Shushtar Hydraulic System (Iran) No 1315

Official name as proposed

by the State Party: Shushtar Historical Hydraulic System. Bridges, dams, canals, buildings and watermills from ancient times to present

Location:

Khuzestan Province Islamic Republic of Iran

Brief description:

The Shushtar multifunctional hydraulic system dates back to ancient times, finding its roots in Mesopotamian and Elamite knowhow. It involved the creation of two main water diversion canals on the river Kârun: one, the Dâriun canal, starting from a monumental bridge-dam, now in ruins, and the other, the Gargar canal, starting from a dam water intake still in use. The Gargar canal is a veritable artificial river, still surviving, which for many centuries provided water supply to the city, operated a series of mills, irrigated vast farming zones, and provided facilities for fish farming, river transport, and the city's defence. Several of these hydraulic functions are still in use.

Category of the property:

In terms of the category of cultural property, as defined in Article 1 of the 1972 World Heritage Convention 1972, it is a *group of buildings*.

1. BASIC DATA

Included in the tentative list: 9 August 2007

International Assistance from the World Heritage Fund for preparing the Nomination: No

Date received by

The World Heritage Centre: 30 January 2008

Background: This is a new nomination.

Consultations: ICOMOS consulted its International Scientific Committee on Archaeological Heritage Management.

Literature consulted (selection):

Farshad, M., *The history of engineering in Iran*, Guiesh, Teheran, 1983.

"Shushtar New Town, Iran", *Mimar* (17), Concept Media, Singapore, 1985. p. 49-53.

Lousis-Viollet, P. *Water Engineering in Ancient Civilizations*, IAHR International Association of Hydraulic Engineering and Research, Madrid, 2007.

Technical Evaluation Mission: 14-20 October 2008.

Additional information requested and received from the State Party: ICOMOS sent a letter to the State Party on 11 December 2008 requesting it to:

1. Complete the comparative analysis taking into account similar properties in the region.

2. Provide details about the definition criteria for the buffer zone and its boundaries.

3. State the surface areas of the property and of the buffer zone.

4. State whether the buffer zone is included in the property's up and downstream catchment areas, and if not, state the current water management rules for these catchment areas that ensure the property's long-term viability.

The State Party replied on 24 February 2009 with a detailed letter and three additional documents (30 pages) referring to the comparative analysis, the selection criteria for the buffer zone, and the hydraulic management of the property. The analysis of this documentation is included in the present evaluation.

Date of ICOMOS approval of this report:

10 March 2009

2. THE PROPERTY

Description

The Shushtar Historical Hydraulic System (SHHS) comprises a vast ensemble of flow control structures, canals, some of which are dug into the rock, and numerous water uses, which form a perfectly coherent ensemble. Its installation required major civil engineering works, based on the design of a global water system established in ancient times. It provided the material bases for the economic and social development of a human community for many centuries from irrigated agriculture, fish farming, water mills, town water supply, the role of the ditches in the town's defence system, and navigation. The Gargar canal hydraulic system is still in use; only remains of the older Dâriun system are left, but it was partially rebuilt in the 20th century to maintain its function for irrigation.

The initial project involved controlling the powerful river Kârun with the Shâdorvân weir-dam which raised and stabilised the water level by forming an impounding reservoir. It was then possible to divert a significant part of the river's water to the Dâriun canal via tunnels, and to the Gargar canal, under the control of the monumental Mizân water intake at the exit from a bend in the river Kârun.

The Gargar forms a veritable artificial river, diverted from the main Kârun River, the main section of which below the weir-dam changes its name to become the river Shoteit. The Gargar canal first crosses the rocky bank adjacent to the city of Shushtar. After a further flow control dam, it continues downstream via a series of tunnels that operate mills and supply water to the city. The site forms a spectacular cliff and the water falls in cascades into the downstream basin. The Gargar canal then enters the plain south of the city, at the foot of the mountains, where for almost two millennia its water enabled the planting of orchards and fertile farmland called the Mianâb (literally 'The Paradise'), which covers approximately 40,000ha. After several dozen kilometres (not part of the property nominated for inclusion), the Gargar rejoins the river Dujayl, of which the Shoteit is also a tributary.

The nominated property forms a continuous territory along the various waterways, the river itself, and the canals. It extends to the north and to the west at the centre and the south of the city of Shushtar. Today it includes an ensemble of remarkable sites, hydraulic structures, and monuments, the description of which proceeds in order from upstream to downstream along the two branches. It includes the following elements.

In the north-eastern section of the property, from its intake on the river Kârum and following the urban section of the Gargar canal, there are:

1. The Mizân water intake dam (Band-e), which feeds the Gargar canal, advancing into the heart of a bend on the river Kârun;

2. The Kolâh-Farangi tower at the entrance to the peninsula between the river and the Gargar canal, where the water level is measured;

3. The Gargar canal itself, its city banks, and the city's water supply system involving a series of tunnels that help cool the houses in a region with extremely hot summers;

4. The Gargar bridge-dam (Polband-e), which is the starting point for several tunnels at differing levels; its superstructure was converted into a modern road in the heart of the city (1940).

