Social Complexity and Water Management Strategies at Holtun, Guatemala

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SOCIAL COMPLEXITY AND WATER MANAGEMENT STRATEGIES AT HOLTUN, GUATEMALA

by

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ABSTRACT

Water management strategies are intrinsically associated with the development of complex societies. Traditional approaches have often characterized these strategies as homogenous and monolithic. Recent studies have shown that water management among the ancient Maya was a significant source of power, but the strategies implemented, and the outcomes are highly variable and dependent on the landscape. The case of Holtun, a modest-sized site, adds to the growing body of water management research in ancient Maya archaeology as most water management systems are investigated in large primary centers. Although water resources at Holtun are relatively small, they supported large communities during the history of the site. Holtun developed social complexity during the Middle Preclassic period. The site flourished with some centralized and neighborhood-based water catchment, but most of the springs and water pools remained outside of formal control networks on the outskirts of the site. During the Late Classic period, a monumental group, Group HTN19_20, emerged 1.3 kilometers east of the civic-ceremonial center of Holtun, claiming the territory around the eastern natural water reservoirs. Archaeological excavations conducted in this group indicate signs of status and social power amid similarities and differences from monumental architecture and residences in the site’s core. The relationship between this group, its proximity to water, and the civic-ceremonial epicenter of the site is not completely clear. However, its location on the landscape and material remains suggest that water procurement and control were a motivation for its establishment. The emergence of group HTN19_20 in this location on the landscape added complexity to the sociopolitical dynamics of Holtun and may be the result of competing political factions. This differs from findings at many other Maya sites, demonstrating the complexity and
heterogeneity of ancient Maya water management strategies and their importance in the development and maintenance of social complexity.

**Key Words:** Maya Archaeology, Water Management, Social Complexity, Social Power, Status, Landscape Archaeology, GIS.
For the welfare of humankind
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CHAPTER 1: INTRODUCTION

Water management strategies are intrinsically associated with the development of complex societies (Hassan 2009; Mays 2010; Mithen 2010). Some traditional studies suggest that water management strategies were homogenous or monolithic (e.g., Childe 1950; Wittfogel 1955). However, contemporary approaches suggest that cultural and environmental diversity may have played an important role in the outcomes of social complexity stimulated by water management strategies (Harrower 2016). Among the Ancient Maya, water management strategies represented a significant source of social power. These strategies varied according to the geographic location, the environment, and the period of time when this process happened. In addition, the social dynamics around water management strategies were diverse and not always hierarchical (e.g., Davis-Salazar 2003; Chase A.S.Z. 2019).

The site of Holtun is a case study that contributes to the emerging body of research on water management strategies in the Maya Lowlands. Recent contributions to the literature on water management strategies in the Maya area focus on large primary centers, such as Caracol (Chase A.S.Z. 2019), Copan (Davis-Salazar 2003), and Tikal (Scarborough et al. 2012; Tankersley et al. 2020), as well as smaller centers like La Corona (Canuto and Barrientos 2012, 2013) and Nixtun Ch’ich’ (Rice and Pugh 2017). Holtun is a modest-sized site with freshwater springs and water reservoirs distributed in the periphery of the settlement. Because of the location of the water resources, the site had the potential to support a large population while providing a source of social power to secondary elites. This site emerged in the Maya Lowlands at some point during the Middle Preclassic period (1000 – 800 BCE). This site had a cultural florescence during the Late Preclassic period (250 BCE – 250 CE) and experienced a
depopulation and possible abandonment during the Early Classic period (250-500 CE). Later, the site experienced a modest repopulation during the Late Classic period (500 – 900 CE) until its definitive abandonment (Callaghan et al. 2017).

The central hypothesis of this dissertation is that water management strategies at Holtun shifted from the Preclassic to the Classic periods. These strategies preserved some of the sociocultural implications of water management among the Maya, but also incorporated local adaptations. Water springs remained largely open and without evidence of centralized control during the Preclassic period. However, in the Late Classic period one patio-group, Group HTN19_20, developed signs of social power and status 1.3 kilometers east of the central plaza of Holtun. This patio-group is part of a neighborhood of groups settled around water reservoirs. Although the elites of Holtun occupied the epicenter of the site during the Late Classic period (Callaghan et al. 2017), no monumental water reservoirs were developed there. The relevance of this research relies on the differences observed in water management strategies implemented at Holtun and the distinctive natural and sociocultural conditions that may have fostered these strategies. Therefore, an adaptive approach was considered in the assessment of the development and maintenance of social complexity at Holtun. This approach considers the implications of environmental conditions on the configuration of society (Binford 1962, Trigger 1971).

To assess the hypothesis, this dissertation focuses on three specific aims. The first aim is to explain the uniqueness of the natural landscape of Holtun in terms of water availability and accessibility. The second aim is to discuss the signs of symbolic and economic status at Holtun and particularly at Group HTN19_20, an architectural compound composed of patios, a plaza, and buildings surrounding these spaces. The third aim is to discuss the ways in which the
establishment of Group HTN19_20 transformed water management practices and impacted social complexity at the site during the Late Classic period. Therefore, this dissertation seeks to examine the distinctive strategies of water management that promoted and maintained social complexity and status at Holtun and compare the outcomes with other Maya sites. The examination of this process contributes to the understanding of the heterogeneous and complex strategies of water management across the central Maya lowlands and how they impacted the development and maintenance of social power.

Social Complexity and Water Management

Markers of social complexity are present across the cultural landscape of Holtun and within contexts from different periods of the history of the site. Social complexity is defined by Flannery (1972: 409) as the increase and diversification of social groups or subsystems within a society. The level of complexity can be measured according to the specialization or internal differentiation (segregation), or according to the degree of connection among the structure of power of a society (centralization). In addition, Scarborough and Burnside (2010: 330) define social complexity as “a stepwise [and] nonlinear escalation of costs associated with increasing concentration of power and levels of hierarchical or heterarchical organization.” Non-linear stratification or heterarchies are unranked classifications of social groups that reach their status within the society through contributions to the functioning of the community (Crumley 1995). The dynamics between hierarchical and heterarchical structures and the centralized or segregated nature of social structures are deemed to be catalyzers of social complexity among the ancient Maya (e.g. Scarborough and Burnside 2010; Scarborough and Lucero 2010; Robin 2003). This is a continuing research topic that often refers to the origins and first stages of complexity in
ancient Maya sites (e.g., Canuto and Estrada-Belli 2022; Inomata et al. 2013; Inomata et al. 2017; Rathje 1971). However, the objectives of this dissertation focus on elements that added and/or contributed to the maintenance of social complexity at Holtun during the Late Classic period (500 – 900 CE), when the Maya civilization already experienced high levels of social complexity.

Recent excavations at Holtun suggest that water management strategies during the Late Classic period added social complexity to the cultural landscape of the site. Evidence from Group HTN19_20 indicates that the ancient occupants of this group had some level of autonomy related to economic and ritual status. They were able to perform private ceremonies of veneration outside the epicenter of the site during a prolonged period of time during the Late Classic period. Group HTN_20 also has a different orientation than the traditional solstice orientation of other groups inside and outside the epicenter. It is located in an elevation next to water reservoirs and a ravine that filters water down to the valley. This location is the base of a topographic ridge that separates the area of water springs from the rest of the settlement. Nevertheless, HTN19_20 is located 1.3 kilometers east of the site’s epicenter and its construction dates to the Late Classic period. This indicates a significant shift in water management strategies. There are no indicators of water control during the Preclassic period. In addition, monumental water reservoirs have yet to be found near the central plazas.

In the literature on ancient Maya archaeology, the administration of water resources and the configuration of the cultural landscape are processes associated with the development of social complexity. First, the physical demarcation and appropriation of water resources allowed ancient Maya communities to manage water for utilitarian and ritual purposes (Mays 2010; Mays
and Gorokhovich 2010). However, these practices often resulted in the development and establishment of social power and the legitimation of social inequality manifested in rulers and elite groups (Lucero 2006). Alternatively, water management resulted in practices of cooperation and the emergence of alternative sources of power (Scarborough and Lucero 2010; Davis-Salazar 2003). In addition, the symbolism behind water and water resources such as springs, lakes, reservoirs, etc., contributed to the validation of social power (Lucero 2006; Brady and Ashmore 1999). The association of water with ideology and cultural beliefs transcends generations and comes from the origins of the Ancient Maya civilization and its predecessors in Mesoamerica (Scarborough 1998).

On the other hand, water management also required the management of the natural landscape (Scarborough 1998; Sprajc et al. 2021). Previous studies of the distribution of Maya settlements have demonstrated that location, orientation, and relationship to landscape features was rarely arbitrary. It is common to find locations and orientations associated with the observation and veneration of nature (Ashmore 2015; Freidel et al. 1995). It is for that reason that much research focuses on the study of ancient Maya settlements aiming to understand the nature of their social complexity (e.g., Canuto et al. 2020; Chase et al. 2011; Saturno et al. 2007). Therefore, water management strategies also imply a strategic occupation of the landscape that involves the location of settlements to demarcate the territorial possession of water resources.

The site of Holtun offers a case study where the process of adaptation to the environment and the procurement of water is parallel to the dynamics of social complexity that are manifested in the cultural landscape. Contrary to Holtun, many Maya sites are located near water resources such as water reservoirs, lakes, and rivers. In some cases, the lack of a substantial source of
water resulted in the development of engineering works to grant the artificial conservation and redistribution of water, such as the case of the site Tikal (Scarborough et al. 2012). However, the site of Holtun is situated in the south of a lacustrine basin, approximately 12 kilometers away from the nearest lagoon, and 5 kilometers from the nearest water reservoir. The site is settled on karstic elevations within a system of ravines carved by meteoric water through a geological phenomenon known as kegelkarst (Jennings 1971; Monroe 1972). Although the landscape does not present a large source of water, the geology of the location allows for the formation of water springs within the ravines. In addition, at least two square shaped aguadas are in the karstic elevations near Group HTN19_20. The aguadas are water reservoirs naturally formed in the karstic ground or artificially modified after natural depressions. The disposition of water resources at Holtun constitutes a distinctive characteristic of the landscape. The distribution of the settlement around these water resources was initially a passive strategy of water management.

I argue that water management strategies included the location of architecture to symbolically administrate or restrict access to water springs and water reservoirs. This management can be observed in the location of some groups across the landscape. For example, the location of Group HTN19_20 of Holtun is geographically strategic to delimit the area of water springs and the rest of the settlement. This group includes architecture designated for ritual activities and the validation of status and is located next to a massive artificial water reservoir of approximately 8,000 square meters (around the size of a soccer field). However, this group is located approximately 1.3 kilometers east of the ceremonial core of the site.
Therefore, the objective of this dissertation is to assess how water management strategies at Holtun impacted the maintenance of social complexity and how this was represented in the cultural landscape. The case of Holtun contributes to our broad understanding about social complexity among the ancient Maya. In addition, it allows us to value archaeological knowledge for the understanding of water procurement processes in contemporary societies, as water has a symbolic and historical value to the modern community settled adjacent to the site of Holtun.

This dissertation project was built upon two datasets of information. The first one is a compendium generated during almost three decades of research in the area. This includes seven research seasons of the Holtun Archaeological Project (Callaghan et al. 2017; Kovacevich and Rivera 2010; 2011; Kovacevich and Cardona 2014; 2015; 2016; 2017a; 2017b) with two additional field seasons to collect information for this dissertation (Guzman 2019; 2020; 2021; 2022). Although the epicenter of the cite was mapped at least two times before our project (Fialko 1998; Ponciano 1995; Guzman 2020), electronic instruments of precision, like total stations and global positioning system devices, and Geographic Information Systems (GIS) methods were used in the most recent surveying initiative (Guzman 2010; 2011; 2015; 2016; 2017a; 2020; 2021). In addition, local cartography, aerial, and satellite imagery were used for the creation of the map and the analysis of the settlement. Unlike the previous versions, the latest map includes a considerable portion of the periphery and the local geography. Although the project was welcomed by several community members and landowners, it was not possible to visit all the environs of the site. However, future surveys including modern techniques like LiDAR aerial scanning should elucidate with more precision the nature of the settlement of Holtun.
This introductory chapter presents a brief background of water management and landscape studies in ancient Maya Archaeology. This background contextualizes the need to address the case of Holtun as a cultural landscape of water. In addition, the case study of Holtun is described broadly as a contribution to understanding the ancient Maya civilization. The objectives of this research are discussed in this section, followed by the expected significance within ancient Maya literature and the history of the local community. Finally, this section describes some limitations, which encourages the development of future research.

