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# Water Management for Sustainable Development of World Heritage Properties

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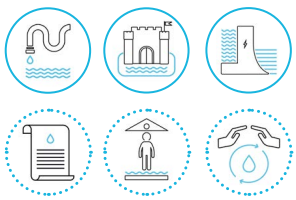
*As climate change and water-related threats like floods and droughts intensify, water management must become a key component of World Heritage management plans. Currently, these plans are not required to address water management even though an increasing number of sites are encountering water-related challenges. A lack of comprehensive data and knowledge sharing hampers efforts to collectively address these issues, posing a risk to the preservation of their Outstanding Universal Value. This article examines the significance of water management for World Heritage Sites, including sites directly connected to water and those facing water-related threats. It presents three examples from Germany to illustrate these challenges and underscores the need for improved knowledge sharing and integration between World Heritage properties and their surrounding environments.*

**Keywords:** *World Heritage, water management, climate change*


KEY THEMES



< Fig.1 Shushtar historical hydraulic system panorama (Source: Iman Yari, 2014, via Wikimedia Commons CC BY-SA 4.0).

## Introduction

Cultural World Heritage properties are inherently connected to water; their construction and preservation have always depended on effective water management. Especially in arid climates and floodplains, communities had to secure a reliable water supply while protecting themselves from water in excessive quantities (UNESCO 2011). Additionally, maintaining these sites for continued use requires a balanced water supply to ensure livable conditions and preserve the functionality and longevity of the properties. However, changing climatic conditions (ECMWF 2024) increasingly threaten cultural sites through water shortages, droughts, floods and damage to foundations.

Addressing these emerging threats demands sustainable adaptations in water management and comprehensive strategies to develop such adaptations. Water management plans have not been included in World Heritage nominations or in the management plans required for inscribed properties since 2005 (UNESCO 2005). However, incorporating these plans could enhance the conservation of World Heritage sites by ensuring adequate water supply and protection from water-related threats. As water problems escalate, appropriate water management can strengthen sites' resilience and long-term sustainability.

The solution to these challenges can often be found within the heritage sites themselves. Many World Heritage properties explicitly relate to water, as they were created to provide or treat water, to utilize water for various purposes or protect against it. Examples include pumping stations, dams, polder areas and historic water management systems. These sites contain valuable information about historical water management practices and strategies that have stood the test of time. Studying these sites can lead to a better understanding of past strategies, as well as inspire contemporary approaches to today's water-related challenges (Dai 2023). Therefore, integrating water management in the conservation of World Heritage Sites is crucial. This integration should focus on preserving sites in the face of climate change, while respecting or adapting them in line with historical water management practices. This integration of water and heritage can help develop solutions that inspire water management beyond the World Heritage Sites (Chen 2016).

This article seeks to encourage further exploration of this topic by examining the relationship between World Heritage and water. It emphasizes the need for water management planning to be included in World Heritage management, arguing that water serves as a critical link between the local and global dimensions of these sites, as well as between their past, present and future. Using cases from Germany, the article considers a variety of relationships between World Heritage Sites and water management, highlights the importance of such management, and outlines current and emerging challenges.

## World Heritage and Water: Multi-Faceted Relationships

While individual World Heritage Sites have unique local relationships with water, climate change is increasingly connecting these relationships to global phenomena within an interconnected system. The water-related challenges for World Heritage Sites need to be assessed individually but can be grouped into categories common to many sites. Although the World Heritage List traditionally maintains a strict division between cultural and natural sites, with separate responsibilities assigned to advisory


^ Fig. 2 An eighteenth-century depiction of the oldest existing waterworks in Germany, the Augsburg waterworks at the Red Gate (Source: Neitram, 2014, via Wikimedia Commons, public domain).

bodies (the International Council on Monuments and Sites [ICOMOS] and the International Union for Conservation of Nature [IUCN]), recent efforts have aimed to bridge this divide to foster a more integrated approach.

