CHANKILLO SOLAR OBSERVATORY
AND CEREMONIAL CENTER

Nomination of property for inscription on
The World Heritage List

Republic of Peru - January 2019
EXECUTIVE SUMMARY

State Party  Republic of Peru
State, Province or Region  Department: Ancash, Province: Casma, District: Casma
Name of Property  Chankillo Solar Observatory and ceremonial center
Geographical coordinates 9°33´18” (S), 78°14’14” (W)

Textual description of the boundary(ies) of the nominated property
The property is made up of two zones: Chankillo Monumental Archaeological Zone and Cerro Mucho Malo (Map 2). As for the limits of Chankillo, the northwest limit has a segment of more than 3700 m, between Pampa Antival to the north and Pampa Cardales to the south. This segment starts from the west near the North Pan-American Highway (220 masl), crossing sandy plains and rolling hills in an approximate northeast direction, ending in the surroundings of the La Hacienda town center, in the San Rafael Valley, at about 120 masl. On the northeast side, it has a segment approximately 4600 long. It begins in the surroundings of La Hacienda, towards a predominantly southeast direction, until the surroundings of the Pueblo Joven town center, at approximately 150 masl. This segment is bordered by the agricultural lands of the San Rafael Valley, sometimes changing direction depending on the boundary with the valley, the dune front, and the carob tree corridor. On the other hand, to the east it presents a segment with irregular bearings more than 3300 m in length, which crosses windy plains and low hills, between the surroundings of Pueblo Joven town center in the north point to the surroundings of the Choloque Chico hill to the south, at 330 masl. To the east of this segment is the site of Virgen de Chapi agricultural company. To the south we find a straight segment of more than 4700 m that begins in the vicinity of Choloque Chico hill, crosses windy plains with active dunes, and hills, reaching the vicinity of the North Pan-American Highway at 240 masl. Finally, to the west, the limit is a segment almost 2600 m long that is almost parallel to the South Pan-American highway, approximately northward, crossing windy plains to meet the first point described in the northwest segment.

On the other hand, regarding the limits of Cerro Mucho Malo, in the north it has a segment more than 1200 m long that borders on the beginning of the alluvial dejection cone that forms Pampa de Las Llamas. It is between 330 and 360 masl. For the northwest and east it presents a segment of 6600 m in length, which goes approximately in the southeast direction to the right margin of the San Rafael Valley. This segment constitutes the approximate boundary between Cerro Mucho
Malo and Cerro Mirador, which are contiguous towards the northeast, forming part of the same mountain range. The segment crosses a maximum altitude of approximately 1000 masl. To the south, the limit runs parallel to the San Rafael Valley, with an approximate length of 7500 m, with a variable direction, depending on the shape of the valley. Finally, to the east the limit is a line segment with an approximate length of 6600 m, crossing the western slopes of Cerro Mucho Malo, having an irregular direction from south to north, as defined by the forms of the boundary of the delimited archaeological sites "Purgatorio" and "Pampa de las Llamas-Moxeque", which are located just to the west of the boundary polygon proposed for Cerro Mucho Malo.

**A4 or A3 size map(s) of the nominated property, showing boundaries and buffer zone (if present)**
1. General location map (country, region, department, district)

2. Boundary map: The Property

3. Boundary map: The Buffer zone

4. Chankillo Monumental Archaeological Zone Boundary map, according to Ministry of Culture

5. Map of archaeological sites in the Buffer zone

**Criteria under which property is nominated (itemize criteria)**

i. to represent a masterpiece of human creative genius

v. to 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.

**Draft Statement of Outstanding Universal Value**

**Brief synthesis**
The Chankillo Solar Observatory and ceremonial center comprises a set of monumental constructions set among various related buildings and plazas in a well-preserved desert landscape in coastal Peru. They include a unique triple-walled hilltop complex known as the Fortified Temple, and an iconic line of thirteen cuboidal towers stretching along the ridge of a natural hill. The ceremonial center was dedicated to a solar cult, and the presence of two archaeologically distinct Observing Points on either side of the north-south line of Thirteen Towers unequivocally shows that the primary purpose of these structures was to function together as a calendrical instrument using the sun to define dates throughout the seasonal year.
Several of the related monuments that form Chankillo are also constructed and oriented in relation to artificial and natural horizon markers and the sun in order to support, and in some cases to orchestrate wider participation in, calendrically regulated ceremonials. In addition, the Fortified Temple and the distant eastern horizon it faces demonstrate the development of ideas leading to the construction of the Solar Observatory.

Chankillo is one of only two places in the ancient world known to have incorporated a complete solar horizon calendar, using its markers to track the progressive passage of the sun along the horizon throughout the entire solar year. And it is the only one where this was achieved on a monumental scale and where all the component elements of the instrument are still extant and functional.

Chankillo’s carefully chosen location in a place of exceptional natural beauty, with a natural eastern horizon that is low enough for the observation of a rising celestial objects against distant natural foresights, the construction of an artificial horizon, and the precise design of the observation points and the Thirteen Towers, constitute an extraordinary example of the cultural transformation of the natural landscape, as well as the vital role of astronomical knowledge for early civilizations in the Andes.

**Criterion (i)**
The solar observation device incorporated in the Thirteen Towers of Chankillo, which permits the time of year to be accurately determined not just on one date but throughout the seasonal year, is unsurpassed as an example of ancient landscape timekeeping. Unlike architectural alignments upon a single astronomical target found at many ancient sites around the world, the line of towers spans the entire annual solar rising and setting arcs as viewed, respectively, from two distinctive observing points, one still clearly visible above ground. This device, known as the “Chankillo Solar Observatory”, not only provides direct indications of all four solstitial rising and setting positions but also the means to identify every other day in the year by observing sunrise or sunset against the various towers and gaps between them.

**Criterion (v)**
The Chankillo Solar Observatory is an example, unique in the ancient world, of landscape timekeeping on a monumental scale that integrates elements of both the natural and built environment. Standing at the heart of a ceremonial center which incorporates further solar and possibly lunar alignments upon both constructed and natural targets, it exemplifies human interaction with a desert landscape and skyscape in a way that remarkably incorporates natural elements within the
astronomical function, giving them a value similar to that of constructed elements. Astronomical observations at Chankillo are still possible in the present day because this fragile landscape, very vulnerable to change in the face of development pressures and climate change, keeps the shape and physiognomy that facilitated its astronomical functions over two millennia ago, retaining its exceptional pristine conditions with relict ecosystems that favor the conservation of the property.

**Integrity**
The Chankillo Solar Observatory and the wider set of related monuments that form the site take advantage of a set of artificial and natural horizon markers to define dates. Few places in the ancient world have these attributes, and Chankillo is one of only two yet known to incorporate a complete solar horizon calendar, using markers to track the progressive passage of the sun along the horizon throughout the entire year. These elements are still extant and functional. The property identified as the Chankillo Solar Observatory and Ceremonial Center comprises the necessary elements to preserve and transmit these attributes of its cultural value.

The integrity of the astronomical sightlines at Chankillo is important in evaluating its attributes. The viewsheds that contain these astronomical sightlines are generally unobstructed. In large part the natural environment and climatic conditions that resulted in the good visibility needed for astronomical observations at the site are conserved and the sightlines still function as intended.

**Authenticity**
The position of the Western and Eastern Observing Points in relation to the Thirteen Towers at Chankillo, identified by archaeological excavation and geophysical survey and verified by archaeoastronomical data, unequivocally shows that the primary purpose of all these structures was to act together as a calendrical instrument. This conclusion enjoys high scientific credibility, which is vital for archaeoastronomical data being considered in a heritage context.

Since the 3rd century BC the sun has shifted slightly at and around the solstices, less at other times in the year. This small change has a negligible effect on the solar and possibly lunar alignments around the site and does not affect the ability of a present-day observer to understand through experience, directly, the way in which the Chankillo Solar Observatory functioned.

**Requirements for protection and management**
The property “Chankillo Solar Observatory and ceremonial center” is owned by the Peruvian nation, represented by the Republic of Peru, and administered by the State through its Ministry of Culture. It is protected by a series of legal provisions that recognize its condition of inalterable, inalienable, and imprescriptible National Cultural Heritage. Specifically, Law 30467 (June 2016),
promulgated by the Congress of the Republic of Peru, declared of national interest and public necessity the investigation, protection, revalorization and dissemination of Chankillo and adjacent prehistoric sites located in the province of Casma, department of Ancash.

The Ministry of Culture is the institution responsible for protecting the declared property through measures for its delimitation and its physical and legal protection. Likewise, any archaeological or conservation activity occurs within the framework of established regulations on archaeological and conservation interventions.

For the preservation, management and promotion of this property and its buffer zone, the Ministry of Culture, in cooperation with the local municipality and other institutions convened a multi-disciplinary team of professionals for the development of a Management Plan, as an instrument for the investigation, conservation, and social use of the Chankillo Solar Observatory, from the perspective of its surrounding territory, where its interpretative meaning lies. The plan considers the Chankillo astronomical landscape not only from its visual and physiognomic aspects, but also from the perspective of the natural and sociocultural processes that underlie it. The plan is multi-sectorial, decentralized and participatory; it includes government branches as well as members of civil society (community organizations, universities, etc.). It identifies problems and proposes the protection, conservation, and regulation of the use of the property and its environment through zoning the property and its buffer and by establishing a series of programs and projects to provide solutions. Currently, the Management Plan is under review by the Ministry of Culture.

In addition, the Provincial Municipality of Casma has approved a Territorial Conditioning Plan (PAT) 2017-2037, which recognized the proposed boundaries of the property and its buffer zone as part of areas reserved for the development of agriculture, tourism, and ecotourism.

**Name and contact information of official local institution/agency**

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1. IDENTIFICATION OF THE PROPERTY
1.a Country (and State Party if different)
Republic of Peru

1.b State, Province or Region
Department: Ancash, Province: Casma, District: Casma

1.c Name of Property
Chankillo Solar Observatory and ceremonial center

1.d Geographical coordinates to the nearest second
9°33’18” (S), 78°14’14” (O)

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1.e Maps and plans, showing the boundaries of the nominated property and buffer zone
1. General location map (country, region, department, district) (Figure 1-1) (Appendix 1)

2. Boundary map: The Property (Figure 1-2)

3. Boundary map: The Buffer zone (Figure 1-3)

4. Chankillo Monumental Archaeological Zone, according to the Ministry of Culture (Figure 1-4)

5. Map of archaeological sites in the Buffer zone (Figure 1-5)

1.f Area of nominated property (ha.) and proposed buffer zone (ha.)
Property: 4480 ha, Buffer Zone: 43990 ha, Total: 48470 ha (Figure 1-3). Chankillo is integrated masterfully into its landscape, taking advantage of elements of the near and distant natural horizons for their use as astronomical markers. Despite the pressures of development and the management challenges, the property (4480 ha) and the buffer zone (43990 ha) were chosen to represent and protect well-preserved attributes that convey its extraordinary universal values.
Figure 1-2. Boundary map: Property
Figure 1-3. Boundary map: Buffer zone
Figure 1-4. Chankillo Monumental Archaeological Zone. Boundary map prepared by the Ministry of Culture of Peru
Figure 1-5. Map of archaeological sites within the Buffer zone
2. DESCRIPTION

2.a Description of property

The Chankillo Solar Observatory and ceremonial center is a prehistoric site with astronomical, ritual, defensive and administrative functions, occupied between 250 and 200 BC. It is located on the north-central coast of Peru, Ancash department, 15 km east of the Pacific Ocean and 12 km south of the city of Casma. It faces the steep western slopes of Cordillera de los Andes, between 80 and 1180 masl, in a desert that has remained practically without major geological changes since the Pleistocene. The area occupied by Chankillo is adjacent to the irrigated valleys of the southern branch, called Casma or Grande river, of the Casma and Sechin river basin, and made up of mountains, rocky outcrops, dry ravines, sand ramps and dunes, and carob tree forests, that largely retain their original conditions. However, there have been considerable fluctuations in the course and the size of the river, which have shaped the area into two different parts: on the one hand, a mountainous area formed by Cerro Mucho Malo, and on the other wide sand ramps and low hill chains occupied by the Chankillo monumental archaeological zone (Map 1). As seen from the latter, Mucho Malo forms a near, elevated horizon, while in the bearing of the Chankillo site the horizon is distant and relatively low, unique in the entire Casma region. Additionally, the local terrain, which includes a mountain range adjacent to the Pacific Ocean, usually prevents the winter fog, very common in coastal Peru, from entering this part of the valley, creating often favorable weather conditions for the observation of celestial objects. Thus, Chankillo is found in an area with naturally exceptional conditions for astronomical uses (Ghezzi and Guadalupe 2013).

The Casma valley, like the others on the Peruvian coast, has been for long an oasis that made the settlement of human populations, which in this valley goes back several millennia, possible in an inhospitable territory. Despite the favorable conditions that such oases offer for its occupation, Chankillo was in use for a relatively brief time between 250 and 200 BC (Ghezzi 2016), during a late phase of the Early Horizon Period (500-200 BC) of Peruvian prehistory (Table 2-1).

Chankillo is a planned site. Each of its cultural elements relates to all others, as well as to elements of its natural environment and the contemporary prehistoric settlements along the valley. This creates a sense of unity and synchrony. For this reason, the definition of the extension of the property and its buffer zone considers several factors:

a) The physical area occupied by buildings that incorporate astronomical functions—the Temple of the Pillars, Observatory Building, Thirteen Towers, and East Observing Point—all within a “monumental archaeological zone” defined by the Peruvian state. The first boundary polygon of this zone was defined in 2008 (INC 2008). Later, based on the
extension of prehistoric occupations reported by archaeological surveys (Ghezzi 2003, Ghezzi, Salcedo et al. 2013), it was reviewed and updated to include surrounding areas up to 2112 ha, encompassing quarries, workshops, geoglyphs and many other prehistoric features (Benavides and Vásquez 2015). (Map 4)

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b) Elements of the natural environment outside the monumental archaeological zone used as astronomical markers, such as the southeastern slope of Cerro Mucho Malo, and others in the zone of visual influence between 5 and 15 km away from the Temple of the Pillars, which are within the visual horizon of the observing points. Cerro Mucho Malo is also included as part of the property, because it was used as a natural astronomical marker (Map 2).

c) Elements of the natural environment outside the monumental archaeological zone that still preserve a great part of the original visual landscape, such as Cerro Mongon and the Manchan dune to the west, Cerro La Cumbre and Cerros Los Medanos to the south, and the chain of high hills and visible peaks found to the north and south of Cerro Mucho Malo, integrated into the landscape of dunes that characterizes Chankillo and the Casma coastline in general (Map 1).

d) Archaeological sites outside the monumental archaeological zone, associated with Chankillo, both because of their contemporaneity, their visual connection (Huaca A and
Pampa de Llamas) and because they are linked by roads (Cantina). To these must be added the presence of a section of Qhapaq Ñan (the Inka road) between the Casma Valley and the coastline, possibly constructed during the time of Chankillo, which would give this road a temporal extension of more than 1600 years (Map 5).

e) The existence in the areas of interaction within the lower Casma valley of monumental archaeological sites (Sechín Bajo, Cerro Sechín, Las Aldas, Sechin Alto, Taukachi-Konkan, Moxeke, Huaca A, Pampa de las Llamas, Cantina, San Diego, Huerequeque, Pallka, etc.), which highlight Chankillo as the culmination of a long and unique process of development and accumulation of astronomical knowledge during the prehistoric era (Map 5).

The interconnection of the various cultural and natural elements underlies the proposed extent of the property and buffer zone of Chankillo. The buffer zone aims to protect the coastal desert around the property in order to guarantee the continuity of its astronomical function and of the landscape values inherent to this function. It includes a zone of visual influence formed by the chain of mountain tops in the sightline of the astronomical horizon, agricultural zones, Andean foothills, the coastal desert, zones of cultural and natural heritage, and zones with terrain or materials necessary for the preservation of the landscape.

The property is composed of two parts, a prehistoric ceremonial center (Chankillo monumental archaeological zone), and a natural sector composed by part of the adjacent Cerro Mucho Malo (Map 2). The two parts, demarcated by polygons, are:

I. The Chankillo monumental archaeological zone (2112 ha), as defined by the Ministry of Culture. It is a ceremonial center dedicated to a solar cult, which contains a solar observatory. Its main buildings are:

a) The Chankillo Solar Observatory, composed of the Thirteen Towers, a line of buildings on a natural hill that functioned as astronomical markers, and two observing points from which the annual solar cycle is observed using these towers: the Western Observing Point, an open entranceway in a building known as the Observatory Building, and the Eastern Observing Point, contained within an isolated small building in an adjacent plaza.

b) The Fortified Temple, whose interior houses several buildings, including the Temple of the Pillars, that contain elements with an astronomical function.
c) The Observatory Building, at the foot of the hill where the row of towers was built, which contains not only the Western Observing Point but also an entrance facing the Fortified Temple which itself has possible astronomical significance.

d) The Administrative Center, a large platform with a U-shaped atrium and a series of enclosures and courtyards, from which the public rites and ceremonies of solar worship were managed.

II. Cerro Mucho Malo (2368 ha). This massif forms a high horizon whose southern slope becomes a natural marker when, as seen from the Western Observing Point, it intersects the artificial profile of the Thirteen Towers to form a continuous astronomical horizon. It is part of the coastal foothills of the western chain of the Andes mountain range and sits next to a pronounced bend in the Casma River. Its exposed bedrock belongs to the Early Cretaceous. For a few million years, tectonic elevation, fluvial and pluvial erosion were substantial. There were considerable fluctuations in the course and size of the river. It is composed mainly of andesite, which is a harder rock than the tonalite characterizing the Chankillo zone; therefore, differential erosion explains why this hill is much higher than the surrounding terrain (Ghezzi and Guadalupe 2013).

2.a.1 Chankillo monumental archaeological zone
The area is occupied by Chankillo, a prehistoric ceremonial center dedicated to a solar cult. Its orientation is defined broadly by the alignment between the single restricted entrance on the atrium of the Temple of the Pillars and the single direct entrance to the Administrative Center (Figure 2-1). This defines a site axis with an azimuth of approximately 120° that connects the Temple of the Pillars, the center of the Observatory Building and the Administrative Center, and passes through the gap between Towers 12 and 13, where the southern end of the line of towers bends round until it is perpendicular to the axis. This orientation is maintained throughout the site—even buildings not along the main axis share it—and it is broadly solstitial (Ghezzi and Ruggles 2011). For further details, see Section 2.b.6 The “site axis” and the broadly solstitial site alignment of all the principal buildings at the site.

The main buildings are the Fortified Temple (Figure 2-1A), the Thirteen Towers (Figure 2-1B) and Observatory Building (Figure 2-1C), components of the Chankillo Solar Observatory, and the Administrative Center (Figure 2-1D). A detailed description follows.
Figure 2-1. Map of the main Chankillo monuments

Figure 2-2. The Chankillo Solar Observatory
2.a.1.a The Chankillo Solar Observatory

It is composed of the Thirteen Towers (Figure 2-2A), the Observatory Building, containing the Western Observing Point (Figure 2-2B), and the Eastern Observing Point (Figure 2-2C).

The Thirteen Towers

The towers are a row of thirteen cuboidal constructions built of stone and mortar along a low ridge roughly at the center of Chankillo (Figure 2-3). They are regularly spaced and run broadly N-S, although Towers 11 through 13 turn noticeably southwest to become perpendicular to the site axis (Figure 2-4). Since 2007 it has been recognized that the towers were horizon markers enabling privileged observers to accurately track the seasonal passage of the sun throughout the year. From two observing points to the W and E, the towers span, respectively, the entire range of sunrise and sunset positions as the sun moves between its limits at the solstices, including a part of Cerro Mucho Malo to complete the profile in the former case (Ghezzi and Ruggles 2007).

Figure 2-3. The Thirteen Towers (view to the east)
Figure 2-4. Map of the Thirteen Towers

Figure 2-5. 3D Model of Tower 1
The towers are well preserved, except for Towers 4 and 13, whose east walls and fills have largely collapsed. However, enough fabric survives to recognize the main components of their design and construction (Figure 2-5; Figure 2-6). Each tower is composed of four retaining walls, with steep stairways built between parallel walls recessed into the north and south walls, holding a fill of carefully laid stone and mortar. The stone blocks in these walls are mostly tonalite, with some granite. In contrast with the Fortified Temple, the stones tend to be smaller, and basal stones can be the same size or smaller than those in the rest of the wall. Most towers were built directly over leveled bedrock, without a foundation. Tower 13, with a large foundation, is the exception.

The ground plan of the towers varies from rectangular to rhomboidal. For example, the corner angles at Tower 7 range from 73° to 109° approximately. The size (75-125 m²) and height (2-6 m) of the towers also vary widely, with the northernmost towers being higher than the rest, apparently to compensate for the descent in the height of the hill in this end. However, the towers are regularly spaced: the gaps between them range only between 4.7 and 5.1 m. Additionally, Towers 11 and 12 have a greater than average area; combined with the change in orientation, Tower 13 would remain hidden for some observers to the east.

On each of the shorter walls (north and south), a flight of stairs leads up to the summit. The northern stairways are usually centered along this side, though not always aligned with the long axis of the tower. The southern stairways, on the other hand, are often offset towards the east side. All the stairs are narrow, only 1.4-1.5 m wide. Since the height of the towers varies widely, the same is true of the total rise of the stairways (1.3-5.2 m).

Tower 9 was excavated (Ghezzi, Alvarez et al. 2013). The stairs were built with stone blocks and slabs. Each step is composed of several blocks joined with mortar. Relatively larger blocks are found in the landing. Often the blocks have two faces, so they form the treads, or part of the stair that was stepped on, and the risers, or vertical portions between each tread. Usually a block laid on the edge of a step is interlocked with the sidewalls. The steps in the northern stairway of Tower 9 have treads 24 cm deep, and risers 24 cm high, while those in the southern stairway have 24 cm-deep treads and 18 cm-high risers (Figure 2-7). These dimensions would suggest that the northern stairs favored going up, while the southern stairs favored going down (Hoskins and Milke 2013). However, the stairways, which are less steep than those in the Fortified Temple, were not meant for defense, and such differences in the heights of the risers may be related to the direction of ritual ascent and descent from the towers, as suggested by Malville (2011). Likewise, the importance of the concept of duality has been documented in the Andes, and its manifestation
in these dual stairs, as well as in those in the entrance plaza to the Administrative Center and in the atrium of the Temple of the Pillars, and the use of the double-step motif in the slitted pillars of the temple and in sculptural pottery vessels found at Chankillo, reflect the symbolic importance of the stairs of the Thirteen Towers (Ghezzi 2016). Some tower summit floors have been partially preserved. They consist of a layer of coarse sand, which may have been covered with mud (Figure 2-8). The existence of the stairs strongly suggests that the summits were important loci of ritual activity related to the solar cult, although there is no direct evidence of such practices.

Figure 2-6. Reconstruction of the construction system in Tower 13. Stone masonry walls hold a fill of stone and mortar. Stairways are cut in on the north and south sides. The top is capped with small stone slabs, laid flat
Figure 2-7. Tower 9 after excavation, showing its form and construction technique

Figure 2-8. View of the summit of Tower 6
The Observatory Building and the Western Observing Point

There is a group of buildings immediately west of the towers (Figure 2-9). Structures 2 and 3 are walled courtyards largely destroyed by a prehistoric flood of unknown date, as suggested by a deep gully running through them. Aerial photos and contour maps suggest that Structure 2 was square, 130 m on each side. Only its eastern side remains, a very tall wall that still stands at 7 m high. Windblown and flood deposits cover its base, suggesting that it might have been even taller. Despite its height, it is not interpreted as defensive. A small direct entrance between the surviving walls of both structures (Figure 2-9E), leads to Structure 1, a small building with three rooms and surface evidence of food and drink preparation and/or serving. It is curtained from view by the high wall of Structure 2. Possibly, the intended function of the high wall is to separate visually the service area from the sacred area directly to the west.

Figure 2-9. The Observatory Building and nearby structures

Structure 4 is rectangular (53.6 x 40.3 m). Its northeast entrance (Figure 2-9A) leads to two internal corridors running along the perimeter walls, which exit to the opposite side (south) of the interior courtyard. Another corridor, this time external, runs along the southwest perimeter wall (Figure 2-9, B-C). It is unique for various reasons. For instance, it has a right-turn baffled entrance (Figure 2-9B). A right-turn baffle is unusual at Chankillo; more common left-turn baffles protect
against attackers carrying shields on their left, exposed by the turn (Keeley, Fontana et al. 2007). A right-turn baffle thus suggests non-military control of the entrance to the corridor. The corridor widens towards its eastern end exit, an open doorway (Figure 2-9C) that is unique at Chankillo for lacking the typical wall niches that hold doors in all other entrances, large and small, known at this site. From this open doorway the view of the towers and their surroundings is unimpeded (Figure 2-10). Additionally, important votive offerings were found in the area around the exit. Thus, the purpose of the corridor was not to channel traffic from its access restricted for social control at one end to the interior of Structure 4, but to the doorway facing directly the Thirteen Towers on the other end. Owing to these attributes and its location, the open doorway was identified as the Western Observing Point (Figure 2-11), from which the Thirteen Towers and Cerro Mucho Malo were used as solar horizon markers (Ghezzi and Ruggles 2007). Structure 4 has come to be known as the “Observatory Building”. For further details, see Section 2.b.1.a The viewshed from Western Observing Point (WOP) to the Thirteen Towers together with part of Cerro Mucho Malo.

Figure 2-10. View of the Thirteen Towers from the Western Observing Point
Structure 5 is a rectangular building abutting the northwest corner of Structure 4. The adobe on its surface, a material that was not used until centuries after the abandonment of Chankillo, suggests a later reoccupation of the Observatory, although the purpose is not well understood. Applying principles of symmetry, evident throughout Chankillo, it has been proposed that this construction obscures a possible doorway in the Observatory Building at the corner opposite to the Western Observing Point (Figure 2-9D). From here, the Fortified Temple stands out on the horizon, offering viewpoints in the westerly direction that could reference astronomical phenomena over the Temple skyline. Research suggests that this possible doorway could have been used for observations of the June sun descending over the Temple of the Pillars. In addition, ceremonies relating both to the sun and moon might have taken place at the full moon nearest the December solstice (see Section 2.b.3 The viewshed from the WNW entrance of the Observatory Building to the Fortified Temple). Since the orientation of the corridor points toward the Southern Keep (see Section The Keeps), it would imply that from the time of its construction, this Keep was associated with the moon, just as the Temple of the Pillars was associated with the sun.

Figure 2-11. June solstice sunrise, as seen from Western Observing Point
The Eastern Observing Point

A small building, 200 m east of the Thirteen Towers (Figure 2-2C), contains what has been identified as the Eastern Observing Point (Ghezzi and Ruggles 2007). The building no longer stands; it suffered deterioration owing to its proximity to areas of human and animal transit. However, its foundations partially survive, in their original orientation and position, below the surface. The position of this structure mirrors almost exactly the Western Observing Point; it has the same distance to the towers and a similar elevation, and both are aligned on an east-west axis perpendicular to the Thirteen Towers.

No other built feature was identified by survey or excavation in this area (Ghezzi 2003). Recent sub-surface remote sensing (Huayhua and Sueldo 2018) confirms that this structure is completely isolated in a 200 m by 160 m survey area of open space bounded by the Administrative Center and the hill where the Thirteen Towers are found (Figure 2-14). It is possible that the structure is larger than revealed by excavations. The small uncertainty in the exact location of the Eastern Observing Point is insufficient to affect the conclusion, clearly revealed by the archaeoastronomical data, that this small building, broadly solstitially aligned like the rest of the site, included an entrance or platform that acted as a fixed observing point to view the seasonal passage of the sun over the Thirteen Towers. From here, the line of visible towers coincides with the range of sunset positions throughout the solar year (Figure 2-12, Figure 2-13). Further details in section 2.b.1.b The viewshed from the Eastern Observing Point (EOP) to the Thirteen Towers.
Figure 2-13. View of the Thirteen Towers from the Eastern Observing Point
Figure 2-14. Single magnetic anomaly around the center of the survey area coincides with the position of the Eastern Observing Point identified through excavation. Other anomalies toward the edges relate to rising bedrock or standing prehistoric buildings.
2.a.1.b The Fortified Temple

The Fortified Temple is a large (area 55,134 m², perimeter 851 m) hilltop building composed of three inner structures (a rectangular temple and two keeps with a circular ground plan) surrounded by three concentric ovoid defensive walls through which large baffled gates provide access to the interior (Figure 2-15, Figure 2-16).

![Figure 2-15. Plan of the Fortified Temple](image)

The building’s location is defensible, yet, intriguingly, it does not occupy the highest ground on this hilltop, leaving the fort vulnerable to attack from its west flank. Built on the edge of the hilltop, where the summit is to the west and the ground drops away abruptly to the east, it appears as though, counter-strategically, the fort is yielding higher ground. This apparent design flaw was actually a compromise between interconnectivity and defensive strategy: the eastern defensive walls could rise tall from the slope without blocking the view to the east from the interior structures (Figure 2-16). Thus, the inner buildings were well protected while visibility to and from the ceremonial center to the east and the eastern horizon was kept (Ghezzi 2006). Visibility maps of Chankillo show that visual interconnectivity between different areas of the site was important in choosing the location not just of the Fortified Temple but of buildings and other features throughout the site (see 2.b.5 The sightline from certain limited areas in the plaza to the entrance
to the Temple of the Pillars). Additionally, this compromise between visibility and the location of defenses was achieved without sacrificing the apparent goal of erecting two identical ovoid concentric walls (Figure 2-15D). It would have been very difficult to accomplish, given the uneven terrain, and it could only have been done by ingeniously projecting a pre-conceived architectural design. It shows great precision in the conception and execution of this unusual form.

![Figure 2-16. Aerial view (from the NNE towards the SSW) of the Fortified Temple (Servicio Aerofotografico Nacional, Peru)](image)

The outer concentric walls, designated Defensive Wall 1 (outer) and Defensive Wall 2 (inner), are massive and tall, ranging from 5.5 to 6.5 m thick, and still standing over 5 m high in some places. They are compound walls, comprising up to 5 parallel sections of wall and fill (Figure 2-17), wide enough to support defenses on the top while maintaining rigidity and stability. The tops of the walls were accessed from inside by stairways meant to be used only from the interior of the building.

Although the Chankillo stonemasons aimed to lay blocks in coursed rows of uniform height, their product was rustic, and no decoration was attempted with the stones. Wall faces, on the other hand, were always finished and often painted white, gray, beige, yellow or red ochre (Ghezzi,
Excavations at the Fortified Temple revealed decoration in vertical panels (Figure 2-18). Three different panels were exposed, one colored beige and another colored white. The third panel had no pigment and was instead textured by a myriad of finger impressions, pressed while the mud in the wall finish was still plastic (Figure 2-19). It is likely that the walls were decorated all around in such variations. From the large plazas below the Fortified Temple, the walls would have resembled a rope or a beaded necklace around the hilltop (Figure 2-20).

Figure 2-17. Preserved portion of a defensive wall, showing its five parallel sections
Figure 2-18. Excavated wall finish showing decorative panels

Figure 2-19. Close up of white (left) and finger-textured panel (right), Fortified Temple
While the entrances in the interior concentric wall are small and direct, the outer defensive walls of the Fortified Temple have monumental gates: five in Wall 1, four in Wall 2 (Figure 2-15D). The gates are baffled, a universal feature of fortifications (Keeley, Fontana et al. 2007). The entrance corridor is a wall opening, 7-9 m long, 1.8 m wide, 2.7 m tall, roofed with wooden lintels. The baffled corridor is defined by blocking walls and was not roofed (Figure 2-21).
There are wall sockets or *cajuelas* outside each doorway at Chankillo (Figure 2-22). Firmly set inside a socket is a vertical stone pin. The excavations indicate that a door, probably made by tying together wooden poles—as was suggested for Inca architecture (Bingham 1979)—may have hinged vertically on each side of the doorway.

![Vertical stone pin set at the back of a wall socket](image)

**Figure 2-22. Vertical stone pin set at the back of a wall socket**

Access through the gates was controlled not only with doors, but also by the maze effect of blocking walls and by second-story defenses. Some gates were false entrances. These defensive measures surround and protect the inner structure known as The Platform, a substantial area (2915 m$^2$) of artificially raised and leveled open space created using a fill and Wall 3, another 2.5 m-thick defensive wall, as a retaining wall (Figure 2-15C; Figure 2-23). The Platform in turn surrounds the highest point of the hill where the three interior structures of the Fortified Temple—a rectangular temple and two circular keeps—were built (Figure 2-24). The fact that the ground around the three interior structures of the Fortified Temple was filled to form a platform surrounding them contrasts with the fact that the ground between the defensive walls at the Fortified Temple was left largely intact.
The Temple of the Pillars

The rectangular building is known as the Temple of the Pillars (Figure 2-15A). It is composed of an atrium with four interconnected rooms at the back (Figure 2-25). Its dimensions are 51.6 m long and 38.7 m wide, and its area is 1,992.7 m$^2$. Measurements along the perimeter walls yield a WNW–ESE orientation of 119.0°/299.0° and a SSW–NNE orientation of 25.4°/205.4° respectively; thus, they deviate by 3.6° from perpendicularity. The level of precision achieved at Chankillo, and especially the geometrical precision of the Fortified Temple’s defensive walls,
implies that this was done for a reason, not just because the Temple of the Pillars was built on uneven terrain. The WNW–ESE orientation is broadly solstitial, like the rest of the site. The SSW–NNE orientation coincides closely with that of the line of centers of the two circular structures inside the Platform and to some extent with that of the WNW segments of the defensive walls. It has no astronomical significance.

The atrium is a rectangular two-level platform connected by pairs of stairways up from the outside and up to the rooms behind. The lower level was accessed from below by staircases on each side, each with 9 steps and a landing. The upper level is U-shaped, with a central dais and two lateral extensions, built atop the lower level; it was accessed by shorter stairways (4 steps and a landing) aligned with those below. The upper level of the platform has pillared galleries (16 pillars on the central dais, 4 on each arm), which originally supported a roof made of perishable materials.

Figure 2-25. The Temple of the Pillars

A narrow doorway, aligned with the SSW flight of stairs, is the only entrance to the secluded rooms in the back of the temple (Figure 2-25A). This circulation pattern, a two-level atrium with stairs on the NNE and SSW sides, where the only entrance to the rest of the building is a restricted access doorway on the SSW side, is repeated at the Administrative Center.
This entrance to the (rooms of the) Temple of the Pillars is one of the most important symbolic positions at Chankillo. The archaeoastronomical evidence supports the idea that elite individuals could have made sudden public appearances here, emerging at auspicious times relating to the solar cycle, and presiding over ceremonies taking place in and around the buildings and plazas below (Ghezzi and Ruggles 2008). The timing would have meant, in effect, that they became part of a sacred manifestation or hierophany (see Section 2.b.5 The sightline from certain limited areas in the plaza to the entrance to the Temple of the Pillars). If that is the case, then from certain areas in the plaza, temple officials standing at the entrance to the Temple of the Pillars could have been seen with the sun setting behind them, thus providing a sort of “hierophany for the masses”. The association apparently relates to the Andean concept of the Sun’s house or temple, where it dwells during the solstices (Bauer and Dearborn 1995). A similar hierophany would have worked for the moon, which, as seen from the Plaza, sets behind the Temple of the Pillars on certain dates.

The distant eastern horizon is clearly visible from the single entrance and the atrium of the Temple of the Pillars. This spectacular mountainous profile, with a variety of prominent natural features, would have provided natural foresights marking the changing rising position of the sun.