The Distinctive Landscape of Holtun

The site of Holtun is located in the central Maya lowlands, in the region of the central lakes (as it is referred to by Rice et al. 1998). The settlement was located in the karstic elevations, or hills shaped by weathering, south of the basin of the Yaxha-Sacnab lacustrine system (Kovacevich et al. 2011) (See Figure 1). The community of Holtun developed social complexity at some point during the early Middle Preclassic Period (1000 – 600 BC). The site experienced events of depopulation and reoccupation until a final abandonment at the end of the Terminal Classic period (AD 800 – 900) (Callaghan et al. 2016). The site is characterized by its monumental architecture in the central plazas. The composition of the architecture and the archaeological evidence suggest that these plazas were utilized for community congregation and the ritual commemoration of the cycle of life (Fialko 2011; Kovacevich et al. 2011). Cultural traits associated with the commemoration of water have been found in excavations in those plazas, such as water cisterns, offerings with shells and a speleothem (Callaghan et al. 2016; Cardona and Sagastume 2017).
The settlement of Holtun contains at least 350 structures organized around plazas and patios (Guzman 2019b; 2020). A plaza group is a large compound of structures around a plaza with a rectangular tendency. On the other hand, a patio group is a small compound of structures around an area with quadrangular tendency. At the epicenter of the site, large plazas are nucleated in areas strategically selected in karstic elevations within a network of ravines. Two buildings in the main plazas are adorned with mask facades. The composition of the buildings in the central plaza forms an E-Group. These types of groups are compounds for astronomical observations frequently observed in sites with Preclassic occupation in the Maya Lowlands (Chase and Chase 2017, Ricketson 1928; although cf. Šprajc 2021).

The hydrology of the landscape of Holtun includes at least four water springs and several ponds of water supplied by the moisture filtered through the sediments in the bed of the ravines (Guzman 2017a; 2019a). In addition, the site has at least two artificially modified water reservoirs in the karstic elevations near peripheral groups east from the epicenter. The availability of water resources in the area makes this location a landscape of water. The distribution of the settlement at Holtun within the topography suggests that the plazas, as the infrastructure that supported the social and ideological power, were placed strategically to demarcate key elements of the landscape of water.
Plaza-groups in sites in the Maya Lowlands often contain elements that provide evidence for the diagnosis of the development and maintenance of social complexity. The process of development of plaza-groups, as the infrastructure that supported social gatherings, often contains markers of social complexity represented in symbols and elements of ritual activity. The practice of rituals of veneration is considered one of the indicators for the emergence and maintenance of social complexity among the Maya. This is because several segments of the community participated in the event (LeCount 2001). In addition, the presence of symbols of political and economic status in areas of ritual commemoration and evidence of continuity in the performance of these rituals indicate maintenance of social complexity throughout generations (McAnany 2013 [1995]).

Markers of ritual activity have been found in early stages of the central plaza-groups at Holtun as well as Late Classic contexts in the periphery of the site. The Plaza F-B of Holtun has
caches and offerings dating to the early Middle Preclassic period (Callaghan et al. 2017).

However, evidence of ritual activities during the Late Classic period has been found in Group HTN19_20, 1.3 kilometers east of Group F-B. The occupants of Group HTN19_20 had the potential to administer control over the nearby water reservoirs as well as monitoring the area of water springs. This may be one of the strategies that supported the social power and status evidenced in the goods and artifacts found in the excavations.

In addition to the plaza-groups, patio-groups are the settlement units that complemented the cultural landscape at Holtun. They are commonly residential units that sometimes present evidence of a specialized workshop and local ritual activities (Blackmore 2011; Gonlin and Lohse 2007). The difference between patio-group and plaza-group is: 1) The dimension of the open space between mounds, and 2) The function of the buildings around the open space. Plazas are larger than patios and the rectangular shape tends to be modified according to the shape of the buildings, as in the case of Holtun. On the other hand, the function of the buildings in plazas tends to be civic and ceremonial. Therefore, buildings like palaces, shrines, astronomic observatories, funerary compounds, and ballgames are commonly found in plazas. Architecture in patio groups can be also ceremonial, but on a smaller scale. For example, small funerary buildings and shrines may be found in patio groups.

A common pattern in patio and plaza groups at Holtun, and in the Maya area, is the orientation to cardinal or solstice directions. The orientation of the plaza and patio groups tends to be towards the north. Some variants include solstice orientations, which implies a slight inclination towards the east or the west (Šprajc 2021). Some archaeologists have proposed that the orientation of the plaza-groups correspond to the interpretation of the cycle of life and the
universe. The Maya quadripartite cosmogram represented in art, iconography and rituals (Freidel et al. 1995) is also represented in the settlement (Ashmore and Sabloff 2002; 2003). Although some authors have opposed to the approach to the cosmological significance in ancient Maya site planning (Smith 2003), references to solstice orientations are broadly present in the Maya area (Šprajc 2021). This model also considers that the orientation of patio groups represents an identity with the cultural beliefs of the central plazas (Ashmore 1986). In that sense, the presence of patio groups with an orientation different than the central plazas may be indicative of heterogeneity in the conception of the universe. The majority of plaza and patio groups at Holtun are oriented towards the north. However, there are a small portion of groups with a different orientation that may have added diversity to the social complexity of the site, and these different orientations may be associated with water management outside the epicenter.

Water Management, Landscape, and the Ideology of Water

The site of Holtun is characterized by its location on karstic elevations, or karstic hills, 12 kilometers south from the large bodies of water in the Yaxha-Sacnab basin. Unlike other sites, the landscape of Holtun lacks a substantial body of water (i.e., lake, river, etc.). However, the small water resources in the ravines and the artificial ponds or aguadas seems to provide enough water for human consumption. Although the water supplied by these resources is limited, it was enough to satisfy the needs of the ancient community of Holtun. Therefore, the management of these limited water resources is considered a process that contributed to the maintenance of social complexity and inequality at the site.

Water springs are important symbolisms in the ideologies of Mesoamerica (Moyes and Brady 2012) and the ancient Maya (Brady and Ashmore 1999). However, their use for human
subsistence is still less explored. The communities in the central Maya lowlands preferred locations adjacent to larger bodies of water such as lakes and reservoirs and practiced the harvest of meteoric water (Scarborough 1998, Scarborough and Gallopin 1991). Therefore, Holtun represents a case study where the water supply was satisfied by water springs, water naturally filtered in the sediments of the ravines, and a limited amount of water reservoirs strategically located in the landscape. It is possible that the strategic administration of these resources contributed to the maintenance and increase of social complexity in a secondary site like Holtun. The nature of water resources may have contributed to the allocation of value to the landscape.

In Maya archaeology, studies of water management have often explored periods and sites associated with large-scale water features and complex management systems (e.g., case studies in Lucero and Fash 2006). These studies often focus on the adaptation and vulnerability of the environment (e.g., Brenner et al. 2002; Scarborough et al. 2012), subsistence and migration (e.g. Scherer et al. 2015; Wright 2005), the social power acquired from the dynamics around water management strategies, (e.g., Lucero 2006; Scarborough 1992), and the conceptualization of the ideology of water (e.g., Brady and Ashmore 1999). In addition, recent studies have discovered that ancient Maya developed strategies to optimize the harvesting of meteoric water and mitigate water contamination. These strategies are clearly documented at the monumental site of Tikal, Guatemala (Lentz et al. 2020; Tankersley et al. 2020).

This dissertation supplements studies of water management by presenting a case of social complexity dynamics in a modest-size site based on the permanent accessibility to freshwater resources and the establishment of a landscape of water (as seen in Wyatt 2014 for other regions). The presence of water filtered through the ravines represents a natural phenomenon that
may have inspired the artificial sand filters observed at sites like Tikal (Tankersley et al. 2020). Research at Holtun has documented the fertile and resilient characteristics of the landscape due to the diversity of water resources available. The site was not immune to the abandonments associated to cycles of drought at the end of the Terminal Preclassic and Terminal Classic periods (Douglas et al. 2016, Ebert et al. 2017). Therefore, the discussion of water management and the association with the maintenance of social complexity also contributes to debates related to the Preclassic abandonment and the Terminal Classic Collapse in the Maya Lowlands, outside the main monumental centers.

In summary, this dissertation includes interpretations about the location of Group HTN19_20 within an apparently hidden landscape of water and the implications of this for social complexity of Holtun during the Late Classic period. The impact of water in the maintenance of social complexity at Holtun may support theoretical models that consider the contribution of water in the development of social complexity in other sites in the central Maya lowlands. Water had an important connotation in the ideology of the Ancient Maya (Ashmore 2015; Lucero and Kinkella 2014) and subsequently in the development of social power (Lucero 2006). Therefore, the presence of water resources may have allocated symbolic value to the land, which is reflected in the elements of ritual and status present in Group 19_20. This group could have been an outpost of the elites of the epicenter or a factional group. Either outcome is a marker of social complexity associated with the administration of water resources.

**Holtun, a Landscape of Water**

The objective of this dissertation is to discuss how the cultural landscape of Holtun reflects the dynamics of social complexity around water management strategies implemented at
the site. The distinctive characteristics of water resources at Holtun contributed to the maintenance of social complexity at the site during the Late Classic Period and perhaps even before. The landscape includes water springs, artificial water reservoirs, and a network of ravines that filter water down to the valley. The distribution of the settlement suggests that water management strategies included spaces dedicated to ritual veneration that symbolically demarcated the landscape. These ritual activities are markers of social complexity and validated status at the site. The activities performed at HTN19_20 demarcate this location as a place of ritual and status. This represents a symbolic boundary between the water resources and the rest of the settlement.

Assessing the case of water management at Holtun enriches our understanding about the impact of water management within the development and maintenance of social complexity among the ancient Maya. The water springs and water reservoirs that sustained the site of Holtun, also sustained the nearby modern village of La Máquina for decades. Therefore, the history of both ancient and modern communities is intertwined. The documental evidence created in this dissertation aggregates information with the rich local oral history. It has the potential to strengthen the engagement of the community with their archaeological heritage. The interaction with local informants promoted an exchange of information and a rupture of a knowledge barrier, supplying valuable information to this dissertation and to the oral tradition of the village. This project adds to academic literature and local knowledge, showing that scarce resources are not always geographically centralized, and their management may have involved community participation.
Chapter Organization

This dissertation is organized into six chapters. Chapter 2 consists of a contextualization of the site Holtun within the millenary history of the Maya Lowlands. The chapter focuses on the use of water as a source of subsistence, social power, and representation of ideological values. Ancient Maya communities adapted to diverse environments and developed multiple types of settlements in the lowlands (Chase et al. 2014). The adaptation process required the incorporation of water resources to the cultural landscape and socioeconomic dynamics. Therefore, different adaptation strategies were taken according to the geographic location and chronology of the site. This chapter explains how water is a substance embedded in Ancient Maya ideology and the symbolism is present in all Mesoamerica before and after the existence of Holtun. An assessment of water management practices from different environments and periods of ancient Maya civilization allow the reader to understand the specific characteristics of water management practices at Holtun. In that sense, topics like water storing practices and environmental variability will be discussed in this chapter.

Although the modern Maya have a direct connection with their ancient relatives and often practice veneration of archaeological sites, that is not the case with Holtun. The modern community of La Máquina, adjacent of Holtun, colonized the area as part of a governmental project to develop the tropical forest in the northern area of Guatemala (Schwartz 1987). The modern community shares with Holtun the experience of adapting to the environment and accessing water resources. Therefore, this is a particular case where ties with the heritage are built by allocation and not by inheritance.
Chapter 3 will provide a general overview of the site of Holtun, including its geographical context and the history of the project. The chapter starts with a description of the settlement of the site according to the most recent version of the map of the site. The chapter will continue with the history of archaeological research on the site. It will include the aims and achievements of six seasons of the Holtun Archaeological Project. Finally, it will include a description of the two field seasons that supplemented information to develop this dissertation.

In Chapter 4, the materials and methods used for this research are presented. This chapter is organized according to materials used and research methodology. It starts with the Geographic Information Systems and cartographic procedures used for this dissertation. It includes the mapping procedures and the analyses conducted on cartographic information available for this research. These analyses aim to achieve a better understanding of the morphology of the land as well as the distribution of the settlement and the water resources. The results of the study of the terrain supported the development of a reconnaissance and mapping season in the east of the site that resulted in identified areas with markers of social complexity associated to water management.

