of newly created open green spaces. According to the analysis between 1990 and 1998, there was no vegetation in the study area. By 2024, the area included Maltepe Bazaar, parking areas, and abandoned spaces, where some vegetation has developed due to the lack of active use. However, when examining the green infrastructure in the NDVI analysis, it is clear that Maltepe Gasworks lacks green connectivity. There is no connection to nearby green spaces such as Anıtkabir to the northwest, Youth Park to the north, Abdi İpekçi Park and Kurtuluş Park to the east, and Başkent Millet Bahçesi to the west (Figure 6). These surrounding open green areas highlight the potential for enhancing green connectivity through the proposed industrial landscape design for the former Gasworks site. In addition, while the connections between the parks are planned to be provided by green roads, the connections in the newly proposed landscape industrial landscape design can be supplied by green bridges to be proposed over Celal Bayar Boulevard.

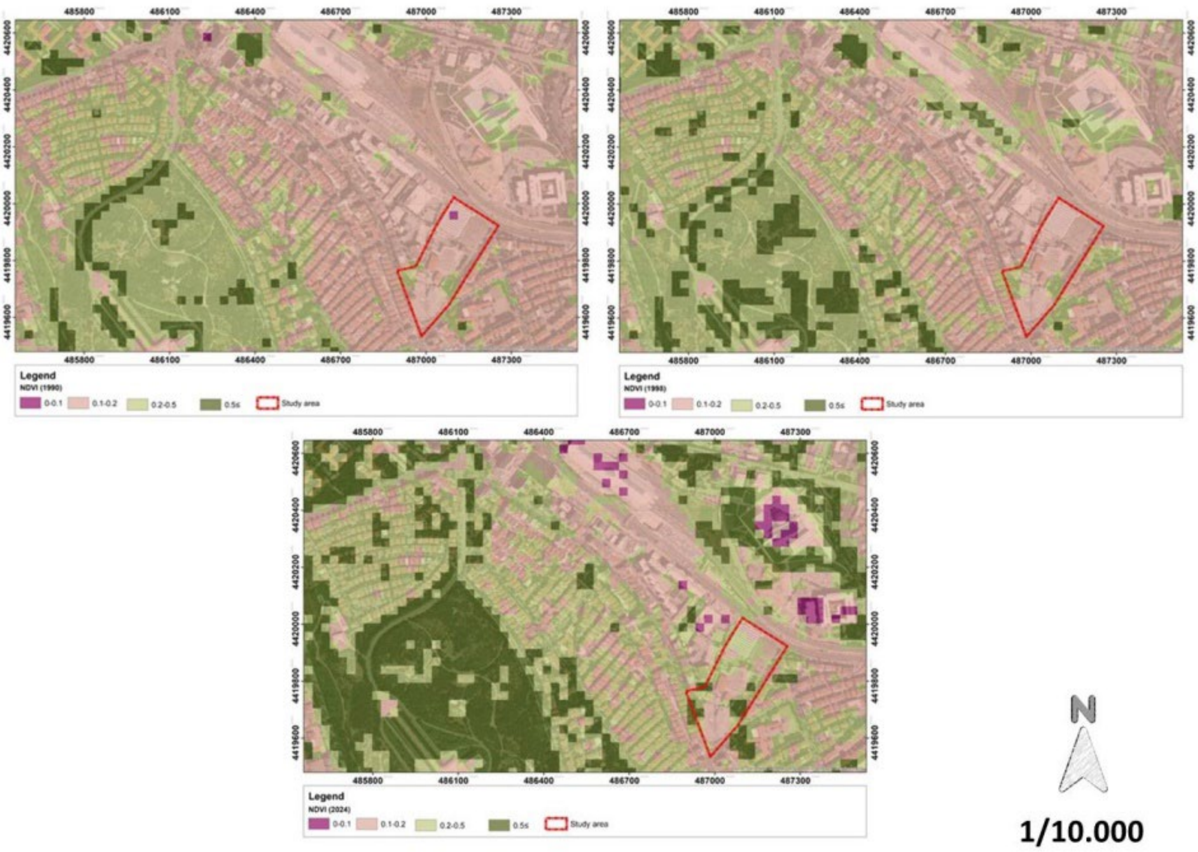

Figure 5. NDVI analysis in the study area and its surroundings for the years 1990, 1998 and 2024 (Original).