5. The site of fourteen mills and waterfalls downstream from the tunnels bored into the cliff, the outfall basin between the cliffs; some mills using traditional equipment are still in operation. Contemporary installations have been added (a hydroelectric power plant and pumping station).

In the central section of the Gargar canal, south of the city, there are:

6. The remains of the Borj-e 'Ayâr bridge-dam and the archaeological site of the Sâbe'in (Sabean) sanctuary.

The following are located at the southern extremity of the property, on the Gargar canal:

7. The remains of the Khodâ-âfarin bridge-dam and the Mâhi-bâzân fish-farming ponds.

The following are located in the north-west, on the banks of the river Shoteit:

8. Salâsel Castle was the control and decision-making centre for the operation of the entire hydraulic system. It now consists only of ruins and an archaeological site near the Shâdorvân weir. The underground hydraulic sections are well preserved, including a vast water reservoir and the castle's cooling system.

9. The Dâriun canal intake tunnel, in a basement near the castle. Today this is an accessible heritage site, since a new water intake feeds the downstream reconstructed section of the old canal; the site also has three old single-arch bridges.

10. The remains of the Shâdorvân bridge-dam, which controlled the water intake on the Dâriun canal, still called the *Grand Weir*. Damaged on several occasions by floodwaters, it was been repeatedly repaired and restored, until it was finally abandoned (date unknown, but before the 20th century).

In the centre-west of the property, there is an old section of the Dâriun canal which includes significant remains of the historical hydraulic system, notably the Raghat canal junction that connected it to the Gargar canal. It was the final component in the city's defensive water belt. This zone includes the following monumental elements:

11. The remains of the Khâk dam;

12. The Lashkar bridge-dam as well as the nearby Emâmzâdeh Abdollâh temple, an Iranian historic monument, and the triple-arched Shâh Ali bridge;

13. The remains of the Sharâbdâr dam.

ICOMOS notes that there is no element with a direct link to the irrigated agriculture in the property nominated for inscription, only in the buffer zone, where it has undergone significant transformation for operational and economic reasons.

ICOMOS considers that the name of the property is somewhat complicated and that it could be simplified to: 'The Shushtar Historical Hydraulic System.'

History and development

The first confirmed water irrigation systems from canals in the region date back to the Elamite civilisation (Chogha Zanbil region), notably in the 13th century BCE. They were probably influenced by the large-scale irrigation work undertaken in Mesopotamia by the Sumerians from the 4th millennium BCE.

Darius the Great, the Achaemenid king from the start of the 5th century BCE, had the Elamite irrigation systems repaired, and he is attributed with the creation of the Dâriun canal, to the west of the current site of Shushtar. Archaeological remains near the canal would tend to confirm this. Darius and the Achaemenid kings are also known for their hydraulic works, notably in Egypt.

The construction of the large Shâdorvân weir dammed and provided a passage across the river Kârun. This audacious construction was performed by the second Sassanid emperor, Shapur, in the middle of the 3rd century CE.

The presence of Roman prisoners on the dam site, including the Emperor Valerian, is referred to in a 12th century Persian source. It also indicates that the builder of Shâdorvân may well have been the engineer and architect Andimeshk, who was of Roman origin. Roman civil engineering influence would seem to be borne out by certain aspects of the hydraulic system installed at the time. It is also probable that the hydraulic works in Petra carried out by the Nabateans in the 1st century CE influenced the project to divert a river in a rocky site using a dam and boring a tunnel.

With the addition of the monumental Mizân water intake upstream from Shâdorvân and the Gargar canal, the hydraulic ensemble as then reworked and extended was designed to supply water to the new city of Tustar, later called Chouster or Shushtar, and to irrigate the vast semidesert plain to the south, along the last of the mountain foothills, for the systematic development of agriculture, notably the planting of orchards.

Arab-Muslim sources attest to the reputation of the Shâdorvân civil structure, termed *Great Weir* and *Wonder* of the World. Although there is no material evidence for the more ancient periods, it is acceptable to think that this is a tradition dating back to the Persian origins of the construction. The structure and the hydraulic system together left an impression on visitors throughout the centuries, right through to the Europeans in the 19th century.

During the Islamic period, the various Iranian dynasties carefully maintained the Shushtar Hydraulic System as an essential component in the country's development. They carried out significant maintenance work, and sometimes additional work, such as during the Safavid (1500–1700) and then the Qadjar (1779–1925) dynasties for the Gargar bridge-dam and the Shâdorvân Grand Weir. The mill, bridge-dam, and tunnel region was developed from the origins of the system through to at least the 15th century, and then again in the 19th and 20th centuries.

Shushtar Historical Hydraulic System values

In its current form the Shushtar Historic Hydraulic System dates from the 3rd century CE, when the Shâdorvân Grand Weir and Mizân water intake were built and the Gargar canal dug. However, the site's first hydraulic installations most probably date back to the reign of Darius the Great, in the 5th century BCE, who in turn inherited the irrigation traditions of the Elamites and Mesopotamians who preceded them.