In Chapter 5, the results of the spatial analyses and the excavation conducted in Group HTN19_20 are described. This chapter starts with a description of the morphology of the landscape and the patterns of dispersion observed in the landscape. It also contains the location of the water resources and the spatial relationship of these resources with the cultural landscape. Next, the archaeological contexts excavated and the artifacts collected from them are described in detail. The artifacts collected are described according to their manufacture and provenance. Therefore, ceramics, obsidian, chert, shell, and special artifacts will be described separately. This
differentiation will allow us to understand the nature of the social dynamics according to the presence of these artifacts.

Chapter 6 consists of the discussion of the sociocultural nature of Holtun as a place of water. This chapter discusses how the cultural landscape of Holtun is a social construction that resulted from the dynamics of social complexity and status developed around water management. The location of Group HTN19_20 and the presence of ritual and prestige goods in that group indicates that controlling access to water was a source of status that maintained social complexity within the community. In addition, the presence of symbols of status indicates that this location also validated the authority of elites, which withhold the most valuable areas of the landscape of Holtun. This fosters discussion about the nature of the elites occupying this group. Two interpretations arose from the assessment of the evidence. The first one is that this group is an outpost of the central elites. The second is that they were factional elites that managed to control an important segment of the landscape. The case of Holtun supports the argument that water management strategies were not homogenous. Among a constellation of water management studies, this site presents something different.

Chapter 6 also includes a summary of the research and the conclusions achieved are described. The conclusions were created based on the research aims and objectives. These conclusions address the impact of water management on the development and maintenance of social complexity. The case of Holtun is unique, because it combines the presence of water springs with artificial reservoirs. This is a characteristic rarely seen in Maya sites in the central lowlands. Finally, the parallels in water management practices offer a venue for the development
of identity of the modern community of La Máquina with the ancient community of Holtun and the archaeological heritage left behind.
CHAPTER 2: WATER AND THE DEVELOPMENT OF SOCIAL COMPLEXITY IN THE CENTRAL MAYA LOWLANDS

Water is a substance embedded in the ideology and social organization of the ancient Maya. For that reason, water management practices are considered salient factors for the development and maintenance of social complexity in the Maya Civilization (Brady and Ashmore 1999; Davis-Salazar 2003; Scarborough 1998; Scarborough and Burnside 2010; Šprajc et al. 2021). In that sense, social complexity is defined as the combination of subsistence practices and the physical infrastructure created to support the cultural practices of a community. The combination of these elements promotes the concentration of power in social entities and the acquisition of social status. These social entities achieve authority through labor distribution and the intellectual merit achieved during the negotiation of the environment to grant subsistence to the community (Scarborough and Burnside 2010).

However, water management strategies among the Maya were not always homogenous and did not always result in a total centralization of power surrounding water resources. Recent studies suggest that non-centralized groups, such as secondary elites and communities in peripheral households, were often able to administrate water resources outside of the cultural epicenter of sites (Chase A.S Z. 2016; 2019; Scarborough 1998; Scarborough and Burnside 2010). This was the case in sites with a dispersed settlement and less centralization towards the civic-ceremonial epicenter (Chase A.S.Z. and Cesaretti 2019; Scarborough 2006). The objective of this chapter is to contextualize the case of Holtun geographically and culturally within the Maya region. Holtun is located in the center of the Maya region, and it is culturally tied to the Maya civilization. Although water management practices have similarities with other Ancient
Maya sites, the landscape of Holtun depicts particular characteristics that may have resulted from their own dynamics of social complexity and the local distribution of social status.

The Ancient Maya and Holtun

The Maya civilization arose in southeast Mesoamerica, a subtropical region in the middle of Central America. Mesoamerica is the geographic model of a transnational region that hosted the emergence, fluorescence, and collapse of several cultures and civilizations before the arrival of Columbus to the Americas (Creamer 1987; Ivic de Monterros 1999; Kirchhoff 1960[1943]). Not all civilizations coexisted simultaneously, but some overlapped in time and exchanged cultural traits. According to the model, these cultures and civilizations shared cultural traits across time. Among the cultures manifested in Mesoamerica are the Olmec (Approx. 3000 – 400 BCE), Mixtec (1500 BCE – 1523 CE), Teotihuacan (100 BCE – 850 CE), Toltec (900 – 1150 CE), and the Maya (2000 BCE – 1542 CE), among others. Some of the shared traits include the sacred ballgame, the ritual calendar, agriculture technology, and monumental architecture, among other cultural institutions and characteristics. Some of these cultural traits are still present within descendant communities (McKillop 2004; Sharer and Traxler 2006: 8-11). In addition, water was a substance with a symbolic value capable of supporting ideologies, rituals, and social power among the multiple cultures in Mesoamerica (Lucero and Fash 2006).

Ancient Maya settlements occupied territories in the southeast of the modern republic of Mexico, the complete territory of Guatemala and Belize, and the western portions of Honduras and El Salvador. Ancient Maya civilization was characterized by ideology manifested in their political systems, spirituality, and art (Demarest 1992; Martin and Grube 2000; Masson 2002; Schelle and Miller 1986). Material culture was expressed in the monumental architecture of
temples and plazas combined with a well-developed sculpture tradition (c.f. Proskouriakoff 1963). In addition, the Maya developed an extensive system of ceramic traditions with pieces that satisfied utilitarian, ritual, and prestige purposes (e.g., Smith and Gifford 1966; Callaghan and Nievens de Estrada 2016). One of the most outstanding characteristics of the Maya civilization was the creation of a writing system displayed in carvings, ceramics, and murals (Coe 2012; Coe and Van Stone 2001). Additionally, a complex calendar system was created based on astronomical observations and the count of days (Milbrath 1999; Rice 2009). Finally, a complex system of overland and aquatic trade routes supported the economy and status of Maya societies during centuries and contributed to the origins and development of the Maya civilization (Masson 2002).

Ancient Maya civilization flourished in Mesoamerica for more than three centuries until the arrival of the Spanish conquerors. The first cultural traits of Maya civilization can be traced back to ca. 2000 BCE. Although multiple aspects of the culture continued over time, some transformations are perceived, especially in political organization and the exploitation of natural resources (Chase and Chase 2005; Lucero 2006; Scarborough 1998; Sharpe et al. 2020). For these reasons, archaeologists of the ancient Maya created a system of classification to standardize a chronology for Maya history (Estrada-Belli 2011). These periods are known as the Preclassic period (c. 2000 BCE to 250 CE), Classic period (250 to 950 CE), and Postclassic period (950 to Spanish Conquest). Maya contact with the first Spanish explorers dates to 1511. However, some of the last Maya sites remained unconquered until 1697 (Chase 1976, Pugh et al. 2013).
Ancient Maya archaeological periods are also subdivided into sub-periods according to historical events or changes in cultural characteristics. In that sense, the Preclassic period is subdivided into the Early Preclassic (1500 to 1000 BCE), Middle Preclassic (1000 to 400 BCE), and Late Preclassic (400 BCE to 250 CE). The Classic period is subdivided into Early Classic (250 to 550 CE), Late Classic Period (550 to 800 CE), and Terminal Classic Period (800 to 950 CE). Finally, the Postclassic period is subdivided in Early Postclassic (950 to 1200 CE) and Late Postclassic (1200 through the main Spanish conquest period from 1519 to 1542). The site of Holtun is contextualized chronologically from the Middle Preclassic through the Terminal Classic periods, with some evidence of cultural activities during the Postclassic period. The site experienced a decrease in population or even a possible abandonment during the Early Classic period (Callaghan and Castillo 2011; Callaghan et al. 2017).

Maya communities survived the Spanish conquest and the colonial period, and their descendants still live in the Maya region. They maintain some remnants of ancient culture through language and spiritual practices, like the veneration of water bodies and caves for example (Vogt and Stuart 2005). In Mesoamerican archaeology, caves are associated with the cult of water and the origins of life (Moyes and Brady 2012). Alongside other ritual practices and cultural traits, some of the modern Maya expressions can be connected to archaeological records. It is for that reason that the pre-conquest Maya communities are referred to in archaeological literature as the ancient Maya (Demarest 1992; Foias 2004; Sharer and Traxler 2006). Nevertheless, there is no evidence of ritual activities of the modern Maya at the center of Holtun or its water resources.
Water in the Different Maya Environments

The Maya region contains a diversity of environments and different types of geomorphologies. Therefore, archaeologists have classified the Maya region into three sub-regions to characterize the geographic and environmental context where each archaeological settlement is located. Three main sub-regions are known as lowlands, highlands, and Pacific Coast. This classification corresponds to the elevation above the mean sea level, the geomorphology, and the environment of the sub-region (McKillop 2004; Sharer and Traxler 2006).

According to geomorphology, these regions also have different types of water resources available. The Maya region has three main hydrographic slopes that drain water in different directions. The first drains meteoric water towards the Pacific Coast, the second drains towards the Caribbean Sea, and the third one towards the Gulf of Mexico. In addition, volcanic and karstic landscapes created endorheic basins with an internal drainage (Suarez 2011).

The Maya Pacific Coast benefits from the multiple rivers that descend from the Highlands and fertilize the coast. The drainage begins in the volcanic ridge of Guatemala and Chiapas and has a permanent flow of water. In that region, the Maya site of Tak’alik Ab’Aj benefited from the availability of running water from rivers and water springs to develop and maintain dynamics of social complexity. The site has a complex hydraulic system, which was created to distribute water during the rainy season and avoid flooding (Alfaro 2013; Marroquin 2005).

The Maya highlands region is defined by the mountain chains and the volcanic plateau that runs east to west between Guatemala and Chiapas, Mexico. Water is supplied by rivers,
lakes and water springs. From the western portion of the Maya highlands, rivers drain towards the Gulf of Mexico. From the eastern portion of the Maya highlands, rivers drain toward the Caribbean Sea. In addition, several lakes supported the economy of the ancient Maya highlands. The direction of the river drainages may have affected the direction of the main trade routes within the whole Maya region (as seen in Popenoe de Hatch, et al. 2011). The Maya site of Kaminaljuyu benefited from the presence of Lake Miraflores and the connections with the Motagua River that drains towards the Caribbean Sea. This site is characterized by the implementation of a complex water canal system (Popenoe de Hatch et al. 2002).

The Maya lowlands are located in the northern and larger portion of the Maya area, covering the whole Yucatan peninsula with portions of the states of Chiapas, Campeche and Quintana Roo in Mexico. The territory of Belize and the departments of Peten and Izabal in Guatemala are also considered the Maya lowlands. In addition, it covers the northwestern portion of Honduras. The vast sub-region of Maya lowlands has also been subdivided into Northern Maya lowlands and Southern Maya Lowlands (Sharer and Traxler 2006). Similar to the Maya highlands, the western portion of the Maya lowlands drains the rivers towards the Gulf of Mexico and the eastern portion drains towards the Caribbean Sea. The central karstic plateau demarcates the threshold of these drainage slopes.

The site of Holtun is located in an intermediate region of the Maya lowlands. Some literature refers to this as a third sub-region with the name of central Maya lowlands (e.g., Beach et al. 2006; Rice 1976; Turner and Sabloff 2012). Other literature still includes this area within the southern Maya lowlands (e.g., Doyle et al. 2012; Lucero 1999). This is a portion of the lowlands that contains the basins of the rivers San Pedro Martir, which drains towards the Gulf.
of Mexico, and the basins of the rivers Holmul and Belize, that drains towards the Caribbean Sea. In addition, a series of lakes and bodies of water are spread in an elongated portion of land known as the Central Lakes region. For the purposes of this dissertation, the area of cultural interaction of Holtun is referred henceforth as the Central Lakes Region within the central Maya lowlands.

**Holtun in the Central Lakes Region**

Holtun is situated in the southern portion of the Yaxha-Sacnab basin, where at least 32 archaeological sites have been reported (Guzman 2019; Quintana 1996). The largest site in the basin is Yaxha, which is located on the north shore of the namesake lake. Yaxha is the literal translation of “Green Water”, probably because of the coloration of the reflection of the lake. This site participated in the complex political dynamics of the Late Classic period and the name of the site is known because of the decipherment of its emblem glyph (Culbert 1991: 130).