Regarding transportation, Tok Street runs along the west side of the area, Celal Bayar Boulevard is to the north, Gazi Mustafa Kemal Boulevard is to the south, and Toros Street is to the east. Ankara Train Station is situated to the north of the area, and there are two bus stops nearby. Additionally, several minibus lines run along Celal Bayar Boulevard (Figure 6).

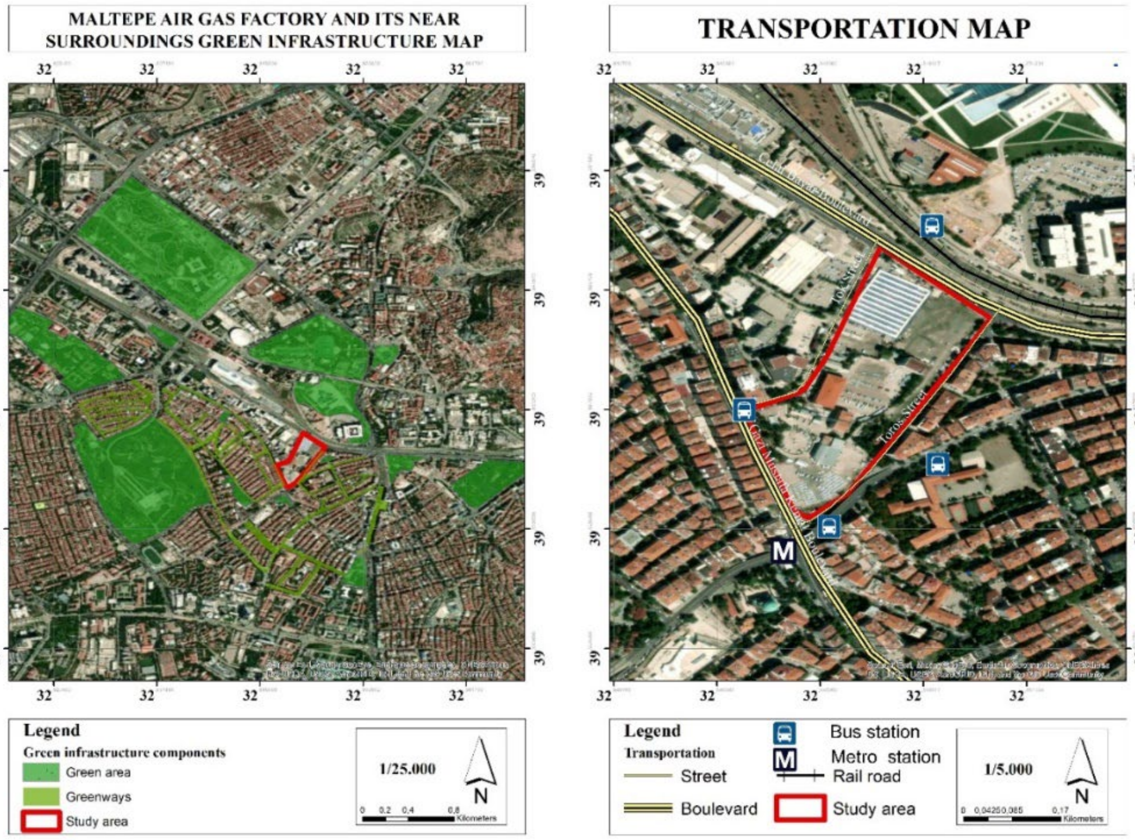

Figure 6. Green infrastructure map (left) and transportation map (right) showing the study area and its immediate surroundings (Original).

In addition to analyzing the green space and transportation, a visual analysis was conducted to show the historical changes in the area over time. This analysis provides an overview of how the Gasworks has evolved from its inception to the present day (Figure 7).

Figure 7. Visual analysis of the historical process of Gaswork from past to present (Original).