Shushtar is a homogeneous ensemble of highly diversified and complementary hydraulic functions, ranging from the construction of a dam to control a powerful river's flow to the creation of a veritable artificial watercourse, from the construction of a new town to the irrigation of a vast and at the time semi-desert plain, from the installation of mills to providing the possibility of river transport through to the Persian Gulf, from the construction of a bridge on the river Kârun to a hydraulic defence system for the town. This system has remained functional for eighteen centuries, and it is still in use today.

It is one of the most complete examples of an integrated hydraulic system, with numerous functions, that predates the industrial era. It reflects harmony in the relationship between man and nature through regional development that has remained functional ever since.

The creation of the Persian Sassanid Empire, Shushtar is one of the few very great, large-scale irrigation and regional development projects in the ancient history of China, Egypt, Mesopotamia, the Middle East, and the Greco-Roman world. In terms of its sources of inspiration, it is linked most closely to the latter three. It became a reference of civil engineering in ancient times, and was especially recognised at the peak of the Arab-Muslim civilisation.

Shushtar was carefully maintained and repaired throughout the Islamic period by the various Iranian dynasties.

3. OUTSTANDING UNIVERSAL VALUE, INTEGRITY, AND AUTHENTICITY

Integrity and Authenticity

Integrity

The hydraulic functional integrity is maintained through the use of the Mizân water intake (site 1 in the file – see Description) which diverts part of the river Kârun to feed the Gargar canal (site 3). Still in use, it continues to fulfil the role of town water supply (4, 5) and irrigation for the plain downstream from Shushtar (6, 7). The agricultural zone, with its modernised functions, is outside the nominated property, but a small part close to the city is inside the buffer zone.

Further downstream, a modern water intake feeds a renovated section of the hydraulic system, on the remains of the old Dâriun canal (9), but mainly in the buffer zone; it resulted in the old underground intake being drained (8).

Among the historic structures, the Mizân dam intake (1) and the nearby Gargar bridge-dam (4), with its tunnels, are still in use; they have retained their original function, at the cost of more or less extensive modifications (see Authenticity). The other structures are today monumental testimonies or sometimes mere archaeological remains, notably the Shâdorvân weir-dam, which was the masterpiece of the project in ancient times (10). The road function was sometimes maintained by a modern structure built alongside the ancient one (6 and 10).

The integrity of the monumental elements and the remains in terms of their location is satisfactory. It has not been changed by urban development in the region of the nominated property.

ICOMOS recognises the integrity of the location of the Shushtar Historical Hydraulic System, as well as the importance of its monuments, its archaeological remains, and its landscapes which render possible an understanding of this historical hydraulic ensemble.

In its reply to the request from ICOMOS dated 10 December 2008, regarding the inclusion of the upstream catchment area in the conservation of the integrity of the property, the State Party provided a summary note about the regional climatic and hydrological conditions with regard to the water flow in the river Kârun. The State Party highlights the fact that the inhabitants of the foothills of the Zagros Mountains have for centuries provided continuous careful management of the hydraulic aspects. However, both human ignorance and natural disasters can seriously damage a structure like the Shushtar Hydraulic System. A series of measures, set out in the note, is therefore recommended by the State Party in the management plan and for monitoring the property.

ICOMOS considers that these sixteen measures for the proper hydraulic management of the property contribute significantly to maintaining its integrity. Particular attention should be paid to the hydraulic management of the river Kârun and its affluents, upstream from Shushtar, notably the management of the weir-dams, and any future work.

Authenticity

In addition to changes due to the passage of time or sometimes abandonment, the component parts of the property have undergone alteration to their original built structure in several important places. Particular attention should be paid to the concrete platform on the top of the Mizân dam (1), added to make vehicular traffic possible. The Gargar bridge-dam (4), which was partially reconstructed and heightened in the 19th and 20th centuries, now carries a modern traffic route, in the heart of the city and used by dense traffic. The mill site (5) downstream from the dam underwent significant alteration by local industry in the 20th century – a hydroelectric power plant and a pumping station in particular. Built on the rock, these buildings lower the authenticity of the hydraulic landscape but without altering it irreversibly and remain compatible with its prime functions. The Dâriun canal (9) was rebuilt for the purposes of modern irrigation and its tunnel outfall under the castle was abandoned (8).

Otherwise, the maintenance of the structures over the centuries has been carried out with due respect for the initial constructions, with similar materials and binders and using construction traditions that have persisted throughout its long history. Nonetheless, most of the hydraulic structures have not been maintained for many years, in some cases since ancient times, nor have they been restored using modern technical techniques, which contributes to their authenticity as remains, although they no longer have any functional purpose.

The territory of the nominated property is in places affected by modern buildings that change its authenticity (5, 9); this may also be in order to maintain an ancient road function, as already stated (6, 10). In the case of the buildings, the State Party has indicated that solutions to restore the authenticity are under examination. These may at times be minor issues, such as electrical power masts.

In many cases, constructions in the buffer zone adversely affect the expression of its authenticity. The State Party is aware of this difficulty and has stated that it is actively seeking appropriate solutions that are acceptable to the local community.