The system of lakes of Yaxha-Sacnab is part of a sub-region within the central Maya lowlands known as the central Peten lakes region (Segura 2012; Rice et al. 1998). This region is one of the longer occupied in the Maya Lowlands, with settlements dating from the Middle Preclassic period and Postclassic settlements that resisted the Spanish conquest until 1697 (Callaghan et al. 2017, Chase 1976; Johnston 1985; Pugh et al. 2012; Rice and Rice 1985).

The Central Lakes region is characterized by a karstic geomorphology and a strip of bodies of water running east to west in the middle of the department of Peten, Guatemala. These bodies of water range between small reservoirs to considerably large lagoons and lakes (~100 km²), in addition to several seasonally flooded areas or bajos (Brenner et al. 2002a; 2002b). The
western end of the Central Lakes Region is demarcated by Lake Peten Itza and the eastern end is demarcated by the lakes Yaxha and Sacnab.

The phenomenon of the Central Lakes results from the geomorphology of the soils and the chemical weathering of the limestone. In that sense, limestone tends to dissolve and erode with meteoric water creating depressions in the landscape. As a result, the larger bodies of water created their own endorheic (closed) basin. This means that the perimeter of the basin is closed and without external water tributaries. In these closed basins, the rainforest and the level of the bodies of water relies on rainfall, environmental moisture, and undercurrents (Brenner et al. 2002b).

The south perimeter of the Yaxha basin is a landscape of elevated hills and ravines. The system of ravines at Holtun was formed by erosion, a phenomenon known as kugelkarst. This is a characteristic of tropical karstic topographies where residual limestone hills are surrounded by depressions (Jennings 1971; Monroe 1972). The karstic geomorphology may also cause the formation of caves, karstic springs, and cenotes or dolines (underground collapse) inundated with water (Jennings 1971). Although all these elements are significant in ancient Maya ideology, only karstic springs are present at Holtun. However, one speleothem was found in a Late Classic context in one of the main buildings at Holtun (Callaghan 2016). A speleothem is a column of minerals formed in caves as a secondary deposition through the process of dripping water or other mineralized solutions (Jennings 1971). Due to the geochemical formation and composition of speleothems, they are used to date environmental and climate change in the Maya lowlands (e.g., Medina-Elizalde et al. 2016; Moyes et al. 2009; Webster 2000). Nevertheless, speleothems have a symbolic value among the Maya and are often associated with the cult of caves, the cycle
of life, and water. Samples of speleothems removed from caves have been found as dedicatory offerings in ritual contexts in other sites in the Maya lowlands (Brady et al. 1997).

**Water Subsistence in the Central Maya Lowlands**

In the central Maya lowlands, communities relied mainly on bodies of water as well as natural and artificial reservoirs. In addition, meteoric water was collected artificially or in seasonal swamps known as *bajos* (Scarborough 1993; 1998). Water management often required considerable labor that implied the modification of the landscape and the maintenance of water features like canals, ponds, cisterns, and reservoirs (Scarborough 1983; 1998). In addition, water quality and redistribution were part of the management strategies. The vulnerability of water in Maya sites was confirmed by the discovery of traces of contamination by mercury in sediments of a water reservoir (Lentz et al. 2020) and the implementation of a water filtration system using particles of Zeolite, a mineral used in water purification (Tankersley et al. 2020). Holtun is located far away from larger bodies of water and bajos. Therefore, water accessibility relied on *aguadas*, *chultunes*, and springs.

Some of the most distinctive water features in the Maya sites are called *aguadas* (Ferrand et al. 2012). These are small water reservoirs within Maya settlements that could have been natural features or artificially modified (Dunning 2016). The topography and geomorphology of the central lowlands allowed for different scenarios of use of the *aguadas*. In some cases, it was possible to centralize a settlement around them such as the case of Tikal and Nixtun-Ch’ich’ (Scarborough et al. 2012; Rice and Pugh 2017). In other cases, the dispersion of the settlement granted access to *aguadas* spread in the landscape, such as in the case of Caracol (Chase A.S.Z.
and Cesaretti 2019). The only known *aguadas* at Holtun are located outside of the epicenter of the site (Guzman 2022).

A distinctive storage facility in the Maya lowlands is the *chultun*. *Chultunes* (Hispanicized plural of *chultun*) are bottle-shaped underground chambers or groups of chambers carved in the bedrock with one or more bottleneck entrances. These entrances often have a circular shape carved at the surface level (Calderon and Hermes 2005). They are ubiquitous in the Maya lowlands, and some have been found in other regions. There is not a standard size for *chultunes*, and they are not directly associated with any location of Maya sites, they can be found anywhere (Cagnato 2017). Multiple functions have been ascribed to the underground chambers because of the different archaeological contents found inside them (Cagnato 2017). The common agreement for their function is the generic use for storing things.

The term *chultun* comes from the Maya language and scholars believe it means “cistern in stone” (Tozzer 1913; Zapata 1989). However, there is no evidence of the use of these underground chambers to collect meteoric water. There is some consensus (Cagnato 2017) about the use of *chultunes* to store grains and seeds of Ramon tree (*Brosimum alicastrum*) used in the Ancient Maya diet (e.g., Blom 1936; Bullard 1960; Freidel and Sabloff 1984; Puleston 1965; 1971). However, *chultunes* are still considered as an alternative to storage water in residential groups and plazas (Scherer et al. 2015, Puleston 1971). In addition, the presence of *chultunes* in patios and plazas supports the idea that these features represented caves and were used in rituals of commemoration (Brady 2004; Cagnato 2017)

The site of Holtun has at least 64 *chultunes* spread in the landscape and one cistern in one of the central plazas (Guzman 2022; Cardona and Sagastume 2016). In lesser quantity, cisterns
were carved in plazas, and they are associated with ritual and storing purposes. Examples of cisterns have also been found in sites like Nakum in the central Maya lowlands (Zralka and Koszkul 2015) and Utatlan in the Maya Highlands (Carmack 1981).

Water springs were often modified to optimize the collection of the water in the area of the outcrop. The use of springs in the Maya Lowlands has been documented in sites like Tikal, where the spring became part of a larger water collection system (Scarborough et al. 2012). It has also been documented that water springs were exploited by the elites and transformed into sacred pools (e.g., Barrientos 2008). At the site of Holtun, the geological conditions given by its location in a karstic basin facilitated the permanent access to water from water springs in the environs (Guzman 2017; 2020).

**Water, Social Power, Status, and the Maintenance of Social Complexity**

The negotiation of power and the achievement of social status are processes that play an instrumental role in the development and maintenance of social complexity (Scarborough and Burnside 2010). Power and status are recognized archaeologically through symbols and artifacts. Archaeologists use prestige goods, exotic artifacts, and scarce resources as markers to identify status and prestige within the residents of palaces or domestic structures (Blanton et al. 1996; Feinman 1995; 2001). In that sense, water management may be understood as a salient factor in the achievement of power and prestige due to the seasonal scarcity and vulnerability of the substance (Davis-Salazar 2003; Moyes 2007; Scarborough 1998; Scarborough and Gallopin 1991).

Ancient Maya social organization was diverse in social statuses and classes. Therefore, prestige and exotic goods, and privileged access to water were not exclusive to the dominant
elites (Jackson 2013). It is common to find evidence of secondary and tertiary elites (Elson and Covey 2006, Walden et al. 2019) and some models of social organization suggest the existence of middle classes (Chase and Chase 1996). Therefore, one would expect to find prestige goods associated with water management in diverse locations at archaeological sites.

Ancient Maya water management has been traditionally studied as a large-scale process of social complexity that often resulted in the development of social status ascribed to centralized entities of social power, such as elite groups or royalty (e.g., Lucero 1999; Lucero et al. 2014; Scarborough 1992; 1998). However, alternative water management strategies were implemented on a domestic scale or by secondary elites (Brewer 2018; Chase A.S.Z. 2019; Davis-Salazar 2003; Grauer 2021). These practices prevented the centralized elites from achieving total control of water resources (Davis-Salazar 2003). In addition, these practices caused a negotiation of status and power in a local community level. Some models suggest processes of social integration and collaboration through the management of water at a local level (Scarborough and Lucero 2010). Therefore, the presence of water resources outside of the cultural epicenter of the settlement and the analysis of small-scale sites constitute an opportunity to understand the complexity of the ancient Maya social organization in regard to water management.

Water management also required the use of ideology and cultural beliefs to legitimize power and authority (Lucero 1999; 2006, Scarborough 1998). The incorporation of water resources within the settlements granted privileged access to water and created a privileged cultural landscape (e.g., Beach and Dunning 1997; Scarborough et al. 2012). As a result, water became a source of power, prestige, and status among elite groups (Lucero et al. 2011; Lucero et
Water management strategies had an important role in the sociocultural dynamics of the ancient Maya, besides being a basic subsistence practice.

The conceptualization of water as a sacred but necessary and life giving substance in ideology and cultural beliefs was a salient factor in the development and maintenance of social complexity in Ancient Maya civilization (Lucero and Fash 2006). The location and design of ancient Maya centers were influenced by the cult commemoration of water, earth, and sky as interconnected layers of the universe (Ashmore 2015). That influence is observed in the myth of the water mountain alluded by the architecture of ceremonial centers. The design and decoration of buildings represent the sacred mountain (Brady and Ashmore 1999; Scarborough 1998) while the plazas represent the bodies of water (Schele and Mathews 1998). Additional elements that represent the cosmogenesis of Maya civilization are the Earth Monster, the Cave of Origins, and the Watery Underworld. These elements are represented in buildings and ritual contexts making reference to water as a substance of ritual veneration (Brady 2005, Moyes and Brady 2012, Lucero and Kinkella 2015). In addition, artifacts and accessories associated with the cult of water (i.e. shells, speleothems) were often deposited as dedicatory elements in ritual contexts (Halperin et al. 2003; MacLeod and Puleston 1978; Vidal-Lorenzo and Horcajada-Campos 2020). Besides the elements allusive to water in the sites, ritual pilgrimages towards places of water are a recurrent practice in the ancient and contemporary Maya (Lucero and Kinkela 2014; Moyes and Brady 2012; Palka 2014).
Environmental Variability, Anthropogenic Disturbances, and the Abandonment of sites in the Maya Lowlands

The general environment of the central Maya lowlands is a warm and humid tropical rainforest, but water is seasonally scarce. Social groups and the dynamics of social complexity among them may have contributed to the development of sustainability in the procurement of water (Scarborough 1998). However, climate variability and anthropogenic disturbances affected the equilibrium in water management sustainability. Studies conducted on the sediments of water reservoirs support the theory about cycles of droughts during second century CE (Douglas et al. 2016; Webster et al. 2007). Another period of intense droughts has been documented during the eight century CE (Ebert et al. 2017). The decay in rainfall volume and environmental moisture affected the volume and quality of water (Gill 2000). For that reason, these two cycles of climate variability are associated with the social imbalances that resulted in the abandonment of sites in the Maya lowlands at the end of the Preclassic period and at the end of the Terminal Classic period. The central Maya lowlands never overcame the decay of population and abandonment of sites at the end of the Terminal Classic period. That is why some archaeologists call this phenomenon the Terminal Classic Maya collapse (Rice et al. 2004; Webster 2012).

From the anthropogenic perspective, the establishment of social complexity often results in environmental consequences for the natural landscape. Anthropogenic disturbances in the Central Lakes region consisted of deforestation and intensive agriculture. These practices left a signature in the environment and can be detected in the sediments of the bodies of water (Beach et al. 2006; Rosenmeier et al. 2002; Rice and Rice 1984). “Maya Clay” is a layer of sedimentation accumulated in the beds of bodies of water from the Middle Preclassic through the Terminal Classic periods. This is the consequence of the runoff of sedimentation from a
deforested basin. The sediments contain organic samples that evidence the extension of the cultural occupation of the area (Brenner et al. 2002a; 2002b; Rice and Rice 1984). These environmental disturbances are contemporary with the social instability associated with the abandonment of sites during the Late Preclassic and the Terminal Classic periods (Curtis et al. 1998; Turner and Sabloff 2012).