Considering the SWOT analysis and literature research, an industrial landscape design proposal was developed at the Maltepe Gasworks. The study area is in the center of

Ankara and easily accessible. The study area can be easily reached by many means of transportation such as metro, bus, train and minibus. In addition, the rent value of the study area located in Ankara's Eti Neighborth is also high. These are all strengths of the study area in general. While it is close to important transportation axes and has many open green areas in its immediate vicinity, it serves recreational functions and provides wildlife habitat. These features have been evaluated as opportunities in the field. Despite all the strengths and opportunities, the lack of green connections, the use of the area other than industrial historical heritage, and the fact that it is idle are among the weaknesses of the area. General threats in the region are; noise and air pollution caused by the lack of protection of industrial heritage, the current idle use of the area, and the presence of many transportation axes in the immediate vicinity. The detailed SWOT analysis of the study area is shown in Figure 8.

STRENGTHS	WEAKNESSES
* The parcel no. 29228/4, where Maltepe Ankara Gas Factory is located, is a protected area. * Between 1929 and 1960, Ankara served as an important electricity generation facility * Adoption of the Republican Era architectural understanding in the construction of the factory * Ankara's being among the important industrial identity structures * Due to its location, it is located in the center of Ankara * The area has industrial historical heritage value * The area is located in an important rent area * Easily accessible area	* The fact that the facility does not serve the old industrial identity and most of the buildings shaped by the architectural understanding of the Republican Period have been demolished * Demolition of cooling towers and chimneys, which are important architectural structures of the area * Almost all of the area is covered with hard flooring material *Demolition of immovable cultural assets in the area by lowering their status
OPPORTUNITIES	**THREATS**
* Location of the area among important transportation axes * Ecological and economical transportation opportunity due to the presence of Ankara Train Station in the north of the area * The presence of many open green areas in the immediate vicinity of the study area allows recreational activities and also provides a habitat for wildlife. * Ankara Stream and Imrahor Stream are located in the immediate surrounding of the area. * The connections between the newly proposed industrial landscape design and open green areas can be provided by both greenways and green bridges.	* Air pollution caused by heavy vehicle traffic from the main transportation lines in the immediate vicinity of the area * Deterioration of the natural landscape character of the area after the use of industrial area * The area has gone through many legal processes with the zoning plan in 2010, 2012, 2013 and 2016. In these processes, the remaining industrial structures in the area are destroyed.

Figure 8. SWOT diagram in the study area (Original).

The SWOT analysis identified several issues in the study area: idle use of work area, traffic and noise pollution, a disconnect from urban identity, and underutilizing the site's industrial historical heritage. To address these problems, a new landscape design proposal was recommended. The new design aims to restore the area's historical identity while incorporating ecological and economic properties. This proposal, which is illustrated in

Figure 7, seeks to address the identified weaknesses and leverage the area’s strengths and opportunities for a more cohesive and functional landscape.

A new landscape design was created based on SWOT analysis and field surveys. This design restores the area's historical identity and incorporates ecological and economic properties. The proposed landscape design, which addresses the issues identified in the SWOT analysis, is shown in Figure 9.