ICOMOS notes, with a repeated logic that has its own legitimacy, that it is the structures or sites still in active use that have undergone the most extensive modifications to their authenticity, especially those starting in the 20th century, such as the bridge-dams (1 and 4), the Dâriun canal (9), and the mill site (5). ICOMOS urges the inception of research and authenticity value restoration programmes, notably for these major property components, which are essential for its understanding.

ICOMOS considers that the site's hydraulic integrity is satisfactory, even though some of the ancient structures are now in ruins. ICOMOS considers that the authenticity, which is in general good, needs to be strengthened in several of the most significant places and in the landscape close to the property.

Comparative analysis

The State Party has provided a detailed comparative analysis for the various topics linked to the nature of the property and its history, first within Iran and then within the context of ancient and medieval times in the Middle East, Persia and Europe. The approach is made simultaneously in terms of the property's history and heritage; it mainly concerns:

- Ancient and medieval dams in Iran and in the ancient world (Mesopotamia, Middle East, Roman Empire, and Spain).

- Bridge-dams for irrigation purposes; there are many of these in Iran where they are a particular feature of land management in ancient and medieval times. Some are exceptionally well preserved masterpieces, still in use (Dezful, Amir, Shahrestan, Khajoo, and Siosepol). Dezful is the closest to the nominated property.

- The earlier large bridges of the ancient world (Mesopotamia, Urartu, Pont du Gard).

- The hydraulic tunnels associated with dams in Iran, Mesopotamia, and Petra,

- Large irrigation systems, including canal ensembles in Urartu and in China.

- Water mills dating from antiquity in Iran and the Roman Empire.

In its reply dated 24 February 2009, the State Party provides a comparative analysis extended to include three other important hydraulic properties in Iran: Duruntash (Khuzestan), Pulvar (Fars), and the Ispahan water supply system.

ICOMOS considers that it is necessary to compare hydraulic systems that extend beyond the components parts of the property, notably those already inscribed on the World Heritage List. That of Dujiangyan (China) has a similar function (Mount Qingcheng and Dujiangyan Irrigation System, 2000, criteria (ii), (iv), (vi)). Started in the 3rd century BCE, it still regulates the waters of the river Minjiang and distributes them to the fertile lands of the Chengdu Plain. Its structure is, however, not the same, nor are the technical solutions implemented since they are specific to Chinese civilisation. There are also other potential comparisons drawn from ancient times and located in the Middle East. For example, the Aflaj Irrigation Systems of Oman (2006, criterion (v)); this is, however, an exceptional system for water capture at the foot of a mountain and then distributing it to a network of oases. Moreover, although this irrigation system is probably very old, the exact dating of the *aflaj* is uncertain. Other similar hydraulic systems dating from ancient times have existed in the arid regions of the Middle East, from ancient Persia to North Africa. The Qanat in Bam (Bam and its Cultural Landscape, Iran, 2004-2007, criteria (ii), (iii), (iv), (v)) are underground systems that are similar to the previous system. The Nabatean irrigation networks in the Negev Desert (Incense Route - Desert Cities in the Negev, Israel 2005, criteria (iii), (v)) also include remarkable hydraulic engineering elements, in this instance based on the multiplication of small dams and reservoirs dug into the rock.

ICOMOS considers that the Shushtar Historical Hydraulic System appears to be comparable with the best hydraulic engineering achievements of antiquity, by diverting a river and creating an artificial river, and by a remarkable and diversified ensemble of technical structures. It is a very complete overall system, endowed with all the functions associated with the simultaneous control of water and the land. In this respect, it is exceptional. It is one of the most extensive still conserved, and it is one of the rare hydraulic systems of ancient times still in use. It also provides an important example of the meeting of hydraulic techniques linked to Mesopotamian antiquity, and more broadly to the Middle East and those of the Roman world.

ICOMOS considers that among the many hydraulic systems dating from the ancient and medieval periods, Shushtar is one of the most complete and one of the most important.

ICOMOS considers that the comparative analysis justifies consideration of this property for the World Heritage List.

Justification of the Outstanding Universal Value

The nominated property is considered by the State Party to be of Outstanding Universal Value as a cultural property for the following reasons:

- In its present form, the Shushtar Historical Hydraulic System dates back to the 3rd century CE, but it was probably originally undertaken by Darius the Great, the Achaeminid king in the early 5th century BCE. It is one of the very rare large-scale complete hydraulic systems as old as this.

- It is a homogenous hydraulic system designed in a global and definitive manner in the 3rd century CE. It is rich in terms of its civil engineering structures (bridge-dams, weirs, tunnels, canal dug in the rock), its functional buildings (control castle, water level control tower), and the diversity of uses (urban water supply, irrigation, fish farming, river transport, and defence system).

- It is testimony to the heritage and conjunction of skills from earlier times, Elamite and Mesopotamian; it was probably influenced by the Petra dam and tunnel and by Roman civil engineering.

- The Shushtar Historical Hydraulic System, as an ensemble and especially the Shâdorvân *Grand Weir* (bridge-dam), was considered a *Wonder of the World* not only by the Persians but also by the Arab-Muslims at the peak of their civilisation.

- The Gargar canal is a veritable artificial watercourse that made possible the building of a new city and the irrigation of a vast and at the time semi-desert plain.