**Water Management Strategies in the Maya Lowlands and Holtun**

Water management strategies required the exploitation of existing bodies of water and the use of slopes and natural depressions to create zones of water catchment (Scarborough 1993; Scarborough and Galopin 1991). The model of concave and convex water management suggests a shift in water management strategies between the Preclassic and Classic period. Water management during the Preclassic period used slopes, natural depressions, and the hydrology of the landscape to take advantage of bodies of water, natural reservoirs, and the rain runoffs (a concave landscape). During the Classic period, people shifted the strategy of water procurement in the landscape. Sites relied less on natural resources and created or modified water reservoirs in the epicenters of their cultural landscapes. These artificial reservoirs were created in higher positions of the landscape and included systems for catching the rain runoff (a convex landscape) (Scarborough 1998). However, different landscapes allowed for the development of alternative strategies according to the local environment and the internal sociopolitical dynamics of each site.

To address these differences, water management strategies in sites of the Maya lowlands will be described below. The sites of Caracol, Copan, La Corona, and Tikal are referred as samples of case studies of water management strategies and availability of water in different
environments of the Maya Lowlands. These sites were selected due to the distinctive characteristics of water management strategies implemented there and water availability in their locations. In addition, a considerable amount of research has been conducted in these sites, including a large coverage of land surveying and aerial LiDAR survey. Several sites in the Central Lakes region near Holtun have bodies of water, such as El Venado, La Naya, and La Blanca. However, research conducted on these sites only produced maps of the civic-ceremonial epicenter, limiting the comparative approach with Holtun and the water management strategies in the peripheral settlements of the site addressed in this dissertation.

The site of Caracol is in Belize, in the east of the central Maya lowlands (See Figure 2). This is one of the larger sites of the Maya Lowlands with a cultural florescence during the Classic period (Chase et al. 2011). Archaeological research has been conducted at Caracol since the 1950s (Beetz and Satterthwaite 1981). The Caracol Project from the University of Central Florida started in 1985 and since then archaeologists have conducted excavation and mapping at the site (Chase and Chase 1987; Chase et al. 2011). In 2009, archaeologists of Caracol Project introduced airborne LiDAR (light detection and ranging) to the central Maya lowlands. This allowed a large coverage of mapping due to the capacities of this laser scanning methodology to penetrate the forest canopy and cover a large area from an aircraft (Chase et al. 2012). This allowed archaeologists to understand the nature of the settlement of Caracol and its relationship with the landscape.

The landscape of Caracol lacks a substantial body of water, and the settlement is dispersed in clusters or district nodes around monumental architecture. Water in the monumental centers of these nodes is supplied by large reservoirs, but not all the nodes have reservoirs. The
residential and peripheral groups are supplied with residential water reservoirs and catchment zones in agriculture terraces (Chase A.S. Z. 2016). It is believed that the presence of water reservoirs in several areas of the site allowed transformations in water management administration, since these reservoirs seems to be less restricted than the reservoirs of Tikal, for example (Chase A.S.Z. 2019; Chase and Cesaretti 2019). Water management strategies of Caracol are comparable with Holtun through the presence of monumental water reservoirs in neighborhoods outside the civic-ceremonial epicenter of the site.

Copan is a UNESCO World Heritage site located in Honduras (See Figure 2). The site is located in the southern Maya Lowlands and had a cultural flourishing during the Classic period. First explorers arrived at Copan at the beginning of the 19th century creating one of the first maps of the site (Stephens 1969[1841]). Archaeological research at Copan was conducted during the second half of the 20th century, including intensive excavations (Canuto et al. 2004; Agurcia 2004), epigraphic and iconographic studies (Fash 2004) and settlement pattern (Willey et al. 1978) and household archaeology (Webster et al. 1998). In 2013 an aerial LiDAR scanning provided a detailed map of the epicenter of the site and its periphery, including topographic and environmental information (Von Schwerin et al. 2015).

The civic-ceremonial center of Copan is situated in the north shore of the Copan River. Besides this large body of water, the landscape has several natural still-water reservoirs that remain within the settlement. Peripheral clusters of settlement also have access to these types of water resources (Davis-Salazar 2003). Based on the iconographic analysis of Copan’s art, it is believed that these still-water reservoirs were used for human consumption and for ritual purposes (Fash 2004; Fash and Davis-Salazar 2006). Archaeologists suggest that access to these
natural water reservoirs allowed for the development of identity and community cohesion in the neighborhoods outside the epicenter of Copan (Davis-Salazar 2003). Water management strategies of Copan are comparable with Holtun by the use of natural resources scattered across the landscape and not being geographically exclusive to the epicenter of the site.

La Corona, the mysterious “Site Q”, flourished in the western central Maya lowlands and had a cultural apogee during the Late Classic period (See Figure 2). The site has been studied by La Corona Regional Project with the sponsorship of the MARI Institute of Tulane University. Archaeological research has included excavations, epigraphic research, and mapping. Mapping at La Corona has been conducted through pedestrian surveying (Canuto et al. 2005; Guzman 2012) and aerial LiDAR scanning (Canuto et al. 2018). The site is situated in an area of multiple natural water reservoirs. The settlement is organized around some of these reservoirs and this practice granted access to water to the epicenter of the site and the peripheral households (Barrientos et al. 2011; Canuto and Barrientos 2011). The toponymal glyph of La Corona reads as Sak Nicte’, meaning White Flower (Canuto and Barrientos 2013). The multiple water reservoirs of La Corona grow water lilies, which are a white flower venerated by the ancient Maya and associated with royalty in the iconography, as seen in the previously discussed case of Copan (Davis-Salazar 2003; Fash 2003). Archaeologists from La Corona Archeological Project identified this symbol as a regional reference of royalty and the rulers of La Corona were referred in monuments as “the holy lords of Sak Nicte’” (Canuto and Barrientos 2013). Although the settlement was dispersed within multiple water reservoirs, the central plaza had a water reservoir with a square shape known by the archaeologist of the project as the Royal Reservoir, or aguada real (Barrientos et al. 2011). In addition, a dock was created in one of the reservoirs in
the periphery of the site probably for fishing or catching water during dry seasons (Guzman 2011). The case of La Corona illustrates the case of Holtun, where centralized and engineered water strategies were implemented despite the large availability of water.

Tikal is also a UNESCO world heritage site located in Guatemala (See Figure 2). It is in the central Maya lowlands and had a cultural development from the Preclassic through the Classic period. The site has been explored since the 19th century (Laporte and Valdes 1993). Pioneering research at the site promoted the importance of its size, monumental architecture, and carved monuments and wooden lintels with decorations, scenes of personages, and inscriptions (e.g., Maler 1913; Maudslay 1883). The first archaeological project conducted at the site was sponsored by the Museum of the University of Pennsylvania. This project included an intensive pedestrian surveying that resulted in a detailed map of the core of the site (Carr and Hazard 1961) and peripheral settlements (Puleston 1983), including topography and environmental features. The elaboration of these maps allowed archaeologists to conduct important studies of ancient Maya settlement patterns used as a reference for the understanding of Maya architecture in the central Maya lowlands (e.g., Becker 2003; Arnold and Ford 1980; Havillard 1982). The recent Pacunam LiDAR initiative has produced a detailed map of Tikal and other archaeological sites in the central Maya lowlands based on aerial laser scanning technology with a larger coverage capacity (Canuto et al. 2018). The detail achieved in the topographic map of Tikal allowed archaeologists to conduct studies about water management in the site (Scarborough and Gallopin 1991; Scarborough et al. 2012).

Tikal is settled in uplands lacking a substantial body of water. However, it is believed that water springs and natural reservoirs were in the area at the time of the foundation of the site. The
water management of Tikal is one of the most documented cases in the Maya Area. The site had monumental water reservoirs built in the civic-ceremonial center and it had water reservoirs in the periphery (Scarborough 1993; 1998). The causeways of the site and the artificial canals constitute a catchment system that granted a massive collection of rainfall runoff (Scarborough et al. 2012). Water management strategies of Tikal are comparable with Holtun through the location of a monumental water reservoir next to a slope to create a water catchment.

As observed in the representative cases of Caracol, Copan, La Corona and Tikal, water management strategies depend on the conditions of the local environment and the internal dynamics of social organization. Even sites with geographic similarities and similar solutions for water collection may have differences in the social outcomes of water management strategies, such as the case of Tikal and Caracol (Chase A.S.Z and Cesaretti 2019) or the similarities observed between the four sites and Holtun. Although it is possible to compare the site of Holtun with the universal concave and convex model of Scarborough (1998), the natural resources flowing down the landscape (concave) and the water reservoirs centralized in the uplands (convex), the site presents significant variations to the model.

The people of Holtun managed dynamics of social complexity around artificial water reservoirs created in the uplands of the landscape during the Late Classic period. However, different from Caracol, Copan, and Tikal, the elites of the civic-ceremonial epicenter did not develop monumental artificial water reservoirs. Presumably, they continued relying in the fluid convex landscape irrigated by the water springs. Therefore, during the Late Classic period, two water management systems operated simultaneously at Holtun. One is based on natural springs and still-water pools, and the other is based on water reservoirs. The diversity in water
management strategies at Holtun supports the argument that water management strategies were not homogeneous and they are rather diverse and variable. Details about water availability and water management strategies implemented in the landscape of Holtun are provided in the following chapter.
Figure 2. Map of the Maya area depicting the Southern Lowlands, Highlands and Pacific Coast. Hydrology and sites mentioned in the chapter are included. Map by Rodrigo Guzman.
CHAPTER 3: HOLTUN

Water management practices in Holtun are similar to practices observed in other Maya sites in the central Maya lowlands. The landscape of Holtun has cisterns, reservoirs, water springs, and still-water pools. However, some water management practices were local variations and adaptations of regional practices. The landscape lacks a substantial body of water as in other sites in the Maya lowlands. In addition, the artificial water reservoirs are not always centralized in the epicenter of the site. The presence of multiple sources of water spread around the landscape of Holtun has the potential to support a large community, as contemporary inhabitants have demonstrated. In addition, the distribution of water resources in the ancient Holtun may have also supported secondary elites to develop and maintain social power outside the epicenter of the site.

In this chapter, the cultural and natural landscapes of ancient and modern Holtun are explained. A brief history of Holtun Archaeological Project is included here to examine the process of understanding the characteristics of the landscape. Finally, the history of the modern community of La Máquina, which is adjacent to Holtun is included. The modern community and Holtun share the experience of exploiting the same water resources. Although water is available most of the time, the resources are vulnerable to anthropogenic disturbances to the environment and dynamics of power among the community today, as in the past.

The Natural Landscape of Holtun

The site of Holtun is located on top of karstic hills in the south of the basin of the Yaxha-Sacnab lakes system. This basin is the eastern end of the Central Peten Lakes region in the
central Maya lowlands (Kovacevich et al. 2011, Rice P. 1984). Like the other basins in the west, this is an endorheic or closed basin relying only in meteoric water and it does not have drainage. The lakes Yaxha and Sacnab are two elongated bodies of water situated adjacently in the bottom of the basin. Yaxha is in the west and Sacnab in the east. During the rainy season, two additional bodies of water flood lowland areas west of Yaxha and east of Sacnab. The shoreline of Yaxha is 20 kilometers in length and the shoreline of Sacnab is 12 kilometers (Brenner et al. 2002a; 2002b; Rice and Rice 1980).

The topography of the basin consists of a tropical karstic landscape, with hills in the north and the south that rarely surpass 450 meters above the mean sea level. The valley between the elevations connects the Central Lakes region with the Holmul River basin. This connection makes the Central Peten Lakes region a natural path between the basins of the Holmul River in the east and the San Pedro Martir River in the west. These two rivers flow in two different drainage systems, Holmul flows towards the Caribbean Sea and San Pedro Martir flows towards the Gulf of Mexico. This geographic composition allows for communication and interaction with other regions of the Maya lowlands. The modern highway CA13 crosses the basin east to west and a modern village is adjacent to the location of the site (Guzman 2017b).

The karstic landscape of Holtun is characterized by a system of ravines (See Figure 3). These ravines start in the upper portion of the southern hills and descend towards the valley in the north. The ravines have ramifications similar to a river system. However, there are no perennial streams running on the surface of the ravines. In several points of the ravines, water flows from springs or accumulates in natural pools. Meteoric water and water from the springs
filtered through the sediments of the ravines causing underground streams (Guzman 2017a; 2019).

The natural environment of Holtun is similar to the environment in the whole basin. Botanical analysis conducted in previous archaeological research indicates that the Yaxha basin was able to support at least four different types of vegetation: 1) tall upland forest and the forest in humid slopes, 2) upland forest in areas of no-inundation, 3) swamp forest and thickets, and 4) areas of seasonal inundation (Rice, D. 1977; 1978; Rice and Rice 1980). However, these environments have changed due to the anthropogenic modification of the land. A great portion of the forest has been destroyed and replaced by grassland for cattle ranches. According to the local people, the destruction of the forest in the hills has caused an increase in the sedimentation of the ravines (Guzman 2019).