Figure 2-26. Digital visualization of the eastern horizon as viewed from the entrance to the Temple of the Pillars. The lines show the rising paths of the sun at the June solstice (left), equinoxes (center) and December solstice (right) in the 3rd century BC.
A roughly crescentic feature marks broadly the June solstice sunrise, and a minor feature marking more clearly the December solstice sunrise is one of several, so that their cultural significance is questionable. However, the equinoctial sunrise coincides with the most prominent dip in this whole horizon, which is also the lowest point on the horizon within the entire solar rising arc. While there is much specialist discussion about the precise definition and cultural significance of the equinox (Ruggles 2017), it seems likely that this prominent natural feature marking the equinoxes to remarkable precision provided the initial motivation for the establishment, at this spot, of a solar horizon calendar using natural foresights to keep track of the changing position of sunrise with the passage of the seasons. This horizon calendar might well have been the precursor of, and inspiration for, the later construction and use of the Chankillo Solar Observatory for an astronomical purpose (Ghezzi and Ruggles 2011).

The temple entrance leads to four secluded rooms inside the temple that were probably used for ritual functions or elite habitation (Figure 2-25A). It is not a simple, direct entrance; to the contrary, it is cleverly designed: towards the left, a blind corridor disguises the true access, while to the right the corridor leads to the interior through an entrance baffled by two small blocking walls and offset doorways.

The four rectangular rooms are interconnected by direct entrances. The excavations suggest that each entrance had wooden lintels and doors. Room 3 stands out because it has the largest (area 347 m$^2$) and is the only one that includes a platform. The patio in front of the platform is rectangular and though it is half the total area (173.43 m$^2$), it is relatively small compared to other patios at Chankillo. Two direct entrances connect this patio to other rooms, while small stairways lead to the platform.

*Mural decoration*

A notable feature of this patio is its mural decoration. The excavations uncovered painting on the east wall (Figure 2-27). It was preserved near a corner and likely extended further along the wall, although only 4.2 m of finish were preserved. Only the lower 1.7 m of the wall remains, and to judge from the amount of collapse, it is unlikely to have been much higher. In addition, stones excavated from the collapse of the west wall still have finish with incised designs, suggesting that it also contained mural decoration.

Though relatively well preserved overall, the mural has flaked-off in places, leaving gaps that reveal its manufacturing process. The technique is bas-relief, creating an image with shallow
overall depth that is simpler than other relief techniques: less background is carved out. Once the
tan wall finish was in place, a thin band of grayish white clay was laid as a base surface on which
the design would be carved. It was approximately 55 cm above the floor level, 0.9 m high, and at
least 4.2 m long. Next, a grid of deep incisions into the clay and the finish beneath was created
using a sharp pointed tool (Figure 2-28). The edge damage of the lines suggests they were traced
when the clay was leather-hard. The area covered by the grid is 1.2 m in height and extends along
the entire preserved finish, strongly suggesting that the mural continued further north along the
wall but was destroyed. There is a degree of irregularity in the grid: most cells average 7-8 cm on
a side, but some are as small as 4.6 cm. With the grid as reference, an outline of the design was
then traced over with new incisions. Their edge damage suggests that, like the deep incisions,
they were traced while the clay was still leather-hard. These incisions employed rectilinear as
well as curvilinear motions and are different from the grid. Next, the white clay in the blank
spaces within/around the design elements was carved out or excised, leaving behind the design
in grayish white against the tan color of the wall finish. Finally, the background spaces around
the design were painted white, as suggested by a small area in which this pigment has been
preserved. In the bas-relief technique, paint is usually applied to enhance the design. The color
combination in the mural does not offer much contrast, though the faded grayish white color of
the clay band may have been darker in the past.

Figure 2-27. Mural decoration (EA 43) on east wall of the patio (EA 3)
The design is geometric, with curvilinear elements. It represents two front-facing, interlocked anthropomorphic heads, one upside-down (Figure 2-29). They dominate the design, after the extreme simplification the body; it gives the impression of a synthetic representation of icons known from other media, such as textiles. Atop each head is a horizontal band with ends that curl up on themselves, interpreted as a headdress. The nose is a vertical band ending in a triangular element. The eyes are rectangular with rounded corners, but the iris is almond-shaped. The right-hand head has a circular ear ornament. The most prominent feature of the face is the saw-tooth mouth, represented by a hexagonal shape showing the upper and lower incisors but no fangs. From under the headdress and from the sides of the mouth some curvilinear elements project downwards and turn up to join in a curl or volute. These may represent hair, whiskers, or both.

Three bands extend down from the chin. The central one represents the neck; the other two spread out to represent the arms, which bend in several places to show their articulation. The arms end in a smaller element that curls onto itself. On the side, there are two symmetric elements with similar bends and with appendages: these overlap the arms slightly and could be interpreted as objects held by the arms. A preferable option is that these are “legs,” also spread out in perspective for a symmetrical display. The ends of these legs have appendages, one of them opposing the other two, which could be interpreted as the toes in the foot of an animal or bird. Downward along
the leg there is a curved and pointed element, on the same side as the opposing “finger.” It may represent a spur, as some birds have.

Comparative imagery is found in the bas-relief facades from Animas Altas, in the lower Ica Valley (Massey 1986, Massey 1991). This site has recently been dated to 400-200 BC (Bacha and Llanos 2010), which is roughly contemporary with Chankillo. Among the similarities with Chankillo are the geometricized head, the alternating or “interlocked” arrangement, the appendages between the heads, the whiskers extending from the mouth on both sides of the face, and the saw-tooth mouth (Helaine Silverman, personal communication). Yet the eyes and noses are very different, and the Chankillo figures lack fangs and bodies entirely. The representation of interlocked extremities between the heads is different from Animas Altas, where the figures are adjacent to each other, but do not interlock.

The eyes are similar to anthropomorphic figures from Paracas Necropolis textiles in linear style (multiple line outlines creating the image) (Bacha and Llanos 2010). The whiskers projecting from the mouth, which recurve into the headdress, are reminiscent of Paracas Necropolis appendages, such as in Figure 116 of the Krannert Art Museum catalogue (Sawyer 1975).

![Figure 2-29. Elevation drawing of the mural](image)

Figure 2-29. Elevation drawing of the mural
Pillared galleries

The platform in Room 3 is 153.05 m² in area and elevated 1.5 m above the patio floor. It is formed by a retaining wall holding a fill, with a small stairway (4 steps, 1 landing) at its center. Atop the platform, 8 pillars define the gallery space near the back wall. The pillars were decorated and contained slits forming a double-step motif.

Excavations throughout the temple reveal that its platforms and some of its rooms were partially covered by semi-open, shaded areas known as pillared galleries (Figure 2-30). Similar features have been found in the lower Casma and Nepeña valleys at Huambacho, Sute Bajo, Caylan, Samanco and San Diego (Ghezzi 1997, Cotrina, Peña et al. 2003, Chicoine 2006, Chicoine and Ikehara 2008, Helmer 2014) and hypothetical reconstructions of the structures have been published (Ikehara and Chicoine 2011).

The pillars are rectangular, 1 m long and 0.8 m wide on average. They were built of small tonalite and micaceous andesite blocks, laid with mortar, and finished with mud. They rest on a special foundation that prevented them from sinking into the platform fill, despite the weight of the superstructure supported. Their original height is unknown, owing to their systematic destruction, but a reasonable estimate is 2 m. Chicoine (2006) found those at Huambacho to be to 5 m tall, 3 m of which were under the floor. At San Diego, excavations uncovered a platform with pillars that were sunk 1.8 m into the fill. It was interpreted that a pillared gallery on a patio, 1.8 m high, had been later transformed into a pillared gallery atop a platform (Ghezzi 2004).

The pillars at Chankillo are found in rows of 4 to 16—depending on the length of space to be covered—parallel to and at 2.9-3.5 m from the back wall of the platform or room. They supported a partial roof made from perishable local materials, such as cane, covered in mud. The roof was laid between the row of pillars and the nearby wall to form a covered gallery space. The exact dimensions of any gallery are unknown, but the distances between the pillars and nearby walls are an indication of the area covered. In the atrium of the Temple of the Pillars, the central dais of the upper U-shaped platform has the pillars located 3.5 m from the back wall and 2.15 m from the front wall. In the side arms, they are located on the edge of the platform, 3.5 m from the back wall, and only 50 cm from the front wall. A row of small wooden posts excavated next to this wall suggests that the roof extended past the platform, covering adjacent staircases. In the platform of Room 3, the pillars are located 3.3 m from the back wall and 5.7 m from the front wall. Here, large impressions on the excavated floor indicate that some posts probably lent additional support to the roof, indicating that it may have extended almost 10 m from the back wall.
wall, to cover the entire platform. Finally, in Room 1, a row of pillars was excavated 2.9 m from the back wall. These measurements indicate that, although the intention was to cover as much of the room or platform as possible, the distance between the pillars and the back wall of the gallery was limited to 3.5 m, probably because this was the maximum distance a simple cane superstructure could cover without additional support.

Very little of the pillared galleries has survived. The excavations carried out in the Temple of the Pillars revealed that the walls, pillars, and religious images were intentionally destroyed and buried under a layer of rubble. This event was probably due to a violent conflict with some external power, which ended with the defeat of Chankillo and the abrupt abandonment of the site (Ghezzi 2006).

One pillar was relatively well preserved, though, protected by the very fill that was meant to bury the building (Figure 2-31). Its excavation showed that its function was not just structural: it was adorned with a double three-step motif, similar to known pottery designs at Chankillo, deeply recessed (7 cm) into its front (ESE) and back (WNW) bases. The steps face each other, and on the outer edge of each motif the recess continues to become a narrow, extended gap or slit that runs straight through the pillar. There is an additional slit between the two motifs. The three slits are 20 cm high, 8 cm wide, and 77 cm deep, and they have an approximate WNW–ESE orientation of 120.0°/300.0°. Indicators for the presence of the same slit feature were found in the remains of pillars in the Atrium, though no example was as well preserved as the one in Room 3. It is likely that several other pillars at the temple, although not preserved, had such slits. Identical slits were found at Huambacho and Caylan (Chicoine 2006, Chicoine and Ikehara 2008), and at least a few have a similar orientation (Chicoine, personal communication 2015).

The rubble from the destruction of the pillars was dumped at the platform, and its excavation recuperated fragments with hollow spaces, round and straight edges, white or yellow paint, etc. This indicates that the lost portions of the pillars were also modeled and painted to represent sculptural figures. Additionally, stones excavated from the collapsed wall in Room 3 at the back of the pillared gallery contain remains of mud finish with geometric incisions, suggesting that this receiving surface had mural decoration similar to other walls described above.
Figure 2-30. The Temple of the Pillars (Ikehara and Chicoine 2011)

Figure 2-31. Pillar (EA 17) from Room 3. The foundation can be seen under the pillar
The pillared galleries at the back of the atrium faced the eastern horizon, unblocked by intervening walls: the low retaining wall at the front of the platform only stood to a height of about 0.3 m below the bottoms of the slits (Ghezzi, 2016), and the surrounding defensive walls drop away in the easterly direction. In the case of Room 3 there was, in addition to a similar low platform-retaining wall, an eastern wall across the patio from the pillars. The calculations suggest with confidence that the top of this wall would have been no less than 0.2 m below the bottoms of the slits on the pillars. Thus, all these pillars would have been able to catch the early morning sunlight.

Each day, during the few minutes following sunrise, a slowly changing pattern of sunlight beams shining through and between the pillars would have created a spectacular display on the dark back walls of both the long gallery of the atrium and the Room 3 gallery. Archaeoastronomical analysis supports the suggestion that the pillars were designed for the projection of spectacular lights and shadows, orchestrated to cover the whole year, accurately marking the solstices and equinoxes, and offering another type of calendar indicator at Chankillo. For further details see Section 2.b.4 Light-and-shadow hierophanies: the back walls and slitted pillars of the atrium gallery and Room 3 gallery within the Temple of the Pillars.

These solar hierophanies would have been observed by very few. Thus, the light-shadow casting devices offer insight into the social differences between the elite audiences at the very secluded Temple of the Pillars and Observatory Building and the more public Eastern Observing Point and Plaza solar alignments and corresponding ceremonies at Chankillo.

Unfortunately, these spectacular effects are no longer visible, both because the temple space is no longer enclosed and because most of the pillars with their slits have been destroyed.

**The Keeps**

The round towers (*torreones* in Spanish) of Chankillo are a defensive type of building known as a keep: a fortified tower within a fort, used as a refuge of last resort. While the astronomical use of the Thirteen Towers has inspired some to speculate on possible astronomical aspects in these dual round towers, these claims need further evaluation. A possible lunar alignment was identified (see Section 2.b.2 The viewshed from the entrance to the Temple of the Pillars to the distant mountainous horizon profile to the east). On the other hand, it is evident that the principles used in the strategic design of the Fortified Temple were applied in the design and defense of the keeps: high ground, concentric defensive compound walls, baffled gates paired to maximize protection, and wall top defenses accessed through interior stairways.
The keeps were built on the highest ground within the hilltop encompassed by the defensive walls of the Fortified Temple. They are formed by two concentric circular walls. The walls are compound: each has two joined sections, which at Chankillo is an attribute of defensive walls. Small stairs along the walls lead to the top, from which the keep could be protected. There are three left-turn baffled entrances in the outer wall and two in the inner wall. Like the monumental gates of the outer defensive walls, these entrances are paired or lined up with each other. Their doorways have niches for holding doors, and lintel roofs. The entrances are often simple ramps, although some had stairs (Figure 2-32, Figure 2-33). The existence of two identical and adjacent keeps might also be a strategic measure.

Figure 2-32. Ground plan of the North Keep
2.a.1.c The Administrative Center

East of the towers is a 1.2 km²-area of relatively flat but sloping sand ramps and exposed bedrock. Its main features are the Administrative Center, a large Plaza, and other minor buildings (Figure 2-34). This sector is interpreted as a public area with functions related to solar cult practices, redistribution, and feasting. Clusters of stone and lithic workshops indicate that the constructions were ongoing when Chankillo was abandoned. This is confirmed by excavations.

The Administrative Center (Building 3) is a large complex of platforms, patios, and rooms. At approximately 170 x 170 m, it is the second largest such complex at Chankillo. It is relatively well preserved, except for its perimeter wall, which was partially dismantled by recycling its stone after the abandonment of the site. Circulation patterns identify a lobby or entrance hall and several room complexes (Figure 2-35). The lobby is a longitudinal group of patios that organizes traffic across the building. The front center of the building has a single entrance. As much of the perimeter wall is missing due to stone robbing, it is uncertain whether this front entrance was the only one. It led to a large patio surrounded by a U-shaped platform, similar to the atrium of the Temple of the Pillars. Each part of the “U” has stairways facing the patio, located at either end. On the lateral arms of the “U” these stairs lead to the two front-room complexes. On its central dais, and also just like the Temple of the Pillars, the south stairways lead to a single entrance, which controls access to a maze-like four-room group connected by long corridors. Through a
baffled entrance, the maze leads to a secluded lobby in the back of the building with two large patios distributing traffic to two room complexes. Each complex is a closed group of interconnected rooms sharing one single entrance. In general, these rooms are smaller the farther they are away from the main entrance. Yet because of the terrain, they gain in elevation. The rooms are interconnected by dead-end corridors and baffled entrances; a majority are left-turn defensive baffles. The control of access gets progressively tighter towards the building’s interior.

South of this building there are dozens of large vessels buried in the ground. This was probably a facility for storing drinks, which would have been kept cool in this way.

Figure 2-34. Administrative Center area
Buildings 1 and 4 are rectangular, with two rooms (Figure 2-34). Most of Building 4 is buried by a dune. Its entrances are obscured, but excavations in Building 1 show that each room has a left-turning baffled entrance, and the rooms are interconnected through a doorway in the median wall. Building 2 is a large platform with incomplete retaining walls. Unlike the Administrative Center, where surface finds and excavations show some walls are missing due to stone robbing, this one is unfinished. The halt in construction most likely had to do with the site’s abrupt abandonment.

The Plaza is approximately 600 m by 400 m (Figure 2-34). Buildings 2 and 3 partially define it on two sides, yet the Plaza has no perimeter wall. However, there was an artificial modification of the terrain to create a space that is relatively flat and open compared to the surrounding terrain. There are offerings of mullu (Spondylus princeps sp.) and pottery panpipes around the Plaza, and the middens surrounding it have remains of utilitarian vessels, panpipes, and maize. The main features of Chankillo, such as the Thirteen Towers, the Fortified Temple, and the Administrative Center (Figure 2-20), stand out as the dominant elements of the built landscape visible from here.

A group of geoglyphs is found 700 m southwest of the Fortified Temple (Figure 2-36), another is 2.2 km away. Both are found along a natural route through the site, still in use, connecting the valley to La Gramita cove in the Pacific Ocean. They were created by piling up small fragments.
of dark green andesite from nearby dikes over a light gray sand layer. This technique was used to create simple figures of triangles, circles, concentric circles, and rectangles. One of them, a circle surrounding a small square, resembles the circle-and-dot motif typical of Chankillo pottery. Their location, design, and associated pottery suggest these geoglyphs are contemporary with Chankillo and date to the late Early Horizon. The location of the first geoglyph group, away and apparently disconnected from the main monuments at the site, is revealing. In this built landscape, visibility may be as critical as distance in judging association (Moore 1996). Visibility maps reveal that these geoglyphs are found on the highest possible location of a small sliver of terrain visible from the Plaza, 2 km away. It has been suggested that flat elements such as geoglyphs mark the location of ceremonial processions or dances, and thus become visible from quite a distance (Lambers 2006). Similarly, the Chankillo geoglyphs could be a stage for ritual activities, in concert with solar cult ceremonies taking place in the Plaza.

Figure 2-36. Oblique photograph of the geoglyph group, during mapping
2.a.2 Cerro Mucho Malo
Cerro Mucho Malo is a rocky massif, 1180 masl in height, that forms part of the foothills of the western chain of the Andes Mountains on the Peruvian coast. Its exposed bedrock belongs to the Early Cretaceous. During the millions of years that have since elapsed there was substantial elevation of tectonic plates, fluvial and pluvial erosion in the area. There were also considerable fluctuations in the course and size of the river. But Cerro Mucho Malo is composed mainly of andesite rock, which is much harder than the surrounding tonalite rock that characterizes the Chankillo monumental archaeological zone, so the differential erosion explains why Cerro Mucho Malo is much higher in elevation, and why at this point the Casma River surrounds it, forming a sharp curve.

As noted in 2.a.1.b The Fortified Temple, the horizon to the east and southeast viewed from the Temple of the Pillars is low and distant. This is unique in the entire Casma region, and ideal for astronomical purposes, as it covers most of the solar rising arc (see Figure 2-26). On the other hand, as a result of the characteristics described above, Cerro Mucho Malo forms a nearby, high horizon to the ENE (Ghezzi and Guadalupe 2013); it can be seen forming the horizon at the point of June solstice sunrise in Figure 2-26. For this reason, its southern slope was used as a natural marker: as viewed from the Western Observing Point, its intersection with the artificial profile of the Thirteen Towers forms a continuous astronomical horizon that coincides with the range of sunrise positions throughout the solar year, with the intersection itself marking the position of the June solstice.
2.b Tangible manifestations of astronomy at Chankillo
In the previous section, various tangible astronomical elements at Chankillo were presented in their broader archaeological context. Here we describe the various astronomical viewsheds, sightlines and light-and-shadow displays, focusing upon the nature of these astronomical elements in themselves, including necessary technical detail, and their interrelationships.

These elements, which feature both constructed and natural sub-elements, can be summarized as follows:

1. The Chankillo Solar Observatory, composed of the Thirteen Towers and the Western and Eastern Observing Points, from which the towers profile spanned the annual sunrise and sunset arcs, respectively. These are the leading elements that make Chankillo unique and outstanding in a global context.
   a) The viewshed from the Western Observing Point (WOP) to the Thirteen Towers together with part of Cerro Mucho Malo. The WOP, an open entranceway on the ESE side of the Observatory Building, is well attested archaeologically both as a viewing position and a location of considerable ceremonial importance accessible only to elite participants.
   b) The viewshed from the Eastern Observing Point (EOP) to the Thirteen Towers. The EOP was a room or platform in an isolated small building in the plaza to the east, now largely destroyed but whose foundations partially survive.

2. The viewshed from the entrance to the Temple of the Pillars to the distant mountainous horizon profile to the east, which features a prominent horizon notch precisely at the position of equinoctial sunrise. Together with part of Cerro Mucho Malo, this profile includes the annual solar rising arc. It is a likely precursor for the later Observatory.

3. The viewshed from the WNW entrance of the Observatory Building to the Fortified Temple, which dominates the horizon in this direction. If, as seems likely, astronomical observations were also made from here, then the archaeoastronomical data suggest that they would have focused upon the setting moon.

4. The back walls and slitted pillars of the atrium gallery and Room 3 gallery within the Temple of the Pillars. Although the in situ physical evidence is largely destroyed, it is clear these would have produced a series of spectacular light and shadow effects during the minutes
following sunrise, orchestrated to span the entire year, with the slits producing particularly
dramatic effects for a few weeks around the December solstice.

5. The sightline from certain limited areas in the plaza to the entrance to the Temple of the
Pillars, a key position from which high-status individuals could have presided over ceremonials,
but also where they would have stood in full view at the point of entry to (or emergence from)
the Temple itself. From certain small areas in the plaza, Temple officials standing at the entrance
could have been seen with the sun or moon setting behind them, thus providing a kind of
“hierophany for the masses”.

6. The solstitial axis connecting the Temple of the Pillars, the Observatory Building and the
Administrative Center, which also passes through the gap between Towers 12 and 13, where the
southern end of the line of towers bends round until it is perpendicular to this axis. The orientation
of this site axis is followed to within 3° throughout Chankillo, resulting in the broadly solstitial
alignment of all the principal buildings at the site.

Nature of the data underlying the archaeoastronomical conclusions
For archaeoastronomical purposes it is important to establish the relative locations of, and
imperative to obtain accurate measurements of the true orientations between, different locations,
both on the prehistoric site and in the natural landscape. It is also necessary to establish which
points are intervisible and the nature of the visible horizon from different places, including the
azimuths (bearings) and altitudes (vertical angle above or below horizontal plane of the observer)
of horizon features. From these data, we can determine the (astronomical) declinations of horizon
points, as described below, and from these declinations we can identify any astronomical bodies
that rise or set there and would have done so at the time of construction and use. Generally
speaking, it is desirable to specify orientations (azimuths and altitudes, hence declinations) to the
nearest 0.1° (= 0° 6’), but it is not crucial to georeference the locations themselves to an accuracy
exceeding about 1m.

The archaeoastronomical conclusions presented here are based on a combination of data from
differential GPS surveys (2005, 2008) and Total Station surveys (2011, 2017), georeferenced
using terrestrial (CyArk 2011) and aerial (LiDAR) laser-scanning data (Paz 2017). Specifically,
the latter provided coverage of the core monumental archaeological zone at 1m x 1m resolution
and of a wider area at 5m x 5m resolution. The raw digital surface model (DSM) data were
processed in the commercial GIS (Geographical Information System) ArcGIS in order to remove
spike anomalies, and then textured for display and analysis in the open-source program QGIS.
Features such as walls visible in the textured DSM then enabled the local grid system used for the site plan to be georeferenced to the LiDAR data. See Figure 2-37 for an example. Further details can be found in Ruggles (2017).

In the Total Station surveys, timed observations of the sun were used to determine true north at each station independently of other observations. This is standard practice in archaeoastronomy (see Ruggles 1999: 167–169) and enables us to take account of the difference between azimuths relative to the UTM grid (obtained, for example, when calculating orientations directly from the grid co-ordinates of two points) and those relative to true cardinal directions (needed when investigating the astronomical implications). The grid convergence (grid azimuth minus true azimuth) varies from +0° 27.5´ (at the Fortified Temple) to +0° 27.7´ (in the plaza). This is comparable to the apparent diameter of the sun or moon. Throughout this section, as throughout the document as a whole, quoted azimuths are true azimuths unless otherwise stated. Numerous consistency checks during the Total Station surveys established that all azimuth readings were consistent within 3´ (0.05°), i.e. 1/10 the apparent diameter of the sun or moon.

Figure 2-37. Part of the Administrative Center, showing rendered 1m-resolution DSM data with points (green) and lines (yellow) from the 2008 differential GPS survey superimposed. The orange lines are from the 2015 laser-scanning data, uncorrected. The discrepancy requires a correction of approximately 7m to the E and 6m to the N.
Declination is equivalent to latitude on the rotating celestial sphere. The declination of the north celestial pole is +90°, that of the south celestial pole –90°, and that of the celestial equator 0°. Each day a "fixed" celestial object such as a star moves around the sky (above and below the horizon) on a line of declination. The declinations of the sun, moon and planets change gradually on a day-to-day basis, being the most marked in the case of the moon. The declination of the sun varies on a seasonal basis—nowadays between ±23.45° and around 200 BC between ±23.75°. Thus, at the time of construction and use of Chankillo, the solar disc (0.5° wide) spanned declinations +23.5° to +24.0° at the June solstice and –24.0° to –23.5° at the December solstice.

GIS tools permit the visualization of topographic data and viewsheds, e.g. Figure 2-42 (a), produced in QGIS. In addition, horizons and their astronomical potential can be visualized in several ways, such as:

- from photographs taken on site, marked up with the azimuths, altitudes and declinations of particular points as determined from the site survey (Figure 2-41);
- by digitally generating the view from the DSM data, annotated as required with grids of azimuths and altitudes, declinations, and/or the horizon rising and setting lines of celestial bodies, e.g. using the HORIZON program produced by Dr. Andrew Smith of the University of Adelaide, Australia (www.agksmith.net/horizon/) (Figure 2-40);
- using the sky visualization program Stellarium (stellarium.org), which can be configured to show the sky at any point in time and into which horizon photographs and topographic models can be imported and integrated (e.g. Figure 2-26).

2.b.1 The Solar Observatory
2.b.1.a The viewshed from Western Observing Point (WOP) to the Thirteen Towers together with part of Cerro Mucho Malo

The WOP and the configuration of the towers as viewed from it is the leading element that makes Chankillo unique and outstanding in a global context. As noted in Section 2.a.1.a The Chankillo Solar Observatory, the WOP was an open doorway offering an unimpeded view of the towers and their surroundings; around it was excavated a scattering of votive offerings, indicating that this was a place of considerable ritual importance.

The SSW corridor of the Observatory Building, along which the WOP was approached, follows the orientation constraints of the overall grid (see below Section 2.b.6 The “site axis” and the broadly solstitial site alignment of all the principal buildings at the site). As a result, it is oriented some 7° to the right of the right-hand side of Tower 13, and consequently the impactive profile
of the towers would have remained hidden to someone walking along the corridor until they came very close to the opening itself, surely adding to the sense of veneration at this spot.

As seen from here, the towers themselves are well above the observer and dominate the eastern horizon. The southern slopes of Cerro Mucho Malo, at a distance of 3 km, meet the much closer ridge on which the towers are constructed just to the left of the northernmost tower, Tower 1. The visual effect is to provide a “thirteenth gap” of similar width to those between each pair of adjacent towers down the line.

![Figure 2-38. The towers profile to the east as viewed from the WOP, showing the paths of sunrise at the solstices, equinoxes, and the days of zenith and antizenith passage. Visualization produced in Stellarium](image)

As the sun reached the southernmost limit of its annual passage, at the December solstice, it would have been seen from here to rise directly up from the top of the southernmost tower, Tower 13 (Figure 2-38). At its northernmost limit, at the June solstice, it rose from Cerro Mucho Malo to the left of the “thirteenth gap”. The position of sunrise progressed up and down the towers at intermediate dates, mostly appearing for just one or two days in each gap and then for a period of around 10 days between them but slowing down closer to the solstices. This device permitted the time of year to be accurately determined, not just on one date but throughout the seasonal year.

Table 2-2 summarizes the archaeoastronomical data for the towers profile as viewed from the WOP. Further details on the survey methods and errors can be found in Ruggles (2017).
Table 2-2. The azimuths, altitudes and declinations of the towers profile as viewed from the WOP. The values are based on measurements of those tower corners that define the “gaps” and refer to the lowest visible point of the wall in each case.

<table>
<thead>
<tr>
<th>Point</th>
<th>True azimuth</th>
<th>Altitude</th>
<th>Declination</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cerro Much Malo</td>
<td>64.3</td>
<td>6.6</td>
<td>+24.0</td>
</tr>
<tr>
<td>Junction between Cerro Mucho Malo and local horizon</td>
<td>66.0</td>
<td>5.9</td>
<td>+22.6</td>
</tr>
<tr>
<td>T1 left</td>
<td>66.4</td>
<td>6.0</td>
<td>+22.1</td>
</tr>
<tr>
<td>T1 right</td>
<td>69.2</td>
<td>6.7</td>
<td>+19.2</td>
</tr>
<tr>
<td>T2 left</td>
<td>69.9</td>
<td>6.7</td>
<td>+18.5</td>
</tr>
<tr>
<td>T2 right</td>
<td>72.8</td>
<td>7.5</td>
<td>+15.5</td>
</tr>
<tr>
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<td>+11.9</td>
</tr>
<tr>
<td>T4 left</td>
<td>77.2</td>
<td>8.1</td>
<td>+11.2</td>
</tr>
<tr>
<td>T4 right</td>
<td>80.3</td>
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<td>T5 right</td>
<td>84.1</td>
<td>9.1</td>
<td>+4.3</td>
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<td>84.9</td>
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<td>+3.5</td>
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<td>9.9</td>
<td>+0.4</td>
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<td>9.6</td>
<td>−0.4</td>
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<tr>
<td>T7 right</td>
<td>91.8</td>
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<td>−3.5</td>
</tr>
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<td>T8 left</td>
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<td>−4.2</td>
</tr>
<tr>
<td>T8 right</td>
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<td>11.0</td>
<td>−7.2</td>
</tr>
<tr>
<td>T9 left</td>
<td>96.3</td>
<td>10.7</td>
<td>−7.9</td>
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<tr>
<td>T9 right</td>
<td>99.0</td>
<td>11.0</td>
<td>−10.6</td>
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<tr>
<td>T10 left</td>
<td>100.0</td>
<td>11.1</td>
<td>−11.6</td>
</tr>
<tr>
<td>T10 right</td>
<td>103.0</td>
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<td>−14.4</td>
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<tr>
<td>T11 left</td>
<td>103.7</td>
<td>11.8</td>
<td>−15.2</td>
</tr>
</tbody>
</table>
The fact that the equinox sun rose in a narrow gap (between Towers 6 and 7), as is evident both from the figure and the table, supports the idea that the tower profile was a constructed reflection and elaboration of earlier observations using the natural horizon (see section 2.b.2 The viewshed from the entrance to the Temple of the Pillars to the distant mountainous horizon profile to the east). This unique and remarkable example of a monumental solar horizon calendar is entirely practical in nature. Even though the interval of time between the sun’s appearance in successive gaps is around 10 days in most cases, this time interval increases towards the solstices, and there is no evidence to suggest that specific divisions of time were being deliberately marked or were conceived as important. In particular, there is no evidence to suggest that either the dates of “zenith sunrise” (sunrise on the days when the sun will reach the zenith at noon, which occur when the declination of the sun is equal to the latitude of the site, i.e. $-9.55^\circ$) or those of “antizenith sunrise” (sunrise on the days when it reached the nadir at midnight, which occurs when the declination of the sun is equal to the minus the latitude of the site, i.e. $+9.55^\circ$) were of any particular cultural significance at Chankillo, although they are thought to have been significant during much later Inca times (Zuidema 2014:857–858).

2.b.1.b The viewshed from the Eastern Observing Point (EOP) to the Thirteen Towers

There is only one small area on the site from which the Thirteen Towers on the skyline to the west span the sunset arc. The fact that this coincides with the position of an isolated small building is significant in itself, and the fact that the June solstice sun would have been seen from here to set into the top of the northernmost tower, Tower 1 (Figure 2-39), just as from the WOP the December solstice sun rose from the center of the southernmost tower, Tower 13—thus following principles of symmetry evident elsewhere on the site—strongly supports the supposition that this was indeed a viewing point for the setting sun against the towers, even though its importance is less well attested archaeologically.
Figure 2-39. The towers profile to the west as viewed from the EOP, showing the paths of sunset at the solstices, equinoxes, and the days of zenith and antizenith passage. Visualization produced in Stellarium

The line of towers towards the south bends away from an observer at the EOP and disappears over the hill, unlike the situation at the WOP where the southernmost towers bend round to face the observer. As a result, there are no visible gaps between the southernmost four towers, and Tower 13 would not have been visible at all: thus while the December solstice sun set in the direction of this tower, the leftmost limit of the solar arc did in fact occur over natural terrain rather than a tower, in common with the eastern profile from the WOP and arguably manifesting another symmetry between the western and eastern profiles. The azimuths and altitudes of the towers profile as viewed from the EOP are summarized in Table 2-3. Further details on the survey methods and errors can be found in Ruggles (2017).
Table 2-3. The azimuths, altitudes and declinations of the towers profile as viewed from the EOP. The values are based on measurements of those tower corners that define the “gaps” and refer to the lowest visible point of their walls. There are no gaps between towers further to the south.

<table>
<thead>
<tr>
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<th>Declination</th>
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<td>T1, left</td>
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<td>T4, right</td>
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<td>T4, left</td>
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<td>+5.9</td>
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<tr>
<td>T10, right</td>
<td>260.4</td>
<td>14.3</td>
<td>−11.5</td>
</tr>
</tbody>
</table>

2.b.2 The viewshed from the entrance to the Temple of the Pillars to the distant mountainous horizon profile to the east

A digital visualization of the eastern horizon, as viewed from the entrance to the Temple of the Pillars is shown in Figure 2-26. Figure 2-40 shows the same profile as generated from publicly available SRTM data using the HORIZONS program developed by Dr A. Smith of the University of Adelaide, suitably “ground-truthed” using direct measurements taken during the Total Station...
surveys. In this figure the horizon features are overlaid with a grid marking the azimuths, altitudes and declinations, although small horizon features do not show up so clearly.

Regarding the principal “stations of the sun”:

- June solstice sunrise occurred over Cerro Mucho Malo close to, but not quite at, a slight dip at az. 65.4°. The solstitial sunrise occurred at little to the left, at az. +64.3° to +64.8°. The declination of the dip itself is +22.8°, corresponding to sunrise around Jun 4–8 and Jul 6–10 (in the Gregorian calendar).

- December solstice sunrise occurred at an easily identifiable point on the horizon, a discernible dip to the left of a small isolated peak at azimuth 114°. This dip has az. 113.6°, alt. 3.6° and dec. +23.8°, so the December sun would have risen directly out from this dip.

- A prominent dip in the distant mountainous horizon to the east, forming the lowest point on this distant ridge, coincides with sunrise at the two equinoxes. The bottom of the dip has declination –0.15°; at the astronomical equinox, the sun spans declinations –0.25° to +0.25°.

- There is no obvious point on the horizon marking “zenith sunrise” (sunrise on the days when the sun passes across the zenith at noon, an event of significance among various tropical cultures in the Americas), at dec. –8.55°.

Figure 2-40. Digital visualization of the eastern horizon as viewed from the entrance to the Temple of the Pillars. The grids show azimuth, altitude and declinations marked in degrees. The yellow lines show the rising paths of the sun at the June solstice (left), equinoxes (center) and December solstice (right) in the 3rd century BC. The red and green lines show the major and minor standstill limits for the moon (not relevant for this discussion).

Regarding other prominent features on the horizon itself:
At azimuth 103°–105° there is a prominent “half-moon”-shaped dip within the highest part of the distant horizon, with yet more distant horizon rising to a rounded peak beyond. This has attracted attention as a possible foresight. The declination range, –13.5° to –15.2°, corresponds to sunrise between approx. Feb 7–12 and Oct 27–Nov 1 (Gregorian).

At azimuth 106.5°–107.5°, again within the highest part of the distant horizon, there is a feature resembling a stepped pyramid, which has also attracted attention as a possible foresight. The declination range here, –17.0° (peak) down to –17.8° (bottom of right-hand slope), corresponds to sunrise between approx. Jan 29–31 and Nov 8–10 (Gregorian).

In any natural horizon used as a solar horizon calendar, the position of features and foresights available to provide accurate markers of sunrise on certain dates are positioned, in effect, randomly, although the dates when the sun rises behind them may acquire cultural significance as a consequence (Ruggles 2014:24–25). In the case of Chankillo, the most prominent horizon notch coincides precisely at the position of equinoctial sunrise as viewed from the entrance to the Temple of the Pillars. Notwithstanding that there is much specialist discussion about the precise definition and cultural significance of the equinox (Ruggles 2017), it strongly suggests that this location acquired cultural significance as the appropriate viewing point, and was therefore chosen as the site of the Temple of the Pillars.