- The Shushtar Historical Hydraulic System is in an urban and rural landscape environment specific to the expression of its value.

Criteria under which the inscription is proposed

The property is nominated on the basis of cultural criteria (i), (ii), and (v).

Criterion (i): represent a masterpiece of human creative genius.

Shushtar is considered by the State Party to be of outstanding universal value as a masterpiece of human creative genius and a 'Wonder of the World,' which is how it has long been internationally recognised. It has been admired by visitors from the world over throughout the centuries, for its overall elegance as well as for the technical performance of its impressive civil engineering structures and its highly diverse use as a hydraulic system.

ICOMOS considers that the Shushtar Historical Hydraulic System is testimony to a remarkably accomplished and early overall vision of the possibilities afforded by diversion canals and large weir-dams for land development. It was designed and completed in the 3rd century CE as a global system, in terms of both its civil engineering and its diverse hydraulic applications. It was a unique and exceptional ensemble in terms of its technical diversity and its completeness which testifies to the human creative genius. It is preserved today in an urban and rural landscape environment specific to the expression of its value. The Shâdorvân Grand Weir, damming the river Kârun, was considered a technical masterpiece by the Persians, the Arab-Muslims, and their many visitors throughout the centuries. Today, it is reduced to a ruined state, along with many of the dams for the water-flow control system.

ICOMOS considers that this criterion has been justified.

Criterion (ii): exhibit an important interchange of human values, over a span of time or within a cultural area of the world, on developments in architecture or technology, monumental arts, town-planning or landscape design.

This criterion is justified by the State Party on the grounds that the Shushtar Historical Hydraulic System provides an example of the development of hydraulic systems and town planning dating back almost 2000 years. The result is harmonious and very complete.

It is a technical ensemble and a unique installation in both the Far East and the West.

ICOMOS considers that the Shushtar Historical Hydraulic System is a synthesis of diverse techniques brought together to form a remarkably complete and large-scale ensemble. It has benefited from the ancient expertise of the Elamites and Mesopotamians in canal irrigation, as well as the more recent Nabatean expertise in dams and tunnels. The Romans also influenced its construction, notably the Grand Weir. Its many visitors marvelled at it, and were in turn inspired. It testifies to the exchange of considerable influences throughout antiquity and the Islamic period in the area of hydraulics and their applications.

ICOMOS considers that this criterion has been justified.

Criterion (v): be an outstanding example of a traditional human settlement, land-use, or sea-use which is representative of a culture (or cultures), or human interaction with the environment especially when it has become vulnerable under the impact of irreversible change.

This criterion is justified by the State Party on the grounds that the Shushtar Historical Hydraulic System is an exceptionally accomplished example of human establishment and land-use in Iran, found in other great civilisations in antiquity, in Mesopotamia, and in the Roman Empire. During periods of peace there were very significant multinational and multicultural exchanges that continued into the Islamic period.

Unlike many other hydraulic systems, Shushtar is still in use and it is a living heritage in harmonious relationship with nature and its urban environment.

ICOMOS considers that Shushtar is a unique and exceptionally complete example of hydraulic techniques developed during ancient times, to aid the settlement of semi-desert lands. By diverting a river flowing down the mountains, using large-scale civil engineering structures and the creation of canals, it made multiple uses for the water possible across a vast territory: urban water supply, agricultural irrigation, fish farming, mills, transport, defence system, etc. It testifies to a technical culture dating back eighteen centuries serving the sustainable development of a human society, in harmony with its natural environment.

ICOMOS considers that this criterion has been justified.

ICOMOS considers that the nominated property meets criteria (i), (ii), and (v) and that the outstanding universal value has been demonstrated.

4. FACTORS AFFECTING THE PROPERTY

Development pressures

The development of automobile traffic directly affects the Mizân (1) and Gargar (4) dams, which are also used as bridges. There are plans to limit traffic. A road has been built in the city on the western bank of the canal (3).

The increasing road traffic is also contributing to the deteriorating urban atmosphere and its acidity.

The very friable sandstone of the canal banks is affected long-term by chemical pollution in the air and water.

The surroundings of the property (buffer zone) have often been altered by rapid urban growth in the second half of the 20th century, in the form of constructions that are inappropriate in terms of their form and the materials used, and more rarely in the property itself. Modern bridges have also been built over the canals and roads near the property, made necessary by urban growth. An overall review is in progress within the context of the town plan that should lead to a gradual corrective programme and control over new construction.

Tourism pressures

Tourism generally does not pose a problem for the property; quite the contrary, it is a factor contributing to its recognition and its enhancement. Some graffiti and uncontrolled waste disposal show that visitors and passersby are not always aware of the property's value. The monuments and the historical sites such as the tower (2), the mill area (5), or the castle area (8), are generally open to the public; controlled visits to these spaces are to be introduced.

Environmental pressures

The river Kârun has already reduced the Shâdorvân weirdam (10) to a ruined state; its currents can be violent during periods of high water, and they tend to be increased by its water-flow management because of the contemporary dams upstream from Shushtar. The Mizân water intake dam (1) and its dyke, through to the Kolâh-Farangi tower (2) included, are particularly exposed to erosion by the river over time. Monitoring measures are in place.