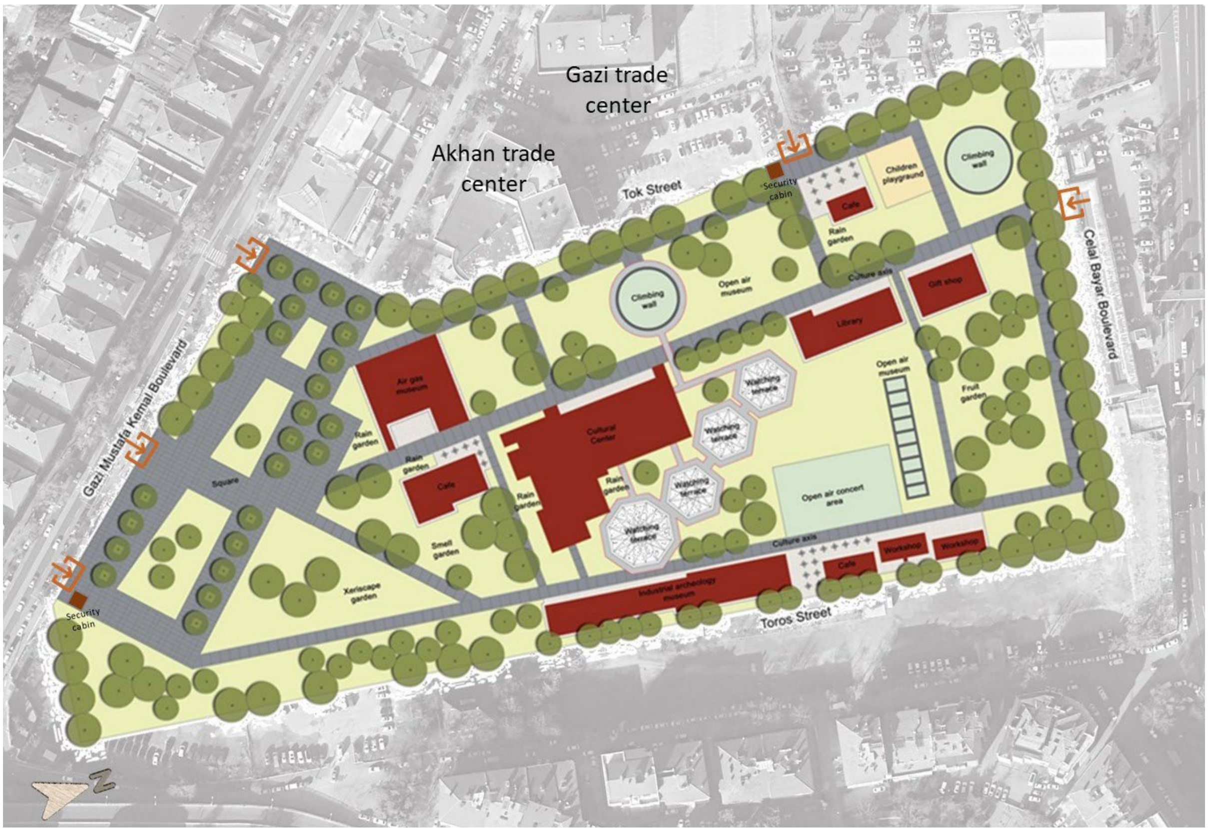

Figure 9. Landscape design of the Maltepe Ankara Gasworks (Original).

5. Discussion and conclusion

A new landscape design proposal has been developed based on the SWOT analysis and surveys conducted for the study area. Considering the current land use, if the area is designed as a green area, it will serve residential areas, high school and university users. There are five entry points to the designed site (Figure 9). These entrance points are located on Tok Street, Gazi Mustafa Kemal Boulevard, and Celal Bayar Boulevard. Two security units have been placed within the site to control entry and exit. No parking area has been proposed for the newly designed site. This is because the area has been used as a parking lot for many years, which has disrupted its ecological character. Additionally, parking needs are planned to be addressed in the nearby spaces at Gazi Trade Centre and Akhan Trade Centre, located to the northwest of the site. The project area consists of as much green space as possible. The hard surfaces are entirely made of permeable materials and feature andesite stone, which is naturally sourced from Ankara. Vehicle access to the site is not permitted, except in emergencies. The entire area has been designed as a pedestrian zone. The project area includes 35,715 m² of green space and 18.613 m² of permeable surfaces. All the furniture materials in the area have been chosen from recycled materials. The existing Maltepe Market and later-added lightweight structures have been removed. The former gasworks structures on the site have been restored and repurposed in accordance with their original design.

In the industrial landscape design, the former power plant building has been repurposed as a Cultural Center, hosting concerts, festivals, and other cultural events. The design also incorporates the four cooling towers from the site's industrial past, which have been transformed into a viewing terrace. Positioned 15 meters above the ground, these cooling towers are arranged to allow visitors to navigate between them (Figure 10).

Figure 10. Water towers (left), which provide watching and walking opportunities on the upper elevations, use gasometers as climbing walls (right) (Original).