It is also likely that this spectacular mountainous profile, with a variety of other features that would have provided natural foresights marking the changing rising position of the sun, provided a precursor of, and inspiration for, the construction and use of the towers for this purpose.

2.b.3 The viewshed from the WNW entrance of the Observatory Building to the Fortified Temple

The Observatory Building (OB) had an entrance facing WNW, symmetrical with the WOP facing ESE. The adjacent later building, Structure 5 (here referred to as “OB2”) is also likely to have had an entrance facing WNW, although that part of the structure has been destroyed. Symmetry principles operating elsewhere on the site suggest the possibility that astronomical observations were also made from the OB entrance or both entrances.

The WNW entrances to the two buildings faced the Fortified Temple, which stands out prominently on the horizon. Figure 2-41 shows the profile as seen from the OB entrance. The NNE wall of the OB (az. 301.7°) is aligned upon the center of the circular Southern Keep (az. 301.8°) as seen from the WNW entrance. Similarly, that of OB2 (az. 300.8°) is aligned upon the
center of the circular Southern Keep as seen from its entrance (az. 301.0°). However, the declination (+29.0° from OB1NW, +27.7° from OB2NW) is well outside the solar range.

Figure 2-41. The Fortified Temple on the skyline as viewed from the WNW entrance of the Observatory Building. The annotations show the orientations of the NNE and SSW walls of the OB and the declinations of certain points on the profile.

In fact, a 2nd-century-BC viewer standing at the OB entrance in the late afternoon at the June solstice would have seen the sun above the southern wall of the Temple of the Pillars moving slightly to the left while descending, eventually setting into the gap immediately to the left of the Temple. The right-hand side of the solar disc, at declination +24.0°, would just have touched the base of the outer side of the Temple’s southern wall. At all other times of year, the sun would have set further to the south: in other words, it would never (quite) have been seen to set behind the Temple itself.

The declination of the Southern Keep does, however, correspond closely to the theoretical northernmost setting point of the moon (δ = +28.9° around 200 BC, falling slightly to +28.6° by the early 2nd millennium AD). While the rising or setting position of the moon (unlike that of the sun) changes a great deal from day to day (further complicated by the moon’s changing phases), the significance of this is that the full moon close to the December solstice, towards which the
Chankillo site is broadly oriented, would have set as far north as this in favorable years within the 18.6-year lunar node cycle (a time known technically as the “major lunar standstill”).

Added to this, the declination of the foot of the outer side of the outer enclosing wall as seen from the entrance to the OB, +18.6°, corresponds almost exactly to the northern minor standstill limit (+18.6° around 200 BC, falling slightly to +18.3° by the early 2nd millennium AD). This limit (being the minimum of the monthly maximum limits of the moon’s motions over the course of an 18.6-year lunar node cycle) is extremely unlikely to have had cultural meaning in itself outside a modern Western cultural context (Gonzales-García 2014), but the fact that the highest part of the Temple profile spans the range between the northern major and minor standstill limits could be significant. This represents the range of positions (over an 18.6-year node cycle) where the full moon would have been seen to set at dawn around the time of the December solstice, the very time when the sun would be seen to rise out of the top of Tower 13 as viewed from the opposite entrance (WOP). Most often, the full moon would have been seen to set close to the Southern Keep (at around the time of the major standstill) or close to the outer walls (at around the time of the minor standstill) rather than towards the center of the range.

It cannot be proved that these alignments were deliberate, but they do highlight the possibility that sunrise observations from the WOP were preceded or accompanied by observations of full moonset over the Fortified Temple from the opposite entrance. Ceremonies held at the full moon nearest a solstice, combining observations of the rising sun and of the setting full moon, are documented in other cultures (Ruggles 2014). At Chankillo, it is likely that ceremonies relating both to the sun and moon took place at the full moon nearest the December solstice.

2.b.4 Light-and-shadow hierophanies: the back walls and slitted pillars of the atrium gallery and Room 3 gallery within the Temple of the Pillars
As described in Section 2.a.1.b The Fortified Temple, the slitted pillars lining the galleries at the back of the atrium and Room 3 in the Temple of Pillars faced the eastern horizon directly, unblocked by intervening walls. In the darkened spaces of the pillared galleries the early morning sunlight, shining in between the pillars and (at certain times of year) through the slits, would have created a spectacular display on the back walls.

Sunlight on the back walls
If the roof of the long gallery in the atrium was 2m high and that it extended beyond the front of the platform, then it would have measured some 7.5m from front to back. If so, then once the sun’s altitude exceeded about 15°, sunlight could not reach the back wall. In the case of the gallery
in Room 3, assuming a height of 2m and an extent about 10m from front to back, this would have been true once the sun reached an altitude of about 11°.

At Chankillo the sun reaches an altitude of 11° approximately 20–30 minutes after sunrise, and an altitude of 15° approximately 40–50 minutes after sunrise, depending upon the time of year (Table 2-4). Thus, we estimate that for around 25 minutes after sunrise each morning during the year, sunlight would have been low enough to light the back wall of the gallery in Room 3; while for around 45 minutes it would have been low enough to light the back wall of the long gallery in the atrium. If a given roof extended out further, the length of time during which sunlight could have struck the corresponding back wall would have been somewhat less; if the gallery roof was higher it would have been somewhat greater.

Table 2-4. Estimated time intervals during which sunlight could have reached the back walls of the pillared galleries in Room 3 and the atrium, obtained by combining data from Stellarium and the horizon data generated from the digital terrain models. The calculations are performed for the 3rd century BC, although the change in the sun’s position over the centuries is very small.

<table>
<thead>
<tr>
<th>Sunrise</th>
<th>End of interval when sunlight can reach the back wall of the pillared gallery in...</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Room 3</td>
</tr>
<tr>
<td>June solstice</td>
<td>06:55</td>
</tr>
<tr>
<td>Equinoxes</td>
<td>06:33</td>
</tr>
<tr>
<td>December solstice</td>
<td>06:13</td>
</tr>
</tbody>
</table>

On days around the December solstice, when the sun rose close to the direction faced by the Temple (119.0°) and at altitude of 3.6°, the effect in both galleries would have been to create vertical stripes of light and shade of more or less equal width (1.0m), extending up the back wall to about 0.45m from the top in the case of the long gallery in the atrium, and about 0.65m in the case of the Room 3 gallery. If the height of the platform retaining wall (front wall) was no more than 0.45m above the floor in the case of the long gallery in the atrium, or 0.65m in the case of the Room 3 gallery, then even at altitude 3.6° the sun would already have been high enough for sunlight to reach to the bottom of the back wall. Otherwise, the bottom of the wall would have remained in darkness at this point.
As the sun rose in the sky and moved slightly to the left, the top of the lit stripes would gradually have descended the wall. At the same time, they would have narrowed somewhat (while their centers remained equally far apart) and moved slightly to the left. They would also have extended further down onto the floor.

At other times in the year, the height of the bright stripes at first glance would have varied slightly because of the variation in the altitude of the distant eastern skyline (Figure 2-26), from a minimum of 3.2° at the equinoxes to a maximum of 6.6° at the June solstice. A more noticeable difference would have occurred because sunlight now entered the galleries from a direction no longer perpendicular to the back walls and lines of pillars. The width of the bright stripes would have been noticeably narrower. The changes over the year are presented in Table 2-5.

### Table 2-5. Parameters of the striped patterning of sunlight and shade on the back walls of the long gallery in the atrium and the Room 3 gallery during the minutes around dawn at different times of year (as determined by the azimuth of the sun, see Table 2-3). In both cases the pillars are assumed to have width 1.0m and thickness 0.8m and to be spaced 1.0m apart.

<table>
<thead>
<tr>
<th>Azimuth faced by temple (°)</th>
<th>119.0</th>
<th>119.0</th>
<th>119.0</th>
<th>119.0</th>
<th>119.0</th>
<th>119.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Azimuth of sun (°)</td>
<td>110.0</td>
<td>100.0</td>
<td>90.0</td>
<td>80.0</td>
<td>70.0</td>
<td>65.0</td>
</tr>
<tr>
<td>Horizontal angle between direction of sunlight and direction perpendicular to wall (°)</td>
<td>9.0</td>
<td>19.0</td>
<td>29.0</td>
<td>39.0</td>
<td>49.0</td>
<td>54.0</td>
</tr>
<tr>
<td>Width of bright stripes (m)</td>
<td>0.9</td>
<td>0.8</td>
<td>0.6</td>
<td>0.4</td>
<td>0.2</td>
<td>0.0</td>
</tr>
<tr>
<td>Width of dark stripes (m)</td>
<td>1.1</td>
<td>1.2</td>
<td>1.4</td>
<td>1.6</td>
<td>1.8</td>
<td>2.0</td>
</tr>
<tr>
<td>Mean displacement along wall (m):</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Long gallery in the atrium</td>
<td>0.4</td>
<td>1.1</td>
<td>1.9</td>
<td>2.8</td>
<td>4.0</td>
<td>4.8</td>
</tr>
<tr>
<td>Room 3 gallery</td>
<td>0.4</td>
<td>1.1</td>
<td>1.8</td>
<td>2.7</td>
<td>3.8</td>
<td>4.6</td>
</tr>
</tbody>
</table>

Whether by accident or design, the width of the bright stripes shrinks to zero more or less exactly at the time of the June solstice. In other words, the width of the bright stripes offered another calendrical indicator, simple and direct, that operated throughout the year.

Furthermore, at the equinoxes the displacement of the stripes was almost exactly equal to the distance from one pillar (or space) to the next, meaning that a viewer looking directly into the back gallery from the atrium or Room 3 patio would have seen the bright stripes on the back wall aligning in the gaps between the pillars. This only happened around the December solstice (no
displacement), the equinoxes (displacement by one pillar) and the approach to the June solstice (displacement by two pillars), by which time the stripes would have been very narrow. At other times the bright stripes would have been partially or completely hidden behind the pillars.

The effect of the slits
Around the December solstice, each 1m-wide dark stripe would have additionally contained three bright rectangles produced by sunlight passing through the three slits in the pillar concerned. These would have been most pronounced at the moment of sunrise on days very close to the solstice, when the sun would have shone more or less directly through the slits, producing full-size (20 cm x 8 cm) rectangles of light on the walls behind. As the sun rose in the sky the slits would have decreased in height (and slightly in width) as well as descending the walls.

A few days after the solstice, the images of the slits would have become noticeably narrower, as sunlight began to enter the galleries at a significantly oblique angle. For the central, 77cm-long, slit, once this horizontal angle had exceeded 5.9°, sunlight was no longer able to penetrate the length of the slit. For the side slits, where the incision may have decreased the effective length to, say, 70cm, the angle was about 6.5°. This occurs when the sun's azimuth falls below about 110°, which happens around 30 days either side of the December solstice. In other words, the pattern of “bright patches” caused by the slits would only have been visible for about a 2-month period around the December solstice.

Discussion
The fact that the width of the bright stripes shrinks to zero more or less exactly at the time of the June solstice, and that the bright stripes align in the gaps between the pillars at the December solstice and equinoxes, considerably strengthens the idea that the light and shadow effects were intentional, and indeed purposefully orchestrated to span the entire year. The importance of the December solstice would have enhanced by the appearance, about a month before the actual date, of the sets of three bright patches in each pillar shadow, widening to their maximum at the solstice itself. These hierophanies (spectacular displays accorded sacred significance) could have offered another type of calendrical indicator at the Chankillo complex, accessible only to those permitted to enter the Temple.

Sadly, these spectacular effects are not visible today, both because the temple space is no longer enclosed and because most of the pillars with their slits have been destroyed.
2.b.5 The sightline from certain limited areas in the plaza to the entrance to the Temple of the Pillars

The entrance to the Temple of the Pillars offered a fine view of much of the Chankillo site. It was a key position from which high-status individuals could have presided over ceremonials, but also where they would have stood in full view at the point of entry to (or emergence from) the Temple itself. The archaeoastronomical evidence suggests that the entrance point was positioned so that, with appropriate timing, the Temple officials could have been seen with the sun (or other celestial body) setting behind them, thus providing a sort of “hierophany for the masses”.

The part of the plaza visible from the entrance, and conversely from which the entrance could be seen, is shown in Figure 2-42 (a). Figure 2-42 (c) shows the view towards the entrance from a typical point on this part of the plaza, with the towers on the foreground ridge and the Temple and its entrance on the more distant ridge behind. The scatter of points marking the edge of the visibility envelope (points from which the entrance to the Temple of the Pillars is just visible) traces out a jagged profile formed by the sharp edges of the towers and the gaps between them moving in relation to the Temple and its entrance. The “shadow” of the towers extends somewhat further (generally by about 10–15m) eastwards than the boundary line generated by the ground survey. This is because the viewshed was based on the eye-height of an observer at the entrance of the Temple of the Pillars looking down over the plaza, whereas the ground survey was based on that of an observer on the plaza looking up at the Temple, which is more relevant here.

The saw-tooth shape of the boundary is most evident in the vicinity of the “shadow” of the southernmost towers Figure 2-42 (b). It is also especially evident in this area that unexcavated features (showing as bumps in the DSM) seem to avoid the area from which the Temple entrance was hidden by the ridge containing the towers. Possible structures, on the other hand, appear to be concentrated along the boundary and just outside it, especially in the vicinity of the “shadows” of Towers 13 and 12. Regardless of the astronomical possibilities, this in itself suggests that it was important for such structures either to be within sight of the Temple entrance or to have the Temple entrance within view. The correlation is much sharper in relation to the surveyed points than to the viewshed boundary, suggesting that it was the view to, rather than from, the Temple entrance that was important.

Figure 2-42 (a) also shows a large area cleared for future construction, approximately 200m square, directly to the ESE of the area just discussed, broadly in line with the administrative building. This lies (just) outside the visibility shadow, meaning that anything built here would also have been intervisible with the Temple entrance.

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As viewed from these points on the plaza, the Temple entrance, appearing just above and behind the towers, or in gaps between them, broadly coincided with the position of sunset at the June solstice. Figure 2-43 gives an indication of the area of the plaza from which the June solstice sun will be seen to set directly behind the Temple entrance: it is that area for which the declination is between +23.5° and +24.0°. Broadly speaking, this is the part of the plaza where the entrance appears in, or above, the gap between Towers 9 and 8. The cultural implications of the resulting “hierophany for the masses” are discussed in Section 2.a.1.b The Fortified Temple.

Finally, as noted by (Ghezzi 2007), there is an intriguing correlation between the area of the plaza from which the Temple platform is visible and the area from which the geoglyphs to the SSW of the Fortified Temple are visible (Figure 2-44). The geoglyphs only seem to be visible from parts of the plaza from which the entrance to the Temple entrance is also visible. Furthermore, there is an additional “cut-off” more or less exactly beyond the part from which the June solstice sun aligns with the Temple entrance. Whether this is significant or could cast any light upon the purpose and possible meaning of the geoglyphs, is impossible to say at this time.
Figure 2-42. (a): Points in the plaza from which the entrance to the Temple of the Pillars just disappeared from view. The green dots indicate points defining the edge of the visibility envelope as determined directly in the field; the computer-generated viewshed is superimposed. (b): Close-up of the area around which the entrance to the Temple of the Pillars just disappeared from view behind the southernmost towers (without the superimposed computer-generated viewshed). (c): Photograph of the horizon to the WNW as viewed from a point close to the limit of visibility on the solstitial line (marked as S7 in [b]). The entrance to the Temple of the Pillars appears between Towers 13 and 12 on the closer ridge.
Figure 2-43. The plaza area as shown in Fig 2.6 (b), with surveyed points marking the edge of
the visibility envelope for the Temple entrance, overlain with numbers (in yellow) showing the
declination of the horizon above the Temple entrance as viewed from that spot. “Tower shadows”
created when the tower in question obscures the view of the Temple entrance, are labeled in red.

Figure 2-44. Part of the viewshed from the geoglyphs, which also shows the area of the plaza from
which the geoglyphs can be seen
2.b.6 The “site axis” and the broadly solstitial site alignment of all the principal buildings at the site

Other than the line of towers and the perimeter of the Fortified Temple, the orientations of buildings and other structures over a wide area generally conform to an overall grid plan consistent to within about 6°. The orientations of the principal rectangular buildings and walls at Chankillo are as follows (summarized in Table 2-6):

- **Temple of the Pillars.** The outer walls have a WNW–ESE orientation of 119.0°/299.0° and a SSW–NNE orientation of 25.4°/205.4°. They therefore deviate from perpendicularity by 3.6°.

- **Observatory Building (OB).** The outer walls have a WNW–ESE orientation of 121.7°/301.7° and a SSW–NNE orientation of 30.9°/210.9°. The walls therefore deviate from perpendicularity by 0.8°. The corridor on the SSW side widens towards the WOP at its eastern end and has a mean orientation of 121.1°/301.1°.

- **Structure 5 adjacent to the Observatory Building (“OB2”).** The east, west and north walls form three sides of a rectangle with an orientation of 30.8°/120.8°/210.8°/300.8°. However, the south wall deviates slightly from this, with an orientation of 121.5°/301.5°.

- **Outer enclosure walls.** The SSW-NNE enclosure wall to the ESE of OB and OB2, and the surviving parts of the adjacent enclosure walls, are oriented with azimuths of 30.5°/210.5°, 121.9°/301.9°, and 121.5°/301.5° respectively.

- **Administrative Center.** Measurements of the sides of the atrium yield a WNW–ESE orientation of 115.6°/295.6° and a SSW–NNE orientation of 26.6°/206.6° respectively.

- **Large rectangular building centered at (804760,8941400).** The long wall on the NNE side of this enclosure yields the most reliable orientation, 115.7°/295.7°, while the shorter wall opposite yields 115.1°/295.1°. The west and east walls yield 26.5°/206.5° and 25.3°/205.3° respectively.
Table 2-6. The orientation of the principal rectangular buildings and walls at Chankillo. The azimuths quoted are true azimuths and given in one direction only (towards the ESE or NNE)

<table>
<thead>
<tr>
<th>Structure</th>
<th>Azimuth WNW to ESE</th>
<th>Azimuth SSW to NNE</th>
<th>Deviation from perpendicularity (Az1–Az2) –90°</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temple of the Pillars</td>
<td>119.0</td>
<td>25.4</td>
<td>+3.6</td>
</tr>
<tr>
<td>Observatory Building (OB)</td>
<td>121.7</td>
<td>30.9</td>
<td>+0.8</td>
</tr>
<tr>
<td>Adjacent building (OB2)</td>
<td>121.1</td>
<td>30.8</td>
<td>+0.3</td>
</tr>
<tr>
<td>Outer enclosure walls</td>
<td>121.7</td>
<td>30.5</td>
<td>+1.2</td>
</tr>
<tr>
<td>Administrative Center</td>
<td>115.6</td>
<td>26.6</td>
<td>–1.0</td>
</tr>
<tr>
<td>Large rectangular building centered at (804760, 8941400)</td>
<td>115.4</td>
<td>25.9</td>
<td>–0.5</td>
</tr>
</tbody>
</table>

A 650m-long wall connected to several buildings in a further plaza to the east, running from approximately 1.3 km to 2.0 km to the ESE of the towers, has approximately the same orientation (114.3°/294.3°) and means that the overall grid plan extends for well over 2 km.

A straight line drawn to connect the entrance to the Temple of the Pillars and the single direct entrance to Administrative Center would pass through the center of the Observatory Building and also the gap between Towers 12 and 13, where the southern end of the line of towers bends round until it is perpendicular to this axis (Figure 2-1). This “site axis”, with an azimuth of 118.8°/298.8°, appears to be the basis for the wider grid. Both the WNW–ESE and SSW–NNE orientations are consistent to within about 1° among each local group of structures, as would be expected if the construction followed a broad overall plan but used local foresights to achieve consistency within each specific locality. The fact that the opposite walls of large rectangular structures are generally only parallel to within about 1°, and that their walls are only perpendicular to within about the same amount, suggests that the required level of precision was no greater than this. The Temple of the Pillars, whose walls are 3.6° off the perpendicular, is an exception, implying that this occurred for a specific reason, but it is not obvious what this reason was (astronomical or otherwise).

The varying altitude of the horizon in either direction from different points around the site, due to the undulating landscape crossing valleys and ridges, makes it unlikely that a consistent type of astronomical observation could have been carried out repeatedly in order to set out the grid orientation in different areas. However, it is possible that an astronomical observation from a particular starting place originally defined the direction of the site axis, which was then propagated across the site by other means. The obvious candidate is December solstice sunrise /
June solstice sunset, and Table 2-7 shows the azimuth of these solstitial events for different horizon altitudes. A comparison of Table 2-6 and Table 2-7 shows that only the orientation of the Administrative complex and other buildings in the eastern plazas could have been directly defined in relation to the solstices, and in fact only in relation to the June solstice sunset. The remaining structures throughout the site broadly follow the solstitial alignment in consequence.

Table 2-7. The azimuth of December solstice sunrise and June solstice sunset at the latitude of Chankillo (–9.55°), for different horizon altitudes. All angles in degrees and to the nearest 0.05°

<table>
<thead>
<tr>
<th>Horizon altitude</th>
<th>December solstice sunrise</th>
<th>June solstice sunset</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Lower limb (δ = –23.5°)</td>
<td>Centre (δ = –23.75°)</td>
</tr>
<tr>
<td>0</td>
<td>113.95</td>
<td>114.2</td>
</tr>
<tr>
<td>5</td>
<td>113.05</td>
<td>113.3</td>
</tr>
<tr>
<td>10</td>
<td>112.4</td>
<td>112.65</td>
</tr>
<tr>
<td>15</td>
<td>111.95</td>
<td>112.2</td>
</tr>
</tbody>
</table>

2.c History and development

Previous Research

Throughout the record, there are common themes worth discussing. For instance, several names have been offered for the site. The first to appear in print, Chancayillo and Chancailllo, were reduced to Chankillo (or its Hispanicized version, Chanquillo), and as such it has survived in the literature. The name Chankillo was used in Tello’s posthumous book (Tello 1956), based on his field notes from the 1930s, but C. Roosevelt (1935), who traveled with Tello, was the first to use it in print. Collier (1962), Thompson (1961) and others have used the Hispanicized spelling. Fung and Pimentel (1973), and most scholars after them use Chankillo. This is the spelling employed by archaeologists who studied the Casma valley in great depth (Tello, Fung, Pozorski), the first archaeologist to carry out systematic research at the site (Fung), and cultural authorities of Peru (INC 2008), thus leaving little doubt about which should be preferred.
The full extent and components of the Chankillo site were only recognized in the 1980s. Many explorers and some pre-1980 scholars used the name to refer only to its hilltop fortification. They failed to include vital sectors, especially large buildings and plazas east of the Thirteen Towers, in their interpretations. Some considered the Thirteen Towers and their surroundings part of the site, while others discussed them as a separate site. Pozorski and Pozorski (1987) were the first to consider as a single site all the components recognized today. The Chankillo Project, through its survey and mapping program, has informed decisions by the Peruvian cultural authorities to recognize Chankillo as a national cultural heritage of the “monumental archaeological zone” category (INC 2008).

There is uncertainty in the previous literature on the chronological placement of Chankillo. Most commonly, it has been assigned by archaeologists to the Early Horizon or the Early Intermediate period (Table 2-1). Two previous $^{14}$C dates (Olson and Broecker 1959, Delibrias, Guillier et al. 1974) have been accepted uncritically to give the site an Early Horizon date. The associated Patazca pottery style was assigned a post-Early Horizon relative dating from previous research (Collier 1962, Carlevato 1979). Wilson's 1995 report defined a preliminary chronological sequence for the Casma valley and assigned Chankillo to the Patazca period (350 BC – 0 AD), which he cross-dated with the end of the Early Horizon and beginning of the Early Intermediate Period in Central Andean chronology.

The previous literature shows great disagreement about the function of the Fortified Temple at Chankillo, with interpretations that range from a fort to a setting for ritual warfare. Most researchers, impressed by its hilltop location, high walls, and baffled entrances, considered Chankillo a fort or refuge. Though some considered the Thirteen Towers “defensive outposts,” many acknowledged that sector of the site might have had public and/or ceremonial functions; a few favored a calendrical-astronomical interpretation based on the number of towers, either solar or lunar in association. Overall, most researchers, while recognizing the probable ceremonial aspects of the site, gave primacy to the defensive function.

Surprisingly, there was a disagreement on the number of towers –thirteen or twelve. Kroeber (1944) did not hesitate to point out Middendorf’s (1973 [1892]) apparent error in print. However, as Ghezzi and Ruggles (2008) showed, from a number of viewing positions in the open public spaces of Chankillo to the east, including the Eastern Observing Point, only twelve towers are visible: the southernmost tower is intentionally hidden from view behind the larger tower 12. It
is likely that Middendorf only observed the long line of towers from the eastern plaza of Chankillo.

Middendorf, Reiche, and Fung coincided that the gates of the Fortified Temple are defensive, not only because of their baffled design, but also because they could be easily blocked off in case of danger. This is important because the defensive purpose of the baffled gates has been a major point of contention, with some authors calling attention to their apparently excessive number and the outside location of their doors.

Worth discussing is an observation found in our literature review that the rectangular structure inside the Fortified Temple known as the Temple of the Pillars was “so destroyed” that its layout could not be recognized. Even the excellent map of Reiche and Fung (1956) is only a sketch when it comes to this temple. It was not until Pozorski and Pozorski (1987) worked at the site that a reasonable plan of this structure appeared in print. Unlike the rest of the site, where standing architecture is relatively easy to read, the Temple of the Pillars has an unusual overburden of rubble that suggests building burial and obscures its ground plan. Much of the most current interpretation of the hilltop building rests on the idea that this temple was artificially buried, and may have been a locus of ritual termination, or a target of attack and violent destruction.

Kosok was the first to suggest that ceremony was a primary function of Chankillo. Topic and Topic later argued persuasively against its defensive function, noting the absence of parapets or slingstones, and the location of doors outside of baffled gates defied military logic. They believed Chankillo is best viewed as a ceremonial setting for ritual battles. Though these different positions on the function of Chankillo are influenced by theoretical perspectives on Andean warfare, a methodological issue has also distorted the arguments: scholars who only considered “Chankillo” to be the Fortified Temple, or who focused on it exclusively, have overwhelmingly favored the interpretation of the site as a fortification or refuge. On the contrary, researchers with a more comprehensive view of the site, especially those with a clear interest in the Thirteen Towers and associated public spaces, have leaned towards its interpretation as a ceremonial center, with an important defensive component.

Current research

From a historical perspective, two themes stand out: the visual integration of elements of the landscape, both natural and constructed in relation to the skyscape, as indicators of the cyclical movement of the sun and therefore the passage of time; and the relationship between war, power, and ideology, on which Chankillo gives us empirical information that is thus far unparalleled in the archaeology of the Andes.

The span of the construction, occupation, destruction, and abandonment of Chankillo is very short, apparently lasting less than half a century. A large sequence of cultural materials dated by relative (pottery styles) and absolute (dendrochronology and $^{14}$C) methods demonstrates this. Based on these studies (Ghezzi 2016), it has been possible to establish the following chronological indicators of the architectural and occupational history of the site (Figure 2-45):

- There is compelling evidence that natural features in the eastern horizon visible from the sacred entrance to the Temple of the Pillars were used as natural markers, especially to date the equinox. This alignment may have determined the location of the Temple of the Pillars, itself a known origin point for the broadly solstitial orientation of the entire site, and probably a precursor to the concept of building a Solar Observatory at this location. This likely use of the eastern horizon is undated but would predate the construction of all the monuments at Chankillo.

- The oldest dates associated with the beginning of the occupation range between 244 and 202 BC, which correspond to the beginning of construction at the Temple of the Pillars.

- High-precision dates obtained from the wooden lintels used in the ceiling of the gates of the Fortified Temple give a cutting date of $214\pm7$ BC. This is considered to represent the last construction stage of this building.

- It is not possible to define the temporal relationship between the Temple of the Pillars and the walls that surround it. Archaeological and dendrochronological data indicate that the Fortified Temple was a large-scale construction project executed very quickly, and thus the different sectors could have advanced in parallel or with small gaps in time.
The construction of Building 4 in the area of the Administrative Center has been dated to 213±11 BC, contemporary with the construction of the Fortified Temple.

The occupation of the Temple of the Pillars is dated between 224 and 195 BC.

The occupation of the Observatory Building has been dated between 234 and 195 BC. It is contemporary with the occupation of the Temple of the Pillars.

The destruction of the Temple of the Pillars has a high-precision date of 202±9 BC.

The identification of buildings with a halted construction, and the presence of quarries of building materials, especially stone, as well as the identification of accumulations of construction materials in the routes between the quarries and the main buildings, indicate that at the time of the attack and the destruction of the Temple of the Pillars, and the consequent abandonment, Chankillo was in the process of constructing and expanding its facilities to the east. This destruction and abandonment occurred suddenly and violently, as the buildings were unfinished, and the tools used to work the stone were abandoned.

The Fortified Temple was abandoned for over a millennium before it was reoccupied, yet without its defensive, ritual or astronomical functions. Late Intermediate Period occupants (1100-1470 AD) left human burials, graffiti on the surviving walls, offerings, and some possible constructions of ephemeral use. This occupation is dated between 1051 and 1286 AD. It is likely that there is much more evidence of the occupation of the area at this time in sectors not investigated within the Chankillo Monumental Archaeological Zone.

There is a brief Inca occupation, identified through a typical ritual offering to fertility, placed on the first step of the northern staircase of the northernmost tower (Tower 1) of the Thirteen Towers. It is dated between 1293 and 1511 AD. At the Solar Observatory of Chankillo, this position is associated with the June (winter) solstice, and among the Incas this is the date of Inti Raymi, their most important festival.

So far, no evidence of subsequent historical occupations has been recovered within the Chankillo Monumental Archaeological Zone. After the 1970 earthquake that devastated the Ancash region, small human populations settled on the edges of the site.

Despite the short duration of the process of construction, use, destruction and abandonment of Chankillo, the meticulous planning of this ceremonial and astronomical center was a product of knowledge accumulated since the arrival of the first inhabitants, ten millennia ago, through later social processes initiated around 3500 BC with the construction of large ceremonial centers in Casma. This long cultural history manifests in the masterful way in which the builders of
Chankillo integrated human constructions and the environment, using both the built architecture and natural viewsheds for the production and cultural application of astronomical knowledge.

Figure 2-45. Bayesian modeling of radiocarbon dates from Chankillo
3. JUSTIFICATION FOR INSCRIPTION

3.1.a Brief synthesis
Chankillo is a prehistoric (250-200 BC) ceremonial center in northern Peru with astronomical, ritual, defensive and administrative functions. It contains a Solar Observatory, composed of the Thirteen Towers and the Western and Eastern Observing Points, from which the towers profile spanned the annual sunrise and sunset arcs, respectively. These are the leading elements that make Chankillo unique and outstanding globally. The term observatory implies here that astronomical observations were its primary goal, something that is rarely demonstrable outside the context of the world's great literate cultures and the history of modern scientific astronomy, but is indeed the case at Chankillo. While its solar horizon calendar is not directly comparable with modern instruments, it can justifiably be termed an observatory because the position of the towers and observing points shows unequivocally that their primary end was to serve as a precise calendrical instrument.

Solar horizon calendars require the progress of sunrise or sunset to be tracked accurately from a single spot using natural or artificial markers. Examples of true horizon calendars are extremely scarce. At Chankillo, seasonal observing activities appear to have been arranged from a restricted spot by (presumably) a privileged elite. Narrow gaps between a series of artificial markers defined time intervals of just a few days, so that by reference to the gaps and markers an observer could identify a date in the seasonal year to within a margin of, at most, one or two days.

There is extensive evidence of astronomical alignments within existing world heritage properties. Solar alignments are common, because they are the simplest to recognize and show to have been intentional. Some of the alignments at Chankillo, such as the broadly solstitial orientation of the overall grid pattern of the buildings stretching over several plazas, are comparable with patterns of orientation and alignments found at many sites elsewhere. It shows that the whole landscape was planned in relation to the sun, and a variety of astronomically aligned architectural elements encapsulated sky events that were visible to all, while observations of sunrises against the towers from the Western Observation Point could only be made by privileged individuals (presumably members of a chiefly or priestly elite) and (from the evidence of numerous votive offerings at this spot) accompanied by due ritual. In this respect, Chankillo belongs in the category of sites that represent the complexity and diversity of ways in which people rationalized the cosmos and framed their actions in accordance with that understanding.
However, the mere existence of solstitial or equinoctial alignments does not prove that a site was a calendrical instrument, not even that it was necessarily used specifically for observations of the sun. In this sense, the Thirteen Towers unquestionably did form an observing instrument. Unlike the architectural alignments upon a single astronomical target found at many ancient sites around the world, they span the entire annual solar rising and setting arcs as seen from the two observing points, not only giving direct indications of all four solstitial rising and setting points but also the means to identify every other day in a year by observing sunrise or sunset against the intervening towers and gaps between them. Chankillo is unique worldwide as a functioning solar calendrical observation device and quite an extraordinary example of native landscape timekeeping.

Moreover, Chankillo is one of only two places in the ancient world known to have incorporated a “complete” solar horizon calendar, using its markers to track the progressive passage of the sun along the horizon throughout the entire year. And it is the only one where this was achieved on a monumental scale and where all the component elements of this unique instrument are still extant and functional.

Chankillo also embodies an accumulation of knowledge about natural and astronomical processes and their connection to the solar cult, expressed masterly in the integration of the skyscape to the natural and built environment. Besides the Solar Observatory, a wider set of monuments forming the ceremonial center likewise took advantage of further solar and possibly lunar alignments upon both constructed and natural targets to define dates. It provides a prominent example of human interaction with a desert landscape that, while retaining its values, is also very vulnerable.

This location was meticulously selected on a natural vantage point of exceptional beauty in the coastal Casma valley of northern Peru. The prehistoric site is laid over gently rolling hills sculpted over millennia by the wind and the river, which offer a viewshed with a natural horizon that is appropriately low for the observation of the sky, and which favored the construction of the Solar Observatory and associated buildings along a broadly solstitial site axis. In addition, it takes advantage of the comparatively higher clarity of the skies afforded by the Cerro Mongon massif sitting on the Pacific Ocean shorelines, which combined with the point of origin and direction of the winds disseminated the mist that usually moves from the sea to the valleys in coastal Peru.

Astronomical observations at Chankillo are still possible today because the valley maintains its pristine conditions. Its exceptional features preserve ancient ecosystems such as fog-oases and carob forests that are of special importance in view of present-day climate change, and also help
preserve the prehistoric site. Thus, the shape and physiognomy of the natural landscape facilitate the astronomical function of Chankillo, today, just as they did more than two millennia ago.

As seen from the Western Observing Point, the southeastern slopes of Cerro Mucho Malo, 3 km away, intersect the much closer ridge on which the Thirteen Towers are built, just to the left of the northernmost tower. The visual effect is to provide a “thirteenth gap” of similar width to those between each pair of adjacent towers down the line, marking June solstice sunrise and creating a continuous astronomical horizon for viewing sunrises throughout the year. It is a brilliant example of intervention in the landscape integrating a natural element within the astronomical function, thus giving it a value comparable to that of the constructed elements.

Likewise, the distant eastern horizon is visible from the entrance to the Temple of the Pillars. This spectacular mountainous profile is within the entire solar rising arc and has a variety of prominent natural features that would have provided foresights marking the changing rising position of the sun. It might well have been a precursor of, and inspiration for, the construction and use of the Solar Observatory for astronomical purposes. The most prominent notch in this horizon coincides precisely with the position of equinoctial sunrise. It suggests that this natural location acquired cultural significance as the appropriate viewing point and was therefore chosen as the site of the Temple of the Pillars, a building of paramount importance at Chankillo with a broadly solstitial orientation and endowed with calendrical installations that also created sacred manifestations or hierophanies.