At times, plants may colonise the dam structures and some species can alter the canal's natural banks.

More particularly, in the urban zone of the Gargar canal and in the mill zone, a veritable gorge downstream from the Gargar dam, the natural cliffs reveal areas subject to erosion which could collapse. On the other hand, their reinforcement using visible modern means would alter the site's authenticity. It is intended to study this issue as part of the conservation plan.

Natural disasters, impact of climate change

Thanks to the effectiveness of the Mizân water intake dam over the millennia, the Gargar canal has not caused any known major natural catastrophe along its course. Climate change could increase the level and frequency of the river Kârun's high water, and so place greater demands on the robustness of the hydraulic system.

There is no evidence of earthquakes in the past, but it is a risk that could potentially affect the region.

ICOMOS considers that the main threats to the property are urban pressure from non-compliant construction and the effects of traffic, and the river Kârun's upstream hydraulic management.

5. PROTECTION, CONSERVATION, AND MANAGEMENT

Boundaries of the nominated property and buffer zone

According to the maps, which clearly define the boundaries of the property, the surface area is comprised of strips of land bordering the various watercourses and which include the thirteen remarkable civil structures, monuments, and sites. They measure between 100m and 800m wide, giving an average of 200m for a total length close to 10km. The surface area of the property is c 240 hectares. The population is 410.

However, according to the maps that define the buffer zone boundaries, it is a territory that broadly encircles the property, except to the east of the city and adjacent to the rich ensemble at the start of the Gargar canal (1, 2, 3, 4, and 5), where it is sometimes reduced to just 150m. Its total surface area is *c* 1600ha. It is 8.5km along its north–south axis, and 3.6km at its widest east–west point. Two sub-zones are considered in the buffer zone: the urban section and the rural section, each with its own specific conservation measures.

The population in the urban buffer zone is around 150,000, and it is 1400 in the rural buffer zone.

The property also has a landscape control zone that surrounds the city of Shushtar, with a radius of c 12km.

In its reply dated 24 February 2009, the State Party provides a detailed note about the reasons governing the choice of boundaries for the buffer zone: on the one hand, to define a coherent territory providing complete continuity of meaning and landscape with the property; and on the other as a function of the requirements for its conservation and the control of urban and farming development. The management criteria for the buffer zone are also recalled (see *Protection*).

ICOMOS considers that the boundaries of the property nominated for inscription and of the buffer zone are satisfactory.

Ownership

The Islamic Republic of Iran owns the property nominated for inscription with the exception of the private dwellings included in the property and the Mâhi-bâzân ponds (site 7).

The main bodies responsible for representing the public ownership are the Iran Cultural Heritage, Handicrafts and Tourism Organisation (ICHHTO), the Municipality of Shushtar, and religious organisations. Depending on the relevant issue, other State bodies may be called upon to exercise this right. The buffer zone mainly belongs to private owners; some parts are public.

Protection

Legal protection

In accordance with the Conservation of Monument and National Sites Act (1930), the protection of monuments inscribed on the National Heritage List falls to ICHHTO.

The thirteen monumental elements or remarkable sites of the nominated property are inscribed on the National Heritage List.

The property and its buffer zone also come under a series of the State Party's general laws (Civil Code, Islamic Penal Code, National Economy Act, Public Land Development Act, National Security Decree, and Five-Year Development Plan). It also falls under texts specifically dealing with the protection of cultural heritage:

- Prevention of unauthorised excavations (1980),
- Land acquisition, construction, and areas for the protection of historic property (1969),
- Organisation of Iranian heritage services (1979).

In agreement with the local authorities, the protection measures applying to the property have been summarised in the form of a document outlining the legal constraints and conditions for works. In particular, this document reveals that any public or private body or any individual with a project concerning the property or its buffer zone and liable to affect its historic and heritage values must inform ICHHTO and obtain its authorisation, in addition to and overriding that of the usual services. This concerns all projects for construction or changes to urban infrastructure, transport, and any agricultural project that risks affecting the property and/or its landscapes. In particular, it enables ICHHTO to intervene on existing structures affecting the authenticity of the property and its landscapes. The document concerns the various levels: the property itself, the urban buffer zone, the rural buffer zone, and the landscape zone.

Effectiveness of protection measures

ICOMOS considers that all the legal and regulatory measures in place are adequate for providing effective protection of the property.

ICOMOS considers that the protective measures for the property are adequate.

Conservation

Inventories, recording, research

The current inventory and research tools are the database for the Shushtar Historical Hydraulic System, under the responsibility of ICHHTO, along with various heritage documents, such as photographs, maps, and archives. The database itself is a research programme and the supporting element for the conservation control plan (called the SHHS Plan). The database and the documents are held by ICHHTO and by the Shushtar Governorate. The following also contribute to this documentary fund and guide the action plans:

- A programme for development and territorial control under the town plan,

- A programme for research and study of the property's components,

- A programme for the development of tourism.

Present state of conservation

Based on the situation of the property's current integrity and authenticity (see above), the State Party has developed, through its study programme, a good knowledge of the state of conservation of each of the property's civil structures, monuments, and sites, and has formulated the appropriate diagnostics.