Initiatives such as the Nature-Culture Journey at the 2016 IUCN World Conservation Congress and the establishment of an International Scientific Committee on Water and Heritage by ICOMOS are examples of efforts to close this artificial gap and promote a more comprehensive understanding of cultural heritage sites as part of a complex natural system. Also, there is growing interest from the field of hydraulic engineering in historic aspects of water management, as demonstrated by an increasing number of sessions on water heritage at international conferences.[1]

*Water-Related World Heritage*

Beyond the institutional level, there are important relationships between water and heritage at individual sites that make any conceptual separation between culture and nature inconsistent. This is particularly evident in World Heritage Sites with an explicit connection to water, such as the Water Management System of Augsburg. Listed in 2019, the site comprises 22 elements, including a historic water-powered cooling system, weirs, wells, canals and waterworks (fig. 2). These components connect the city of Augsburg, its inhabitants and local indus-

1. Examples of such sessions took place at Amsterdam International Water Week 2023 and at the UN Water Conference 2023.

^ Fig. 3 The Srah Srang, a tenth-century artificial reservoir close to Angkor Wat (Source: Diego Delso, delso.photo, via Wikimedia Commons CC BY-SA 4.0 DEED).

try with the surrounding natural environment, forming a larger, integrated system.

Augsburg's ingenious management of water resources has helped the city prosper for centuries, highlighting the interdependence of culture and nature. Inscribed on the World Heritage list specifically because of its water management system, Augsburg naturally plays a key role in emphasizing the importance of water management in World Heritage Sites. The City of Augsburg has published numerous resources on their website (https://wassersystem-augsburg.de/de/mediathek), detailing individual elements of the system and their functions.

Other World Heritage Sites represent different types of water-related heritage. These include sites associated with distribution and drainage (such as the Persian Qanat and the Mill Network at Kinderdijk-Elshout), the use of water for industrial purposes (Mines of Rammelsberg, Historic Town of Goslar and Upper Harz Water Management System), military purposes (Dutch Water Defence Lines), trade and exchange (Venice and its Lagoon, Canal du Midi), agriculture (Rice Terraces of the Philippine Cordilleras) and leisure and health (the Great Spa Towns of Europe). So far, their common challenges have not been addressed as a unifying and compelling issue for World Heritage Sites

and their managers. Research, exchange and education in the field of water management at World Heritage sites are urgently needed and will only become more important in the future.[2]

The sites mentioned above are prime examples of sustainable water management. They illustrate its specific forms and show what has worked well in particular places and contexts. Research on these sites can illuminate which solutions have worked over a long period of time and under certain circumstances and how past approaches may be relevant today. Even examples that tell of the failure of long-term water management can be instructive, such as Angkor Wat, an extensive twelfth-century temple complex in the historical Khmer kingdom (fig. 3). The empire perished when the water supply system failed in the fourteenth century, and the site now offers insights into the complexity of the relationship between culture and nature (Prasad 2020). Historical examples can aid the development of new water management strategies. Today's changing climatic conditions make it necessary to adapt historical systems so that they continue to function effectively and meet current and future needs.

*Water Challenges at World Heritage Sites*

In addition to World Heritage Sites related to water and water management designated as having Outstanding Universal Value, there are a number of sites that are facing water-related problems. These include the Palaces and Parks of Potsdam and Berlin. Located in Germany's most water-rich federal state and surrounded by lakes, the existence of the historical parks is increasingly threatened by dry periods and declining water tables. As a result, almost 80 per cent of the trees in the Sanssouci World Heritage Site have suffered damage and every year 160–300 trees must be cut down (UNESCO-Welterbestätten 2024). Changing precipitation patterns have made tree damage a widespread problem across Europe and call for effective solutions. If sufficient water cannot be provided through adapted management, significant changes, such as the introduction of more resistant tree species, may alter the character of historic parks.