The Temple of the Pillars lies at the heart of an impregnable fortification known as the Fortified Temple, where the astronomical knowledge and associated solar cult were guarded. It overlooks the ridge containing the line of towers and the expanse of buildings and plazas around them. It is unparalleled in architectural terms; a construction that denotes great sophistication in defensive architecture and provides greater understanding of the forms of social and ritual organization of war in the Andes. Its huge triple defensive walls, draped over an irregular plateau edge, provide an extraordinary degree of protection yet drop away to leave a clear view eastward from the platform of the Temple of the Pillars—enabling it to be interconnected with solar observances from the area below—and at the same time exhibit a geometrical perfection which is evident when viewed from directly above. The Fortified Temple is thus the focal space of astronomical knowledge and of the possession of power.

The characteristics and attributes that give Chankillo its Outstanding Universal Value are:
1. The Chankillo Solar Observatory, composed of the Thirteen Towers and the Western and Eastern Observing Points, from which the towers profile spanned the annual sunrise and sunset arcs, respectively. These are the leading elements that make Chankillo outstanding and truly without parallel in a global context.

a) The viewshed from the Western Observing Point (WOP) to the Thirteen Towers together with part of Cerro Mucho Malo. The WOP, an open entranceway on the ESE side of the Observatory Building, is well attested archaeologically both as a viewing position and a location of considerable ceremonial importance accessible only to elite participants.

b) The viewshed from the Eastern Observing Point (EOP) to the Thirteen Towers. The EOP was a room or platform in a completely isolated building in the plaza to the east. It is now buried, but its foundations survive.

2. The viewshed from a single entrance to the Temple of the Pillars to the distant mountainous horizon profile to the East, which features a prominent notch precisely at the position of equinoctial sunrise. Together with part of Cerro Mucho Malo, this profile includes the annual solar rising arc. It is a likely precursor for the later Solar Observatory.

3. The viewshed from the WNW entrance of the Observatory Building to the Fortified Temple, which dominates the horizon in this direction. If, as it seems likely, astronomical observations were also made from here, then the archaeoastronomical data suggest that they would have focused upon the setting of the moon.

4. The back walls and slitted pillars of the Atrium and Room 3 galleries within the Temple of the Pillars. Although the in situ physical evidence is largely destroyed, it is clear these would have produced a series of spectacular light and shadow effects during the minutes following sunrise, orchestrated to span the entire year, with the slits producing particularly dramatic effects for a few weeks around the December solstice.

5. The sightline from certain limited areas in the Plaza to the single entrance to the Temple of the Pillars, a key position from which high-status individuals could have presided over ceremonials, but also where they would have stood in full view at the point of entry to (or emergence from) the Temple itself. From certain small areas in the plaza, Temple officials standing at the entrance could have been seen with the sun or moon setting behind them, thus providing a kind of “hierophany for the masses”.

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The solstitial axis connecting the Temple of the Pillars, the Observatory Building and the Administrative Center, which also passes through the gap between Towers 12 and 13, where the southern end of the line of towers bends round until it is perpendicular to this axis. The orientation of this site axis is followed to within 3° throughout Chankillo, resulting in the broadly solstitial alignment of all the principal buildings at the site.

Considering all these elements, it is clear that the Chankillo Solar Observatory and ceremonial center was dedicated to a solar cult, and the presence of two archaeologically distinct Observing Points on either side of the north-south line of Thirteen Towers unequivocally shows that the primary purpose of these structures was to function together as a calendrical instrument using the sun to define dates throughout the seasonal year. This is an outstanding example of the different ways in which people before the advent of written records perceived, understood, and attempted to order and control, the world they inhabited through astronomy.

3.1.b Criteria under which inscription is proposed (and justification for inscription under these criteria)

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<th>Criteria</th>
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<td>(i) represent a masterpiece of human creative genius</td>
<td>The solar observation device incorporated in the Thirteen Towers of Chankillo, which permits the time of year to be accurately determined not just on one date but throughout the seasonal year, is unsurpassed as an example of ancient landscape timekeeping. Unlike the architectural alignments upon a single astronomical target found at many ancient sites around the world, the monumental line of towers spans the entire annual solar rising and setting arcs as viewed, respectively, from two distinctive observing points, one still clearly visible above ground. This device, known as the “Chankillo Solar Observatory”, not only provides direct indications of all four solstitial rising and setting positions but also the means to identify every other day in the year by observing sunrise or</td>
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sunset against the various towers and gaps between them.

The nearby Fortified Temple, which overlooks the ridge containing the line of towers and the buildings and plazas surrounding it, is itself unparalleled in architectural terms. Its huge triple defensive walls, draped over an irregular plateau edge, provide an extraordinary degree of protection yet drop away to leave a clear view eastward from the platform of the main temple (the Temple of the Pillars)—enabling it to be interconnected with solar observances from the area below—and at the same time exhibit a geometrical perfection which is evident when viewed from directly above.

| (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 | The Chankillo Solar Observatory represents an example, unique in the ancient world, of landscape timekeeping on a monumental scale that integrates elements of both the natural and built environment. Standing at the heart of a ceremonial center which incorporates several further solar and possibly lunar alignments upon both constructed and natural targets, it provides a prominent example of human interaction with a desert landscape and skyscape that, while retaining its core values, is also very vulnerable.

The location of Chankillo was carefully chosen on a natural vantage point of exceptional beauty, which offers a viewshed with a natural horizon that was adequately low for the observation of the sky. In addition, the relief, characterized by the coastal mass of Cerro Mongon, as well as the point of |
origin and direction of the winds, combine to create a scenario of clear skies, favorable to the astronomical observations. Due to its special location, Chankillo has a range of short, medium, and long-distance perception. From the Fortified Temple, when viewing conditions are at their clearest, one can see the profile of hills between 4 and 10 km away to the east, with the more distant high-mountain peaks of the Cordillera Negra behind. The evidence suggests that these prominent features were used as natural markers of solar rising points and particularly the equinoxes.

Building on these natural conditions, the Thirteen Towers were placed on the crest of an elongated hill, with the appropriate height and orientation to form (as viewed from the two Observing Points) an artificial horizon broken at intervals by deep narrow cuts, ideal for accurate solar observation. The builders also incorporated elements of the landscape for solar observation, marking the winter solstice sunrise by the visual intersection between the first tower and the prominent hill Cerro Mucho Malo. This is an exceptional example of intervention in the landscape, integrating a remarkable natural element within the astronomical function, thus giving it a value similar to that of the constructed elements.

Astronomical observations at Chankillo are still possible in the present day because the Casma valley, where the site is located, maintains pristine conditions of conservation of the coastal Peruvian desert. These exceptional conditions preserve
ancient ecosystems such as fog-oases and carob forests that are of special importance in view of present-day climate change and help preserve the prehistoric site. Thus, the shape and physiognomy of the landscape facilitate the astronomical function of Chankillo, today, just as they did two millennia ago.

3.1.c  Statement of integrity
The Solar Observatory and the wider set of related monuments that form the Chankillo site take advantage of a set of artificial and natural horizon markers to define dates. Few places in the ancient world have these attributes, and Chankillo is one of only two known to have incorporated a complete solar horizon calendar, using artificial markers to track the progressive passage of the sun along the horizon throughout the entire year. The property identified as the Chankillo Solar Observatory and Ceremonial Center comprises the necessary elements to preserve and transmit these attributes of its Outstanding Universal Value.

The Chankillo Solar Observatory has a high degree of integrity, because the Western Observing Point and the complete line of foresight towers, together with the relevant part of the Cerro Mucho Malo slope, are still extant and functional. The position of the Eastern Observing Point, although not visible on the ground, is accurately determined from archaeological research (details below).

The Thirteen Towers are a set of structures used as artificial horizon markers. Most upper corners have collapsed, exposing their inner fill and covering the tower sides with debris. Likewise, while it seems many retain almost all their original height, this cannot be known with exactitude. However, all the towers are standing and maintain their original position and orientation. The archaeoastronomical survey determined that all 52 corners of the towers are preserved intact at their base, and that the uncertainty about their original height has an insignificant effect on their astronomical use, since the sun rises and sets almost vertically at the latitude of Chankillo.

Likewise, the part of the Cerro Mucho Malo slope that serves as a natural astronomical marker and an integral part of the Solar Observatory—since the artificial horizon formed by the Thirteen Towers intersects the slope, forming a continuous astronomical horizon and marking the solstitial
position—retains its original profile intact. This is even though a modern power line has been installed on the hillside: fortunately, this is barely visible to the naked eye because of its distance.

The Observatory Building is a rectangular building west of the Thirteen Towers. It has a long corridor that leads to an open threshold, from which the Thirteen Towers can be seen, and which has been identified by archaeological research as the Western Observing Point. This building remains standing, in its original place and orientation, with a minimum loss of height in its walls, and mostly covered by sand.

The small building on the east side of the Thirteen Towers that contains the Eastern Observing Point has suffered greater deterioration, owing to its proximity to areas of human and animal transit. It is no longer standing, but a part of its foundations survives, in its original position and orientation, below the surface. Its deterioration has halted because the traffic has been eliminated.

The orientation of the Temple of the Pillars is considered the likely point of origin for the broadly solstitial axis that characterizes the buildings throughout Chankillo. The temple is standing, in its original position and orientation, and retains all its walls, with a minor, variable loss of height that does not affect its shape. From the atrium, the eastern horizon can be seen unimpeded, conserving intact its natural astronomical markers. The pillared galleries that distinguish the architecture of this temple were darkened spaces where slits in the pillars created sacred manifestations or hierophanies by beams of light and shadow that marked the dates of the solstices and equinoxes. When the temple was later attacked, this resulted in the loss of most of the pillars, and the complete destruction of the gallery roofs they supported. Fortunately, enough of the walls and pillars remains in situ for us to understand and appreciate the temple's astronomical function, although owing to its poor state of preservation the solar hierophanies no longer operate today.

An important aspect in the evaluation of the attributes of Chankillo is the integrity of its astronomical sightlines. Their preservation is a management problem that is only beginning to be considered in a World Heritage context (Chadburn and Ruggles 2017). If we start with the premise that one or more people in Chankillo stood at a place of observation to visualize the rising or setting of a celestial object, then the integrity of the astronomical sightline, and in turn our understanding of how the whole site functioned, depends on the preservation of these visual lines (Ruggles 2017).

The viewsheds that contain the astronomical sightlines at Chankillo are generally unobstructed. In large part the natural environment and climatic conditions that resulted in the good visibility
needed for astronomical observations at the site are conserved and the sightlines still function. In addition, the desert nature of the Chankillo environment prevents vegetation from blocking views. Finally, the visual basins are not affected by modern constructions. An exception in the last case is a power line on the hillside of Cerro Mucho Malo. Because of its distance, it does not impede the view of the horizon itself, although it is a visual distraction with an impact on integrity, because it partially obstructs the view of the sunrise at the June solstice as seen from the Western Observing Point and the Temple of the Pillars.

The constructions that define the alignment between the Western and Eastern Observing Points and the horizon markers are still standing and functional. In the case of the artificial horizon formed by the Thirteen Towers, as seen from either Observing Point, the partial collapse of the towers undoubtedly impacts their integrity, since it hinders the view of the real corners, and modifies the original shape of the horizon. As already noted, all of the 52 corners of the towers are preserved, even though they are partially covered with collapsed material. Also, estimations of the original height of each tower is inexact, but this has no significant effect on the astronomical use, and therefore on the integrity, since the sun rises almost vertically at Chankillo's latitude. The exception to this rule is that, from the Eastern Observing Point, towers 11 to 13 disappear from the horizon. While it is certain that Tower 13 was never visible, it is not clear whether 11 and 12 were, since their exact original height is unknown.

As already mentioned, the architecture of the pillared galleries at the Temple of the Pillars produced hierophanies, or sacred manifestations, at key dates through light and shadow effects produced by slits in the pillars. Although this element constitutes another key aspect of the solar associations at Chankillo, its integrity is severely compromised. The roofed galleries were destroyed, thus eliminating the dark space in which the hierophanies occurred. Only fragments remain of the pillars, save for the base of one pillar that retains enough of its slitted design to allow the rest to be reconstructed by extrapolation.

In common with the Temple of the Pillars, many buildings at Chankillo—of various functions—follow the broad alignment towards the June solstice sunset and December solstice sunrise that characterizes the whole site. They are preserved with a high degree of integrity, and provide evidence, like many other places in the world, of the way in which their ancient inhabitants rationalized the cosmos and structured their behavior according to this understanding.
### 3.1.d Statement of authenticity

The authenticity of the Chankillo Solar Observatory and Ceremonial Center relates both to its global cultural context and to the following attributes.

#### Use and function

The use of the term "observatory" implies that the astronomical observations are the sole purpose of a site or building, or at least its main one. This can rarely be demonstrated outside the context of the great literary cultures of humanity and the history of modern scientific astronomy (see 3.2 Comparative Analysis). Fortunately, at Chankillo, the position of the Western and Eastern Observing Points in relation to the Thirteen Towers unequivocally shows that the primary purpose of all these structures was to act together as a calendrical instrument. This conclusion is based on archaeological and archaeoastronomical research published in leading peer-reviewed journals and books (Ghezzi and Ruggles 2007, Ghezzi and Ruggles 2011). It enjoys high scientific credibility, a quality that is vital for archaeoastronomical data being considered in a heritage context (Ruggles and Cotte 2010).

A solar horizon calendar involves observing the progress of the sunrise or sunset positions from fixed points, using natural or cultural markers. There are numerous examples worldwide of structures oriented to a single "astronomical target", that is, to the rising or setting position of the sun or other celestial object on a defined date, but this alone does not provide credible evidence that the structures concerned had a calendrical function. The Chankillo Solar Observatory, on the other hand, provided the means to clearly identify not only the solstices or equinoxes but every single day with precision. In that sense, it is a true solar horizon calendar, one of only two known in the world in which the positions of the sun could be tracked throughout the year, and the only one where the relevant structures remain standing (see 3.2 Comparative Analysis).

The Solar Observatory is composed of two fixed observing points using the horizon formed by the Thirteen Towers and (in the case of the view to the east around the time of the June solstice) the slopes of Cerro Mucho Malo to define dates throughout the year. Both observing points were identified by archaeological excavation and verified by archaeoastronomical data.

The Western Observing Point is an open doorway in a building to the west of the line of towers—an anomalous feature, all other doorways having held doors—located at the end of a long corridor, yielding an open view of the towers profile. A scatter of votive offerings revealed this to be a place of considerable importance, shedding light on the social and ritual activities associated with the astronomical observations. Radiocarbon dates obtained directly from the organic remains in
the occupation floor of the Observatory Building fit perfectly into the short temporal occupation known to Chankillo (Ghezzi 2016). The archaeoastronomical data confirm that as seen from this observing point, the row of Thirteen Towers and the hillside of Cerro Mucho Malo coincide with the range of sunrise positions throughout the year.

The Eastern Observing Point is part of a small building in the plaza to the east of the towers whose foundations—partially destroyed—were revealed by archaeological excavation. Geophysical survey (Huayhua and Sueldo 2018) confirms that the structure is completely isolated, although possibly somewhat larger than revealed by excavations. This small uncertainty in its exact location is insufficient to affect the conclusion, clearly revealed by the archaeoastronomical data, that this small room acted as a fixed observing point to view the seasonal passage of the sun over the Thirteen Towers. From here, the line of visible towers coincides with the range of sunset positions throughout the solar year.

The visualization of the sunrise and sunset from the two observing points takes advantage of a restricted viewshed defined by the Thirteen Towers and Cerro Mucho Malo, which is preserved with its original characteristics, and therefore allows the observer to understand, through direct experience, the way in which the observation system functioned.

**Form and design**
The current state of preservation of the observing points and the Thirteen Towers is enough to ensure that the basic form and design of the Chankillo Solar Observatory has survived virtually intact. Despite the collapse of most of the upper tower corners, and the uncertainty in their original height, their ground plan and orientation, and in particular the precise position of all of the 52 the corners, is well preserved at the base of the structures. As described before, the uncertainty about the original height of the towers has insignificant effect on their astronomical use, since the sun rises and sets almost vertically at the latitude of Chankillo. The position, ground plan, and orientation of both observing points are also well determined and preserved, and in the case of the Western Observing Point, clearly visible above ground.

**Materials and substance**
The raw materials, construction techniques, and architectural forms used in a very consistent way at Chankillo are common to the architecture of the region and the period (Ghezzi 2016), attesting to its authenticity. Archaeological research has documented in several parts of the property the quarries used for the provision of stone, the main construction material, the lithic workshops, both at the same quarries and in specialized spaces, the accumulations of shaped stones in the process
of transfer between the quarries and the constructions, the tools used in the construction, and the areas for discarding materials leftover from the construction. All this evidence points to the originality of the construction materials used in Chankillo.

In addition to their materials and construction techniques, the Chankillo buildings follow architectural patterns known since the Late Pre-ceramic period on the north coast of Peru, maintaining their original shape until today (Ghezzi 2016). In the case of the Thirteen Towers, formally they are a *sui generis* element with no functional or architectural parallels. However, the raw materials and construction techniques used are the same as those that are found repeatedly in the architecture of the site and the region for the time of occupation of Chankillo. Although no radiocarbon dates directly date the Thirteen Towers, archaeological research verified their authenticity by recovering several diagnostic artifacts from the time of occupation of Chankillo.

During the 1960s, archaeologist Rosa Fung excavated in Chankillo, with the collaboration of architect-conservator Víctor Pimentel, who verified the authenticity of the Fortified Temple (Fung and Pimentel 1973). The Chankillo Program, started in 2011, has excavated to date in all sectors and almost every building, confirming their authenticity (Ghezzi 2016). In 2017, conservation work was started at the Thirteen Towers, following the principles of minimum intervention, respect for a building’s history, and reversibility of the materials applied. All conservation is done using the same materials used in the construction of the site, which have been recycled whenever possible. Archaeological and conservation activities, as well as other interventions resulting from the development pressures to which the site is subject, do not compromise its authenticity, as they have not altered or diminished the ability to appreciate the archaeological site and its astronomical function.

**Location and setting: landscape and skyscape**

The natural landscape and its preserved viewsheds are an important aspect of the authenticity of Chankillo. The Fortified Temple is built on a crest at an elevation of 315 m, dominating the entire site. With its 360° vista it is an excellent place to obtain an appreciation of the environment, to identify geographic landmarks, such as the visually outstanding peaks, and to understand the processes of astronomical observation associated with this site. Much of this environment formed by sand ramps, hills, rock outcrops, and a corridor of high dunes integrated into a dry forest of carob trees, is preserved with its original features, allowing the observer an approximation to the original environmental conditions of Chankillo.
The property proposed genuinely maintains many of the original conditions of its geography and landscape. The boundaries of the property and the buffer zone are chosen to encompass the visual interconnectivities between observing locations, horizon foresights (both artificial and natural) and sightlines, except for the distant mountains to the east of Chankillo, where any conceivable interference would be too small to have significant visual impacts.

An important element to consider regarding the authenticity of the astronomical sightlines is the changing appearance of the sky. While the positions of individual stars (although not their appearance or the shape of the constellations in the sky) have shifted somewhat during the last two millennia owing to the precession of the equinoxes, the rising and setting positions of the sun and moon are only subject to a much smaller effect—the changing obliquity of the ecliptic. Since the third century BC the sun has shifted slightly (about 0.2°, or half of the sun's diameter) at and around the solstices, less at other times in the year. This small change does not affect the ability of a present-day observer to understand, through direct experience, the way in which the Chankillo Solar Observatory functioned, and has a negligible effect on the broader solar and lunar alignments around the site.

3.1.e Protection and management requirements

Framework of legal protection

The Peruvian State has a legal framework that guarantees the protection and management of its declared National Cultural Heritage, and those sites presumed as such. This framework ensures also the sustainable preservation over time of the physical attributes of the Outstanding Universal Value of Peruvian properties registered on the World Heritage List.

In this sense, the legal protection of the "Chankillo Solar Observatory and its Ceremonial Center" and nearby properties is supported by Article 21 of the Political Constitution, which guarantees the ownership of the Peruvian State over all archaeological sites.

This article states that "The archaeological sites and remains, buildings, monuments, places, bibliographic and archival documents, artistic objects and testimonies of historical value, expressly declared as cultural heritage, and provisionally those presumed to be such, are the National Cultural Heritage, regardless of their status as private or public property. They are protected by the State. The law guarantees the ownership of said heritage. In accordance with the law, it encourages private participation in the conservation, restoration, exhibition and dissemination thereof, as well as its restitution to the country when it has been illegally transferred outside the national territory."
Likewise, the General Law of the National Cultural Heritage -Law 28296- in Article 6, guarantees the said property, expressly stating the following: "Every Pre-Hispanic property that is part of the National Cultural Heritage belongs to the State, as well as its integral and/or its accessory parts and its discovered or undiscovered components, regardless of whether it is located on public or private land. The said property belonging to the National Cultural Heritage has the condition of inalterable, inalienable and imprescriptible, being administered solely by the State."

While in Articles V and 22, it is established that the properties that make up the National Cultural Heritage are protected by the State.

"Article V.- Protection

The properties belonging to the National Cultural Heritage, independently of their private or public condition, are protected by the State and subject to the specific regime regulated in the present Law. The State, the holders of rights over properties belonging to the National Cultural Heritage and the general public have a common responsibility to comply with and monitor the proper compliance with the legal regime established in this Law. The State will promote the active participation of the private sector in the conservation, restoration, exhibition and dissemination of the properties of the National Cultural Heritage and its restitution in the cases of illegal export or when the period of loan outside the country granted by the State has expired ".

"Article 22.- Protection of properties

22.1 All public or private works of new construction, remodeling, restoration, expansion, refurbishment, conditioning, demolition, enhancement or any other involving a property integral to the National Cultural Heritage, requires for its execution the authorization of the Ministry of Culture ".

Likewise, in Article 4 of its Regulations it also states it expressly:

"Article 4°.- Protection of cultural property

The identification, registration, inventory, declaration, protection, restoration, research, conservation, valorization and dissemination of cultural property, and their restitution in relevant cases is of social interest and public need and involves all citizens, authorities and public and private entities ".

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According to Article 195 of the Political Constitution, local governments are competent for "the conservation of archaeological and historical monuments". In accordance with the provisions of Articles 28 and 29 of the General Law of the National Cultural Heritage, Regional Governments are competent to provide "assistance and cooperation to the pertinent organizations for the execution of research, restoration, and conservation projects, and dissemination of the integral properties of the National Cultural Heritage in its jurisdiction". Likewise, the Municipalities cooperate with "the National Institute of Culture -now Ministry of Culture-, the National Library and the General National Archive in the identification, inventory, registration, investigation, protection, conservation, dissemination and promotion of movable and unmovable property belonging to the National Cultural Heritage".

In accordance with the provisions of the Organic Law of Municipalities - Law No. 27972 - Article 82, municipalities have specific powers and functions to "promote the protection and dissemination of the National Cultural Heritage, within their jurisdiction, and the defense and conservation of archaeological, historical and artistic monuments, collaborating with competent regional and national organizations for their identification, registration, control, conservation and restoration". Likewise, the Organic Law of Regional Governments - Law No. 27867 - Article 47, expressly establishes the role of this level of government in the protection and management of cultural assets such as the "Chankillo Solar Observatory and Ceremonial Center", as its function, shared with the Ministry of Culture to "Protect and conserve, in coordination with local governments and the corresponding agencies, the existing National Cultural Heritage in the region, as well as promote the declaration by the competent bodies of the unrecognized cultural properties found in the region."

In coincidence with the aforementioned norms, the Law of Creation of the Ministry of Culture -Law No. 29565 - provides in articles 6, 8, 19 and 20, the exclusive competence of this governing body in cultural matters, and those shared with local and regional governments; as well as the intergovernmental articulation and coordination, in order to ensure the protection and management of the National Cultural Heritage, through various legal, scientific, technical, administrative, and financial mechanisms.

The declaration as National Cultural Heritage of the "Chankillo Monumental Archaeological Zone", through National Direction Resolution 075/INC of January 18, 2008, issued by the then National Institute of Culture, and the demarcation of its limits, represented in the Delimitation Plan PP-027-MC-DGPA/DSFL-2015 prepared by the Ministry of Culture, are a clear expression
of the will of the Peruvian State to apply the available protection mechanisms in order to preserve this cultural property for the knowledge and enjoyment of the generations of today and tomorrow.

The "Chankillo Solar Observatory and Ceremonial Center" includes the "Chankillo Monumental Archaeological Zone" and Cerro Mucho Malo as unalterable zones. This property is reinforced by a buffer zone that extends around the site and part of its immediate cultural landscape that includes part of the San Rafael Valley, Cerro Mongón, Lomas Las Haldas, Pampa Los Médanos, Cerro Manchán, Cerro San Francisco, and Cerro Monte Grande.

To the aforementioned declaration is added the promulgation of Law 30467 on June 17, 2016, by the Congress of the Republic of Peru, which declares of national interest and public necessity the investigation, protection, valorization and dissemination of information of the "Chankillo Monumental Archaeological Zone" and adjacent archaeological sites, located in the province of Casma, in the Ancash region.

Thus, in accordance with the aforesaid legal framework, the Provincial Municipality of Casma issued City Ordinance Nº 002-2014-MPC, which declared of tourist interest the archaeological sites of Chankillo, Casma Alta and Manchán; as well as the natural heritage composed of the Longitudinal Dune of Manchán and Cerro Mongón and the adjoining areas that they enclose. In this regard, it should be noted that this natural heritage is located within the Buffer Zone of the "Chankillo Observatory and Ceremonial Center".

Likewise, the Provincial Municipality of Casma issued Resolution of Municipal Management Nº 094-2016-MPC, September 23, 2016, on the formulation of the Management Plan of the "Chankillo Solar Observatory and Ceremonial Center" and the coordination to be carried out in the process of territorial planning. In the same way, through City Ordinance Nº 036-2017-MPC, Cerro Mucho Malo, which is a fundamental component of the property, was declared a Municipal Protected Area.

In the same way, City Ordinance No. 034-2017-MPC of December 13, 2017, approved the "Plan for Territorial Conditioning in the Province of Casma 2017-2037", which includes the "Chankillo Solar Observatory and Ceremonial Center". In this Territorial Conditioning Plan, the preservation of the property, "as the oldest solar observatory in America", forms part of their Vision to 2037. Likewise, the property is recognized as an archaeological zone, comprised within an Unalterable Archaeological Area, which forms a Conditioning Territorial Unit of Special Treatment, included in the various Territorial Conditioning Units of the Plan. This Archaeological Unalterable Area
corresponds to “all areas declared as archaeological zone and all its categories, where the main directives are dictated by the Ministry of Culture.”

The Territorial Conditioning Units for Special Treatment also include the proposed Buffer Zone, which "corresponds to the area adjacent to each unalterable archaeological area, allowing a support area to serve as a transition and protection; its current use is not restricted; however, it must be aligned with the respective management rules that guarantee the protection of the unalterable area." Likewise, it includes the Area of Agricultural Valley within the Buffer Zone of the property.

In sum, the Territorial Conditioning Plan represents the planning and management instrument for the territory of the province of Casma, under the responsibility of the municipal government that contributes, as part of the Peruvian State and in accordance with the law, to strengthen and secure over time, the unconditional protection of the "Chankillo Solar Observatory and Ceremonial Center", as well as the regulation of its Buffer Zone.

While there is a national and local legal framework for the protection of the property, as described previously, there is a protection mechanism in operation on the ground since 2015, consisting of the surveillance of the "Chankillo Solar Observatory and Ceremonial Center" by staff from the Provincial Municipality of Casma, and by promoting awareness in the local community regarding the need to avoid damaging the monument, preventing the unregulated passage of vehicles and people. The activities carried out with this goal are supervised by the Decentralized Department of Culture - Ancash of the Ministry of Culture, through the "Max Uhle" Casma - Sechin Regional Museum, and also by personnel of the House of Culture of Casma, a local entity recognized by the Ministry of Culture through Regional Directorial Resolution N° 049-2013 / DRC-ACN / MC, of April 11, 2013, and Regional Directorial Resolution N° 213-2015 / DRC-ACN / MC, of December 22, 2015.

Through the Regulation of Archaeological Interventions approved by Supreme Decree N° 003-2014-MC, the Ministry of Culture rules and regulates all projects and programs of research, conservation, and enhancement, among others, carried out under scientific, political and Priority interests for the State, which are executed by public or private institutions throughout the national territory. Articles 34 to 40 establish the characteristics and requirements of the Research Programs, a modality permitted for the study of World Heritage Sites in Peru.
Research and conservation

Current research

The actions carried out by the local government and the Ministry of Culture, aimed at facing threats to property, are added to those made from 2001 to the present by the Chankillo Project of Instituto de Investigaciones Arqueológicas (IDARQ), consisting of the execution of research and conservation projects and programs in the "Chankillo Solar Observatory and its Ceremonial Center", carried out under the authorization of the Ministry of Culture and the sponsorship and financial support of various national and foreign institutions.

In this way, since 2001 Instituto de Investigaciones Arqueológicas IDAR, through the Chankillo Project, has carried out 25 studies aimed at discovering, protecting and preserving its physical attributes of Outstanding Universal Value, under the auspices and financing of World Monuments Fund ($1,500,000), US State Department ($125,000), Yale ($350,000), National Science Foundation ($15,000), Wenner-Gren Foundation ($30,000), Field Museum of Natural History ($10,000), Center for Field Research ($100,000), Antamina Mining Company ($200,000), Provincial Municipality of Casma ($100,000), Innovation Fund in Science and Technology-Peru ($120,000), French Institute of Andean Studies ($20,000), and British Peruvian Cultural Association ($50,000).

These archaeological investigations, conservation interventions, and cultural management proposals are the following:

   2003a Propuesta de Delimitación del Complejo Arqueológico Chankillo. Informe.


2013b Estrategia de manejo para el bosque seco de algarrobo en el área protegida de Chankillo. Instituto de Investigaciones Arqueológicas. Informe. Salazar, Pablo.


The results of this research have been disseminated nationally and internationally in specialized academic and scientific publications, as detailed below (Appendix 2):


2016 "Fenómenos geológicos que afectaron las edificaciones en el complejo astronómico Chankillo (Casma, Ancash)." Revista del Instituto de Investigación de la Facultad de Ingeniería Geológica, Minera, Metalúrgica y Geográfica 17(33): 45-51. Ghezzi, I. and E. Guadalupe Gómez


**Threats to the property**
The main threats to the property, identified through the specialized studies mentioned above and in the diagnosis of the Management Plan as environmental factors of deterioration, require ongoing maintenance and monitoring. These threats are of climatic and mechanical origin. The former relates to the strong insolation on the site and the winter presence of high humidity and surface runoff; they are of seasonal and annual periodicity. The latter refers to the erosion caused by aeolian sands and/or the constant coverage of buildings, especially those in the lower part of the site, that is, the Eastern Observation Point, the Observatory Building and the Administrative Center. Sand as an abrasive erosion agent also affects walls and their mud finish.

Other threats recognized by specialists correspond to the pressures of development, such as the construction of infrastructure and urban expansion in the cultivated valley, the expansion of cultivation fields, the overlapping of mining claims, the installation of basic services in human settlements of the vicinity, modern infrastructure that stand out in the landscape. To this is added the legitimate expectation of the local population for tourist development in the area. These anthropic changes due to development pressures could affect the carob tree forest, the natural dune corridor, and the desert, given the environmental fragility of the area. It is also necessary not to lose sight of the seismicity, the eventual rains, and the precipitations related to the El Niño Phenomenon, which can cause damage to the prehistoric structures at Chankillo.

In the face of such threats and risks to property, the Management Plan establishes that the Ministry of Culture is the administrative body responsible for ensuring the protection, management and integral conservation of the Chankillo Solar Observatory and the associated astronomical landscape. In turn, the implementation of the "Territorial Conditioning Plan of the Province of Casma 2017-2037", in charge of the Provincial Municipality of Casma, contributes to strengthen and ensure the protection of the "Chankillo Solar Observatory and Ceremonial Center" and the regulation of its Buffer Zone.
The Management Plan is in accordance with the national administrative regulations and is inspired by international principles of World Heritage management, in order to guarantee the continuity and sustainability of the conservation of the attributes that justify the Outstanding Universal Value of the property, as well as its Authenticity and Integrity.

In this regard, in order to mitigate and eliminate the threats and vulnerabilities that would affect the property, the Management Plan strategically establishes the execution of 49 projects over a ten-year horizon, comprised of 14 programs that will require a total budget of S/ 57'654,758.62. This budget has the following distribution: a) Investment Program: S/ 39'173,216.62; and b) Management System: S/ 18'481,542.00.

The programs planned to ensure that the physical attributes of Outstanding Universal Value of the property are maintained over time are as follows: 1) Custody and legal protection of the monument (2 projects); 2) Participatory security and protection (1 project); 3) Facilitation and visitor services (3 projects); 4) Environmental management (1 project); 5) Promotion and dissemination (2 projects); 6) Territorial management (2 projects); 7) Management of priority conservation ecosystems (3 projects); 8) Education for the heritage of the Casma Valley (3 projects); 9) Archaeological Research (5 projects); 10) Conservation (13 projects); 11) Adaptation of infrastructure for research, conservation, treatment of Chankillo study materials and for public use (2 projects); 12) Capacity building (6 projects); 13) Safeguarding the memory of the landscape in the San Rafael Valley (2 projects); 14) Rural habitat (2 projects) (see complete list in Section 5.i Policies and programmes related to the presentation and promotion of the property).

Management Plan
The property has a “Management Plan of the Chankillo Solar Observatory: Management of an ancient astronomical landscape in the Casma Valley 2018-2028”. It identifies the current conservation and management conditions of the site and its context, the risks and threats to the cultural and natural attributes of the property and its surroundings, and establishes the policies that govern conservation and heritage management, the strategies and protection measures and the regulation of the use of the property and its surroundings through zoning, as well as the programs and projects to face the adverse conditions and achieve sustainability in the preservation of the property.

The Specific Agreement of Interinstitutional Cooperation between the Ministry of Culture, the Provincial Municipality of Casma and World Monuments Fund, signed on October 15, 2014 has
as a purpose to establish the framework of relations between the Ministry, the Municipality and WMF Peru for the development of inter-institutional actions to guarantee the preservation and strengthening of the cultural values of Chankillo for its nomination to UNESCO World Heritage List. Specifically, it achieved the formulation of a plan entitled "Management Plan of the Chankillo Solar Observatory: Management of an ancient astronomical landscape in the Casma Valley 2018-2028".

The renewal of the aforementioned Specific Agreement for Interinstitutional Cooperation on October 15, 2018 for three years, gives continuity to the interinstitutional actions and ensures the preservation of its physical attributes of Outstanding Universal Value through the execution of the programs, projects and activities in the Management Plan.

The programs, projects and activities mentioned above have contributed to strengthen the Outstanding Universal Value and the preservation of its physical attributes, as well as to build the foundations of an effective Management System, with the participation of diverse local, regional, national and international actors. In this regard, the appropriate inter-institutional framework for establishing the foundations of the Management System for property has been created, as indicated in the Chankillo Solar Observatory Management Plan: Management of an ancient astronomical landscape in the Casma Valley 2018-2028, and also to strengthen the mechanisms of inter-institutional collaboration initiated in 2001, with a long-term vision.

The Management Plan for the protection, conservation, management, and dissemination of the "Chankillo Solar Observatory and its Ceremonial Center" was prepared by a multidisciplinary team of professionals, convened by the Ministry of Culture, in cooperation with the Provincial Municipality of Casma and World Monuments Fund. It is an instrument for the investigation, conservation and social use of property, formulated from the perspective of its surrounding territory, where its interpretative meaning lies. The plan considers the astronomical landscape of Chankillo not only from its visual and physiognomic aspects, but also from the perspective of the broader natural and socio-cultural processes that sustain it. It is therefore multisectoral, decentralized and participatory; it includes government branches at the national, regional and local levels, as well as civil society (community organizations, public and private institutions, universities, etc.).