The Cultural Center provides entrances and exits to the watching terraces. The gas chimneys located in the past, located at different points of the area, are also exhibited in the open-air museum. The structures that used to serve as gasometers in the area were redesigned by giving them a similar function to the climbing wall in Duisburg Nord Park (Figure 11). While some of the lodgings used for factory workers and civil servants in the past were converted into workshops containing handicrafts and other arts, reflecting Ankara's old identity, some lodgings were converted into cafeterias that meet the food and beverage needs of the users of the park. The building, which was used as an administrative building in the first days of its establishment, has been converted into an industrial archaeology museum. In the industrial archaeology museum, Türkiye's historical industrial process, information and models of the established factories and industrial machines used in the factories will be exhibited. Another power plant, which used to be located in the northwest of the area, has been converted into a gas museum. When examining Türkiye’s historical industrial processes, one can observe that numerous old and industrial areas remain idle or repurposed without undergoing industrial transformation. However, in recent years, several notable transformations have taken place, converting former industrial sites into spaces serving recreational, cultural, and historical purposes. Examples include the Cendere Art Museum in Istanbul, Es Park in Eskişehir, Beykoz Shoe Factory in Istanbul, Cubuklu Silos in Istanbul, Museum Gashouse in Istanbul, Baruthane in Istanbul, and Izmir Historical Coal Gas Factory in Izmir. This museum exhibits the historical cycle from the first establishment of the Maltepe Gasworks to its destruction and other industrial elements used in the factory. Transportation between all these structures is provided by a road that has gained an identity as the 'cultural axis'. There is also a playground for children in the area.

Figure 11. Use of gasometers as climbing walls (right) (Original).

In the landscape design for Maltepe Gasworks, various ecological proposals were developed, keeping the area's historical identity in mind while focusing on environmental sustainability. Native plant species (Table 1) were chosen to minimize water consumption and maintenance costs, aligning with both ecological principles and the site's historical context. A smell garden and xeriscape applications are proposed for the northern part of the area. These features are intended to enhance the sensory experience of the space while reducing water usage.

Table 1. Natural plant species are used within the scope of the planting design proposed for the study area (TUBIVES, 2004).

Trees (Broad-leaved)	Trees (Coniferous)	Bush	Herbaceous plant-ivy
Acer campestre	*Juniperus foetidissima*	*Cornus mas*	*Cistus laurifolius*
Carpinus betulus	*Juniperus oxycedrus*	*Jasminum fruticans*	*Hedera helix*
Elaeagnus angustifolia	*Pinus nigra*	*Lonicera caprifolium*	*Iris orientalis*
Platanus orientalis		*Ligustrum vulgare*	*Mentha longifolia*
Populus alba		*Pyracantha coccinea*	*Muscari armeniacum*
Salix alba		*Rosa canina*	*Salvia tomentosa*
Ulmus glabra		*Viburnum opulus*	*Verbena officinalis*

Another significant ecological element included in the design is the rain garden. Rain gardens manage stormwater by capturing runoff, filtering pollutants, and allowing water to seep into the soil gradually. This process helps remove pathogens, nutrients, organic matter, and heavy metals from the runoff, while also creating natural habitats in previously industrialized areas (Uncapher and Erskine, 2012; Song, 2022). The rain gardens will be situated in locations where sulfur treatment plants and coal storage facilities once stood, as well as around the remaining buildings. Each rain garden will consist of three distinct zones: the innermost zone will feature water-loving plants, the middle zone will have plants that require moderate amounts of water, and the outermost zone will be planted with drought-resistant species. Additionally, the plants selected for these rain gardens have properties that allow them to absorb heavy metals. For instance, *Cistus ladanifer* and *Lavandula stoechas* can absorb chromium, manganese, and zinc; *Lobularia maritima* absorbs chromium; and *Urtica membranacea* retains cadmium, copper, lead, nickel, and zinc. Plants such as *Sorghum bicolor* and *Arabidopsis thaliana* can also absorb various heavy metals (Aksoy et al., 2023). The plant species chosen for the rain gardens are native to Ankara, ensuring their suitability for the local environment (TUBIVES, 2004).

Table 2. Plant species used in the rain gardens proposed for the Maltepe Gasworks area.