While many World Heritage properties are affected by drought, an excess of water also poses a serious challenge, with over 20 per cent of World Heritage Sites worldwide affected by river flooding (Arrighi 2021). These problems extend beyond the physical boundaries of heritage sites, as water cannot be managed in isolation. Issues like drought and flooding are influenced by climate but also by large-scale infrastructure planning and often require solutions at the regional or even international level – if they can be addressed at all. When increasing flooding can no longer be controlled by flood defenses, site managers must implement structural measures to protect the properties. Where drought is a problem, they must develop mitigation strategies.

Water-related hazards not only can damage or alter the sites but can jeopardize World Heritage status if adequate protection is not provided (Gerard-Sharp 2017). A look at the 56 properties on the World Heritage in Danger list reveals that, after armed conflict, water issues are a major factor threatening the survival of the sites. Threats include the loss of aquatic life, siltation, flooding and the construction of reservoirs. Two of the three delisted World Heritage sites – Dresden and Liverpool – were water-re-

2. The upcoming conference "WORLD.HERITAGE.WATER - Water Management as a Potential and Challenge in World Heritage Sites," on November 7, 2024, in Leipzig will explicitly address this topic for the German-speaking world.

lated and insensitive changes to their attributes led to the loss of their Outstanding Universal Value. In the case of Dresden, the construction of a bridge over the Elbe destroyed a cultural landscape that had been designated a special treasure of humanity.

**Water Management for (the) Future (of) World Heritage Properties**

More than ever, site managers are required to incorporate water considerations into the preservation and operational strategies. This need aligns with a broader understanding of World Heritage as "a process influenced by social, environmental and economic dynamics" (Gioia 2022) and calls for a deeper understanding of the systemic integration of cultural heritage sites. UNESCO's support for education in sustainable development, such as the e-learning curriculum series on water management at World Heritage sites, reflects increased awareness of water issues in heritage preservation (UNESCO 2024). Exchange and education on this topic are crucial for implementing effective water management measures.

A comprehensive consideration of water management is not only important for current sites but also enables better assessment of the values and vulnerabilities of potential World Heritage Sites, guiding the designation of attributes that convey these values. A better understanding of water relationships and challenges at World Heritage Sites can aid the integration of water management in required site management plans, which will become increasingly important as water-related climate variability grows. However, UNESCO's (2023) *Policy Document on Climate Action for World Heritage* does not fully recognize this need; while it emphasizes researching and documenting water management techniques to support climate science, it omits any reference to water management plans for individual sites.

In many cases, water management was historically integral to these sites but was not recognized as essential to their heritage. For example, could better research into the now-defunct historic water supply system at Sanssouci and its recognition as a vital part of the estate help improve the park's ecological situation? Sound water management can certainly support the preservation of World Heritage Sites and inspire broader strategies to address increasing water challenges.

**Conclusion**

The risk assessment of World Heritage Sites and changing weather patterns demonstrate that integrating water management is crucial for the sustainable conservation of many cultural heritage sites, including cultural landscapes. This article confirms the need for water management plans and encourages further research and communication on this topic. It serves as a call for ongoing international exchange to develop guidelines for integrating water management and preservation. Such efforts may play a key role in incorporating water management into the management plans of World Heritage sites, which currently do not adequately address climate and water-related threats. In order to ensure the sustainable preservation and development of heritage sites, it is essential to challenge the arbitrary and misleading separation of culture and nature. Instead, built heritage should be conceptualized as a synthesis of both cultural and natural elements. Monument preservation and climate protection are intertwined, and water management plans represent a valuable step toward an integrated sustainability strategy.

**Policy Recommendations**

- Water management must become an integral part of the management plans of World Heritage Sites. This includes comprehensive research into each site's water management needs and the exchange of knowledge among site managers. A systemic understanding of heritage sites, viewing them not merely as cultural artifacts but as entities embedded in natural systems, will help promote innovative approaches to conservation.

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