Active conservation measures and maintenance

The municipal services and ICHHTO jointly provide the standard and hydraulic maintenance of the property. Specialist companies may be called upon for certain work.

Under the management plan, ICHHTO is responsible for the conservation control plan (SHHS Plan). Particular attention is paid to the condition of the civil structures and their restoration planned in accordance with acceptable authenticity criteria.

Effectiveness of the conservation measures

The knowledge and control databases are in place and work efficiently. Conservation and gradual authenticity rehabilitation issues are appropriately raised. However, given the scope and the size of the difficulties encountered, the conservation will require significant work in the years ahead.

ICOMOS considers that the issue of the property's conservation is suitably raised; however, given its scope, the conservation and authenticity restoration plan for the structures and the functional sites will require major work in the years ahead, which it is appropriate to encourage. In particular, the archaeological remains should be consolidated and their stability ensured. In addition, this conservation plan does not appear to be a totally complete and approved document, but rather an ongoing process. It should be finalised and approved.

ICOMOS also considers it necessary to establish monitoring and a detailed inventory of the underground hydraulic networks, and then to initiate an archaeological study of them in relation to the urban structures and dwellings. It would also be important to restore certain of the town's houses in relation to the property and its landscapes and to encourage owners to do this.

ICOMOS considers that the issue of the conservation of the property is appropriately raised. However, particular attention needs to be paid to consolidating the archaeological remains, monitoring and studying the underground elements, and renovating the old houses linked to the property and its landscapes.

ICOMOS considers that the conservation plan for the property should be finalised and approved by the property's management authorities.

Management

Management structures and processes, including traditional management processes

All the plans and programmes concerning the property nominated for inscription must be approved by the ICHHTO Technical High Council, in Teheran. The High Council is also responsible for supervising their implementation. It has the final say on all major operations and it allocates the financial resources needed for their implementation.

At the executive level, ICHHTO appoints a director in charge of the database and the implementation of the Conservation Plan. This executive body is called the SHHS Base for short. It is responsible for all technical aspects of the conservation and management of research, tourism, and education.

The architectural and urban questions are under the control of the High Council for Architecture and Town Planning. It must also approve the programmes and plans for the property in liaison with the city's master plan.

At the regional and local levels, the property management includes:

 A Steering Committee responsible for approving the technical decisions. It is comprised of specialists and professionals from various backgrounds, commensurate with the complexity of the property.

- A Local Supervisory Council for the hydraulic system in charge of its regular supervision; it includes representatives of ICHHTO and the regional and local authorities (the governorate and municipality in particular}.

- At the local level, there is a strong tradition and strong local motivation to participate in protecting the property.

Policy framework: management plans and arrangements, including visitor management and presentation

The management plan mainly comprises the conservation plan combined with the SHHS database, plus aspects of the tourism and educational development plan.

The plan is presented with planning element-by-element for the various components of the property in accordance with a completion schedule (2008–2022).

The plan reveals a set of precise measures which, in addition to conservation and research, concerns the presentation of the site and its tourism development (lighting, signage, visitor pathways).

The management plan must be compatible and developed in conjunction with the city of Shushtar's Master Plan.

Management of the property is also governed by:

- The hydraulic management plan of the upstream dam on the Kârun, affecting the water level and currents;

- The wastewater network extension plan.

ICOMOS considers it necessary to improve supervision of the water quality and to confirm that the management of the catchment area ensures the long-term conservation of the property.

Risk preparedness

The analysis of threats has been carried out in detail and for each component of the property.

There is no specific plan linked to potential risks threatening the property, other than the general civil protection plans applicable to the city of Shushtar and the Kârun Basin.

Involvement of local communities

The local population is involved through representatives of municipalities on the various management bodies.

The local population still seems to be insufficiently informed and insufficiently aware of the property's value.

Resources, including staffing levels, expertise, and training

ICHHTO is directly involved in the management of the property and guarantees an annual budget, which was significantly increased between the years 2002–2003 and 2006.

The Khuzestân water and electricity organisation also made significant contributions to the maintenance of the hydraulic system between 2001 and 2005.

The Municipality of Shushtar guarantees an annual budget, which was significantly increased in 2007.

The executive management body for the Shushtar Historical Hydraulic System (SHHS Base) employs outright, in addition to its director, five architects, three archaeologists, two engineers, sixteen architect's technicians and workers skilled in traditional practices, two guides, twelve guards, and five clerical and other staff members.

Traditional masons and tradesmen are also available in sufficient number for the restoration work, under the supervision of the SHHS Base staff.

Various professional training, meeting, and internship possibilities are available in Iran or through international organisations. Some of these have a direct link with the Shushtar Historical Hydraulic System's conservation.

Effectiveness of the current management

ICOMOS considers that the current management system is effective.

ICOMOS recommends improving the property's interpretation for the local population and visitors.

ICOMOS considers that the management system for the property is appropriate. Nonetheless, the management plan, especially its conservation section, must be approved by the State Party authorities and the partners in the management. ICOMOS also recommends boosting the water quality monitoring measures and improving the interpretation of and information on the property and the involvement of the local population.