In order to ensure the effective protection and management of the property, and above all, the sustainable preservation of its physical attributes of Outstanding Universal Value over time, the
Management Plan contemplates the definition of eleven strategic lines of intervention, articulated to the zoning proposal, under three axes of intervention: 1) Legal physical sanitation, security and public use; 2) Strengthening institutionality around heritage and territorial development; and 3) The systemic articulation of the interventions in the archaeological heritage and the strengthening of local identities and capacities, which will guide the execution of the programs, projects and activities.

The implementation of the Management Plan, through its programs, projects and activities, will help address the most important threats to the property described above. The Ministry of Culture is responsible for the execution, monitoring and evaluation of the Management Plan.

The Management System indicated in the Management Plan responds to a participatory approach expressed in two levels: The Management Committee and the Board of Trustees of the Chankillo Solar Observatory. The first is multisectorial, which guarantees a coordinated vision within the administrative system, thus avoiding the emergence of conflicts or activities incompatible with the conservation of cultural heritage and its rational use for development. Secondly, it is noteworthy that it has an external support body, the Board of Trustees of the Chankillo Solar Observatory which is included in the organizational approach as a means to guarantee its activity, its effective functionality and its strength of action. It constitutes a social coordination organism of great importance and, drawing on the experience from other sites in Peru, it will guarantee rationality and social commitment.

It also establishes three Line Units that cover the different technical and administrative aspects involved in the protection, conservation and management of Chankillo as an archaeological landscape: 1) the Archeology and Conservation Unit, responsible for the proper management of the archaeological site, in accordance with the scientific guidelines and with basic conservation and maintenance tasks; 2) the Territory Management Unit, responsible for the territorial monitoring of changes that may affect the integrity of the site and the landscape; it fulfills an articulating role with the provincial municipality in its management competencies and assignment of uses to the territory of its jurisdiction; and 3) the Participation, Communications and Tourism Unit, linked to the participative management of the local population and the management of visitors, generating the adequate conditions for public use.

On the other hand, the Management Plan foresees the participation of professional, technical and administrative personnel, dedicated to the direct administration of the programs, projects and
activities of the "Chankillo Solar Observatory and its Ceremonial Center". The personnel of the Decentralized Directorate of Culture – Ancash, of the Ministry of Culture, and of the Provincial Municipality of Casma, designated to support the implementation of the Management Plan, are added to this work team according to both entities (see Section 5.j).

Likewise, the Management Plan establishes the collaboration and participation of various relevant stakeholders interested in its implementation, such as national and international public and private institutions; committed to supporting the financing of programs and projects, through government sources, investment funds, non-reimbursable funds, works for taxes, international cooperation, and non-reimbursable financial cooperation (see Section 5.f Sources and levels of finance). Likewise, the collaboration of national and international institutions that will provide professional and technical academic support to research, conservation and management work is foreseen (see Section 5.g Sources of expertise and training in conservation and management techniques).

In this regard, since 2001, a relevant actor such as IDARQ has conducted archaeological research and conservation interventions for the buildings of the Chankillo Solar Observatory, under the auspices of World Monuments Fund, US State Department, Yale University, National Science Foundation, Wenner-Gren Foundation, Field Museum of Natural History, Center for Field Research, Compañía Minera Antamina, Provincial Municipality of Casma, Fund for Innovation in Science and Technology - Peru, French Institute of Andean Studies, and British Peruvian Cultural Association. In this sense, the Management Plan contributes to strengthen the inter-institutional cooperation that has already been developed in favor of the "Chankillo Solar Observatory and its Ceremonial Center", within a framework of institutionalized management and with a long-term vision.

**Monitoring**

Monitoring compliance with the objectives and results of the projects proposed in the Chankillo Solar Observatory Management Plan: Management of an ancient astronomical landscape in the Casma Valley 2018-2028 constitutes one of the priority tasks of the Ministry of Culture to ensure over time the conservation and sustainability of the physical attributes of Outstanding Universal Value of the property.

Therefore, the protection and management of the "Chankillo Solar Observatory and Ceremonial Center" represents for the Peruvian State the commitment to preserve for the present and future generations, the physical attributes of Outstanding Universal Value of an extraordinary property that is an example, unique in the world, of time control through the landscape in a monumental
scale. This property masterly integrates cultural elements and the natural environment and reveals the vital role of astronomical knowledge for early civilizations in the Andes, constituting one of Peru's valuable contributions to universal culture, and thus contributing to a representative, balanced and equitable World Heritage List.

**Monitoring of the landscape and the natural environment**

The Territory Management Unit is responsible for the territorial monitoring of the site and its landscape. It fulfills an articulating role with the municipality in its management competencies and assignment of uses to the territory of its jurisdiction. Because the astronomical landscape of Chankillo is highly fragile, with pressure from land uses that can affect the preservation of its values, it is essential to have an instrument to control and monitor changes and permanence in the territory. In this regard, through the project "Information and territorial monitoring" a technical solution will be found that will inform the management of Chankillo as municipal management, updated information on land use and territorial occupation trends. In this way, the multisector and multilevel articulation in landscape protection is reinforced (Project N° 11, Appendix XIII of the Management Plan).

Likewise, through the project "Institutional strengthening for the creation of the municipal service for the management of priority ecosystems for conservation", the Provincial Municipality of Casma will be supported in the implementation of the institutional arrangements and actions leading to the adequate conservation of the ecosystems present in the property, where the first step is the enactment of city ordinances recognizing their ecological importance, monitoring and awareness actions for their conservation (Project N° 13, Appendix XIII of the Management Plan).

**Monitoring of buildings**

The Archeology and Conservation Unit is responsible for the management of the archaeological site, according to scientific guidelines. It is responsible for the periodic monitoring of the state of the architectural structures throughout the site, so that the impacts and modifications are detected in a timely manner; as well as to prioritize the conservation actions that are required. In this sense, the monitoring and follow-up of the deterioration processes, as well as the effectiveness of the restorations, constitutes a permanent activity whose goal is to update the risk map and establish intervention priorities.

As a result, the Management Plan proposes routine monitoring, establishing periodic reviews to detect early modifications in the structural situation of the buildings of the property, anticipating
the conservation actions required to guarantee their preservation. This implies establishing a long-
term conservation program whose objective is to preserve the buildings of the site as an
expression of the physical attributes of the Outstanding Universal Value of Chankillo; working
to maintain its Integrity, Authenticity and respecting its cultural meaning. The program includes
preventive actions such as reinforcements, construction of temporary roofs, etc. Also,
conservation, restoration and maintenance works, according to intervention phases, specific
procedures, follow-up routines and monitoring.

It should be noted that monitoring the state of conservation of the architectural structures that
make up the buildings surveyed and registered between 2011 and 2013, will allow us to identify
how the deterioration processes are evolving in the property, which will generate both the
updating of risk maps, as well as the determination of intervention priorities and the deadlines in
which said interventions should be carried out, and in accordance with the Management Plan.

To the actions mentioned above, others are added such as the monitoring of the progress of the
implementation of conservation projects to evaluate results. Likewise, the monitoring of the load
capacity in Chankillo and the conditions of implementation of public use in Chankillo as part of
the action aimed at adopting measures to improve legal protection, access and public use of the
property and other sites in the astronomical landscape.

Similarly, in order to minimize the impacts on Chankillo, the monitoring of the environmental
footprint of the archaeological and monument conservation projects, the construction of the
service infrastructure, and the ecological footprint of visitors is considered.

The management system of Chankillo must ensure the good performance of the research projects,
which entails the conduction and monitoring of the progress of the research according to
compliance with the project monitoring indicators, established in the Management Plan.
3.2 Comparative analysis

3.2.1 Introduction and methodology

3.2.1.a Sources


The astronomical significance of the Chankillo site makes it outstanding and truly unique. The main component of the comparative analysis must therefore be thematic, and cultural astronomy (archaeoastronomy and ethnoastronomy) provides the necessary framework. Accordingly, the principal sources consulted in generating this comparative analysis, in addition to World Heritage List and national Tentative Lists, are:

- the two Thematic Studies on the heritage sites of astronomy and archaeoastronomy produced by ICOMOS in conjunction with the International Astronomical Union (IAU): Thematic Study 1, hereinafter "TS1", and Thematic Study 2, hereinafter "TS2" (Ruggles and Cotte 2010, Ruggles 2017);
- the UNESCO–IAU Portal to the Heritage of Astronomy (www.astronomicalheritage.org); and
- the Springer *Handbook of Archaeoastronomy and Ethnoastronomy* (hereinafter "HBAE"), which contains 182 case studies "ranging as widely as possible both geographically and through time and also in terms of the nature of the society in question and of their astronomical perceptions and practices" (preface, p. vi) (Ruggles 2014).

Regarding astronomically related properties already on the World Heritage List, we have also taken account of a list produced in 2009 by members of the IAU’s Working Group on Astronomy and World Heritage of no fewer than 78 World Heritage Properties with known or alleged astronomical connection, whether this forms part of the OUV or not (see TS1: 69–70 and www.astronomicalheritage.net/index.php/show-theme?idtheme=9). A list of the properties in this analysis, considered or mentioned, together with sources of information on them, is provided in Table 3-1. The site names given in bold in the text are presented in alphabetical order in the first column of Table 3-1. Cross-references are given to further information in TS1, TS2, HBAE and Portal to the Heritage of Astronomy, which in turn cite references in the academic literature. For the Portal, id=24 (say) indicates that the information in question will be found at www.astronomicalheritage.net/index.php/show-entity?identity=24&idsubentity=1.
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<td>Abu Simbel</td>
<td>Egypt</td>
<td>Inscribed</td>
<td>Nubian monuments from Abu Simbel to Philae</td>
<td>88</td>
<td>1979</td>
<td>(I)(iii)(vi)</td>
<td>124</td>
<td>9</td>
<td>138-139</td>
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<td>Caracol at Chichen Itza</td>
<td>Mexico</td>
<td>Inscribed</td>
<td>Pre-Hispanic Town of Chichen-Itza</td>
<td>483</td>
<td>1988</td>
<td>(i)(ii)(iii)</td>
<td>49-50, 271</td>
<td>35</td>
<td>106-124, 527-528</td>
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<td>1988</td>
<td>(i)(ii)(iii)</td>
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<td>Cueva de las Espeletias</td>
<td>Spain</td>
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<td>Cuzco</td>
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<td>City of Cuzco</td>
<td>273</td>
<td>1983</td>
<td>(iii)(iv)</td>
<td>72</td>
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<td>Dengfeng great grotto</td>
<td>China</td>
<td>Inscribed</td>
<td>Historic Monuments of Dengfeng in “The Centre of Heaven and Earth”</td>
<td>1305</td>
<td>2010</td>
<td>(i)(ii)(vi)</td>
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<td>[group] at Tikal</td>
<td>Guatemala</td>
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<td>Tikal National Park</td>
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<td>1979</td>
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<td>[group] structures (multiple locations)</td>
<td>Guatemala &amp; Belize</td>
<td>(site example inscribed at Tikal)</td>
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<td>USA</td>
<td>Inscribed</td>
<td>Chaco Culture</td>
<td>353</td>
<td>1987</td>
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<td></td>
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<td>596-598</td>
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<td>Giza necropolis</td>
<td>Egypt</td>
<td>Inscribed</td>
<td>Memphis and its necropolis—the pyramid fields from Giza to Dahshur</td>
<td>86</td>
<td>1979</td>
<td>(i)(iii)(vi)</td>
<td>133-135</td>
<td>24, 134</td>
<td>1519-1530</td>
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<tr>
<td>Governor’s Palace at Uxmal</td>
<td>Mexico</td>
<td>Inscribed</td>
<td>Pre-Hispanic Town of Uxmal</td>
<td>791</td>
<td>1996</td>
<td>(i)(ii)(iii)(vi)</td>
<td>50</td>
<td>24</td>
<td>1572-1573</td>
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<td>Grand Menhir Brist at Locmariaquer</td>
<td>France</td>
<td>Tentative List</td>
<td>Sites mégalithiques de Carnac</td>
<td>224</td>
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<td>Holy Moses navigation temple, Hawaii</td>
<td>USA</td>
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<td>67</td>
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<td>785-786</td>
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<td>Island of the Sun, Lake Titicaca</td>
<td>Bolivia</td>
<td>Tentative List</td>
<td>Sacred Titicaca Lake</td>
<td>1817</td>
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<td>893-896</td>
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<td>Jantar Mantar observatory at Jaipur</td>
<td>India</td>
<td>Inscribed</td>
<td>The Jantar Mantar, Jaipur</td>
<td>1138</td>
<td>2010</td>
<td>(iii)(iv)</td>
<td>108-112, 20</td>
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<td>Kamakura</td>
<td>Japan</td>
<td>Inscribed</td>
<td>Ancient Thebes with its necropol</td>
<td>87</td>
<td>1979</td>
<td>(i)(ii)(iv)(vi)</td>
<td>129-131, 22</td>
<td>135</td>
<td>1531-1539</td>
<td></td>
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<tr>
<td>Manjūra</td>
<td>Malta</td>
<td>Inscribed</td>
<td>Megalithic temples of Malta</td>
<td>132</td>
<td>1981-1992</td>
<td>(iv)</td>
<td></td>
<td></td>
<td>1421-1430</td>
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<tr>
<td>Monte Albán</td>
<td>Mexico</td>
<td>Inscribed</td>
<td>Historic Centre of Oaxaca and Archaeological Site of Monte Albán</td>
<td>415</td>
<td>1987</td>
<td>(i)(ii)(iii)(vi)</td>
<td>49</td>
<td></td>
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<td>Navao star-cirlces</td>
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<td>Palenque</td>
<td>Mexico</td>
<td>Inscribed</td>
<td>Pre-Costan City of Palenque</td>
<td>411</td>
<td>1987</td>
<td>(i)(iii)(iv)(vi)</td>
<td>49</td>
<td></td>
<td></td>
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<tr>
<td>Peak-dro-2000 circles (multiple locations)</td>
<td>Mexico</td>
<td>(some inscribed e.g. at Teotihuacan)</td>
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<tr>
<td>Peña de la Mula petrified forest</td>
<td>Mexico</td>
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<td>Piramids of Meidum, Giza</td>
<td>Egypt</td>
<td>Inscribed</td>
<td>Pre-Hispanic Town of Giza</td>
<td>483</td>
<td>1988</td>
<td>(i)(ii)(iii)</td>
<td>271</td>
<td>48</td>
<td>273</td>
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<tr>
<td>Piramids of Guadu and related structures</td>
<td>Egypt</td>
<td>Inscribed</td>
<td>Memphis and its necropolis—the pyramid fields from Giza to Dahshur</td>
<td>86</td>
<td>1979</td>
<td>(i)(ii)(iv)(vi)</td>
<td>133-135</td>
<td>24, 134</td>
<td>1519-1530</td>
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<tr>
<td>Rio Caldo</td>
<td>Spain</td>
<td>Tentative List</td>
<td>Rio Caldo and the sacred mountains of Gran Canaria</td>
<td>6081</td>
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<td>1112-1113</td>
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<td>Rock-cut panel at Ekeberg</td>
<td>Norway</td>
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<td>Saqqara</td>
<td>Egypt</td>
<td>Inscribed</td>
<td>Memphis and its necropolis—the pyramid fields from Giza to Dahshur</td>
<td>86</td>
<td>1979</td>
<td>(i)(ii)(iv)(vi)</td>
<td>122</td>
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<tr>
<td>Seven stone masts (multiple locations)</td>
<td>Portugal &amp; Spain</td>
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<tr>
<td>Stone circles</td>
<td>Poland</td>
<td>Not on List</td>
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<tr>
<td>Stonehenge</td>
<td>UK</td>
<td>Inscribed</td>
<td>Stonehenge, Avebury and associated sites</td>
<td>373</td>
<td>1986</td>
<td>(i)(ii)(iii)</td>
<td>41-62, 6-49, 105</td>
<td>1223-1238</td>
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<td>Stonehenge and associated monuments</td>
<td>UK</td>
<td>Inscribed</td>
<td>Stonehenge, Avebury and associated sites</td>
<td>373</td>
<td>1986</td>
<td>(i)(ii)(iii)</td>
<td>41-62, 6-49, 105</td>
<td>1223-1238</td>
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<td>Structure J at Monte Alban</td>
<td>Mexico</td>
<td>Inscribed</td>
<td>Historic Centre of Oaxaca and Archaeological Site of Monte Alban</td>
<td>415</td>
<td>1987</td>
<td>(i)(ii)(iii)(vi)</td>
<td>49</td>
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<tr>
<td>Structure P at Monte Alban</td>
<td>Mexico</td>
<td>Inscribed</td>
<td>Historic centre of Oaxaca and Archaeological Site of Monte Alban</td>
<td>415</td>
<td>1987</td>
<td>(i)(ii)(iii)(vi)</td>
<td>49</td>
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<tr>
<td>Tumuc Huato</td>
<td>Mexico</td>
<td>Inscribed</td>
<td>Chaco culture</td>
<td>503</td>
<td>1987</td>
<td>(iii)</td>
<td>227</td>
<td>41</td>
<td>594-599</td>
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<td>Tuxtlas</td>
<td>Mexico</td>
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<tr>
<td>Temple of the Feathered Serpent, Xochicalco</td>
<td>Mexico</td>
<td>Inscribed</td>
<td>Archaeological Monuments Zone of Xochicalco</td>
<td>939</td>
<td>1999</td>
<td>(i)(iv)</td>
<td>51</td>
<td></td>
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<tr>
<td>Temple of Heaven in Beijing</td>
<td>China</td>
<td>Inscribed</td>
<td>Temple of Heaven: an Imperial Sacrificial Altar in Beijing</td>
<td>881</td>
<td>1998</td>
<td>(i)(ii)(iii)</td>
<td>5</td>
<td>78-79</td>
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<td>Temple of Io at Dendra / Dendra</td>
<td>Greece</td>
<td>Tentative List</td>
<td>Phaneritic temples in Upper Egypt from the Ptolemaic and Roman period</td>
<td>1824</td>
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<td>Teotihuacan</td>
<td>Mexico</td>
<td>Inscribed</td>
<td>Pre-Hispanic Town of Teotihuacan</td>
<td>414</td>
<td>1987</td>
<td>(i)(ii)(iv)(vi)</td>
<td>50</td>
<td>23</td>
<td>729-736</td>
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<td>Thoth of Semneuma</td>
<td>Egypt</td>
<td>Inscribed</td>
<td>Ancient Thebes with its necropol</td>
<td>87</td>
<td>1978</td>
<td>(i)(ii)(iv)(vi)</td>
<td>125-128</td>
<td>22</td>
<td>1478-1484</td>
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<td>Ultaq Bugh’s meridian quadrant</td>
<td>Uzbekistan</td>
<td>Inscribed</td>
<td>Samarqand – Crossroad of Cultures</td>
<td>603</td>
<td>2001</td>
<td>(i)(iv)</td>
<td>166-168, 67</td>
<td>181</td>
<td>1922-1924</td>
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<td>Urupakha sun pillars</td>
<td>Peru</td>
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<td>Velshabamber, Neaj</td>
<td>Peru</td>
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<tr>
<td>Vila do Carro</td>
<td>Chile</td>
<td>Inscribed</td>
<td>Quipu Tar – Andean road system</td>
<td>1649</td>
<td>2014</td>
<td>(i)(ii)(iv)(vi)</td>
<td>62-64, 12</td>
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<td>Vila do Carro</td>
<td>Chile</td>
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<tr>
<td>Wadi Freij</td>
<td>Egypt</td>
<td>Inscribed</td>
<td>Ancient Thebes with its necropol</td>
<td>87</td>
<td>1979</td>
<td>(i)(ii)(iv)(vi)</td>
<td>122, 22</td>
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<td>Wadi Freij</td>
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<td>Xochicalco</td>
<td>Mexico</td>
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<td>Archaeological Monuments Zone of Xochicalco</td>
<td>939</td>
<td>1999</td>
<td>(i)(iv)</td>
<td>51</td>
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<tr>
<td>Xochicalco</td>
<td>Mexico</td>
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<td>Archaeological Monuments Zone of Xochicalco</td>
<td>939</td>
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<td>(i)(iv)</td>
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<td>749-758</td>
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3.2.1.b Themes

Shortly after its inception in 2004, UNESCO's Astronomy and World Heritage Initiative (AWHI) (whc.unesco.org/en/astronomy) proposed four broad types of cultural property associated with astronomical heritage (TS1: 1):

- properties which by their concept and/or their environmental situation have significance in relation to celestial objects or events;
- representations of the sky and/or celestial objects or events;
- observatories and instruments; and
- properties with an important link to the history of astronomy.

In this comparative analysis, we are concerned with a property of the first type, but also with something that can justifiably be termed an "observatory" or "instrument".

The observatories and instruments being referred to by the AWHI are generally sites important in the development of modern scientific astronomy (HBAE: 356–357), such as the great pre-telescopic observing instruments built between the 13th and 18th centuries in the Far East and the Islamic world, of which three outstanding examples are already inscribed on the World Heritage List—the Dengfeng great gnomon in China (inscribed in 2010 as part of "Historic Monuments of Dengfeng in ‘The Centre of Heaven and Earth’" [#1305], under criteria (iii) and (vi)); Ulugh Beg's meridian quadrant in Uzbekistan (inscribed in 2001 as part of "Samarkand—Crossroad of Cultures" [#603], under criteria (i), (ii) and (iv)); and the instruments at the Jantar Mantar observatory at Jaipur in India (inscribed in 2010 [#1338], under criteria (iii) and (iv)).

The term "observatory" implies that astronomical observations were the sole or primary purpose of a given site or construction, something that is rarely demonstrable outside the context of the world's great literate cultures and the history of modern scientific astronomy but is indeed the case at Chankillo. While the solar horizon calendar at Chankillo is not directly comparable with such technically sophisticated instruments as the examples mentioned above, the site could justifiably be termed an "observatory" because the evidence of the positioning of the towers and the observing points shows unequivocally that their primary purpose was to act as a calendrical instrument.

More broadly, Chankillo firmly belongs in the category of "properties [that] stand as a tribute to the complexity and diversity of ways in which people rationalized the cosmos and framed their actions in accordance with that understanding" (whc.unesco.org/en/astronomy). It demonstrates
and reflects the human capacity to understand the sky and celestial phenomena within an integrated world-view that brings together many different aspects of the social order and the perceived environment. This has happened in a tremendous variety of ways outside the Western scientific context, throughout the history of humankind, up to and including many modern indigenous cultures.

Astronomical connections may be manifested materially at these cultural properties in several ways. The most extensively recognized and discussed among archaeoastronomers are alignments, hierophanies (displays of light, usually sunlight or moonlight in enclosed spaces, often accorded sacred significance), and calendrical devices (HBAE: 358–359). These three aspects form the framework of the thematic analysis that follows.

In other cases, the intangible connections of a place with astronomy are preserved in surviving cultural traditions but are not manifested in any tangible way. An example is Holo Moana navigation temple in Hawai‘i, USA (TS1: 67; not on WH List), whose connection to navigation stars is not evident from the placement of components such as the stone uprights.

It is impossible to completely separate the first two broad types of astronomical heritage identified by the AWHI. Representations of the sky and/or celestial objects or events are less common than alignments, hierophanies and calendrical devices but a few examples do exist on the World Heritage List, such as the Pyramid of the Niches at El Tajín, Mexico (inscribed as part of "El Tajín, Pre-Hispanic city" (#631) in 1992, under criteria (iii) and (iv)), an architectural model of the world containing a series of 365 niches, and celestial diagrams such as those included in "astronomical ceilings" in Egyptian New Kingdom tombs, of which there are several examples in Western Thebes, Egypt (inscribed as part of "Ancient Thebes with its necropolis" (#87) in 1979, under criteria (i), (iii) and (vi)) (TS1: 122), the earliest known celestial diagram being contained within the astronomical ceiling at the tomb of Senenmut (TS1: 127-128). Other immovable celestial representations include Navajo star ceilings (TS1: 71–73; not on WH List), clusters of stars painted or stamped on the overhanging ceilings of natural rock shelters in the "four corners" region of the USA, and the Cueva de las Estrellas ("Cave of the Stars") in Gran Canaria, Spain, whose black ceiling is covered in white dots representing stars while the walls are dyed red, to represent the heavens and earth respectively (part of "Risco Caido and the sacred mountains of Gran Canaria", Spain's Tentative List—Portal to the Heritage of Astronomy www.astronomicalheritage.net, id=77). Rock art provides many motifs claimed to be symbolic representations of the sun, moon, or stars or of astronomical events, but most have very low
credibility (see below) because meaning is highly dependent upon context and cannot be assumed in the absence of living or historically recorded cultural connections. The archaeoastronomical literature abounds with notorious examples such as the supposed Supernova petroglyph at Chaco Canyon, USA (within the Chaco Culture National Historical Park, inscribed as part of "Chaco Culture" (#353) in 1987, under criterion (iii)—TS1: 271; HBAE 594-595) and a rock-art panel at Ekenburg, Sweden, interpreted as a literal depiction of the configuration of the sky during a total eclipse (see Ruggles 2005: 412-414; HBAE 357).

The other form of representation is manifested in the positioning of constructions within the landscape. "Cosmic landscapes", meaning landscapes modelled on the cosmos, are known in Chinese cities dating back at least as far as the 3rd century B.C.—an example being the Qin imperial capital of Xianyang (Not in WH List; HBAE: 2089–2090)—and in the layouts of temples such as the Temple of Heaven in Beijing, founded in the 15th century A.D. (inscribed as "Temple of Heaven: an Imperial Sacrificial Altar in Beijing" (#881) in 1998, under criteria (i), (ii) and (iii)), as well as in the general layout of the Giza necropolis in Egypt (inscribed as part of "Memphis and its necropolis—the pyramid fields from Giza to Dahshur" (#86) in 1979, under criteria (i), (iii) and (vi)) (TS1: 133–135; HBAE: 1511-1512).

The World Heritage List also contains examples from literate cultures of inscriptions referring to astronomical phenomena and the calendar. Thus there are inscriptions referring to the conjunction of the planets Jupiter, Saturn and Mars and the moon at the Mayan site of Palenque, Mexico (inscribed as "Pre-Hispanic City and National Park of Palenque" (#411) in 1987, under criteria (i), (ii), (iii) and (iv)) (TS1: 49) and references to stars among Egyptian Old Kingdom pyramid texts and Middle Kingdom coffin texts (HBAE: 1477–1487), with several examples at Saqqara (inscribed as part of "Memphis and its necropolis—the pyramid fields from Giza to Dahshur" (#86) in 1979, under criteria (i), (iii) and (vi)) and Western Thebes (inscribed as part of "Ancient Thebes with its necropolis" (#87) in 1979, under criteria (i), (iii) and (vi)) (TS1: 122).

Calendrical inscriptions include festival calendars found both at Saqqara and Western Thebes (TS1: 122) and various stelae with calendrical inscriptions at Xochicalco, Mexico (inscribed as "Archaeological Monuments Zone of Xochicalco" (#939) in 1999, under criteria (iii) and (iv)) (TS1: 51). In particular, the Temple of the Feathered Serpent at Xochicalco contains iconographic imagery relating to a hypothesized calendar reform in the 7th century AD (TS1: 51). Other examples of global importance include the Presa de La Mula petroglyph in Nuevo León, north-east Mexico (not on WH List; HBAE: 663-664), which is a tally record of seven lunar
synodic months, roughly equal to the gestation period of the female whitetail deer, including special markers interpreted as being for the 148- and 177-day eclipse cycles. The site is extremely important for studies of the use of calendars and astronomy by hunter-gatherers in the past. Credible tally records of apparent calendrical significance are rare, but the East Temple at Mnajdra, Malta (inscribed as part of "Megalithic temples of Malta" (#132) in 1980, under criterion (iv)) contains several series of drilled holes, which have plausibly been interpreted as intervals in days between the heliacal risings of successive bright stars (HBAE: 1426-1429).

**Pecked-cross circles**, of which scores of examples are known at and around Teotihuacan, Mexico (inscribed as "Pre-Hispanic City of Teotihuacan" (#414) in 1987, under criteria (i), (ii), (iii), (iv) and (vi)) as well as at a range of other Mesoamerican ceremonial centers, are symbols pecked in stucco floors or engraved on natural rocks. Comparison with ethnohistoric evidence, and counts of dots, suggest that these were primarily cosmological and calendrical symbols, but a variety of other meanings (not necessarily exclusive) have been suggested (HBAE: 737-742). However, there is no evidence of symbolic representations or inscriptions at Chankillo; thus alignments, hierophanies and calendrical devices constitute the thematic elements considered in detail in the following thematic analysis.

### 3.2.1.c Credibility

The credibility of a "fact" and its interpretation is the degree to which these have been proven or demonstrated according to current standards in a given scientific or academic discipline. In a World Heritage context, the concept of credibility is linked to that of authenticity (TS1: 267). The notion of credibility is a critical one in the case of archaeoastronomical evidence, because of the relative youth and interdisciplinary nature of the field, and the continuing tendency among some scholars to make claims that clearly cannot be sustained according to the standards of disciplines other than their own.

The first ICOMOS-IAU Thematic Study on astronomical heritage identifies four broad categories of archaeoastronomical credibility (TS1: pp. 270–271): (1) generally accepted; (2) debated among specialists; (3) unproven; and (4) discredited. The history of archaeoastronomy contains many notorious examples of sites claimed to contain many astronomical alignments, often leading to their being labelled, for example, as an "ancient observatory", despite the evidence not having withstood professional scrutiny. These include (i) the **stone circles at Odry** in Poland (TS1: 44; *not in WH List*), which were interpreted in the 1930s as a precise calendar, a claim that was later
thoroughly refuted, but not until after the site had become notorious by being used as a propaganda tool by Nazi archaeologists; (ii) The "Grand Menhir Brisé" at Locmariaquer, Carnac, France (part of "Sites mégalithiques de Carnac", France's Tentative List), claimed in the 1970s to be a lunar observatory (HBAE: 379); and indeed (iii) Stonehenge itself (inscribed as part of "Stonehenge, Avebury and associated sites" (#373) in 1986, under criteria (i), (ii) and (iii)), where archaeological and statistically flawed interpretations of dozens of putative alignments in the 1960s led to the site falsely being proclaimed as an ancient observatory and eclipse calculator (HBAE: 1224).

As the credibility of archaeoastronomical evidence is clearly an issue that must be taken into consideration, estimations of credibility are included throughout the thematic analysis that follows.

3.2.2 Thematic analysis
3.2.1 Properties considered in this analysis

(A) Stonehenge and associated monuments, UK

Inscribed as part of "Stonehenge, Avebury and associated sites" (#373) in 1986, under criteria (i), (ii) and (iii)

The Stonehenge area, which forms one half of the Stonehenge, Avebury and Associated Sites World Heritage Property, contains complexes of outstanding prehistoric funerary and ceremonial monuments dating to the Neolithic and Early Bronze Age. Stonehenge is the most architecturally sophisticated prehistoric stone circle in the world and, in addition, the area around it contains many hundreds of archaeological sites and monuments, many of which are also prehistoric. These monuments in their associated landscapes help us to understand Neolithic and Bronze Age ceremonial and mortuary practices in England and indeed in north-west Europe. They demonstrate around 2000 years of continuous use and monument building between c. 3700 BC and 1600 BC.

Alignments:
Several broadly contemporary sites within the Stonehenge area exhibit solstitial alignments (TS2: 43; HBAE: 1223-1238):

i) the axis of the stone setting at Stonehenge itself (bluestone horseshoe, trilithon horseshoe, bluestone circle, sarsen circle, Slaughter Stone and its companion, Heel Stone and its companion);

ii) Stonehenge Station-Stone rectangle (shorter axis);
iii) Stonehenge Avenue (the straight segment closest to Stonehenge);

iv) the axis of Woodhenge (concentric timber ovals);

v) the entrance of the southern circle at Durrington Walls henge; and

vi) the Avenue at Durrington Walls.

The longer axis of the station stone rectangle is roughly aligned upon the most southerly possible moonrise and most northerly possible moonset.

Credibility: 1—generally accepted. The existence of several solstitially-aligned monuments, incorporating both solstitial axes, makes it highly unlikely that this arose fortuitously as a result of other factors. However, whether the lunar alignment of the station stone rectangle was intentional is much more questionable, particularly as this is the direction perpendicular to the solstitial axis.

(B) Newgrange Neolithic passage tomb, Ireland

Inscribed as part of "Brú na Bóinne—Archaeological ensemble of the Bend of the Boyne" (#659) in 1993, under criteria (i), (iii) and (iv)

Newgrange, some 60m in diameter, is one of three great round cairns built within 3 km of one another on the northern side of the River Boyne during the latter part of the 4th millennium BC. The Newgrange cairn covers a single passage tomb while the others, Knowth and Dowth, cover two each. The area contains 38 known monuments in total, many of which are smaller satellite tombs surrounding Knowth and Dowth.

Hierophanies:

• For a few minutes after sunrise, on a few days around the winter solstice, a shaft of sunlight entered the tomb through a "roof-box" above the entrance and shone down the entire 19m-long passage into the central chamber. The sun's path at this solstice has shifted slightly since Neolithic times (by about one solar diameter), but the effect is still visible today.

Credibility: 1—generally accepted, because the case that Newgrange was deliberately "engineered" for this purpose is compelling (HBAE: 1273).

Alignments:

• The entrance of Newgrange is oriented towards sunrise at winter solstice.
Credibility: 1—generally accepted, because of the hierophany above. This is even though the solstitial alignment is not repeated Knowth and Dowth, except approximately in the case of one of the passages at Dowth; the idea that the nearly (but not quite) east- and west-facing passages at Knowth were equinoctial has now also been discounted. Nor is it repeated among the "satellite" tombs, which are generally oriented inwards towards the main tomb.

(C) Seven-stone antas, Portugal and Spain
Not on List

Seven-stone antas are a distinctive form of megalithic tomb built during the 4th millennium BC in central Portugal and the Extremadura region of western Spain. They were constructed to a surprisingly consistent architectural design.

Alignments:

- The 177 examples whose principal orientation has been reliably determined all, without exception, face within the arc of sunrise—the part of the horizon where the sun rises at some time during the year.

Credibility: 1—generally accepted. This extraordinary consistency in an orientation pattern that extends over hundreds of kilometers provides an exceptionally clear indication of its astronomical, and specifically solar, origin. While it is possible that the alignment target was the rising moon, the fact that the monumental orientations span the solar range but not the wider lunar range means that Occam's razor strongly favors the solar explanation.

(D) Pantheon, Rome, Italy
Inscribed as part of "Historic center of Rome" (#91) in 1980, under criteria (i), (ii), (iii), (iv) and (vi)

One of the best-preserved buildings of the Roman period in Rome, the Pantheon comprises a rectangular pronaos (portico) with three lines of granite columns fronting the main building, which is a huge hemispherical dome, 43.3m in diameter, built over a cylinder of the same diameter and as high as the radius. There is a circular opening (oculus) 8.3m wide in the top of the cupola. The wall in the interior is divided into sixteen regularly spaced sectors: the northernmost contains the entrance door while the rest contain niches and columned recesses in alternation. The Pantheon was built by Agrippa around 27 BC under Augustus’s rule, but its present form is due to Hadrian, c. AD 128.
Hierophanies:

• On sunny days, a beam of sunlight enters the dark interior through the oculus. During the winter months, it only illuminates the vaulted dome, but during summer days it reaches below the dome and on days close to the summer solstice it passes across the floor during the middle of the day. Around Apr 21 (as well as in late August) the beam of sunlight fully illuminates the entrance at noon, creating a spectacular hierophany. It has been suggested that this was orchestrated so that the emperor could "enter with the sun" during celebrations of the foundation of Rome on Apr 21.

Credibility: 3—unproven. The extraordinary architectural perfection suggests that the architects were certainly capable of producing the Apr 21 hierophany should that have been required, and the beam size does fit the entrance, but the annual and daily sweep of the beam of light is a simple consequence of the sun's motion in the sky given the presence of the oculus, and the days on which the supposed hierophany occurs could be a fortuitous consequence of the geometrical design and proportions for which a cultural explanation has been fitted post hoc.