Figure 3. Holtun seen from the south. 3D reconstruction of the landscape of Holtun showing the location of the settlement from a southern perspective. Arrows indicate the location of the main water sources (By Rodrigo Guzman based on cartographic sheets scale 1:50,000 from the National Institute of Geography of Guatemala, courtesy of Holtun Archaeological Project, see Appendix A).
The Cultural Landscape of Holtun

The site of Holtun is a modest sized settlement comprised by at least 350 structures organized in patio or plaza groups (Guzman 2019; 2020) (See Figure 4). The organization of the settlement in Holtun consists of clusters of these patio/plaza-groups placed on karstic hills and spread around a landscape of at least 7 square kilometers. The groups have a square or rectangular shape and in the majority of cases they are oriented towards the north (Guzman 2020). This is a type of architecture typical of Maya settlements in the lowlands (Becker 2003).

Figure 4. Map of Holtun indicating the distribution of the settlement in the landscape. Map by Rodrigo Guzman Courtesy of Holtun Archaeological Project (See Appendix A)
The settlement with most area of coverage at Holtun is known as the central plazas or the epicenter of the site. This portion of the settlement is characterized by the presence of plazas and large patios. The proportion of the size of these plazas and patios contrasts with the rest of the plaza/patio-groups in the site. The epicenter of the site is subdivided into two groups: one in the north and another in the south. These groups contain some of the most distinctive markers of social and cultural complexity of the site.

The north group of the epicenter contains a massive structure (See Figure 5) identified as Group B by the archaeologists that documented the site in the 1990s (Fialko 2011; Ponciano 1995). This structure contains at least two *mascarones*, or gigantic mask facades, created in two different stages in the construction of the building. The earliest one measures 3.50 meters in height, and the latter is approximately 5.00 meters (Fialko 2002; 2011). *Mascarones* are interpreted as markers of Late Preclassic social complexity because of the quantity of labor, the intellectual skills used, and the cultural beliefs represented in their manufacture (Inomata and Henderson 2016). Distinctive examples of *mascarones* are present in sites with early manifestations of social complexity such as Cival (Estrada-Belli 2006), Tikal, and Uaxactun (Schele 1998). As mentioned above, the name of the Holtun was given by Guatemalan authorities because of the exposure of these early cultural features through looters’ trenches.
The southern cluster of the epicenter contains the second most distinctive cultural marker of Holtun (See Figure 6). This cluster consists of a grouping of four plazas of Group F, according to the nomenclature of the first researchers of the site (Fialko 1998; Ponciano 1995). These plazas are identified as F-A, F-B, F-C, and F-D. The plazas are aligned consecutively from north to south, respectively. The distinctive marker is an architectural compound known in Maya Archaeology as E-Group and it is in the Plaza F-B. These types of groups are considered one of the earliest manifestations of social complexity during the Middle Preclassic period and often the first standardized, monumental building in ancient Maya centers (Šprajc 2021). They are described as a plaza compound with a sequence of structures in the east and a pyramid in the west. The organization of the structures is associated with astronomic observations, particularly to observe the translation of the sun in the horizon from south to north and vice versa and to commemorate equinoxes and solstices (Aylesworth 2015; Ricketson 1928). Recent studies
suggest that the function of the eastern building may have changed during later periods because of the funerary contexts and change of orientation (Becker 2003). However, the symbolic value of the building remained venerated and even transferred to other buildings with different characteristics (Šprajc 2021).

Figure 6. Group F with E-Group seen from the southeast (By Rodrigo Guzman, courtesy Holtun Archaeological Project, see Appendix A).

The E-Group in Plaza F-B consists of four structures organized around a large plaza of 50 by 30 meters. The western structure is a pyramid, and the eastern structure is a building with multiple structures aligned north to south. The eastern structure contains markers of social complexity from different periods of occupation of the site (Guzman 2017). Among these cultural markers is a cruciform cache with a solstice orientation carved in the bedrock and a shrine with graffiti above that cache. In addition, two mascarones were constructed in the south and north of the shrine in an axial design (Callaghan 2017; Callaghan et al. 2017) (See Figure 7).
Figure 7. Photo and digital photogrammetry of south Mascaron in the eastern structure of Group F-B (Photogrammetry by Rodrigo Guzman, courtesy Holtun Archaeological Project, see Appendix A).

The rest of the settlement consists of clusters of patio-groups. The cluster with the highest density of settlement is situated northwest of Plaza F. The cluster of groups south of Plaza F and east of the site have less settlement density. Although the larger plazas are in the epicenter of the site, some of the groups in the east contain medium size patios and plazas. For example, Group HTN19_20 contains a plaza of 30 by 15 meters, which is 30% of the size of Plaza F-B. This settlement is characterized by an atypical size and orientation of the structures, and the proximity to water reservoirs or aguadas.

**Archaeological Research at Holtun**

The first official investigation of the site was conducted by a governmental commission in 1994 after members of the local community reported looting in the area. The site was named Holtun based upon the presence of massive mask facades exposed by looter trenches in one of the main buildings. The name Holtun means “head of stone” in the Maya Itzá language. After the
official reconnaissance of the site, Holtun was declared an archaeological park and the first version of the map was created. Boundaries were traced in the perimeter of the epicenter of the site (Ponciano 1995). After that, the conservation endeavors included permanent guards in the park and monitoring from archaeologists of Yaxha, a larger park in the vicinity (Quintana 1996, 2003; 2013; Quintana and Wurster 2001).

Between 1997 and 1998, archaeologists lead by Vilma Fialko conducted archaeological research in Holtun. The activities of this project included a site map, excavation test pits, and the consolidation of architecture damaged by looting. In addition, the team documented the sculptural facades of the site (Fialko 1997; 1999; 2002). Their research produced the first archaeological information about the site and an initial ceramic chronological sequence (Fialko 2011).

The architecture of Holtun has been recently used as a reference alongside 70 other Maya sites to assess the function and meaning of architectural compounds known as E-Groups. These groups are usually placed in the east of large plazas marking the solstice and the equinox. Although it is considered the first form of ancient Maya architecture, the function of these buildings changed across time to more political and administrative (Šprajc 2021). These transformations in E-Groups were observed at Holtun during the excavations conducted by the Holtun Archaeological Project (Callaghan et al. 2017).

**Holtun Archaeological Project**

This dissertation is based upon data and information collected between 2010 and 2021 during field and laboratory seasons of the Holtun Archaeological Project (HAP). This is a multidisciplinary project initiated by archaeologists Dr. Brigitte Kovacevich and Dr. Michael
Callaghan with academic sponsorship from the University of Central Florida, in Orlando, Florida. The project was conducted with the collaboration of Guatemalan professional archaeologists and students from Del Valle University and San Carlos University of Guatemala. In addition, it has supported research activities of graduate students from Southern Methodist University, University of California in Los Angeles, and the University of Central Florida (Kovacevich and Rivera 2011; Guzman 2017).

The research initiatives conducted by HAP have produced a corpus of information and congregated a diversity of specialists from different areas of expertise in archaeological research. Results from the research seasons have allowed the project to contribute to the understanding of ancient Maya civilization through analysis of human skeletal remains (Izzo 2017; Palacios 2021; Scherer 2011), ceramics (Callaghan et al. 2018; Callaghan et al. 2017a; 2017b), local fauna (Bishop and Lopez 2015; Bishop 2016; 2017), lithic and obsidian (Crawford and Kovacevich 2017; Kovacevich 2014; Guzman 2017b), and landscape archaeology (Guzman et al. 2018). In addition, the project has hosted research for six graduate theses at a master’s level (Batres 2021; Kebler 2019; Gill 2018; Guzman 2017b; Palacios 2021; Whyte 2020) and three doctoral dissertations in progress, including this one.

*History of the Project*

The first season of the project was conducted between July and August of 2010. This season was co-directed by Dr. Brigitte Kovacevich, Dr. Michael Callaghan, and the Guatemalan archaeologist Patricia Rivera Castillo (Kovacevich and Rivera 2010). Rodrigo Guzman, the author of the present dissertation, was in charge of the cartography of the project. The objective of the 2010 season was to explore cultural activities from the Preclassic period at Holtun. The
focus of the research was political and economic changes, especially during the transition towards the Classic period. The specific objectives of the season were: 1) create an archaeological map using digital and electronic technologies, 2) survey the periphery of the site to assess the physical extension of the site, and 3) conduct an inventory of unauthorized excavations and looting in the buildings (Kovacevich and Callaghan 2010; Guzman 2010). The main outcome of this season was the creation of the first version of a digital map for the epicenter of the site. It allowed the researchers of the project to understand the dimensions of the epicenter of the site and plan for future research seasons (Guzman 2010).

The second research season was conducted between May and July of 2011. This season was led by Dr. Brigitte Kovacevich, Dr. Michael Callaghan, and Patricia Rivera Castillo. This season included the participation of students from San Carlos University and one graduate student from Southern Methodist University. The objective of the project was to identify the multiple chronological stages of the settlement and create an initial chronology of the site. To achieve that, test pits were excavated in the center of plazas and patio groups at the epicenter of the site. The research focused on areas of the site with evidence of early occupation. In this case, plazas B and F were selected for excavation due to the presence of markers of social complexity such as the *mascarones* and the E-Group. The outcome of the season was the excavation of 30 test pits across the site. That allowed us to know the early cultural stages at the site and understand the process of settlement and transformation of the community at Holtun (Kovacevich and Rivera 2011). In addition, the continuous mapping process resulted in the inclusion of another seven architectural compounds to the digital map (Guzman 2011).
In 2012, the research season consisted of laboratory analyses conducted on archaeological samples collected during the previous season in 2011 (Kovacevich and Cardona 2014). The objective of this analysis was to understand the development of social complexity at Holtun. In this season, a collection of obsidian samples was analyzed with a portable X-Ray Fluorescence device. In addition, ceramic samples were selected and prepared to conduct analyses such as petrography and Instrumental Neutron Activation (INAA) (Kovacevich 2014a). Finally, charcoal samples were selected and prepared to conduct a radiocarbon analysis (Kovacevich 2014b). During this season, a 3D map of the site was created based on the cartographic sheets of the National Institute of Geography of Guatemala scale 1:50,000.

The information collected during the first stage of the project and the results achieved allowed the principal investigators to obtain an important grant to continue with the development of the project (NSF Grant ID# BCS-1430954). The following research season was conducted between May and June of 2014 under the direction of Dr. Brigitte Kovacevich, Dr. Michael Callaghan, and Guatemalan professional archaeologist Karla Cardona. The excavations were conducted in the plazas D, F-A, and F-B, continuing the test pits initiated in 2011 (Kovacevich and Cardona 2015). The methodology of excavation experienced a change this year due to governmental dispositions regarding archaeological research methods. Test pits were limited to a dimension of 1.00 by 1.00 meters. Therefore, any trench or a larger excavation should be an extension of a first test pit, digging a new test pit as the continuation or extension of the previous one. The excavation trenches in the plazas selected for research were lines of pits aligned north and east respectively, in a cruciform pattern. Each test pit was intercalated every two meters and soil samples were taken in the unexcavated locations with a soil auger. The outcome of this
The next research season was conducted in June of 2015 under the direction of Dr. Brigitte Kovacevich, Dr. Michael Callaghan, and Karla Cardona. Excavations were conducted in the plazas of Groups F-A, F-B and H. The general objective of the season was to understand the sequences of building at the central plazas and to explore the settlement of the site in the periphery of the epicenter (Callaghan et al. 2017). The outcome of the season was a collection of artifacts from the archaeological contexts that were subsequently documented and analyzed. The results of the analyses conducted to these archaeological materials informed subsequent research about the origins of the site during the Preclassic period and the transition through the Classic period (Callaghan 2016). The dimensions of the map increased in area of coverage with the inclusion of a new cluster of 89 mounds organized around 29 patio-groups settled in the karstic hills in the northwest of the epicenter of the site (Guzman 2016).