6. MONITORING

The local council for the supervision of the hydraulic system meets monthly under the chairmanship of the Governor of Khuzestân Province. It examines the property monitoring reports compiled by the SHHS Base executive body staff. These are performed in accordance with the following topics and frequencies:

- Water control level, water quality, with the assistance of the Environmental Protection Agency of the Meteorological Office: weekly;

- Monitoring the state of conservation: fortnightly and monthly;

- Geological and geophysical monitoring: annually;

- Tourism: daily presence of guides and guards; annual visitor number statistics;

- With the municipality, supervising constructions liable to affect the property and the property's urban landscape: every three days.

- Ongoing documentation work, mapping and photographing the property to expand the database.

ICOMOS considers that the monitoring of the property is appropriate.

7. CONCLUSIONS

ICOMOS recognises the outstanding universal value of the Shushtar Historical Hydraulic System.

Recommendations with respect to the inscription

ICOMOS recommends that the Shushtar Historical Hydraulic System, Bridges, dams, canals, buildings and watermills from ancient times to present, Islamic Republic of Iran, be inscribed on the World Heritage List on the basis of *criteria (i), (ii), and (v)*.

Recommended Statement of Outstanding Universal Value

The Shushtar Historical Hydraulic System demonstrates outstanding universal value:

- In its present form, it dates from the 3rd century CE, probably on older bases from the 5th century BCE. It is complete, with numerous functions, and large-scale, making it exceptional.
- It is a homogeneous hydraulic system, designed globally and completed in the 3rd century CE. It is as rich in its diversity of civil engineering structures and its constructions as in the diversity of its uses (urban water supply, mills, irrigation, river transport, and defensive system).
- It testifies to the heritage and the synthesis of earlier Elamite and Mesopotamian knowhow; it was probably influenced by the Petra dam and tunnel and by Roman civil engineering.
- The Shushtar hydraulic system, in its ensemble and most particularly the Shâdorvân Grand Weir (bridge-dam), has been considered a Wonder of the World not only by the Persians but also by the Arab-Muslins at the peak of their civilisation.
- The Gargar canal is a veritable artificial watercourse which made possible the construction of a new town and the irrigation of a vast plain, at the time semi-desert.

 The Shushtar Historical Hydraulic System sits in an urban and rural landscape specific to the expression of its value.

Criterion (i): The Shushtar Hydraulic System is testimony to a remarkably accomplished and early overall vision of the possibilities afforded by diversion canals and large weir-dams for land development. It was designed and completed in the 3rd century CE for sustainable operation and is still in use today. It is a unique and exceptional ensemble in terms of its technical diversity and its completeness that testifies to the human creative genius.

Criterion (ii): The Shushtar Historical Hydraulic System is a synthesis of diverse techniques brought together to form a remarkably complete and large-scale ensemble. It has benefited from the ancient expertise of the Elamites and Mesopotamians in canal irrigation, and then that of the Nabateans; Roman technicians also influenced its construction. Its many visitors marvelled at it and were in turn inspired. It testifies to the exchange of considerable influences in hydraulic engineering and its application throughout antiquity and the Islamic period under the various Iranian dynasties.

Criterion (v): Shushtar is a unique and exceptionally complete example of hydraulic techniques developed during ancient times to aid the occupation of semi-desert lands. By diverting a river flowing down the mountains, using large-scale civil engineering structures and the creation of canals, it made possible multiple uses for the water across a vast territory: urban water supply, agricultural irrigation, fish farming, mills, transport, defence system, etc. It testifies to a technical culture dating back eighteen centuries serving the sustainable development of a human society, in harmony with its natural and urban environment.

The integrity of the hydraulic footprint is good, but its functional integrity compared with the original model is only partial and reduced, notably for the dams; it remains good for irrigation and water supply. The authenticity of elements reduced to archaeological remains is certain, but has been affected by 20th century works and materials so far as the civil structures and sites still in use are concerned. Efforts directed to the restoration of authenticity must be pursued.

The components of the management plan are satisfactory, but they need to be improved in terms of the interpretation of the sites and the involvement of the local population.

ICOMOS recommends that the State Party give consideration to the following points:

- Examine the future possibilities of combining irrigation and agricultural development with the expression of the universal value of the property, notably with regard to its dimension as an exceptional example of sustainable development;
- Finalise, approve, and ensure the correct application of the conservation and authenticity restoration plan for the property's civil structures, monuments and functional sites;

- Pay particular attention to consolidating the archaeological remains, monitoring and studying the underground elements, and renovating the old houses linked to the property and its landscapes;
- Strengthen water quality control and pay particular attention to the hydraulic management of the river Kârun and its affluents upstream from Shushtar, especially the management of the weir-dams, and any future work;
- Improve the interpretation of the property and the information and involvement of the local population;
- Eventually simplify the name of the property to 'The Shushtar Historical Hydraulic System.'



Map showing the boundaries of the nominated property



Band-e Mizân dam



Watermills and waterfalls area



The Khodâ-âfarin dam-bridge



Polband-e Shâdorvân Bridge-dam