(E) Pyramids of Giza and related structures, Egypt

Inscribed as part of "Memphis and its necropolis—the pyramid fields from Giza to Dahshur" (#86) in 1979, under criteria (i), (iii) and (vi)

The Giza Plateau contains the large pyramids of three kings of the 4th Dynasty; their related valley temples, upper temples, and causeways; the Sphinx and its temples; and the necropoles of the royal family and the nobles laid out to a grid plan. The site was selected by the 4th-Dynasty pharaoh Khufu (c. 2550 BC) as his resting place. His burial enclosure included a large pyramid, a large family necropolis and possibly the Sphinx. His son Khafre, who added several monuments and finished the second pyramid, completed this part of the necropolis. Menkaure, Khafre’s son, constructed the third pyramid and associated monuments at a later date. The entire period of construction lasted for some 80 years. The last major monumental construction on the Giza plateau was the step pyramid of Queen Khentkaus, forebear of the kings of the 5th Dynasty.

Alignments:

• The three main Giza pyramids are orientated to the cardinal directions with extraordinary precision, within a few minutes of arc. For such huge monuments, this could only have been achieved by astronomical observation, probably of ‘imperishable stars’ revolving around the north celestial pole such as those of Meskhetyu (Ursa Major).
Credibility: 2—debated among specialists. It is generally agreed that the north direction was most likely used as the point of reference but the method of using circumpolar stars to determine this direction accurately, as well as the particular stars that might have been used, remains open to question.

- Some of the ventilation channels emanating from two chambers in the interior of the Khufu's pyramid are aligned upon the passage of stars. If deliberate, these alignments could not have been of any practical use, and it has been suggested that their purpose may have been to symbolize and perhaps to facilitate the passage of the pharaoh into the sky in the afterlife (HBAE: 1526).

Credibility: 3—unproven. While the shafts from the King's Chamber fit two culturally significant stars quite well, the same is not true of the shafts from the Queen's chamber (HBAE: 1527), which weakens the hypothesis.

- Because of the general cardinal grid of the necropolis, the Sphinx, a personification of the god Horus at the horizon (at least from the New Kingdom onwards), faces the equinoctial rising sun. The general pattern of the necropolis also encapsulates a series of additional solstitial, cardinal and topographic and alignments.

Credibility: 2—debated among specialists. Many of the landscape alignments are plausible but the variety of alignments and the method of their selection leaves room for some doubt as to the intentionality of all of them.

(F) Temple of Isis at Dandara [Dendara], Egypt

On Egypt's Tentative List as part of "Pharaonic temples in Upper Egypt from the Ptolemaic and Roman periods"

The Dandara complex is one of the best-preserved temple enclosures in Egypt. While it includes the remains of buildings constructed in the Old, Middle and New Kingdom periods, most of what is seen today dates to the Ptolemaic and Roman periods. A circular zodiac apparently dating to the reign of Ptolemy XII or Cleopatra VII (1st century BC) was removed from the ceiling of a small chapel within the Temple of Hathor to the Louvre Museum in Paris and replaced by a replica.
Alignments:

- The Temple of Isis is aligned upon the rising point of Sirius (Sopdet), known to have been important in regulating the Egyptian calendar.

Credibility: 3—unproven. The idea that this alignment was deliberate is plausible because of the well-known cultural/calendrical importance of Sirius, but it is still only one of several temples within the Dandara complex and oriented differently from the others (TS1: 131).

(G) Karnak, Egypt

Inscribed as part of "Ancient Thebes with its necropolis" (#87) in 1979, under criteria (i), (iii) and (vi)

A large religious complex located in ancient Thebes, containing at least ten temples. The earliest structures date to the 21st century BC (11th Dynasty) and several kings from the New Kingdom onwards successively enlarged the sanctuary. The largest and most conspicuous temple is that of the god Amun-Re, the most important divinity of the ancient Egyptians from the 12th Dynasty through to the Ptolemaic period.

Alignments:

- The main axis of symmetry is aligned upon winter solstice sunrise and summer solstice sunset. It is also aligned perpendicularly to the course of the river Nile, owing to its situation on a bend in the river, at the only place in Upper Egypt where these two directions are perpendicular. This gives rise to the suggestion that this concurrence between topography and astronomy determined the location of Thebes, and Karnak in particular.

Credibility: 2—debated among specialists. The issue in question here is not whether the axis of symmetry was deliberately aligned but whether this was topographically or astronomically motivated (i.e. determined by perpendicularity to the Nile or by the solstices), or indeed whether the location was deliberately chosen to incorporate both.

(H) Abu Simbel, Egypt

Inscribed as part of "Nubian monuments from Abu Simbel to Philae" (#88) in 1979, under criteria (i), (iii) and (vi)

The temple of Abu Simbel was constructed in the 13th century BC, during the first decades of the reign of Ramesses II (19th Dynasty).
Hierophanies:

- A beam of sunlight enters the temple at dawn on Feb 22, illuminating the carved figure of Amon-Re and the shoulder of Re-Horakhty at his side, both gods with solar characteristics. The third carved figure—that of Ptah, the god of the underworld—stays in darkness. The date may correspond to the beginning of the Peret and Shemu seasons in the ancient Egyptian calendar.

Credibility: 2—debated among specialists. The solar associations of the two illuminated gods support the idea that this was an intentional phenomenon, but the lack of a convincing explanation of the date on which it occurred weakens it.

(J) Taosi, China

Not on WH List

A semi-circular terraced platform, between 30m and 40m across, situated within a walled town of the Longshan Culture, and dating to the late 3rd millennium BC. A series of 13 rammed-earth pillars spaced along the curved retaining walls of two of the terraces span the solar rising arc as viewed from a well-marked central point and are presumed to have formed a solar horizon calendar predating documented historically recorded methods for carefully determining the seasons. This site was uncovered and explored as part of an archaeological excavation and no trace remains above ground.

Calendrical devices:

- This site is interpreted as being a calendar observational device for observing the changing position of sunrise throughout the year.

Credibility: 2—debated among specialists. This interpretation is corroborated by other archaeological evidence, such as the existence of a painted stick interpreted as a gnomon (HBAE: 2109-2110), and is generally accepted among Chinese archaeoastronomers, although is undermined slightly by certain details, such as the fact that two of the pillars are on a separate wall from the other eleven.

(K) Wurdi Youang, Australia

Not on WH List

This is a 50m-wide egg-shaped ring of stones constructed by Aboriginals possibly relatively recently prior to European contact, but possibly several centuries or even millennia ago.
Alignments:

- The east-west axis of the egg, the solstitial orientation of two straight segments radiating from the eastern end, and the disposition of outlying stones placed beyond the western end together indicate possibly intentional alignments upon sunset at the solstices and equinoxes (TS1: 77).

Credibility: 2—debated among specialists. The east-west axis is clear, as are the solstitially aligned straight segments, which together provide a plausible argument for intentionality. However, the alignments involving the small outlying stones to the west are more questionable.

(L) Atituiti Ruga, Mangareva, French Polynesia

Not on WH List

A plateau containing numerous structures including terraces, walls, platforms, and upright stones, constructed around the 15th century. The largest platform was used until the mid-19th century for observing the range of rising positions of the sun over the islets of the outer reef to the east, with the limits of the sun’s course marked by pairs of stones set up on mountain ridges. The shadow cast by the peak of Mount Duff to the north was also used as an indicator of the December solstice.

Calendrical devices:

- The large platform at Atituiti Ruga is the only surviving structure known unequivocally (from both ethnohistoric and archaeological/archaeoastronomical evidence) to have been used for systematic solar observations in Polynesia prior to European contact.

Credibility: 1—generally accepted.

Alignments:

- There are no tangible alignments apart from those existing in the natural landscape. The platform itself is aligned cardinally and the pairs of stones noted in the 19th century site have disappeared without trace.

(M) Viña del Cerro, Chile

Not on WH List. The site was included in the Qhapaq Ñan World Heritage project (TS1: 64) but was not eventually included within the World Heritage Property "Qhapaq Ñan: Andean road system" (#1459).
A Diaguita-Inka metallurgical center dating to approximately A.D. 1400, located in the middle of the Copiapó river valley on a rocky hill at the foot of the Calquis Mountain, near the ancient Indian town of Painegue.

Alignments:

- The site contains an ushnu (platform) whose walls and diagonals are aligned upon two prominent mountain peaks together with the positions of sunrise on the two solstices (TS1: 62–64).

Credibility: 1—generally accepted. Around the Inca empire, ushnus seem to have served to symbolize the authority of the Inca in various ways, and specifically as places for performing rites related to the sun and the calendar together with sacred elements in the surrounding landscape such as prominent mountain peaks.

(N) Caguana, Puerto Rico, USA

Not on WH List

The Caguana Ceremonial Ball Courts Site, estimated to have been built by the Taíno people in around 1270 AD, is a ceremonial center containing approximately 13 ball courts (bateyes). Among the rocks and stones are various carved monoliths, some weighing over a tonne and most likely brought from the nearby Tanama River, and petroglyphs. Some of the rock engravings appear to be symbolic representations of astronomical objects.

Alignments:

- Several the plazas appear to be aligned according to astronomical events such as sunrise and sunset at the solstices and equinoxes. A long row of monoliths carved with reliefs displaying human figures is aligned equinoctially (TS1: 57-58).

Credibility: 3—unproven. A plan of the site shows many potential alignments with different orientations, out of which only a few have been selected. There are several approximately north-south alignments, suggesting that the east-west alignments may be cardinal rather than necessarily equinoctial.

(P) Group E at Uaxactun, Petén, Guatemala

Not on WH List

"Group E" at the Mayan site of Uaxactun (Waxactun) is the oldest architectural complex in the Americas ever analyzed from an archaeoastronomical point of view (in 1924). It is also important
as having become the ‘type site’ for a group of structures now known as **E-group structures**. These are Mayan structures of a distinctive form—one western pyramid with two or three in a north-south line located to the east—that are found at over 60 sites mostly within the Mayan central lowlands.

**Alignments:**

- As observed from a point on the staircase of the western pyramid, the eastern pyramids exhibited alignments upon sunrise at both solstices and at the equinoxes. However, these alignments became dysfunctional later, when the site had undergone modifications, and are not found at most other E-group structures (Aveni 2001): 288-293. They are now believed to have served as "theatres" from which observations were made not only of the sun but also of the moon, planets and of the stars within the zodiacal band (HBAE: 783-790).

Credibility: 1—the "zodiacal band" interpretation is generally accepted. It is consistent with the archaeoastronomical evidence from all the E-group structures, as well as with broader historical and archaeological evidence.

**Q Chichen Itza, Mexico**

Inscribed as "Pre-Hispanic City of Chichen-Itza" (#483) in 1988, under criteria (i), (ii) and (iii) Chichen Itza grew from a regional civic-ceremonial polity at the end of the 6th century AD, reaching its apex during the Late Classic and the Terminal Classic periods (c. 10th and 11th centuries) before declining following a civil war in AD 1221 (TS1: 49).

In addition to the archaeoastronomical elements listed below, the building known as Casa de Las Monjas contains pictorial representations of the Maya zodiac and the Temple of Venus contains an iconographic representation of 8 solar years equaling 5 Venus cycles.

**Alignments:**

- The **Caracol** is a circular building, which is rare in Mesoamerica and unique at Chichen Itza. Its partially ruined upper chamber contains narrow windows facing solstice sunset, sunset on the day of zenithal passage, the northernmost setting position of Venus, sunset at the equinoxes, and sunsets on August 13 and April 29, thus marking a calendrically significant time interval of 260 days (TS1: 49). It has thus been as interpreted as an observatory for watching the risings and settings of the sun, planets and stars (Aveni 2001: 272-279).
Credibility: 2—debated among specialists. There are multiple orientation possibilities and archaeoastronomers continue to debate the details. Despite the uncertainties, the building is widely referred to as 'the Observatory' (TS1: 271).

- The Great Ball Court is aligned upon sunset on August 13 and April 29, thus marking a time interval of 260 days.

Credibility: 2—debated among specialists. The intentionality of this specific alignment is unprovable but systematic analyses demonstrate that there are many orientations of this type among civic and ceremonial buildings throughout Mesoamerica (HBAE: 715–728).

Hierophanies:
- The Pyramid of Kukulcan, also known as El Castillo, is oriented some 21° clockwise from cardinal. Twice each year, at around the time of the equinoxes, the late afternoon sun slants across the stepped terraces of the NNW corner of the pyramid and casts a sinuous shadow onto one balustrade of the NNE staircase. At the bottom of the balustrade is a large stone serpent's head, and the shadow appears to complete the body of the serpent, undulating back up the balustrade. The shadow is visible for an hour or two, as sunset approaches (Ruggles 2005: 213).

Credibility: 3—unproven. There is no convincing historical or contextual evidence to support the conjecture that this hierophany was actually deliberate and intentional (TS1: 271). Despite this, the phenomenon attracts many thousands of visitors each year.

(R) Governor's Palace at Uxmal, Mexico
Inscribed as part of "Pre-Hispanic Town of Uxmal" (#791) in 1996, under criteria (i), (ii) and (iii)
Uxmal is a late Mayan town built between A.D. 700 and 1100.

Alignments:
- The so-called Governor’s Palace is anomalously oriented regarding other buildings at the site. Its entrance faces ESE-wards towards the most southerly rising point of the planet Venus around the date of its construction (early 10th century); the opposite direction is towards Venus’ most northerly setting point. The façade of the building contains iconographic representations of the Venus cycle and of the Mayan zodiac (Aveni 2001: 283-288).

Credibility: 1—generally accepted. While the directionality of the alignment has been the subject of debate, the iconography places the connections between this building and Venus beyond doubt
and the importance of Venus cycles in the Mesoamerican calendar is well attested in ethnohistory (HBAE: 775-780).

**(S) Monte Alban, Mexico**

Inscribed as part of "Historic Centre of Oaxaca and Archaeological Site of Monte Albán" (#415) in 1987, under criteria (i), (ii), (iii) and (iv)

Monte Alban is a ceremonial-administrative centre situated on the top of an artificially levelled ridge overlooking the valley floor. The city was founded around 500 BC and later became the capital of a Zapotec polity that interacted with other regional states such as Teotihuacan. It was largely abandoned around AD 900–1000.

*Hierophanies:*

**Structure P** contains a vertical shaft passing down into the back of a chamber underneath its main staircase. This has been interpreted as a "zenith tube" which allowed the light of the sun to pass down only at the time of zenith passage (Aveni 2001: 265-268).

Credibility: 2—debated among specialists. This interpretation is not universally accepted, with some claiming that it was more likely a chimney.

*Alignments:*

- **Structure J** is aligned towards the stars of the Southern Cross and Centaurus on one side and towards the heliacal rising position of Capella on the other (Aveni 2001: 262-270; TS1: 49).

Credibility: 3—unproven. Whether this was intentional is debatable.

- Stelae 12 and 13 contain orientations attesting to the division of a 260-day calendar into 4 minor cycles (*cocijos*) of 65 days each (TS1: 49).

Credibility: 2—debated among specialists. These orientations are the more plausible because the stelae also contain the earliest known inscriptions referring to a solar year.

**(T) Xochicalco, Mexico**

Inscribed as "Archaeological Monuments Zone of Xochicalco" (#939) in 1999, under criteria (iii) and (iv)

A fortified political, religious and commercial centre which first developed around 200 B.C. but flourished in the 7th to 10th centuries, a turbulent period following the collapse of Teotihuacan and other great Mesoamerican city-states such as Monte Albán, Palenque and Tikal.
Hierophanies:

- **"Zenith tube"**. A carefully constructed 5m-long vertical shaft descending into an artificial cave produces a column of light when the sun or moon is directly overhead. The shaft is in fact slightly inclined towards the north, so that a spot of sunlight falls on the cave floor on days between Apr 30 and Aug 12, thus dividing the year into periods of 260 and 105 days.

  Credibility: 1—that this was a "zenith tube" is generally accepted. There is no other viable explanation of such a well-constructed vertical tube. It has also been suggested that the shaft was used for precise lunar observations (HBAE: 749-758).

(U) **Teotihuacan, Mexico**

Inscribed as "Pre-Hispanic City of Teotihuacan" (#414) in 1987, under criteria (i), (ii), (iii), (iv) and (vi)

An extensive city founded before 150 B.C., but which grew to cover some 36 km² between the 1st and 7th centuries A.D., after which it collapsed. The ceremonial centre, running along the 40m-wide and 2.5km-long "Street of the Dead", contains the immense Pyramids of the Sun and Moon (named later in Aztec times). Among the later Aztecs the ruined city was revered as the place where the gods were created.

Alignments:

- The orientation of its Teotihuacan's regular street grid may have been determined by astronomical considerations, but this is debated.

  Credibility: 3—unproven.

- The Pyramid of the Sun is oriented to the setting sun on Apr 30 and Aug 13, dates separated by the calendrically meaningful interval of 260 days.

  Credibility: 2—debated among specialists. This conclusion is strengthened by systematic analyses demonstrating that there are many orientations of this type among civic and ceremonial buildings throughout Mesoamerica (HBAE: 715–728).

(V) **Fajada Butte "sun dagger", Chaco Canyon, USA**

(within the Chaco Culture National Historical Park, inscribed as part of "Chaco Culture" (#353) in 1987, under criterion (iii)—TS1: 271)
On a cliff-face towards the top of Fajada Butte, a 135 m-high rock column at the entrance to Chaco Canyon, are two spiral petroglyphs partially covered by three leaning stone slabs.

Hierophanies:
On a few days around summer solstice, shortly before noon, the centre of the larger spiral is directly lit by a "dagger" of sunlight for around 18 minutes. The smaller spiral exhibits a similar effect at the equinoxes (HBAE: 598-600). This spectacle achieved considerable fame following its discovery in the 1970s and remains for many the best-known manifestation of indigenous astronomy in the USA.

Credibility: 2—debated among specialists. Whether the phenomenon was deliberate, and if so, what was its cultural significance, was fiercely debated for many years (Ruggles 2005: 155). The subsequent discovery of several other "solstice daggers" in the south-west USA has strengthened the argument that the solstitial dagger, at least, was deliberate and meaningful (HBAE 621-628).

3.2.2.2 Calendrical devices
Throughout the ages, calendars have been represented or described in various ways in texts written in decipherable languages, monumental inscriptions and art, and on a variety of portable artefacts (HBAE: 26). As already discussed, several examples of tangible immovable heritage of this nature are already included within properties inscribed on the WH List, although they do not necessarily contribute to the recognized OUV.

Indigenous calendars are most commonly based upon the phase cycle of the moon (synodic months) with a variety of devices being used to keep them in tune with the seasonal year, including observations of the heliacal or acronychal rise of bright stars. Since observations of the phase of the moon or of the heliacal or acronychal rise of a star do not necessitate being in a given place with fixed visual reference points, such calendars do not give rise to material heritage in the form of observational markers.

Solar horizon calendars, conversely, do require the progress of sunrise or sunset to be tracked accurately from a single spot using natural or artificial markers. Devices that mark a single sunrise or sunset point on a particular date, for example, oriented structures aligned upon the horizon, are often claimed to have calendrical significance and, in some cases, could have been used for this purpose, but they might well have other functions and meanings (see §2.3 below). Thus, while many such alignments exist at cultural sites of all ages all over the world, it is inadvisable to jump to the conclusion that they were calendrical observing devices or instruments.
On the other hand, examples of true horizon calendars are extremely scarce, and none is currently represented on the WH List.

Atituiti Ruga in Mangareva, French Polynesia [L] is exceptional in that a solar observation point has been preserved in the form of a stone platform. This has been unequivocally identified as a place described in ethnohistorical accounts dating from the 1840s that was used for systematic observations of the sun over the seasons. However, no tangible evidence remains of the foresights. Man-made foresights described in the ethnohistorical accounts have disappeared without trace, and the remaining reference points were all places in the natural landscape.

Only two places in the world are known to exist where the sun could be accurately tracked over the entire year from a fixed spot using a series of man-made foresights. One is Taosi in China [J] and the other is Chankillo. In both cases, seasonal activities appear to have been orchestrated from a restricted spot by (presumably) members of a privileged elite. In both cases, narrow gaps between a series of markers (pillars at Taosi, towers at Chankillo) defined time intervals of just a few days, so that by reference to the gaps and markers an observer could identify a particular date in the seasonal year to within a margin of one or two days at most. By coincidence, there are 13 pillars at Taosi and 13 towers at Chankillo.

Ethnohistorical accounts record the use of towers on the horizon being used to mark positions of the setting sun for calendrical purposes within the Inca empire, some 1500 years after the construction of Chankillo. For example, a pair of vertical pillars located on a ceque line (see below) marked sunset on significant calendrical dates as viewed from the Temple of the Sun, Coricancha, in the Inca capital of Cusco, Peru (inscribed in 1983 as part of "City of Cuzco" [273], under criteria (iii) and (iv)). However, while the existence of these pillars is known from ethnohistorical sources, the pillars themselves have vanished without trace (HBAE: 833-834). Other examples do remain and have been identified by archaeologists and archaeoastronomers. The remains of pillars marking June solstice sunrise have been found in the Urubamba Valley (Sacred Valley), Peru (not in WH List) (HBAE: 873-874); markers for the June solstice sunset have been found on the Island of the Sun in Lake Titicaca, Bolivia (part of "Sacred Titcaca Lake", Bolivia's tentative list) (HBAE: 893-896); and both have been found in the Vilcabamba region of Peru (not in WH List) (HBAE: 833–834). The Chankillo calendar is distinguished from all these examples both by its much greater age and by the fact that there is a line of several towers spanning the entire solar rising and setting arc, so that it functions throughout the year, rather than simply marking particular dates such as one of the solstices.
The very fact that the thirteen towers at Chankillo are more or less equally spaced, rather than closer together towards the end of the line—as would have been needed in order to equilibrate the time interval taken by the sun to move from one tower to the next—emphasizes that the calendar here was based on direct observation rather than counting and calculation: the towers define the temporal structure, rather than the other way around. The slots between the pillars at Taosi do not demarcate equal intervals of time but are not evenly placed either, raising the possibility that they mark particular dates in what was a precursor to the historically recorded Chinese luni-solar calendars (HBAE: 2059-2068).

There are two main differences between Taosi and Chankillo, apart from their cultural context and age. The first is scale: Taosi is smaller, the foresights being rammed-earth pillars, perhaps originally about 1m high, at a distance of a little over 20m from the observer, whereas at Chankillo the towers are between 4m and 6m tall and, in the case of the Western Observing Point for instance, some 250m away from the observer.

The other difference, critically, is that Taosi is only evidenced through archaeological excavation. No trace remains above the ground. The Thirteen Towers of Chankillo, on the other hand, are not only large and impressive standing structures, but still functional. They are truly unique.

3.2.2.3 Alignments

There are numerous examples of sites around the world that contain isolated astronomical alignments, typically upon the rising or setting position of the sun on the visible horizon at one of the solstices or other culturally significant dates in the year. Some of the best-known prehistoric examples include Stonehenge [A] in the UK and Newgrange [B] in Ireland.

As TS1 states (p. 28), in dealing with such alignments one must take account of three fundamental issues. First, every oriented structure must point somewhere, whether intentionally or not. Second, several different factors might have influenced a structural orientation, of which only a few are related to the sky. Third, there are many potential astronomical targets, and there is therefore a good chance of being able to fit a fortuitous astronomical alignment to almost any structural orientation. Such factors have been considered when assessing credibility, as discussed above.

Stonehenge has often been referred to as a "calendar" but the existence of alignments marking the solstitial directions does not in itself imply more than an awareness of the changes in the seasons as a trigger for actions such as seasonal ceremonies. Sites with solstitial alignments such as
Stonehenge and Newgrange are accurate in space but not in time; because the rising or setting position of the sun only changes by a very small amount around the time of the solstices. The existence of the solstitial alignments does not imply the existence of a solar calendar; merely a broad appreciation of the changing position of the sun over the seasons. In practice, "solstitial" ceremonials at Stonehenge might have been held at times differing by several days or even weeks from one year to another. Stonehenge, in other words, was not an observing instrument.

This is even more obvious in the case of Newgrange, a tomb. What the alignment at Newgrange does convey, clearly, is that a strong connection existed in the minds of those who built this tomb between (on the one hand) death, ancestors and (on the other) ancestral spirits and the sun, seasons, and seasonal renewal. The case of Newgrange reminds us that in other cases (Stonehenge, for example) it is also wrong to assume that any such alignment, even if intentional, implies a practical purpose and/or actual repeated observations.

Groups of similar monuments can sometimes provide statistical verification of the intentionality of alignments. Thus, the astronomical significance of the seven-stone antas [C], a group of over 180 Neolithic dolmens in central Portugal and western Spain, is only evident from the group as a whole (TS2: 23–24). Other examples include "Hunebedden" (Neolithic tombs) in the Netherlands, Bas-Rhône-type dolmens in France, and "Tombe di Giganti" in Sardinia, Italy (TS1: 29–32). Systematic analyses of the orientations of ancient Egyptian temples and pyramids reveal both topographic and astronomical influences, including cardinal and solstitial orientation, stretching over some two millennia of construction from the Old Kingdom to the Late Period (TS1: 120-122; HBAE: 1501-1518).

Taken as a group, the orientation pattern of the seven-stone antas provides compelling evidence that the cultural protocols governing orientation were just as strict as those governing the architectural design—and involved orienting each monument as it was built upon the rising sun.

The example of the Group E at Uaxactun, Guatemala [P], considered in the context of other E-group structures, shows that the astronomical associations may be much more complex that simplistic interpretations of solstitial and equinoctial alignments might initially suggest. Although Group E was long proclaimed as an example par excellence of a site used for solstitial and equinoctial observations, it is now generally believed that the E-group structures were used more generally for observing a variety of astronomical bodies (sun, moon, planets, and stars) within the zodiacal band.
Some sites, including a number on the WH List, are claimed to include intentional stellar alignments. This is often controversial because of there are many bright stars and their paths through the sky change significantly on a timescale of centuries, meaning that it is easy to misinterpret fortuitous stellar alignments as intentional, especially if the date of the site in question is poorly known. The three large Pyramids of Giza, Egypt (E) are exceptional in this regard, because here it is probable that circumpolar stars were used to achieve near-perfect cardinal orientation, although disagreement remains among specialists as to which stars are most likely to have been used (HBAE: 1525). On the other hand, other claimed stellar alignments such as that of the ventilation shafts within the Khufu pyramid at Giza upon various stars, that of the Temple of Isis at Dandara, Egypt [F] upon the rising point of Sirius, that of Structure J at Monte Alban, Mexico [S] towards the Southern Cross and Centaurus, and the stellar orientation of the street grid at Teotihuacan, Mexico [U] all have low credibility. The factual basis of the alignment of the Temple of Isis upon Sirius is perhaps more credible than for many claimed stellar alignments because of the reasonably accurate dating of the temple, but it is still only one of several temples at Dandara (TS1: 131) and is oriented differently from later temples within the complex.

Planetary alignments in general are equally questionable because of the complexity of the motions of the planets and the fact that they move in a similar plane and their courses are often indistinguishable from one another. The alignment of the Governor's Palace at Uxmal, Mexico [R] upon the extreme rising or setting point of Venus is exceptional in that its intentionality is strongly attested independently by the associated iconography.

Returning to solar alignments, syntheses of orientations of Mesoamerican ceremonial architecture (HBAE: 715–728) highlight a widespread practice within Mesoamerica to orient civic and ceremonial buildings upon sunrise or sunset on days at intervals significant in the Mesoamerican calendar, e.g. 13 or 20 days. This is borne out at a number of specific sites such as the Caracol and the Great Ball Court at Chichen Itza [Q], stelae 12 and 13 at Monte Alban [S] and the Pyramid of the Sun at Teotihuacan [U], all in Mexico. However, in these cases the calendar is not regulated in any absolute sense by the solar alignments; instead, the alignments seem to symbolize already significant intervals in a calendrical system where counting time intervals was of key importance.

Many other sites appear to incorporate alignments, particularly upon sunrise or sunset at the solstices and/or equinoxes, as part of more complex schemes of sacred geography. A number of
these form part of properties already inscribed on the List, although the alignments do not contribute to the OUV. A good example is the general layout of monuments in the Giza necropolis, Egypt [E]. Around the Inca empire, platforms known as *ushmus* seem to have served to symbolize the authority of the Inca in various ways, and specifically as places for performing rites related to the sun and the calendar together with sacred elements in the surrounding landscape, such as prominent mountain peaks. An example is the *ushmu* at Viña del Cerro, Chile [M], a metallurgical centre dating to approximately A.D. 1400, whose walls and diagonals are aligned upon two prominent mountain peaks together with the positions of sunrise on the two solstices (TS1: 62–64). Another example is the Ceremonial Ball Courts Site at Caguana, Puerto Rico, USA [N], which combines symbolic representations of astronomical objects in rock engravings on rock slabs with several possibly significant astronomical alignments, suggesting that it functioned as a place to observe or predict astronomical events.

The Inca ceque system (HBAE: 851-861) provides an example of a highly complex organization of geographical and social space, interlinked with the sky and the calendar. The Coricancha, or Temple of the Sun, in the Inca capital of Cusco, Peru (*inscribed as "City of Cuzco" (#273) in 1983, under criteria (iii) and (iv) although the Coricancha itself has been largely destroyed) was at the centre of a system of 41 radiating conceptual lines, called *ceques*, which defined the location of 328 sacred places (*huacas*). These were the loci for carefully timed ceremonies played out around the landscape. It has been argued that this was associated with the use of a lunar sidereal calendar, although this interpretation remains controversial (TS1: 52).

In other cases, our knowledge of the cultural context is weak and the archaeoastronomical evidence is confined to alignments alone. Examples include the Wurdi Youang stone arrangement in Australia [K], a 50m-wide egg-shaped ring of stones constructed by Aboriginals possibly relatively recently prior to European contact, but possibly several centuries or even millennia ago. The east-west axis of the egg, the solstitial orientation of two straight segments radiating from the eastern end, and the disposition of outlying stones placed beyond the western end together suggest intentional alignments upon sunset at the solstices and equinoxes (TS1: 77), but the evidence is not conclusive. The example of Karnak, Egypt [G] shows that topographic and astronomical motivations for orientation may not be distinguishable from each other, and indeed may have both been present.
To summarize, while there is extensive evidence of astronomical alignments, many within existing World Heritage Sites, they are of varying credibility. Solar alignments are the most common, because they are the simplest to recognize and show to have been intentional. However, the mere existence of isolated solstitial and equinoctial alignments does not prove that the site in question was a calendrical instrument, or even that it was necessarily used specifically for observations of the sun. Some of the additional alignments at Chankillo, such as the solstitial alignment of the entrance to the Temple of the Pillars as viewed from the Observatory Building, and the approximately solstitial orientation of the buildings stretching over several plazas, are comparable in these terms with the patterns of orientation and alignments found at many sites elsewhere.

The Thirteen Towers, on the other hand, unquestionably did form an observing instrument. Unlike the architectural alignments upon a single astronomical target found at many ancient sites around the world, they span the entire annual solar rising and setting arcs as seen from the two observing points, not only giving direct indications of all four solstitial rising and setting points but also the means to identify every other day in the year by observing sunrise or sunset against the intervening towers and gaps between them. Chankillo is unique worldwide as a functioning solar calendrical observation device and an extraordinary and quite outstanding example of native landscape timekeeping (TS1: 59).

3.2.2.4 Hierophanies
In the archaeoastronomical context, hierophanies are invariably produced by sunlight or moonlight entering dark spaces and producing spectacular visible effects. Only sunlight and moonlight are strong enough to do this.

A few outstanding hierophanies of this type can still be experienced at sites inscribed on the World Heritage List. One of the most famous is the sunrise hierophany at the Newgrange passage tomb, Ireland [B]. It is unlikely that this was to be viewed by living participants, though, and clearly impossible once the tomb had been blocked off, although the roof-box opening above the blocked entrance ensured that light still entered the tomb at the requisite time. This supports the idea, already mentioned, that the phenomenon reflected a strong connection that existed in the minds of those who built Newgrange between (on the one hand) death, ancestors and ancestral spirits and (on the other) the sun, seasons, and seasonal renewal.
For hierophanies, as for alignments, we must consider the question of credibility. Hierophanies, like apparently significant astronomical alignments, can arise fortuitously and we must consider, in the light of all the available evidence, whether this is likely.

One of the most impressive and credible solar hierophanies occurs at the so-called "Cave of the astronomers" at Xochicalco, Mexico [T]. A carefully constructed, almost-vertical 5m-long tube opens out from the roof of this artificial cave. The sun shines down this tube when it passes over or close to the zenith. Because of the slant of the tube, direct sunlight reaches the floor of the cave each day for a 105-day period centered around the summer solstice, before then disappearing for a 260-day period. As both these periods have calendrical significance in Mesoamerica, it is supposed that the slant of the tube, and the timing of the phenomenon, is quite deliberate (Aveni 2001: 269, 360). That said, some scholars have argued that the hierophany is more likely to be lunar (HBAE: 749-758).

One other Mesoamerican zenith tube, also part of a World Heritage Site, is found at Structure P at Monte Alban, Mexico [S]. This is on a much smaller scale and comprises a vertical shaft about 1.5m high ascending from the middle of a staircase into the back of a small chamber below (Aveni 2001: 265-268). Its credibility is more questionable: some scholars argue that it is merely a chimney.

Another impressive hierophany involving an artificial cave takes place at Risco Caído in Gran Canaria, Spain (part of "Risco Caído and the sacred mountains of Gran Canaria", Spain's Tentative List—Portal to the Heritage of Astronomy www.astronomicalheritage.net, id=77). The main cave at this sanctuary is hollowed out with a smooth paraboloidal roof and is decorated with numerous cup-marks and pubic triangles. Between the spring equinox and the autumn equinox, morning sunlight enters the cave each day through a specially constructed opening and interacts with various of the carvings.

A solar hierophany of a different nature, and rather more controversial, occurs at the Pantheon in Rome, Italy [D]. Here, a beam of sunlight passes through an open hole (the oculus) at the top of the hemispherical roof and passes along the inside of the dome and (during the summer months) across the floor. Each year on about Apr 21 the beam fully illuminates the entrance at noon, creating a spectacular hierophany. It has been suggested that this was orchestrated so that the emperor could "enter with the sun" during celebrations of the foundation of Rome on Apr 21, but this idea is not generally accepted.
Three other hierophanies of a more questionable nature that occur at World Heritage Sites are the sunrise hierophany at the temple of Abu Simbel, Egypt [H], where carved figures of two solar-related gods are illuminated by sunlight on certain days in the year; the "equinox hierophany" at the Pyramid of Kukulcan at Chichen Itza, Mexico [Q], when sunlight produces an undulating body running up a staircase balustrade that is attached to the carved head of a serpent; and the "sun dagger" phenomenon involving two petroglyph spirals at Fajada Butte, Chaco Canyon, USA [V].

As described in Section 2.a, it is possible that the north-south row of decorated pillars with slits inside the Temple of the Pillars could have produced a hierophany of light-shadow interactions on the back wall of the gallery. As noted in 2a., it is likely that this wall would have been shaded during the day and throughout the year. This could conceivably have produced spectacular effects. However, this potential has been lost today, both because the temple space is no longer enclosed and because most of the pillars with their slits have been destroyed.

Thus, while the shadow casting hierophany in the Temple of the Pillars does constitute a significant aspect of the solar associations present at Chankillo, in a global context the temple hierophany at Chankillo is not outstanding.
3.3 Proposed Statement of Outstanding Universal Value

Brief synthesis

The Chankillo Solar Observatory and ceremonial center comprises a group of monuments set among various related buildings and plazas in a well-preserved desert landscape in coastal Peru. They include a unique triple-walled hilltop complex known as the Fortified Temple, and an iconic line of thirteen cuboidal towers stretching along the ridge of a natural hill. The ceremonial center was dedicated to a solar cult, and the presence of two archaeologically distinct Observing Points on either side of the north-south line of Thirteen Towers unequivocally shows that the primary purpose of these structures was to function together as a calendrical instrument using the sun to define dates throughout the seasonal year.