In 2016, the research season was conducted between June and July under the same directors as the previous year. The research objectives included finding the earlier elements of social complexity and water resources in the environs of the site. The excavations focused on plazas E, F-A, F-B, F-C, F-D, and H. Besides the excavations in the plazas, the excavations extended towards the east and west buildings of Plaza F-B. The excavations in Plaza F-A and Plaza F-B allowed for the discovery of early manifestation of social complexity in the site.

Markers of social complexity were found at Holtun during the excavations conducted in 2016. These markers consisted of earlier versions of the buildings, one altar, a cruciform cache
resembling a Preclassic dedicatory offering, and a speleothem, among other cultural traits. This cache was found beneath an early shrine buried under a later stage of the eastern building in Plaza F-B, the eastern building of the E-Group. These types of caches are often associated with rituals of foundation in Preclassic sites, as seen in sites like Ceibal and Cival. The cruciform pattern suggests a cosmogram indicating the sides of the universe (Estrada-Belli et al. 2006, Smith 1982). In addition, a speleothem was found in this building but in a Late Classic context (Callaghan 2017). A speleothem is an elongated piece of sedimentary rock formed by mineral depositions in a cave (Jennings 1971). There are still no caves found near the site of Holtun. However, archaeologists suggest that this was part of a ritual of veneration of water that connected important contexts with a sacred cave (Brady et al. 1998).

The mapping activities of 2016 concluded with the integration of one cluster of patio-groups in the southeast of the epicenter of the site. In addition, pedestrian survey in the south of the site resulted in the documentation of water springs and small pools in the ravines. The distribution of the water resources within the ravines indicates the presence of a sub-basin with water availability in the south of the site (Guzman 2017; Guzman 2018).

In 2017, the research season was conducted between May and June under the same directors from the previous three years. This research season focused on the excavation of patio-groups in the northwest and north residential clusters of the site. In addition, works of documentation and restoration were conducted on the walls of the shrine in the eastern building of Group F-A, the E-Group. The walls of the shrine contained a rich collection of Maya graffiti depicting symbolic scenes of life and death (Callaghan et al 2018; Colin 2017; Gill 2017; 2018).
The mapping activities of 2017 concluded with the integration of the northern portion of the site. This portion includes a cluster of patio-groups, a series of platforms, and the only water spring found near the epicenter of the site. This is a water spring that flows during the rainy season and emerges from the base of a platform west from Group B, which is the building that features the *mascarones* in the north of the epicenter of Holtun (Guzman 2017).

In 2019, a mapping and reconnaissance season was conducted east of the site, between June 25th and July 3rd. The project was directed by Rodrigo Guzman as a doctoral student under the supervision of Dr. Brigitte Kovacevich and Dr. Michael Callaghan as Co-PIs. The objective of the reconnaissance was to document the density of the settlement outside the epicenter and the availability of water resources. The reconnaissance was conducted within farms and cattle ranches of the village, with the collaboration of the owners and local personnel. The outcome of the reconnaissance was the documentation of 35 patio-groups dispersed in the landscape. Only 32 of these groups were mapped due to permissions not granted by the landowners. These groups contain 152 mounds, which implies a density of approximately 72 mounds per square kilometer. One of these patio groups stood out among the others due to the orientation of the buildings, the dimension of the plaza, and the presence of a *chultun* at the edge of the central plaza. This was identified as Group HTN19_20 and selected for research in the following season. Finally, three water resources within the ravines were visited and documented. In addition, local personnel served as informants about the history of the village of La Máquina in relation to water management (Guzman 2019; Guzman 2020).

In 2020, a research season was planned and funded by a research award. However, it was later suspended due to the global emergency caused by the Covid-19 pandemic. Therefore,
research activities were moved for the following year. Some analysis on the map of Holtun was conducted during this interim period.

In 2021, the research season consisted of the exploration of Group HTN19_20 between June 26 and August 12. This group was located during the previous season in 2019 in an area near water resources. The project was again directed by Rodrigo Guzman as a doctoral candidate, under the supervision of Dr. Brigitte Kovacevich and Dr. Michael Callaghan as Co-PIs. The objective of this research was to document the cultural characteristics of the group and its relationship with the nearby water reservoirs. The explorations concluded with the excavation of nine test pits that allowed me to document cultural traits and cultural processes. In addition, at least two water reservoirs or aguadas were identified north of this group (Guzman 2021; 2022). Details of this exploration will be further explained in chapter 5 and 6.

The Map of Holtun

Mapping the cultural and natural landscape of Holtun has been an ongoing objective of archaeological research at Holtun for more than 30 years. The first version of the map was drawn by Guatemalan archaeologist Erick Ponciano (1995) in 1994. He reported 86 structures organized in four groups and identified them as A, B, C, and D. The codification of the central plazas corresponds to this classification. A second version of the map was created between 1997 and 1998 as part of the project conducted by Guatemalan archaeologist Vilma Fialko (1997; 2002) and her team.

From 2010, HAP has included a permanent program of reconnaissance and mapping. The objective of this program is to document the settlement in the core and the periphery of the site. In addition, the mapping program sought to understand the relationship of the settlement with the
environment. One of the research questions for the mapping initiative was the relationship of the site with water. From 2016, reconnaissance and mapping has provided information about water availability and water management in the landscape of Holtun (See Figure 8) (Guzman 2011; 2017c; 2020; 2022).

![Map of Holtun indicating the location of the settlement and water reservoirs (Map by Rodrigo Guzman).](image)

**Figure 8.** Map of Holtun indicating the location of the settlement and water reservoirs (Map by Rodrigo Guzman).

**Water Availability and Water Management at Holtun**

Water is available in the landscape of Holtun. However, there are no substantial bodies of water visible near the site. Water is present in the form of water springs, natural pools, and artificial reservoirs and cisterns. Due to the nature of the karstic landscape, water resources are
hidden within ravines and hills. A total of four water springs have been documented in the area as well as a series of natural water pools in sediment beds of the ravines. In addition, two cisterns and two artificial water reservoirs are near or within the settlement of Holtun. Finally, a series of 63 chultunes have been found spread around the landscape and inside patios and plazas. Despite the multiple functions ascribed to chultunes, or underground storage chambers, the possibility of their use for storing water is not ruled out.

Water Spring 1: El Manantial.

This water spring from a small cave in a wall of limestone in the low course of a ravine (See Figure 8). The wall of limestone is in the south shore of one branch of the ravines south of the site. One characteristic of water springs at Holtun is that water flow seeps through the sediments of the ravines, disappearing from the surface as seen in the picture below (See Figure 9). Although this water spring is apparently far from the epicenter of the site, at least three patio groups are located north in the top of the nearby karstic hills. There is a high difference of elevations between the closest patio groups and the spring so there is a steep slope to access it (Guzman 2017a).
Water Spring 2: La Rejoya

Water spring 2 consists of an offspring of water in an exposed limestone wall in the bottom of a karstic hill (See Figure 10). It is located south of the epicenter of the site, near the top course of a ravine. The water spring is north of the three patio groups that are also nearby water spring 1 and almost equidistant. The difference in heights between the three patio groups and water spring 2 is almost the same as with water spring 1. Therefore, access to the spring also requires passing through a steep slope. According to local people, another water spring was 500 meters northwest from Spring 2. However, it became permanently desiccated after the forest was destroyed (Guzman 2017a).
Water Spring 3: La Pepitoria

Water spring 3 is a seasonal spring that flows on a field west of Group B in the epicenter of the site (See Figure 11). This is the only water spring that does not run towards one of the ravines in the area, but it has a small seasonal creek. There is evidence of an ancient land modification around the spring and a retaining wall seems to maintain the angular shape of the land. One underground storage chamber or chultun was made east of water spring 3 next to the retaining wall. This spring is referred to as La Pepitoria because of a crop of a local species of squash used as condiment (Guzman 2017c).
Figure 11. Localization of water spring *La Pepitoria* referred in the map of the project as *Manantiales* (By Guzman 2017c).

*Water Spring 4: El Duende*

Water spring 4 is a permanent spring flowing from an outcrop of limestone in a ravine. The limestone has a crack and inside water accumulates in an open space like a natural cistern. In a lower portion of the ravine, the overflow of water accumulated in a pool. This pool was transformed into a concrete cistern tank by the members of the village (See Figure 12). This spring is 2.3 kilometers southeast of the epicenter of the site and 1.1 kilometer from Group HTN19_20. Differently from the other three springs, this is located in a high position of the landscape (Guzman 2020).
Natural Still-Water Pools in the Ravines: Los Jutes 1 and 2

The water pools in the ravines consist of water accumulation in areas of low slope within the ravines. These pools tend to increase during the rainy season, but some stay during the dry season. An area of pools can be found south of the site in the high course of the ravines. However, there is another system of pools in the low course of a ravine known as El Arroyo (Guzman 2020). The name of the pools corresponds to the high frequency of specimens of the species Pachychilus spp., locally know as jutes (See Figure 13). It is believed that they represented an important source of food among the ancient Maya and their shells were used in rituals of veneration (Halperin et al. 2003).
Figure 13. Still-Water pool of Los Jutes 1 with some specimens of *Pachychilus* spp. (Photo courtesy: Byron Alcantara and Mynor Ceballos).

*Natural Still-Water Pools: El Arroyo*

The water resource of *El Arroyo* consists of a group of pools in the lower course of a ravine. This is the same ravine that has the spring of *El Duende* in the upper course. The pools are in a location northeast of the epicenter of the site. The first pool is the larger body of water among the pools, and it is in the southern portion of the ravine (See Figure 14). This pool maintains clean water and hosts some small species of fish and crustaceans. As well as *El Duende*, the southern pool of *El Arroyo* was declared communal land by the local authorities of the village (Guzman 2020).
Figure 14. Photo of one of the still-water pools in *El Arroyo* (Guzman 2019).

**Water Reservoirs: Aguadas**

The *aguadas* are large depressions with an apparent rectangular shape (See Figure 15. At least two of these water features have been found within a cluster of patio-groups delimited in the south by Group HTN19_20. The size of the *aguadas* is approximately 8000 square meters (86111.28 square feet) and they have drainages running towards the ravines. The soil in the ravines is a dark clay and they tend to catch moisture during the rainy season. Modern water reservoirs have been excavated with mechanized machinery inside the *aguadas* (Guzman 2022).
The Cistern Pit of El Zapotal

The water cistern pit of *El Zapotal* is a cylindrical excavation in the sediments of the lower course of the ravine *El Zapotal* (See Figure 16). The ravine starts next to the group HTN19_20 and descend towards the valley. The water cistern is in a location of the ravine near Group A, a residential group in the northern portion of the epicenter of Holtun. This cistern fills with water during the rainy season, and it maintains a low volume of water during the dry season. According to the local people, the cistern was already there when the colonization of the area took place in the 1960s.
Water Cistern in Plaza F-C.

One water cistern was found on the edge of Plaza F-C, in the epicenter of the site. Originally, it was documented as a *chultun* but it was clarified after excavating the feature. The cistern had a drainage running underneath the plaza that drained water towards the southwest of the plaza. Carved limestone was used to create some of the shapes of the cistern and the drainage (See Figure 17) (Kardona and Sagastume 2016).

![Figure 17](image-url)

**Figure 17.** Photo of drainage of cistern in Plaza F-C (Sagastume 2016), courtesy of Holtun Archaeological Project (See Appendix A).

Underground Storage Chambers: The Chultunes

A large number of underground storage chambers (*chultun*) have been documented in the site of Holtun. In the last field season, one *chultun* was found in the southeast corner of the *aguada* of Group HTN19_20. This *chultun* complete 63 underground chambers documented by HAP during land surveying. Previous archaeological projects documented 12 *chultunes* (Fialko 2012). However, not all of them were found during the pedestrian survey at Holtun. The *chultunes* at Holtun can be found in any type of architectural compound, inside or outside the patio/plaza. They can also be found isolated from the buildings or in independent platforms away
from the settlement. The *chultun* in the plaza of Group HTN19_20 was explored in the most recent research season (Guzman 2022). Due to the size, location, and composition of this *chultun*, it may have had ritual purposes as argued by Brady (2004).

The information provided above indicates that Holtun had a diverse variety of water resources distributed across the landscape. Water springs, still-water pools, water reservoirs, cisterns, and water storage facilities supplied water to the ancient community of Holtun. Water resources at Holtun were livelihoods that shaped the cultural landscape and played a significant role in the sociopolitical dynamics of the site. However, while some of the water sources have strong indicators of centralization and appropriation (*e.g.* *aguadas*), others are secluded and without any indication of control. Finally, as the nature of the water resources at Holtun contributed to the settlement and development of social complexity in the past, the resources continue providing subsistence and status in the modern community of La Máquina as described below.