Achillea millefolium	*Populus nigra*	*Salix cinerea*
Betula nigra	*Ribes uva-crispa*	*Salix excelsa*
Cornus mas	*Rhus coriaria*	*Sorbus domestica*
Miscanthus sinensis	*Salix alba*	

Finally, the landscape design includes the addition of cafeterias and sales units where artworks created in workshops can be sold. These facilities aim to boost the area's economic revitalization. In these sales units, local products from Ankara will be featured. Special events will be organized throughout the year to support the economic development of the area further. During these events, residents from rural areas around Ankara will have the opportunity to showcase and sell their local products. This initiative will help connect the area with its broader community and enhance its economic activity (Figure 12).

Figure 12. Proposed to the area is where residents living in rural areas of Ankara exhibit their local products in open green areas during certain months of the year (Original).

In the proposed industrial landscape design for the Maltepe Gasworks, the design proposals were developed with careful consideration of the area's historical and cultural identity, as well as ecological and economic properties. The final stage involved comparing the conditions of the area before and after implementing the landscape design. Before the design, the green space amounted to 3,700 m². After the redesign, the green space increased significantly to 35,715 m². The built-up area, which was approximately 12,500 m², was reduced to 7,182 m². The redesigned buildings now reflect the historical identity of the area. Ling et al. (2007) emphasized various functionalities—historical, ecological, social, economic, and aesthetic—when transforming post-industrial spaces. Pytel et al. (2021) outlined three main aspects of transforming these areas: preserving industrial cultural heritage, improving environmental conditions, and repurposing the land for economic activities. In the current state, the area's structural texture and usage have evolved without maintaining its industrial heritage. The involvement of multiple property stakeholders and the area's changing status have further compromised its historical identity. The new landscape design addresses all three aspects—heritage preservation, environmental enhancement, and economic repurposing—through thoughtful design proposals.

The area previously covered by structural flooring material was 50,615 m², which can contribute to the formation of urban heat islands, particularly because such surfaces are typically impermeable and lack green areas (Onishi et al., 2010). This area has been reduced to 15,113 m² in the proposed new landscape design. Additionally, the location of the area previously had no connection to other open green spaces. The new design has addressed this issue by establishing green connectivity, which is crucial for creating an effective open green space system (Walmsley, 2006).

During industrial use, land can become contaminated with hazardous substances that pose risks to people, ecosystems, and aquatic environments. Industrial site remediation involves identifying and assessing these hazards and repurposing the land for new uses (Smith, 2008). In the case of the Maltepe Gasworks, investigations revealed that proper remediation procedures were not followed during the demolition of the old buildings and parking structures. Workers did not use personal protective equipment, and no environmental safety measures were implemented (Konak, 2017). Asbestos, a highly carcinogenic material, was prevalent in buildings constructed before 1980 and is restricted or banned in many places, including Türkiye since 2010. Improper handling of asbestos can endanger both demolition workers and residents living nearby due to the spread of asbestos fibers (Müezzinoğlu, 2017). Although there is no asbestos contamination in the area today, the new design incorporates ecological practices such as rain gardens and the use of natural plants to protect human health and ensure safety.

In the case of Maltepe Gasworks, it is essential to make necessary adjustments in protection legislation to ensure effective and sustainable conservation of industrial heritage. First, the definitions of industrial heritage, industrial archaeology, and industrial landscape should be explicitly included in the legislation. Additionally, forming a group of experts to provide consultancy for the protection of legally protected building groups is crucial. Controlled implementation of industrial heritage protection, restoration, and re-functioning studies should be ensured. Re-functioning projects can be obtained through national or international competitions, based on the needs program determined by the Monumental Works Board or a scientific committee. Furthermore, the publication of industrial landscape design stages and results by the Ministry of Culture, municipalities, universities, and private individuals or institutions should be encouraged. These steps will contribute to the effective conservation and sustainable management of industrial heritage sites.

As a result, this study has developed an industrial landscape design proposal that not only addresses ecological, industrial historical identity, and economic considerations but also restores the area's role as a public space. The proposed design not only improves the previously disconnected green connections but also enhances both its functionality and integration within the urban environment, making it a more inviting and accessible public space.

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