Several of the related monuments that form Chankillo are also constructed and oriented in relation to artificial and natural horizon markers and the sun in order to support, and in some cases to orchestrate wider participation in, calendrically regulated ceremonials. In addition, the Fortified Temple and the distant eastern horizon it faces demonstrate the development of ideas leading to the construction of the Solar Observatory.

Chankillo is one of only two places in the ancient world known to have incorporated a complete solar horizon calendar, using its markers to track the progressive passage of the sun along the horizon throughout the entire year. And it is the only one where it was achieved on a monumental scale and where all the component elements of the instrument are still extant and functional.

Chankillo’s carefully chosen location in a place of exceptional beauty, with an eastern horizon that is low enough for the observation of a rising celestial objects against distant natural foresights, the construction of an artificial horizon, and the precise design of the observation points and the Thirteen Towers, constitute an extraordinary example of the cultural transformation of the natural landscape, as well as the vital role of astronomical knowledge for early civilizations in the Andes.

Criterion (i)

The solar observation device incorporated in the Thirteen Towers of Chankillo, which permits the time of year to be accurately determined not just on one date but throughout the seasonal year, is unsurpassed as an example of ancient landscape timekeeping. Unlike architectural alignments upon a single astronomical target found at many ancient sites around the world, the line of towers spans the entire annual solar rising and setting arcs as viewed, respectively, from two distinctive observing points, one still clearly visible above ground. This device, known as the “Chankillo Solar Observatory”, not only provides direct indications of all four solstitial rising and setting
positions but also the means to identify every other day in the year by observing sunrise or sunset against the various towers and gaps between them.

**Criterion (v)**
The Chankillo Solar Observatory is an example, unique in the ancient world, of landscape time-keeping on a monumental scale that integrates elements of both the natural and built environment. Standing at the heart of a ceremonial center which incorporates further solar and possibly lunar alignments upon both constructed and natural targets, it exemplifies human interaction with a desert landscape and skiescape in a way that remarkably incorporates natural elements within the astronomical function, giving them a value similar to that of constructed elements. Astronomical observations at Chankillo are still possible in the present day because this fragile landscape, very vulnerable to change in the face of development pressures and climate change, keeps the shape and physiognomy that facilitated its astronomical functions over two millennia ago, retaining its exceptional pristine conditions with relict ecosystems that favor the conservation of the property.

**Integrity**
The Chankillo Solar Observatory and the wider set of related monuments that form the site take advantage of a set of artificial and natural horizon markers to define dates. Few places in the ancient world have these attributes, and Chankillo is one of only two yet known to incorporate a complete solar horizon calendar, using markers to track the progressive passage of the sun along the horizon throughout the entire year. These elements are still extant and functional. The property identified as the Chankillo Solar Observatory and Ceremonial Center comprises the necessary elements to preserve and transmit these attributes of its cultural value.

The integrity of the astronomical sightlines at Chankillo is important in evaluating its attributes. The viewsheds that contain these astronomical sightlines are generally unobstructed. In large part the natural environment and climatic conditions that resulted in the good visibility needed for astronomical observations at the site are conserved and the sightlines still function as intended.

**Authenticity**
The position of the Western and Eastern Observing Points in relation to the Thirteen Towers at Chankillo, identified by archaeological excavation and geophysical survey and verified by archaeoastronomical data, unequivocally shows that the primary purpose of all these structures was to act together as a calendrical instrument. This conclusion enjoys high scientific credibility, which is vital for archaeoastronomical data being considered in a heritage context.
Since the 3rd century BC the sun has shifted slightly at and around the solstices, less at other times in the year. This small change has a negligible effect on the solar and possibly lunar alignments around the site and does not affect the ability of a present-day observer to understand through experience, directly, the way in which the Chankillo Solar Observatory functioned.

Requirements for protection and management
The property is owned by the Peruvian nation, represented by the Republic of Peru, and managed by the State through its Ministry of Culture. It is protected by a series of provisions that recognize its condition of inalterable, inalienable, and imprescriptible National Cultural Heritage. Law 30467 (June 2016), promulgated by Congress, declared of national interest and public necessity the investigation, protection, revalorization and dissemination of Chankillo and adjacent prehistoric sites located in the province of Casma, department of Ancash. The Ministry of Culture is responsible for protecting the declared property through measures for its delimitation and its physical and legal protection. Likewise, any archaeological or conservation activity occurs within the framework of established regulations on archaeological and conservation interventions.

For the preservation, management and promotion of this property and its buffer zone, the Ministry of Culture, in cooperation with the local municipality and other institutions convened a multidisciplinary team of professionals for the development of a Management Plan, as an instrument for the investigation, conservation, and social use of the Chankillo Solar Observatory, from the perspective of its surrounding territory, where its interpretative meaning lies. The plan considers the Chankillo astronomical landscape not only from its visual and physiognomic aspects, but also from the perspective of the natural and sociocultural processes that underlie it. The plan is multisectorial, decentralized and participatory; it includes government branches as well as members of civil society (community organizations, universities, etc.). It identifies problems and proposes the protection, conservation, and regulation of the use of the property and its environment through zoning the property and its buffer area and by establishing a series of programs and projects to provide solutions. Currently, the Management Plan is under review by the Ministry of Culture. In addition, the Provincial Municipality of Casma has approved a Territorial Conditioning Plan (PAT) 2017-2037, which recognized the proposed boundaries of the property and its buffer zone as part of areas reserved for the development of agriculture, tourism, and ecotourism.
4. STATE OF CONSERVATION AND FACTORS AFFECTING THE PROPERTY

The cultural and natural attributes that express the Outstanding Universal Value of the Chankillo Solar Observatory and its ceremonial center are fully extant and are manifested within a desert environment that retains its pristine conditions. Thus, it is important to preserve and protect from natural and human threats the privileged appreciation we can still have today of the observatory and the natural context that structured the lifeways of Chankillo’s ancient inhabitants, through the social use of such masterly combination of human constructions and natural features.

The relatively short occupation of Chankillo, from the beginning of its construction to its violent end, indicates that the monument could not have been built without an existing accumulation of knowledge of, on one hand, the privileged conditions of its location and, on the other, the cyclical movement of the sun, and possibly the moon, in relation to the horizon. At the same time, the integration into the viewsheds of the Observatory, both from the Thirteen Towers and from the Temple of the Pillars, of a group of monumental prehistoric pyramids in the Casma valley (Huaca A, Moxeque, the summit of Cerro Sechin) and the large settlement at Pampa de las Llamas, indicate that Chankillo was connected, visually and territorially, with a set of sites in the valley.

In this context, it is essential for the understanding and perception of the Outstanding Universal Value of Chankillo to document the processes of the progressive acquisition of astronomical knowledge in sites prior to the property, as well as its relationship with coetaneous ceremonial, administrative and residential settlements within its visual fields. The conservation, protection, and management of this prehistoric heritage and the natural landscape related to its astronomical functions thus defines a very large area of influence, which requires action on a broader scale of intervention, complementing the actions on the property itself.

Owing to their monumentality, the Fortified Temple and Thirteen Towers have attracted visitors and researchers, national and foreign, generally interpreting it as a castle, a fortress, or ceremonial center and, recently, as an astronomical observatory, but always with a halo of mystery regarding its function. The importance of the scientific discovery of Chankillo as a solar observatory, unique in its function and age, has increased public interest in the site and resulted in more visitors. The organization and management of these visits, and the preparation of the site for its interpretive use, are necessary considerations for the conservation and protection of Chankillo while, at the same time, are an indispensable mechanism for transmitting its Outstanding Universal Value.
Considering the above, it is necessary to specify the criteria, guidelines, and procedures according to which we must evaluate both the current condition of the monument and its present threats, as well as the measures for its protection and conservation.

4.a Present state of conservation
Among the main strengths and potentials for public use of the Chankillo Solar Observatory is its state of conservation, which is characterized by its standing architecture and a well-preserved landscape, conditions that allow its astronomical function to be appreciated. However, time has caused deterioration in the elements that comprise it, and although the property has not undergone major alterations, conservation interventions are needed (Figure 4-1).

In the case of the constructions, the worst deterioration at present affects the stability of the walls and their mud finish. Some parts of walls are missing completely, mainly in the tops and faces. In the case of the Thirteen Towers and the east side of the Fortified Temple, both built on steep slopes, the stability of the walls is affected. Displacement has also been detected, due to structural pressures on the constructions, bulging of the masonry, overload and lack of stability of the support for the stone blocks, loss of verticality and partial collapse in the upper third of the walls, and finally, the presence of deep cracks that affect the integrity of the walls (Figure 4-2).
Figure 4-1. Deterioration over time. Source: Pimentel Archive (May 1967) and Chankillo Project (February 2012)
The stone blocks that compose the architectural elements at Chankillo also suffer various types of deterioration: detachments, fissures and cracks, weathering, fragmentation, disintegration or shelling and exfoliation, etc. In the case of the construction joints, the mortars used to lay stone blocks, and architectural fills, the main types of deterioration are fractures, detachments, missing parts, disintegration, erosion and biological attacks (Figure 4-3, Figure 4-4).

The mud finish on the walls is the element showing the greatest deterioration, especially for exposed walls; these suffer from the detachment of their substrate, disintegration, and erosion, caused largely by weathering, which is the most aggressive and persistent factor.

There is also deterioration in the wooden lintels of the Fortified Temple. When the jambs that support them are weakened, they are displaced, and subsequently the lintels fall, together with the fill that they hold. In addition, several factors have been detected that affect the wood itself: there are traces of rotting, attacks by xylophagous insects, crushing of the end of the lintel, deformation (bending) due to overload, and cracks.

A biological study investigated the fungi, lichens and other microorganisms capable of subsisting in arid zones, and the species found at the Fortified Temple (Salazar 2013). Five genera of fungi, one genus of bacteria, and two genera of lichens were identified by sampling on 6 monumental gates where fungi were present in the lintels or walls. Although the lintels do not currently face
any significant tangible damage, the episodic increases in relative humidity on the monumental
gates of the Fortified Temple, where the great majority of the lintels are located, has favored the
colonization of fungi and lichens on their surface and that of the stone walls. Fortunately, the low
rate of precipitation and the high temperatures slow growth and prevent their spread.

Figure 4-3. Physicochemical lesions in the North Keep
The causes of deterioration affecting the Chankillo Solar Observatory are classified into intrinsic and extrinsic. Among the first, the most important are the shortcomings in construction, such as the lack of homogeneity in the conformation of the walls; the arrangement of stone blocks without following a construction logic according to their shape and size; the use of friable lithic materials for the blocks; the absence of efficient ties between the blocks, and between them and structural fills; the lack of structural connection between different sections of the same wall; and deficiencies in the transmission of loads due to the irregularities in the way the stone blocks are laid.

Deficiencies in the materials employed are a serious problem in the structures. Tonalite was used as the main construction material. Because of its composition, tonalite tends to weather with some ease, unlike granite, which is also used at Chankillo. This weathering is worsened by environmental conditions, such as sudden changes in temperature and the presence of moisture.

The main extrinsic factor is wind. It arrives from the Pacific Ocean shoreline and enters Chankillo from the southwest, reaching 35 km/h, impacting with great intensity on all the
south-facing walls (Figure 4-5). These winds directly result in the erosion and loss of the masonry mortars, causing walls to easily lose blocks, whole sections, and in some cases the complete wall, owing to the compounded action of earthquakes and other abiotic events.

Figure 4-5. Wind impact at the Thirteen Towers of Chankillo

The wind also carries and accumulates sand in the form of dunes of different sizes and shapes (Figure 4-6). In addition, the wind carries salts which, combined with humidity, generate physical processes that alter the stones when condensing on their surfaces. An important factor is temperature, since the conjunction of winds and solar radiation generate an unfavorable microclimate, producing notable hygrothermal variations between dawn, noon and twilight. This expands and contracts materials, thus affecting the microstructure of the stones. In 2011, in the Fortified Temple, for example (Table 4-1), a difference of up to about 4°C was identified between a wall exposed directly to the winds (S) and another sector of the same wall protected by the large volume of the architecture (E). A difference of up to 11% in relative humidity was also observed.
Table 4-1. Measurements carried out on Wednesday August 24, 2011, between 10:15 and 14:40, in Wall 2, SE Access (EA 1-009). Conditions were clear and sunny.

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<tr>
<td>14:40</td>
<td>22.6</td>
<td>56</td>
</tr>
</tbody>
</table>
Figure 4-6. Predominant directions of winds and sand dunes
To understand the consequences of hygrothermal changes it is important to analyze one of its main causes: the exposure of the structures to sunshine. For example, at Tower 13 the measurements indicate that December presents greater exposure to natural light, while June has the least (Figure 4-7). This exposure to sunlight is spatially differentiated: the north wall face receives more hours of sunlight in June, despite being the month with the fewest daylight hours. The east and west wall faces receive almost constant sun-hours in the year, while the south face receives the smallest amount (Figure 4-8).

![Monthly natural light hours - 2018](image)

**Figure 4-7. Average monthly exposure to natural light at Tower 13, Chankillo**

As can be seen, the north and south wall faces present the biggest variations between the months with greatest and least natural illumination (December and June). This coincides with at least one of the faces that suffer greater disintegration in their lithic elements. 

![Sun Hours](image)

**Figure 4-8. Tower 13: exposure to sunlight by wall face in selected months, Tower 13**
Regarding salt, the presence of sulphates and sodium chlorides, which favor the weathering of the tonalite used in construction, was detected in different sectors.

Considering the incidence of intrinsic and extrinsic factors, a classification of the types of risk that affect the architectural structures of Outstanding Universal Value has been developed (Table 4-2), as well as an overall quantification of the walls in relation to their level of risk (Table 4-3).

**Table 4-2. Types of risk faced the by architectural structures at Chankillo**

| RISK TYPE 1 “STABLE AND COVERED” |

| The structures are covered by aeolian sand and/or debris from collapse, which protect the wall from changes in humidity & temperature while providing structural stability. |

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RISK TYPE 2 “COVERED AND IN THE PROCESS OF DETERIORATION”

The structures are covered by collapse. Due to the features of this material, it is possible for moisture to leak in, affecting the wall. Also, as part of this type were considered those structures that were excavated and covered with mats and/or polyethylene film to give temporary protection.

RISK TYPE 3 “IN PROCESS OF DETERIORATION”

It refers to the highest preserved section of the compound walls, such as the defensive walls or the gates. It is the exposed section starting at the meeting point between the slopes of the collapse material that cover both sides of the structure and the wall. Due to its features, it is possible that in case of rain, the moisture seeps in, affecting the wall. It also includes the elements exposed totally or partially, product of archaeological excavations.
RISK TYPE 4 “EXPOSED AND VULNERABLE”

It refers to walls that have been mostly covered by collapse, but where the upper courses or an internal fill of the wall or platform remain exposed, and to some extent unguarded.

RISK TYPE 5 “VERY VULNERABLE”

The exposed sections considerably exceed the collapse on the sides. The mortar used to lay the stone blocks is fatigued, and there are blocks in the upper courses that have been displaced.
RISK TYPE 6 “DETERIORATED”

The structures show the fatigue of the mortar used to lay the stone blocks, with some portions covered by collapse, with some displaced blocks and some missing altogether, as well as an internal fill that is loose and unstable.
RISK TYPE 7 “VERY DETERIORATED”

It involves the loss of mortar; displacement of most of the stone blocks, the loss of verticality/horizontality of a portion of the wall, an unstable internal fill, and the presence of cracks.

RISK TYPE 8 “CRITICAL”

Total loss of the mortar, displacement of most stone blocks, loss of some blocks, loss of verticality of the wall, detached and unstable internal fill, presence of cracks that compromise the stability of the wall and the complete loss of information regarding the original form.
RISK TYPE 9 “NOT OBSERVABLE”

These are elements that, as a measure of protection, have been covered with dry walls (pirca) before any conservation diagnosis, which makes it impossible to observe their condition.

Table 4-3. Quantification by risk type in the architectural structures at Chankillo

<table>
<thead>
<tr>
<th>AREA</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>SECTOR I</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1433</td>
</tr>
<tr>
<td></td>
<td>9</td>
<td>251</td>
<td>459</td>
<td>165</td>
<td>184</td>
<td>153</td>
<td>115</td>
<td>55</td>
<td>42</td>
<td></td>
</tr>
<tr>
<td></td>
<td>0,6%</td>
<td>17,5%</td>
<td>32,0%</td>
<td>11,5%</td>
<td>12,8%</td>
<td>10,7%</td>
<td>8,03%</td>
<td>3,84%</td>
<td>2,93%</td>
<td>100%</td>
</tr>
<tr>
<td>SECTOR II</td>
<td>44</td>
<td>54</td>
<td>0</td>
<td>36</td>
<td>14</td>
<td>35</td>
<td>18</td>
<td>2</td>
<td>0</td>
<td>203</td>
</tr>
<tr>
<td></td>
<td>21,7%</td>
<td>26,6%</td>
<td>0,0%</td>
<td>17,7%</td>
<td>6,9%</td>
<td>17,2%</td>
<td>8,9%</td>
<td>1,0%</td>
<td>0,0%</td>
<td>100%</td>
</tr>
<tr>
<td>SECTOR III</td>
<td>67</td>
<td>77</td>
<td>0</td>
<td>104</td>
<td>43</td>
<td>19</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>311</td>
</tr>
<tr>
<td></td>
<td>21,5%</td>
<td>24,8%</td>
<td>0,0%</td>
<td>33,4%</td>
<td>13,8%</td>
<td>6,1%</td>
<td>0,3%</td>
<td>0,0%</td>
<td>0,0%</td>
<td>100%</td>
</tr>
<tr>
<td>CHANKILLO</td>
<td>120</td>
<td>382</td>
<td>459</td>
<td>305</td>
<td>241</td>
<td>207</td>
<td>134</td>
<td>57</td>
<td>42</td>
<td>1947</td>
</tr>
<tr>
<td></td>
<td>6,2%</td>
<td>19,6%</td>
<td>23,6%</td>
<td>15,7%</td>
<td>12,4%</td>
<td>10,6%</td>
<td>6,9%</td>
<td>2,9%</td>
<td>2,2%</td>
<td>100%</td>
</tr>
</tbody>
</table>
4.b  Factors affecting the property
4.b.1  Development pressures
Peruvian coastal valleys are subject to developmental pressures, such as the construction of infrastructure and urban expansions to the cultivated areas. This means that the coast, the desert, the hills, and the river valley of Casma are subject to changes and refinements due to unplanned development. The Chankillo Solar Observatory is not immune to these pressures, but they do not substantially affect its original visual fields, attributes, or monumentality. Therefore, they do not compromise its Outstanding Universal Value. The architectural structures with astronomical functions are not as directly threatened by development pressure as they are by intrinsic and extrinsic deterioration factors. This is true because the property has an extensive unalterable zone and a buffer zone for its protection, and the pressures of development are located far from its limits.

However, in areas of the landscape associated with tracking solar cycles using natural markers, in Cerro Mucho Malo and the buffer zone, a series of threats are present that can affect the visual fields of the astronomical horizons—both the viewshed from the Western Observing Point and the eastern natural horizon visible from the entrance to the Temple of the Pillars (Table 4-4; Figure 4-10). The main risks of alteration to, or loss of character of, this landscape are from the expansion of cultivated fields; overlap with mining claims; human settlement and the installation of associated basic services; and infrastructure developments that produce conspicuous features in the landscape such as elevated drinking water tanks, power lines in neighboring settlements, and the installation of electrical towers within the visual fields. The last of these has already occurred in the case of the slope of Cerro Mucho Malo, where electrical towers hinder the vision of its operation together with the Thirteen Towers (Figure 4-9). Additionally, the expectation of the population regarding tourist development in the area increases the risk of constructions that are not in harmony with the rural landscape, both in terms of the height of the buildings and architectural style.
Figure 4-9. Visual contamination on Cerro Mucho Malo: Powerline on the visible slope (center right of the picture)
Figure 4-10. Activities that alter the archaeological landscape
<table>
<thead>
<tr>
<th>THREATS/RISKS</th>
<th>Infrastructure works</th>
<th>Urban growth</th>
<th>Inadequate use</th>
<th>Potential uses</th>
<th>Mining</th>
<th>Natural extraction resource</th>
</tr>
</thead>
<tbody>
<tr>
<td>PROPERTY</td>
<td>--------</td>
<td>--------</td>
<td>Uncontrolled visits</td>
<td>Scientific research, Education and Tourism</td>
<td>--------</td>
<td>--------</td>
</tr>
<tr>
<td>CHANKILLO MON. ARCH. ZONE</td>
<td>--------</td>
<td>Superposition of boundaries</td>
<td>Animal herding within the dry forest area</td>
<td>Scientific research</td>
<td>--------</td>
<td>Cutting of trees</td>
</tr>
<tr>
<td>CERRO MUCHO MALO</td>
<td>Power lines</td>
<td>El Purgatorio settlement in the lower slopes</td>
<td>Uninhabited</td>
<td>Scientific research, Education and Tourism</td>
<td>Quarry for construction materials in the lower slopes</td>
<td>--------</td>
</tr>
<tr>
<td>BUFFER ZONE</td>
<td>Power lines</td>
<td>Moderately dense human occupation</td>
<td>Agricultural expansion over archaeological sites</td>
<td>Scientific research, Education, Tourism and Agriculture</td>
<td>Adjacent mining claims; Polymetallic illegal mine</td>
<td>--------</td>
</tr>
</tbody>
</table>

Table 4-4. Pressures of development at the Chankillo Solar Observatory
4.b.2 Environmental pressures
These are mainly weathering and other natural processes (winds, marine factors, geodynamics, climate, seismicity) that directly threaten the prehistoric structures to varying degrees, both of intensity and deterioration, in the broader context of climate change and the El Niño Phenomenon (Table 4-5). An added factor is the environmental fragility of the area, since—together with the desert, the river valley and the surrounding mountains—the dune corridor characterizes the landscape. Changes due to human action can also strongly affect the structure of natural and ecological processes, especially those related to the dry forest: the chance of construction of buildings that interrupt the dune corridor, development infrastructure, and any changes in desert use that affect its current physiognomy.

Table 4-5. Physiographic elements and their dynamics

| Weather          | Low-risk environmental pressures, which nonetheless require permanent maintenance and monitoring, are mainly of climatic and mechanical origin. The climatic pressures relate to the strong levels of exposure to sunlight over the archaeological site and the high levels of humidity and surface water runoff during the winter. They are seasonal, with annual periodicity, extending for approximately four months between June and October. |
The mechanical environmental pressures have to do with the movement of sands. These produce continual erosion and/or burial of the architectural structures, especially those in the lower parts of the site (Eastern Observing Point, Observatory Building, Administrative Center). The sands also produce wear and abrasive erosion when hitting the walls and wall finish of the buildings (Figure 4-11).

Figure 4-11. Gate of the Fortified Temple covered by aeolian sand

Analysis of Landsat images since 1975 reveals that there is a dynamic balance in the dune corridors, so that overall, they are practically invariable. Moreover, within the property there are areas of sand sheets with greater stability, on some of which are present geoglyphs that remain clearly visible. The fact that these geoglyphs have not been buried by the sand shows that there has been little change in the surface for 2300 years, at least in this sector. Table 4-6 presents a summary of the environmental threats and vulnerabilities known for the Chankillo Solar Observatory and ceremonial center.
Table 4-6. Environmental threats and vulnerabilities at Chankillo

<table>
<thead>
<tr>
<th>Threats</th>
<th>Description</th>
<th>Vulnerability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strong insolation</td>
<td>Loss of mortar and structures. Thermal fracturing of stone</td>
<td>Exposure to intense and continuous climate factors. Absence of protective covers</td>
</tr>
<tr>
<td>Progressive and intense burial by sand</td>
<td>Accumulation of salts. Burial of walls. Erosion of mortar</td>
<td>Location along dune corridor (accumulation of sand and dunes). Absence of barriers</td>
</tr>
<tr>
<td>Very strong wind</td>
<td>Erosion and exfoliation of stone</td>
<td>Quality of construction materials and resistance to erosion; location along the dune corridor, absence of a permanent conservation team</td>
</tr>
<tr>
<td>Rains and seasonal humidity</td>
<td>Permanent erosion of bases and foundations, filtrations to the interior of structures</td>
<td>Natural features of the terrain and the materials in the soil. Topography and slopes ease run-offs of water</td>
</tr>
</tbody>
</table>

4.b.3 Natural disasters and risk preparedness
Seismic activity, transitory rains, and rains due to the El Niño Phenomenon are the main natural disasters that could damage the prehistoric structures at Chankillo. In addition, the Casma river valley is affected by annual seasonal floods, though not as serious as those produced by El Niño. The most recent El Niño floods and rains, which occurred in March 2017, caused great damage to the population and infrastructure of the province, as well as along the Peruvian coast. However, effects at the Chankillo Solar Observatory were limited; the rains were short-lived and the runoff that formed was not abundant enough to cause collapse of walls or the displacement of structures. Finally, the water was drained by the sandy soil. However, it is possible that the soaking of structures, albeit brief, has produced an internal weakening.

The local rains of March 2017 were intense, contrary to what had happened during the previous strong and very strong El Niño episodes, in the years 1982–83 and 1997–98. Ravines that had been dormant for decades were activated: analysis of the Landsat MSS images of 1975 and 1976 shows that some streams had not been activated since those times.

Chankillo is located within a small basin, although its past events are not evident owing to a constant cover by aeolian sand. Most of the alluvial channels and fans found on the left bank of the Casma river are buried beneath sands of variable thickness, since they are found along a dune corridor. This sand coating may also have contributed to a rapid infiltration (due to the greater porosity of sand), which prevented the occurrence of concentrated flows of great magnitude.
The presence of a dry ravine on the western slope of the hill on which the Thirteen Towers are built indicates that in the past there was a hydraulic event of considerable magnitude, which destroyed part of the structures (Figure 2-9). In the context of forthcoming and probable El Niño phenomena, which have no defined periodicity, and in the context of climate change, with an expected increase in rains and floods on the coast, the activation of this ravine is a risk to the integrity of the prehistoric structures, especially the Observatory Building.

In the area of the Casma valley adjacent to the property, the 2017 floods destroyed the main infrastructure (roads, ditches and canals, water wells, and power lines) and many agricultural fields were washed away by water. In this part of the buffer zone permanent infrastructure must be avoided.

Earthquakes are a perpetual feature of the Andean territory. Chankillo is located within the so-called Pacific Ring of Fire, an area of intense seismic activity. Historically, many earthquakes may have affected its buildings. Casma was hit by a great earthquake in 1970, which devastated the department of Ancash. However, even though earthquakes have occurred continually throughout Peruvian history, Chankillo remains standing. This does not, of course, mean that it could not be affected in the event of a catastrophic earthquake in the region.

There is no vegetation that could be subject to a fire, nor any other combustible elements, near the monumental structures of astronomical value. However, some superficial archaeological remains are situated within the relict dry forest, and there is a risk caused by the local practice, now under greater control but still happening, to burn the forest.

As for geodynamic factors, the possibility of landslides that can damage prehistoric structures is ruled out. Both the Fortified Temple and the Thirteen Towers are built on rock outcrops that ensure the stability of the soil and the archaeological structures, according to the studies conducted.

El Niño and seismic events are both unpredictable phenomena that require preparations to be permanently in place in case they should occur. The management system is tasked to prepare a Risk Plan that includes a seismic micro-zonification in order to evaluate the possible effects of earthquake scenarios on the structures, as well as preparations for torrential rains. Table 4-7 presents the main threats and vulnerabilities in the face of natural disasters at the Chankillo Solar Observatory.

Table 4-7. Main threats and vulnerabilities in the face of natural disasters at Chankillo
<table>
<thead>
<tr>
<th>Threats</th>
<th>Description</th>
<th>Vulnerability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seismicity with grave antecedents</td>
<td>Damage of the structures, proportional to intensity of seism</td>
<td>Geological location of the Thirteen Towers. Fragility of structures. Partial conservation interventions</td>
</tr>
<tr>
<td>Rains (El Niño, climate change)</td>
<td>Seasonal. Low incidence under normal conditions. Weakening of foundations and bases, loss of wall finish and mortars; runoff of water, sand, and mud, erosion and alteration of floors and structures</td>
<td>Exposed structures, absence of drainage, ravines running on natural terrain, especially in the lower parts of the site</td>
</tr>
<tr>
<td>Eventual rains and flooding (El Niño, climate change)</td>
<td>6-8 m of height difference between the lower parts of the site and the riverbed</td>
<td>Weak or inexistent flood defenses</td>
</tr>
<tr>
<td>Hydrological (El Niño, climate change)</td>
<td>Agricultural overexploitation in the context of climate change. Descent of water table</td>
<td>Location of the basin of hydrological capture, with traces of runoffs. Weak system of control of water wells</td>
</tr>
<tr>
<td>Geodynamic factors</td>
<td>Stable soils. No threats identified.</td>
<td>No threats identified.</td>
</tr>
</tbody>
</table>

### 4.b.4 Responsible visitation at World Heritage sites

The influx of uncontrolled visitors is one of the greatest threats against the areas with astronomical significance at the Chankillo Solar Observatory and ceremonial center. This leads to several problems: physical damage to the prehistoric structures; the inadequate use of the site; disorderly circulation; access to fragile or unstable sectors; vehicular access to areas near the main monumental area; solid waste; and a risk to the safety of the visitors when traveling through unstable areas. To these problems is added, owing to the relative absence of information, the partial or erroneous interpretation of the monument in terms of its cultural meaning and its Outstanding Universal Value.

Preparations for tourist visits are necessary. These contemplate the mitigation of the impacts of visitors to the site, by building circuits and infrastructure, as well as reversing the existing situation in which uncontrolled visits affect the physical integrity of the site. The impacts of tourist activity will also be minimized by the application of an established load capacity.

The movement of visitors takes place alternating between two different types of surfaces: natural surfaces (dunes and sands of the lower part of the site and the dry forest, the surface of the rocky outcrops and slopes, rocky soils) and constructed surfaces (interior of the architectural structures,
Qhapaq Ñan road). In the case of sandy soils, there is a need to avoid grooves, footprints and the displacement of terrain with superficial archaeological remains. This can be achieved by means of clearly marked trails that are permanently maintained. In the case of natural rocky soils, especially in the area of ascent towards the Fortified Temple, the impacts are minimal. On the other hand, the Thirteen Towers area, despite having a rocky base, is highly fragile. Both are risky to ascend for a visitor, so circulation must not be allowed.

Constructed or cultural surfaces are encountered mainly while circulating inside the Fortified Temple. The floors here are made up of soil and mud fill, stone and gravel. No cobblestones or pavements have been detected, but there are hard, compact earth floors. Studies have established that, with protection and adequate maintenance, these can support the load capacity. Stone floors have also been found, in the form of leveling foundations covered by layers of fill. These are not subject to direct contact with the public. Stairs, which are associated with entrances and traffic between terraces, must be submitted to conservation and permanent maintenance.

Guides and the mandatory accompaniment of visitor groups by specialized personnel will minimize the possibility of vandalism affecting the wooden lintels, stone surfaces or exposed wall finish. Likewise, the visit to the dry forest will be controlled and limited to restricted areas, thus reducing the impact on the plant and wildlife communities associated with the forest.

Finally, the population in the vicinity of Chankillo has a way of life totally integrated with modern life forms, and due to their migrant nature, they do not possess any cultural traditions related to Chankillo. The disruption of traditional cultures or ways of life will be minimal. On the contrary, it is likely that the management system and the projects to be developed will result in urban and rural memories being rescued together with the recent history of the valley, thus consolidating the local and regional identity through the planned construction of a cultural resource. The benefits of the rescue of the cultural memory include the topic of bilingualism, since many of the families are migrants who conserve Quechua, an indigenous language family, as their mother tongue.

The system of visitor services to be implemented at the Chankillo Solar Observatory is to be based on a signage system, a system of visitor reception and services, and two visitor circuits, as well as the permanent actions of monitoring and conservation. However, the function of interpretation of the site, due to the complex astronomical processes it contains, may not be
completed with a site visit, and should be supplemented with an exhibit that explains in various ways the Outstanding Universal Value of Chankillo.

4.b.5 Number of inhabitants within the property and the buffer zone
A lack of detailed demographic data for the buffer zone impedes an accurate estimate of the number of inhabitants. However, the number of families registered in the national censuses in some of the population centers in the area is available. These figures are approximations (Table 4-8, Table 4-9).

Table 4-8. Estimated populations according to zone

<table>
<thead>
<tr>
<th>Estimated population within:</th>
<th>3 people</th>
</tr>
</thead>
<tbody>
<tr>
<td>The proposed area of the property:</td>
<td>480 people</td>
</tr>
<tr>
<td>Total</td>
<td>483 people</td>
</tr>
<tr>
<td>Year:</td>
<td>2013</td>
</tr>
</tbody>
</table>

Table 4-9. Population by gender and age group, rural settlements in the vicinity of Chankillo (Gonzales, Gargate et al. 2014)

<table>
<thead>
<tr>
<th>Population by gender and age group</th>
<th>Hacienda</th>
<th>Cantina</th>
<th>Bs. As. Aloys</th>
<th>José Gálvez</th>
<th>Pueblo Joven</th>
<th>Paquito Grande</th>
<th>Chololque</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seniors 65</td>
<td>M</td>
<td>2</td>
<td>2</td>
<td>4</td>
<td>4</td>
<td>3</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>Adults (18-65)</td>
<td>M</td>
<td>43</td>
<td>28</td>
<td>24</td>
<td>15</td>
<td>9</td>
<td>7</td>
<td>18</td>
</tr>
<tr>
<td>Youth (12-17)</td>
<td>M</td>
<td>4</td>
<td>9</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>Children (1-11)</td>
<td>M</td>
<td>8</td>
<td>11</td>
<td>4</td>
<td>8</td>
<td>3</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>Infants</td>
<td>M</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>M</td>
<td>59</td>
<td>51</td>
<td>35</td>
<td>30</td>
<td>16</td>
<td>10</td>
<td>34</td>
</tr>
<tr>
<td></td>
<td></td>
<td>110</td>
<td>65</td>
<td>26</td>
<td>61</td>
<td>31</td>
<td>58</td>
<td>18</td>
</tr>
<tr>
<td></td>
<td></td>
<td>23%</td>
<td>13%</td>
<td>5%</td>
<td>13%</td>
<td>6%</td>
<td>12%</td>
<td>4%</td>
</tr>
</tbody>
</table>
5. PROTECTION AND MANAGEMENT OF THE PROPERTY

5.a Ownership
The current Political Constitution of Peru, in its Article 21° National Cultural Heritage, states that "the archaeological sites and remains, ... expressly declared, and provisionally those that are presumed as such, are our Nation's cultural heritage, regardless of their status as private or public property. They are protected by the State."

Thus, the proposed property “Chankillo Solar Observatory and ceremonial center” is owned by the Peruvian nation, represented by the Republic of Peru, and is administered by the Ministry of Culture through the Regional Directorate of Culture – Ancash.

By Law 28296, General Law of National Cultural Heritage, Art. 6.1, Chankillo, due to its "pre-Hispanic character, is the property of the State, as well as its integral and/or accessory parts and its discovered or undiscovered components, regardless of whether they are in public or private property. This property belongs to our National Cultural Heritage and has the condition of unalterable, inalienable, and imprescriptible, being administered solely by the State."

Thus, the Chankillo Monumental Archaeological Zone was declared National Cultural Heritage by National Directorial Resolution N° 075/INC, January 18, 2008 (INC 2008). The demarcation of the archaeological zone corresponds to the Delimitation Map PP-027-MC-DGPA/DSFL-2015, prepared by the Ministry of Culture. Currently the ministry has initiated the process for the legal inscription of the Chankillo Monumental Archaeological Zone, which will culminate with its inscription in the Public Registries of Peru.

On December 4th, 2017, the Provincial Municipality of Casma issued City Ordinance 036-2017-MPC declaring Cerro Mucho Malo a municipal area of conservation.

5.b Protective designation
The Chankillo Monumental Archaeological Zone is protected by a series of provisions that recognize its importance as National Cultural Heritage and ensure its preservation:

- National Directorial Resolution N° 075/INC, January 18, 2008 (INC 2008), declaring National Cultural Heritage the Chankillo Monumental Archaeological Zone, located in the district of Casma, department of Ancash.
- Specific Agreement for Inter-institutional Cooperation between the Ministry of Culture, the Provincial Municipality of Casma, and World Monuments Fund, of October 15, 2014,
renewed for three years on October 15, 2018, to guarantee the preservation and promotion of the cultural values of Chankillo, and the formulation of a Management Plan.

- City Ordinance 002-2014-MPC, January 29, 2014, from the Provincial Municipality of Casma, which declares of tourist interest the prehistoric sites of Chankillo, Casma Alta and Manchan, the natural heritage composed by the Manchan Longitudinal Dune and Cerro Mongon, and the adjoining areas that they enclose.

- Law N° 30467, June 17, 2016, declaring of national interest and public necessity the investigation, protection, revalorization and dissemination of Chankillo and adjacent archaeological sites located in the province of Casma, department of Ancash.


5.c Means of implementing protective measures
Protection of the Chankillo Monumental Archaeological Zone and nearby archaeological sites from alteration is maintained, legally, through their declaration as National Cultural Heritage. In the case of Chankillo, this is done through National Directorial Resolution 075/INC, January 18, 2008 (INC 2008), declaring National Cultural Heritage the Chankillo Monumental Archaeological Zone, located in the Casma district, department of Ancash. The Ministry of Culture is the institution responsible for protecting the declared property through measures for its delimitation and physical and legal protection. Likewise, any archaeological or conservation activity occurs within the framework of the Regulation on Archaeological Interventions (DS 003-2014-MC, Art. 7.2).

Operationally, the basic protection of Chankillo is attained through a formal agreement between the Ministry of Culture, World Monuments Fund, and the Provincial Municipality of Casma. Since 2015, the municipality has hired, in the framework of this agreement, two guards for the Chankillo Monumental Archaeological Zone. The guards, of local origin, provide security in the areas and times of greatest risk, and issue monthly reports of security incidents. They also carry out other actions, such as chatting with the population and appearing on local radio stations to promote the need to avoid damage to the monument by eliminating the unregulated passage of vehicles and people. They are supervised by the regional branch of the Ministry of Culture—the Decentralized Directorate of Culture, Ancash (DDC Ancash)—through the Regional Museum "Max Uhle" Casma - Sechin, as well as by personnel from House of Culture of Casma, a local entity recognized by the Ministry, and of course by the provincial municipality that hires them.
Through Municipal Ordinance N° 002-2014-MPC, January 29, 2014, which declares the natural heritage of the Manchan Longitudinal Dune, Cerro Mongon and adjacent areas to be of “tourist interest”, part of the surroundings of the Chankillo Solar Observatory is protected from the advance of possible damaging uses that are incompatible with its associated cultural values, such as mining and urban development.

Likewise, on December 4th, 2017, the Provincial Municipality of Casma issued City Ordinance 036-2017-MPC declaring Cerro Mucho Malo, an integral component of the property Chankillo Solar Observatory, a municipal area of conservation.

For the preservation, management and promotion of the Chankillo Solar Observatory and ceremonial center, the Ministry of Culture of Peru in cooperation with the Provincial Municipality of Casma and World Monuments Fund convened a multi-disciplinary team of professionals for the development of a management plan (Martinez 2017). Funded by the city of Casma and World Monuments Fund, the project was multi-sectorial, decentralized and participatory; it included government branches, members of civil society (community organizations, universities, others), and local and regional entrepreneurs. A diagnosis of the current situation was made, identifying the problems and establishing a series of programs and projects to provide their solutions; likewise, the proper zoning of both the property and the buffer zone was considered. Currently, the Management Plan is under review by the Ministry of Culture.

5.d  Existing plans related to the municipality and region in which the proposed property is located

In 2017, the Provincial Municipality of Casma approved a Territorial Conditioning Plan (PAT) for the Casma province, 2017-2037 (Casma 2017). The PAT includes Chankillo in its 2017-2037 vision, stating that among the various goals the Casma province should achieve in that period are: "... Chankillo as a unique solar astronomical observatory, promoting the circuit of beaches and adventure sports in the coastline of Casma... ". The PAT includes the Chankillo Monumental Archaeological Zone and the southeastern slopes of Cerro Mucho Malo, as well as the Buffer Zone proposed in this dossier. Chankillo is associated on its west side, and through the North Pan-American Highway, to the "Commercial and Tourist Development Axis", and on its east side, where the agricultural lands of the Casma river valley converge, to the "Agricultural Development and Ecotourism Axis". Both axes of development are included within the PAT.
5.e  Property management plan or other management system
The "Chankillo Solar Observatory Management Plan: Ancient Astronomical Landscape in the Casma Valley, 2018-2028" is an instrument for the investigation, conservation, and social use of the Chankillo Solar Observatory, from the perspective of its territory, where its interpretative meaning lies (Martínez 2017). It considers the Chankillo astronomical landscape not only from its visual and physiognomic aspects, but also paying attention to the natural and sociocultural processes that underlie it—these same processes that have maintained and animated its functional essence for over two millennia.

The Management Plan was developed by Instituto de Investigaciones Arqueológicas, working with the Provincial Municipality of Casma, the Ministry of Culture, and the Chankillo Project, and had an active participation from the local population. It proposes the protection, conservation, and regulation of use of the property and its environment through zoning (Maps 2 and 3, Figure 1-1); operative and administrative aspects are the responsibility of the Management System proposed.

The Plan contemplates the definition of several strategic lines of intervention, articulated to the zoning proposal. Its axes of intervention are the following:

- Physical delimitation, legal registration, security and public use
- Strengthening institutionality around heritage and territorial development
- Systemic articulation of interventions in archaeological heritage and the strengthening of local identities and capacities.

5.e.1 Zoning
Using various analytical criteria, the Management Plan established various sub-zones within the area of the property, and a buffer zone. The sub-zones are considered sufficiently flexible to adapt to changing situations in the territory.

Property
This is the area that contains the attributes of the monumental complex and of the landmarks that demonstrate its astronomical function and constitute the essence of its cultural meaning. It is subdivided into several sub-zones:

- Sub-zone of monumental intensive use (102 ha)
This covers the architectural structures directly linked to the solar cult and astronomical observation. This area will contain facilities for interpreting the cultural significance of the site.

- Sub-zone of extensive construction (213 ha)

This includes architectural structures broadly aligned in a solstitial direction, which are totally or partially covered, and protected, by aeolian sand.

- Sub zone of restricted use (1661 ha)

This includes the entire area surrounding the previous subzones towards the Pan-American highway and the southeastern and northern sector of Chankillo; it contains geoglyphs, quarries, and other highly fragile archaeological elements.

- Sub zone of special treatment (137 ha)

This is a strip bordering the valley, formed by a dry carob tree forest, stabilized dunes, and remains of prehistoric occupations on the surface. It includes some areas occupied by the local population before the first physical delimitation in 2013.

- Sub zone of natural astronomical marker (2368 ha)

This comprises Cerro Mucho Malo, as a fundamental part of the natural elements in the landscape used as horizon markers.

**Buffer Zone**

The buffer zone aims to protect the landscape of the coastal desert around the property in order to guarantee the continuity of its astronomical function and of the landscape values inherent to its astronomical condition. It is subdivided into several sub-zones:

- Sub zone of agricultural valley (2390 ha)

Comprising the middle Casma valley, this extends from Casma Alta to Fundo Pacae; it contains populated centers and scattered dwellings on the edges of the valley.

- Sub zona of coastal desert and Andean foothills (32626 ha)

This is an extensive desert plain, flanked by the foothills of the Andes mountains, dotted with rolling hills.
• Sub zone of natural and cultural heritage (7627 ha)

This includes all areas within the buffer zone declared National Cultural Heritage, or selected to preserve ecosystems, topographic features, or materials essential to the preservation of the astronomical and cultural landscape.

• Sub zone of visual influence (1347 ha)

This comprises the chain of mountain tops in the sightline of the astronomical horizon.

5.e.2 Management Structure
The Management System is the administrative body responsible for the management and integral conservation of the Chankillo Solar Observatory and ceremonial center, together with its associated astronomical landscape. It is constituted in accordance with national administrative regulations and is also inspired by international principles of World Heritage management, since its mission is to guarantee the continuity of the Outstanding Universal Value of the site, its authenticity and its integrity.

Administratively, the Management system belongs to the Ministry of Culture, and is dependent on the Vice-Ministry for Cultural Heritage and Industries. It is responsible for the execution, measurement and evaluation of the Management Plan, as well as for updating it as and when necessary. Its participatory approach is reflected in two levels:

• The Management Committee, an advisory body that is multisectoral, supervisory and regulatory in nature, whose main objective is to ensure full compliance with the Management Plan, but also contributes to the creation of the necessary institutional and social conditions. It seeks the participation of social and cultural organizations from Casma.

• The Board of the Chankillo Solar Observatory, an external support body for the coordination with social organizations, serves to guarantee the effective execution of the plan.

Three Units cover the different dimensions in the protection and conservation of Chankillo as an archaeological landscape:

• Archaeology and Conservation Unit

• Landscape Management Unit.

• Citizen Participation, Communications and Tourism Unit
Finally, a Contingency Plan is proposed, which aims to achieve steady progress, within the framework of the strategic lines of intervention, allowing those projects considered priority can be initiated once while the institutional arrangements for the operation of the Management System are being specified.

5.f Sources and levels of finance
Since 2001, the Chankillo Project, of Instituto de Investigaciones Arqueológicas IDARQ, has conducted research and conservation interventions at the Chankillo Solar Observatory, under the auspices of World Monuments Fund ($1´500,000), US State Department ($125,000), Yale University ($350,000), National Science Foundation ($15,000), Wenner-Gren Foundation ($30,000), Field Museum of Natural History ($10,000), Center for Field Research ($100,000), Compañía Minera Antamina ($200,000), Municipalidad Provincial de Casma ($100,000), Fondo de Innovación en Ciencia y Tecnología – Perú ($120,000), Instituto Francés de Estudios Andinos ($20,000), Asociación Cultural Peruano Británica ($50,000), among others.

The Management Plan for the Chankillo Solar Observatory, currently under review for approval by the Ministry of Culture, is designed to last 10 years, with an estimated budget of:

- Investments S/ 39’173,216.62
- Management system S/ 18’481,542.00
- Total S/ 57’654,758.62

For the execution of the Management Plan of the Chankillo Solar Observatory, the following funding sources are considered:

**Government sources**
- Ministry of Culture
  In the programmatic areas of Legal Registration and Security, Public Use, Heritage Management, Support for the Strengthening of Territorial and Municipal Environmental Management, Support to the Local Unit of Education Management (UGEL) in Heritage Education, Research and Conservation, Adaptation of Infrastructure for Conservation, Research and Public Use, Strengthening of Local Capacities.
- Provincial Municipality of Casma
  In the programmatic areas of Legal Registration and Security, Support for the Strengthening of Territorial and Municipal Environmental Management, Strengthening of local identity.

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• MINCETUR - Plan COPESCO
  In the programmatic areas of Heritage Management, Research and Conservation.

• MINCETUR - CALTUR and CENFOTUR Program
  In the programmatic area of Strengthening Local Capacities.

• PROMPERU and Casma Chamber of Commerce and Tourism
  In the programmatic area of Public Use.

• FONDEP National Fund for the Development of Peruvian Education - MINEDU
  In the programmatic area of Support to the UGEL in Heritage Education.

• Ministry of Housing, Sanitation, and Construction
  In the programmatic area of Strengthening Local Identity.

• National University of Santa - Congress of the Republic - Central Reserve Bank
  In the area of Research and Conservation.

• Antúnez de Mayolo University and OEFA (Agency of Evaluation and Environmental Inspection-MINAM).
  In the programmatic area of Strengthening Local Identity.

**Investment funds**

• MINCETUR-Plan COPESCO
  In the programmatic areas of Public Use, Research and Conservation.

• Regional Government of Ancash
  In the programmatic area of Support for the Strengthening of Territorial and Municipal Environmental Management.

**Non-refundable funds**

• UNESCO - Japanese Funds-in trust for the preservation of the World Cultural Heritage
  In the programmatic areas of Legal Registration and Security.

**Works for Taxes**

• Ministry of Culture Program "Points of Culture"
  In the programmatic area of Public Use.

**International cooperation**

• The Nature Conservancy - TNC
  In the programmatic areas of Sustainable Management of Protection and Public Use, Support for the Strengthening of Territorial and Municipal Environmental Management.

• AECID
In the programmatic areas of Promotion and Dissemination, Support to the UGEL in Heritage Education, Strengthening of Local Capacities.

- JICA (Japan International Cooperation Agency)
  In the programmatic areas of Heritage Management, Research and Conservation.

- Peru Countervalue Fund - Japan
  In the programmatic area of Strengthening Local Identity.

- KOICA (International Cooperation Agency of South Korea)
  In the programmatic area of Strengthening Local Identity.

- GIZ (German Agency for Technical Cooperation)
  In the programmatic area of Strengthening Local Identity.

- UNESCO, CRESPIAL
  In the programmatic area of Strengthening Local Identity

- Inter-American Development Bank and Countervalue Fund Peru - Australia
  In the programmatic area of Strengthening Local Capacities.

- BTC (Belgian Development Agency), Countervalue Fund Peru - France and the Andean Community of Nations (CAN)
  In the programmatic area of Support to the UGEL in Heritage Education.

- UNWTO - ST-EP (Sustainable Tourism Foundation to Eliminate Poverty)
  In the programmatic area of Support for the Strengthening of Municipal Tourism Management

- USAID
  In the programmatic areas of Support for the Strengthening of Territorial and Municipal Environmental Management, Sustainable Management.

- Ministry of Foreign Affairs of Finland
  In the programmatic area of Support for the Strengthening of Territorial and Municipal Environmental Management.

Escrow
- Private Enterprise - Ministry of Culture - Provincial Municipality of Casma
  In the research area of Research and Conservation.

Non-reimbursable financial cooperation
- World Monuments Fund
  In the research areas of Research and Conservation.
5.g Sources of expertise and training in conservation and management techniques
Instituto de Investigaciones Arqueológicas (IDARQ) carries out research, conservation and management work in collaboration with these institutions:

At the national level
- World Monuments Fund Peru (conservation, heritage management)
- Ministry of Culture (heritage management, research, and conservation)
- Provincial Municipality of Casma (heritage management)
- University of Piura (research, heritage management)
- National University of Trujillo (conservation)

On an international level
- World Monuments Fund, USA (conservation)
- Yale University, USA (research and conservation)
- DeVos Institute, University of Maryland, USA (heritage management)
- Center for Pre-Columbian Studies and the Polish Society of American Studies, University of Warsaw, Poland (World Heritage Management)
- Department of Chemistry, University of Warsaw, Poland (conservation)
- French Institute of Andean Studies, France (research)
- Magadán y Asociados, Argentina (conservation)

Similarly, for specialization and training at the national level, the following research and study academic degrees are available:

- Master's Degree in the Conservation and Management of Built Heritage: National University of Engineering.
- Master's Degree in Cultural Heritage Management: San Marcos National University.
- Master's Degree in Cultural Management, Heritage and Tourism: University of San Martín de Porres.
- Master's Degree in Museology and Cultural Management: Ricardo Palma University.
- Master's Degree in Cultural Management: University of Piura
- Master's Degree in Architecture with mention in Management of Cultural Heritage, Centers and Historical Sites: San Antonio Abad of Cusco National University

As national specialization and training, the following accredited courses are available:
• Restoration of Historical, Architectural and Urban Heritage: Faculty of Architecture, Alas Peruanas University.
• Conservation of the Cultural Heritage Property: School of Architecture, Peruvian University for Applied Sciences.
• Conservation of Built Heritage: Faculty of Architecture, University of Lima.
• Monument Restoration and Monument Restoration Workshop; National University of Engineering.
• Historical Heritage Conservation: Faculty of Architecture, Ricardo Palma University.
• Restoration of Monuments: Federico Villarreal National University.
• Architectural Restoration: Faculty of Architecture, San Agustin of Arequipa National University.
• Conservation of Architectural Heritage: Faculty of Architecture, San Antonio Abad of Cusco National University.

Workshops and non-regular courses on architectural heritage conservation are also offered and/or promoted by the Ministry of Culture, Pontifical Catholic University of Peru, National University of Engineering, San Antonio de Abad of Cusco National University, San Agustin of Arequipa National University, and Metropolitan Municipality of Lima, among others.

5.h Visitor facilities and infrastructure
Currently, the Chankillo Solar Observatory is not adequately prepared to receive flows of tourists: there is no minimal infrastructure that would enable visitors to arrive along appropriate roads, no parking area, and no other basic visitor services such as a reception, bathrooms, rest areas, sale of drinks, snacks, or handicrafts, etc. There is security, but it is insufficient. Tourism is thus limited, and there are many improvised, unregulated visits, although the frequency of activity is increasing in the hands of a few operators with good practices. Supporting this requires tourist circuits to be established, with shaded stopping places, signage, interpretive panels, and the other aforementioned services. For these reasons, the Management Plan considers a strong investment in the adaptation of the property for tourism, consisting of the employment of permanent staff and the implementation of services for visitors (parking area, reception area, two visitor circuits, hygienic services, signage, interpretive panels, rest areas, and trained guides).

5.i Policies and programmes related to the presentation and promotion of the property
The Management Plan for the Chankillo Solar Observatory considers a set of policies and programs (
The adequate management and protection of Chankillo and its landscape will promote the well-being of the population that interacts with the monument, generating an effective social use of the property and offering an opportunity for local development.

The process of intervention, management and social use of the Chankillo Solar Observatory is conceived from a comprehensive understanding of the site and its surroundings as an ancient astronomical landscape, within the criteria of conservation of its essential properties, which are inherent to its astronomical function, and on the conditions of articulated management between valley, plains, hills and littoral.

The management and conservation of the ancient astronomical landscape is inspired by the following four axes: participation, facilitation, understanding and valorization, under a rigorous scientific approach, of interventions respectful of authenticity and integrity, with interventions limited to what is necessary, in order to achieve a correct conservation and careful documentary record of the processes.
<table>
<thead>
<tr>
<th>POLICIES</th>
<th>STRATEGIC LINES</th>
<th>PROGRAMS</th>
<th>PROJECTS</th>
<th>ACTIONS</th>
</tr>
</thead>
</table>
| 1. Implement measures to improve the legal protection, access and public use of Chankillo and other cultural heritage within its astronomical landscape | 1.1. Determine the physical delimitation, legal protection and safety conditions at Chankillo | Legal protection and custody of the monument | - Delimitation and legal inscription of Chankillo  
- Delimitation and legal inscription of the archaeological sites in the valley | - Comprehensive security system for Chankillo  
- Organization of spaces for dialogue and permanent evaluation of the participatory protection process |
| | 1.2. Implement a plan for public use that facilitates access and service to local and foreign visitors to the site | Participatory security and protection | - Community protection system for Chankillo and the cultural heritage of the San Rafael Valley | - Monitoring of the load capacity and the conditions of implementation of public use in Chankillo |
| | 1.3. Generate an environmentally sustainable management in the protection and public use of Chankillo and its landscape | Facilitation of services to the visitor | - Chankillo Visitor center: interpretation and other services  
- Implementation of circuits and tourist facilitation  
- Tourist sensitization to local residents | - Monitoring of the environmental footprint of archaeological and conservation projects  
- Implement service infrastructure responsible with the environment  
- Measure ecological footprint of visitors  
- Measure ecological footprint and minimize the impacts of management processes in Chankillo |
| | 1.4. Raise interest in knowledge of the values of Chankillo | Environmental management | - Environmental baseline and management plan of the Chankillo astronomical landscape | - Web page and periodicals with advances of research  
- Planned visits for local population to learn about the progress of the interventions at Chankillo |
<p>| | | Promotion and dissemination | - Publication of educational material on the heritage of the Casma-Sechin valley | |</p>
<table>
<thead>
<tr>
<th>2. Strengthen multisector institutionality linked to the archaeological heritage and its environment</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1. Strengthen the processes of governance and multisector articulation for heritage management</td>
</tr>
<tr>
<td>-</td>
</tr>
<tr>
<td>Renovation of the Max Uhle Regional Museum as support of the heritage management of the Casma – Sechín valley</td>
</tr>
<tr>
<td>2.2 Support local government in the exercise of control over territorial use around Chankillo</td>
</tr>
<tr>
<td>Territorial management</td>
</tr>
<tr>
<td>Information and territorial monitoring</td>
</tr>
<tr>
<td>Landscape management of the Casma – Yaután highway</td>
</tr>
<tr>
<td>Management of priority conservation ecosystems</td>
</tr>
<tr>
<td>Recovery and management of the carob tree forest</td>
</tr>
<tr>
<td>Sustainable management of fog-oases</td>
</tr>
<tr>
<td>Institutional strengthening for the management of priority conservation ecosystems</td>
</tr>
<tr>
<td>2.3. Promote the dissemination of educational themes on the appropriation of local heritage by the UGEL Casma</td>
</tr>
<tr>
<td>Education about the heritage of the Casma Valley</td>
</tr>
<tr>
<td>Capacity building for teacher in heritage education</td>
</tr>
<tr>
<td>Heritage education for students</td>
</tr>
<tr>
<td>Young guardians of heritage</td>
</tr>
<tr>
<td>3. Systemically articulate the conservation and</td>
</tr>
<tr>
<td>3.1 Develop the conservation and</td>
</tr>
</tbody>
</table>
| archaeological and social interventions in the valley with a territorial perspective | study of Chankillo with an articulating vision of the landscape | **Conservation**  
- Preventive actions exterior defensive walls, Fortified Temple  
- Preventive actions interior defensive wall, Fortified Temple | **Conservation**  
- Preventive actions Fortified Temple Keeps  
- Preventive actions Fortified Temple Platform  
- Preventive actions Temple of the Pillars, Fortified Temple  
- Preventive actions Observatory Building  
- Preventive actions Administrative Complex  
- Restoration of the Thirteen Towers, currently underway  
- Restoration Keeps, Fortified Temple  
- Exterior defensive wall restoration, Fortified Temple  
- Inner defensive wall restoration, Fortified temple  
- Restoration Platform, Fortified Temple | **Monitoring, emergency actions and upkeep**  
- Monitoring, emergency actions and upkeep |
<table>
<thead>
<tr>
<th>3.2 Promote processes to strengthen the capacities of the local population</th>
<th>Capacity building</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adequation of infrastructure for research, conservation, treatment of materials for the study and public use of the site</td>
<td>Construction and furnishing of laboratory and storage area</td>
</tr>
<tr>
<td></td>
<td>Evaluation and archaeological monitoring with excavations for the installation of infrastructure for tourism</td>
</tr>
<tr>
<td></td>
<td>Maintenance</td>
</tr>
<tr>
<td>3.3. Promote the strengthening of the local identity of the San Rafael Valley populations</td>
<td>Rural habitat</td>
</tr>
<tr>
<td></td>
<td>Recovery of memory and rescue of the intangible heritage of the San Rafael Valley</td>
</tr>
<tr>
<td></td>
<td>Community Ecomuseum</td>
</tr>
<tr>
<td></td>
<td>Registry of intangible heritage</td>
</tr>
<tr>
<td></td>
<td>Promotion of the dissemination of intangible heritage</td>
</tr>
<tr>
<td></td>
<td>Dissemination and sensibilization of actions to improve the environment and quality of life</td>
</tr>
<tr>
<td></td>
<td>Productive rural housing</td>
</tr>
<tr>
<td></td>
<td>Solid waste management in rural areas</td>
</tr>
</tbody>
</table>
5.j **Staffing levels and expertise**
Currently, the Chankillo Monumental Archaeological Zone has two guards, hired since 2015 by the Provincial Municipality of Casma by agreement with the Ministry of Culture. They are supervised by staff of the "Max Uhle" Casma - Sechin Regional Museum, which belongs to the ministry, and by the House of Culture of Casma. The Management Plan for the Chankillo Solar Observatory provisions the following personnel:

<table>
<thead>
<tr>
<th>AREA</th>
<th>COMPETENCIES</th>
<th>PROFESSIONALS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Executive Directorship</td>
<td>Responsible for managing the site</td>
<td>1 Executive Director, designated by the Ministry of Culture</td>
</tr>
<tr>
<td>Archaeology and Conservation Unit</td>
<td>Responsible for the archaeological management of the site, with three sub-units:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Projects, Registration, Monitoring</td>
<td>- 3 archaeologists</td>
</tr>
<tr>
<td></td>
<td>- Research and Conservation</td>
<td>- 2 conservators</td>
</tr>
<tr>
<td></td>
<td>- Analysis and conservation of cultural materials</td>
<td>- 1 lab and field assistant</td>
</tr>
<tr>
<td>Landscape Management Unit</td>
<td>Responsible for monitoring the evolution in the use of the territory, introduction of new uses, and compliance with the zoning approved in the Territorial Conditioning Plan</td>
<td></td>
</tr>
<tr>
<td>Citizen Participation, Communications, and Tourism</td>
<td>Responsible for managing the participation of the local population and visitors, with two sub-units:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Participation and Communication</td>
<td>- 1 expert in participation and Communication</td>
</tr>
<tr>
<td></td>
<td>- Tourism management</td>
<td>- 1 expert in educational, recreational and outreach activities</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- 1 expert in cultural interpretation for tourism</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- 2 tourism guides, specialized in foreign languages</td>
</tr>
</tbody>
</table>
6. MONITORING

6.a  Key indicators for measuring state of conservation

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Periodicity</th>
<th>Location of records</th>
</tr>
</thead>
<tbody>
<tr>
<td>Risk Map</td>
<td>Every 5 years</td>
<td>Proyecto Chankillo, Ministerio de Cultura, World Monuments Fund</td>
</tr>
<tr>
<td>Monitoring of cracks in the walls of the Thirteen Towers of Chankillo</td>
<td>Annual</td>
<td>Proyecto Chankillo, Ministerio de Cultura, World Monuments Fund</td>
</tr>
<tr>
<td>Reports of occurrences that affect cultural and natural heritage within the property</td>
<td>Monthly</td>
<td>Municipalidad Provincial de Casma, Museo de Sitio “Max Uhle” – Cerro Sechin</td>
</tr>
</tbody>
</table>

6.b  Administrative arrangements for monitoring property

<table>
<thead>
<tr>
<th>MINISTRY OF CULTURE</th>
<th>CONTACT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Administrative body</td>
<td>Dirección de Sitios del Patrimonio Mundial</td>
</tr>
<tr>
<td>Technical units</td>
<td>Dirección General de Patrimonio Arqueológico</td>
</tr>
<tr>
<td></td>
<td>Dirección Desconcentrada de Cultura de Ancash</td>
</tr>
<tr>
<td>Political body</td>
<td>Viceministerio de Patrimonio Cultural e Industrias Culturales</td>
</tr>
<tr>
<td>Foundations</td>
<td>World Monuments Fund Perú</td>
</tr>
</tbody>
</table>
6. Results of previous reporting exercises

Morales, Ricardo


Technical report on the conservation work carried out on large areas of wall finish exposed by archaeological excavations in the Fortified Temple, with a detailed record of the procedures.

Magadán, Marcelo


Architect conservator Marcelo Magadán presents his observations and recommendations on the work carried out in 2011 by the team for the conservation of architectural surfaces. It is based on exchanges of opinions with team members during his visits to the site and laboratory. It indicates guidelines and criteria to be considered during the execution of excavation work and condition survey.

Magadán, Marcelo


This document supplements Magadan´s first report on conservation. It is based firstly on the activities carried out on site as well as in the laboratory of the Chankillo Project in Casma, and secondly on the documentation and records obtained from the condition survey work. Criteria, procedures and intervention strategies are proposed.

Coahila, Alberto and Ivan Ghezzi

2013 Informe Final de Conservación. Report submitted to Instituto de Investigaciones Arqueológicas.

These are the results of the Condition Survey carried out at Chankillo in the years 2011-2. The level of risk for the constructions is evaluated based on the analysis of the factors that affect the deterioration of the structures, describing the geographical characteristics of the site, an analysis of the pathological processes produced by extrinsic and intrinsic causes, a study of the architectural characteristics and the constructive systems employed, etc. This results in a complete diagnosis of the state of conservation of the buildings.

Ghezzi, Ivan, Alcides Alvarez, Cesar Cornejo, Manuel Lizarraga, Ricardo Morales y Cynthia Navarro
Report containing the results from the archaeological excavations carried out in 2011-12, as well as the conservation work carried out on the architectural surfaces exposed by the excavations. It identifies extrinsic and intrinsic factors of deterioration and describes the protection measures carried out at the end of the intervention.

Ghezzi, Ivan, Mónica Suarez y Navarro Cynthia

Report describing the results of the conservation work carried out on Towers 1, 2, 3, 5, 6 and 13 of the Thirteen Towers. It presents a detailed description of the structural studies, analysis of the deterioration factors, the condition survey, and the intervention activities carried out. Also, results of the sampling for the purpose of dendrochronological dating and the archaeological excavations in Towers 1 and 2 are presented.

García, Miguel

Compilation of partial reports issued during the period of the consultancy in 2017, in relation to the conservation works in the Thirteen Towers of Chankillo. This report includes the theoretical and practical considerations applied in the intervention, in which structural activities were executed in order that the structures maintain stability over time, responding to external agents such as seismic movements, rain, and wind, among others.

Morales, Ricardo

Technical report presenting a description of the conservation work carried out in the year 2017 in Towers 1, 2, 3, 5, 6 and 13, based on structural studies and in relation to the environmental factors that affect the process of deterioration. In this report, Tower 1 is taken as a model; its characteristics and structural faults are taken as an example to analyze the construction system and the structural behavior of the rest of the towers. The laboratory analyses carried out on the materials that make up the structures is included in this document.
De Las Casas, Jorge Gino


Report on the conservation work carried out in Tower 13. The different aspects of the monument are detailed, which in turn frame the conservation activities to be carried out. This document presents the preliminary results of the studies at site level, the geographical characteristics and the environmental factors detailing the behavior of solar radiation in relation to the exposed architecture, a description of the architectural characteristics in relation to the elements that comprise them, and a characterization of the intervening walls.

De Las Casas, Jorge Gino


Report based on field observations made during the conservation intervention, describing the construction system of Tower 13 and a characterization of the identified pathologies. In addition, it describes the incidence of solar radiation, as an extrinsic factor, in the structure, further detailing what was indicated in his first report.
7. DOCUMENTATION

7.a Photographs and audiovisual image inventory and authorization form (Appendix 1)

<table>
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<th>Id. No.</th>
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<th>Legend</th>
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<th>Copyright owner (if different than photographer/director of video)</th>
<th>Contact details of copyright owner (Name, address, tel/fax, and e-mail)</th>
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<td><a href="mailto:ighezzi@idaq.org">ighezzi@idaq.org</a></td>
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7.b Texts relating to protective designation, copies of property management plans or documented management systems and extracts of other plans relevant to the property

The following texts are compiled in Appendix 1:

- Political Constitution of Peru
- General Law of the National Cultural Heritage – Law 28296
- Regulation of the General Law of the National Cultural Heritage Law 28296
- Organic Law of Municipalities - Law No. 27972
- Organic Law of Regional Governments - Law No. 27867
- Law of Creation of the Ministry of Culture - Law No. 29565
- National Directorial Resolution N° 075/INC, January 18, 2008 (INC 2008), declaring National Cultural Heritage the Chankillo Monumental Archaeological Zone, located in the district of Casma, department of Ancash. The demarcation of the archaeological zone corresponds to the Delimitation Map PP-027-MC-DGPA/DSFL-2015, prepared by the Ministry of Culture (Map 4).
- City Ordinance 002-2014-MPC, January 29, 2014, declaring of tourist interest the sites of Chankillo, Casma Alta and Manchan, the natural heritage composed by the Manchan Longitudinal Dune and Cerro Mongon, and the adjoining areas that they enclose.
- Law N° 30467, June 17, 2016, declaring of national interest and public necessity the study, protection, revalorization and dissemination of the values of the Chankillo Monumental Archaeological Zone and adjacent prehistoric sites located in the province of Casma, department of Ancash.
- City Ordinance 036-2017-MPC, December 4th, 2017, declaring Cerro Mucho Malo, an integral component of the property, as a municipal area of conservation.
- "Chankillo Solar Observatory Management Plan: Ancient Astronomical Landscape in the Casma Valley, 2018-2028", prepared by the Ministry of Culture in cooperation with the Provincial Municipality of Casma and other institutions. Currently under review by the Ministry of Culture
- Territorial Conditioning Plan (PAT) for the Casma province, 2017-2037, prepared by the Provincial Municipality of Casma.

7.c Form and date of most recent records or inventory of property

In 2003, the Chankillo Project presented a proposal to the Peruvian government to declare this site National Cultural Heritage. The proposal included a technical report, a descriptive report, and delimitation maps (Ghezzi 2003). The proposal was adopted with modifications, so that in 2008
the "Chankillo Monumental Archaeological Zone" was declared National Cultural Heritage (INC 2008). Accompanying the declaration was a boundary map of the site. Subsequently, based on the extension of prehistoric occupation revealed by the archaeological excavations and surveys of the Chankillo Project (Ghezzi, Salcedo et al. 2013), this boundary map was revised and updated (Figure 1-4) to include surrounding areas up to 2112 ha, including quarries, workshops, geoglyphs, and other features (Benavides and Vásquez 2015).

7.d Address where inventory, records and archives are held
- Dirección de Sitios de Patrimonio Mundial, Ministerio de Cultura, Av. Javier Prado Este 2465, San Borja, Lima, Peru
- Dirección General de Patrimonio Arqueológico, Ministerio de Cultura, Av. Javier Prado Este 2465, San Borja, Lima, Peru

7.e Bibliography


8. CONTACT INFORMATION OF RESPONSIBLE AUTHORITIES
8.a Preparer
Name: Iván Augusto Ghezzi Solis
Title: Director, Chankillo Program
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City, province/state, country: Cercado de Lima, Lima 01, Perú
Telephone: (01) 564-1247
Fax: -
E-mail address: ighezzi@idarq.org

8.b Official Local Institution/Agency
Ministerio de Cultura
Address: Av. Javier Prado Este 2465, San Borja – Lima 41
Telephone: 511 - 4769933
Telefax: 511 – 4769901
Rogers Martin Valencia Espinoza
Ministro de Cultura
E-mail: rvalencia@cultura.gob.pe

8.c Other Local Institutions
Dirección Desconcentrada de Cultura - Ancash / Ministerio de Cultura
Address: Av. Luzuriaga Nº 780 Plaza de Armas. Huaraz, Ancash

197
Telephone: 043-427567

Marcela Olivas Weston

Directora de la Dirección Desconcentrada de Cultura Ancash

molivas@cultura.gob.pe

8.d   Official Web address
https://www.gob.pe/cultura

Ana María Hoyle Montalva

Dirección de Sitios del Patrimonio Mundial

amhoyle@cultura.gob.pe

9. SIGNATURE ON BEHALF OF THE STATE PARTY
CHANKILLO SOLAR OBSERVATORY AND CEREMONIAL CENTER

Nomination of property for inscription on The World Heritage List

APPENDIX 1

Section 1.e. Maps and plans
Section 7.a. Photographic and audiovisual image and authorization form (DVD)
  - Legal Framework for the Protection of Cultural Heritage
  - Law N° 29565
  - National Directorial Resolution N° 075/INC
  - Municipal Ordinance N° 002-2014-MPC
  - Law 30467
  - Municipal Ordinance N° 036-2017-MPC

Republic of Peru - January 2019
CHANKILLO SOLAR OBSERVATORY
AND CEREMONIAL CENTER

Nomination of property for inscription on
The World Heritage List

APPENDIX 1

Section 7.b - Chankillo Solar Observatory Management Plan: landscape management
Ancient Astronomical in the Casma Valley 2018-2028
- Territorial Conditioning Plan of the Province of Casma 2017-2037

Republic of Peru - January 2019
CHANKILLO SOLAR OBSERVATORY
AND CEREMONIAL CENTER

Nomination of property for inscription on
The World Heritage List

APPENDIX 2

Publications by the Chankillo Program

Republic of Peru - January 2019