**La Máquina and the Colonization of the Modern Holtun**

The landscape of Holtun is currently occupied by the modern village of La Máquina. This village was founded by cattle ranchers and farmers, but tourism and archaeology have become an important source of income for the community. The village consists of a couple of streets around highway CA13. However, the farms and ranches extend over a good portion of the basin, including the karstic elevations of Holtun. The location of the village is a midpoint between the city of Flores, the capital city of the department of Peten, Guatemala, and the border with Belize. The village is approximately one hour away from both locations and situated at the crossroads to
Yaxha-Nakum-Naranjo national park. This park encloses the archaeological sites of Yaxha, Nakum and Naranjo, among other smaller sites.

The community of La Máquina was founded in the 1960s by migrant families coming from the eastern highlands and the Pacific Coast of Guatemala. The central government of Guatemala granted the families land in this area through a development program known as FYDEP. This program sought the economic development of the department of Peten through the occupation of areas with low population density (Schwartz 1987). The area was previously occupied by camps for the extraction of renewable products from the rainforest like wood, pepper and chewing gum.

The people of La Máquina have been sensitive to the world’s contemporary history. They witnessed the preparations of Guatemalan army to invade Belize in 1976 to maintain sovereignty over their territory (Shoman 2010). A Special Forces training school was created in the neighboring town of La Polvora to train the troops to invade Belize. The negotiations stopped because of an earthquake that struck the highlands of Guatemala on February 4th of that year, affecting a good portion of Guatemalan population (Rossiter 2018). However, the military presence remained and made an impact during the course of the guerrilla wars in Guatemala (Hudson and Leidl 2015). The guerrillas were supported by communist nations and attempted to impose a communist regime in Guatemala during the cold war. The central Peten was the theater of operations of FAR, the Spanish acronym for Revolutionary Armed Forces. The FAR was a communist guerrilla group formed in 1963 after the uprising of a faction of the Guatemalan Army. In the 1970s the violence persisted in La Máquina and the young men were enrolled in the Army’s civil patrols (PAC, Spanish acronym) to create a control point in the road. After a period
of constant violence, multiple families from La Máquina decided to go into exile. Some families migrated to Mexico and others to Belize, there they created the Communities of Population in Resistance (CPR, Spanish acronym) to avoid deportation (c.f. Ybarra 2012). Belize finally became an independent republic gaining independence from England in 1981. In 1996 the Peace Agreements between the Guatemalan Government and the guerillas ended the hostilities in all territory of Guatemala. During the 2000s a new wave of out-migration began with young people moving to the United States to pursue economic stability. The violence in the area continues nowadays due to the activities of international drug cartels (e.g., Yates 2014).

*The contemporary use of water at Holtun*

According to the local residents, the migration of their families corresponded to stories about an area of fertile land and abundant water (Emilio Ceballos, personal communication 2019). The first colonizers of the village collected water from multiple water resources available in the landscape. When it was possible, they dug wells in the ravines and the plains. However, there was enough water in El Arroyo and the water springs. When the land was distributed to the colonizers, they agreed to keep the water resources as communal land. They selected *El Duende* and *El Arroyo* as communal areas.

The water spring of *El Duende* contains evidence of the earliest modern occupation of the area. People from the village think that this area was used as a camp for people who worked harvesting the renewable resources of the tropical forest. One of these products is the chewing gum resin extracted from the Sapodilla tree (*Manilkara zapota*), or *Chico Zapote* as in its Maya-Hispanicized name (Nations 1992). There is still a metal bowl (*paila*) in the area today. It is of the type used in the preparation of the gum resin after extracting it from the trees. The location is

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referred to as *La Paila del Chiclero* and it is used as a local landmark. Apparently, the *chicleros* (workers who extract gum from trees) used this location because of the availability of water, not just for personal consumption but for the process of boiling and packing the chewing gum resin. The name of this water spring comes from an old local legend about a *Duende*, a supernatural entity similar to an elf or leprechaun, which haunted the area and protected natural resources from human depredation (Guzman 2020, based on information from local residents). The legend of *El Duende* is a cultural marker associated with places of water within the Maya area (Brady and Ashmore 1999; Brown 2004).

In 1995, with the aid of the municipal government and conservation agencies, local families of La Máquina joined to build a concrete cistern tank at *El Duende* spring. It was built in the area of the pond that collected the water flowing from the springs. In addition, they built a concrete tank to protect the water spring itself. The tank was connected to a water pipe that supplied water to the village (Guzman 2020).

The second source of water frequently used by the villagers was *El Arroyo*, a series of pools of water in the lower course of a ravine. Because it was an open-air resource with more accessibility, they use this source for utilitarian purposes other than drinking (Guzman 2020). Families from La Máquina also collected water from the other water springs and ravine pools when it was possible and available. In El Máantal spring, landowners built a concrete tank to collect water (Guzman 2017a).

By the time of the contemporary population of La Máquina, the *aguadas* were mostly desiccated. However, the depression in the topography allowed for the collection of moisture. Landowners utilized the *aguadas* to cultivate rice crops and later as a drinking trough for horses.
and cattle. With the growing of the cattle industry, the *aguadas* were modified with bulldozers to collect more water during the rainy season and to receive water from a tanker truck (Guzman 2022).

During the first decade of the 21st Century, the municipal government introduced a network of water pipes. It serves water to most of the houses in the village and it is supplied by a different water resource far away from the location. At this time, forest cover and the subsistence practices changed in La Máquina. Forest cover was reduced and the grassland increased for raising cattle. The level of sedimentation in the beds of the ravines increased with the loss of forests coverage in the slopes of the hills. All the water resources are currently used as drinking troughs for animals (Guzman 2020). The spring of *El Duende* is currently in territorial litigation between the community and landowners from the village of La Máquina, both parties claiming propriety of the communal area (Guzman 2022).

The exploitation of water resources in the landscape of Holtun is an intertwined history about the adaptation of ancient and modern inhabitants of the landscape. The relationship of the modern community with their water resources has contributed to the understanding of the nature of the landscape and the vulnerability of these resources. Because of the morphology of the landscape, permanent and substantial water resources are not evident to people not acquainted with the area. It was necessary to hear the stories of the interactions of people from La Máquina with water resources to learn the location of these resources and understand their potential use.

In the following chapter, the materials and methods to understand the cultural and natural landscape are described. The methodology used in the archaeological explorations conducted at Group HTN19_20 is also described. In addition, the end of the chapter provides a description of
the approach to the artifacts of Group HTN19_20 considered as markers of social power and status.
CHAPTER 4: MATERIALS AND METHODS

The site of Holtun offers a case study on water management from the perspective of a relatively small site that emerged in the Preclassic period. The cultural landscape of Holtun presents elements that are characteristic of an ancient Maya site. The site has plazas and patio groups with monumental architecture clustered in the epicenter of the site or in nearby karstic hills. A closer examination of the site illuminates local adaptations caused by the nature of the landscape and the social dynamics experienced at the site. The site lacks a substantial, above-ground body of water. However, small sources of fresh water are located around the site, sometimes hidden across the landscape. This condition may have contributed to supporting large populations during the early stages of the site, resulting in the location and distribution of the Preclassic settlement. Water management strategies seem to have shifted in the Late Classic period, allowing secondary elites or competing factions outside the civic-ceremonial epicenter to develop social power and prestige. This can be observed in the residential-ritual Group HTN19_20, which is located 1.3 kilometers southeast from the epicenter of the site. This group has markers of social power and status and although it is located close to the still-water pools and the water spring of *El Duende*, it has its own water reservoir.

To understand the nature of the landscape and the impact of the sociopolitical dynamics described above, this research project required the development of two series of procedures. The first one consisted of the analysis of the landscape using Geographic Information Systems (GIS) incorporating several cartographic resources and tools. The second consisted of the analysis of the archaeological evidence of Group HTN19_20, which is directly associated with a human-modified water resource. The material evidence found in Group HTN19_20 was assessed as a
sign of social power, privilege, and status. Analyzing the cultural and natural landscape and the status of Group HTN19_20 enabled assessing the social autonomy of this group and the contributions to the social complexity of the site.

The objective of this chapter is to describe the methods and materials used to understand the landscape of Holtun and the social status of Group HTN19_20. These details are described below in two separate sections. The first section is dedicated to the methods associated with the application of GIS in the process of understanding the cultural and natural landscape of Holtun. The second section is dedicated to the methods associated to the excavations conducted in Group HTN19_20.

**Geographic Information Systems and Cartographic Resources**

The cartography of Holtun includes several layers of information from the natural and cultural landscape. To create maps of Holtun, digital mapping was conducted in the format of Geographic Information Systems (GIS). The mapping process in GIS allows the user to overlap, create, manage, analyze, and display cartographic information on one map. Specialized software was used to process the maps within a GIS interface. Software used in the creation of the maps of Holtun are: ArcMap 10.8.1, QuantumGIS, and Surfer13.

Several sources of information supplemented the creation of the cartography of Holtun. These sources of information are pedestrian surveying maps, satellite imagery, digital cartography, and aerial photogrammetry. That information has been processed and adapted to create a geospatial database of Holtun. The creation of the digital map of Holtun enabled me to conduct several procedures in GIS to understand how the settlement of Holtun adapted to the local environment. The geospatial database of Holtun was used as a reference in the process of
finding and locating the multiple sources of water in the landscape that are not readily visible.

The distribution of the settlement was analyzed with the tools: Slope, Kernel Density and Average Nearest Neighborhood.

The results from the slope analysis indicated the gradient of the terrain in the landscape of Holtun. The slope gradient allowed us to determine which areas have a tendency to be flat and which ones are sloped. This helped us to understand the preferences of ancient inhabitants of Holtun in the selection of land for settlement. The results from the Kernel Density Analysis indicated areas of settlement density in the landscape. Finally, the results from the Average Nearest Neighbor analysis indicated the patterns of clustering or dispersion at the site. Next, the relationship of the settlement with the water resources was analyzed with the tools Buffer and Least Cost Path analysis. The analysis tool Buffer was utilized to create buffer zones around water resources. This enables finding strategies of control of the water resources, or lack of them. Finally, the Least Cost Path analytical procedure provided information to indicate the easiest route to access the water springs from the central plaza, using the slope of the terrain as the cost value. In the following section, details about the sources of cartographic information and methods of GIS analysis are provided.

**Pedestrian Survey**

Pedestrian survey has provided a considerable amount of spatial information about the settlement of Holtun. The objective of pedestrian surveying was to locate cultural and natural traits in the settlement, such as patios, plazas, mounds, *chultunes*, and water resources. These elements were displayed in maps used for descriptive purposes and in analyses such as clustering and dispersion, size proportions, and geographic orientations. In addition, topography of the
The epicenter of the site was collected by pedestrian surveying with precision measuring equipment, such as total stations, laser distance measures, and GPS navigation devices. This enabled the observation of the characteristics of that portion of the landscape with a high level of detail. Although the map of Holtun contains cartographic information gleaned during previous research seasons of HAP (2010 to 2017), targeted pedestrian survey was conducted in 2019 and 2021 to answer the specific research questions addressed in this dissertation.

There are some aspects to take into consideration regarding the pedestrian survey conducted at Holtun for academic rigor. First, pedestrian survey is a slow procedure that requires full access to all the targeted portions of land. In 2019 and 2021, non-electronic measurement instruments were utilized. An optical level, a compass, and a tape measure were used in the documentation of the settlement while conducting pedestrian survey during these field seasons. While a total station can read degrees, minutes, and seconds, an optical level can read only degrees and minutes, while a compass usually measures only degrees. In addition, while a total station can make automatic distance and height difference calculations, an optical level requires a manual trigonometric procedure to make these calculations. A compass requires the use of a tape measure and the measurement of vertical angles is less reliable.

Using non-electronic instruments enabled faster documentation of the settlement with an acceptable degree of accuracy, but it somewhat reduced the degree of precision offered by electronic instruments while documenting topographic and architecture details. In addition, topographic points for surface analysis were not taken. In these pedestrian surveys, focus was placed on the orientation of the groups and the size of the patios and plazas to make them comparable on the map with those taken with electronic instruments. Finally, the lack of
topographic information from pedestrian surveying in the periphery was compensated by
topographic information from digital cartography and satellite imagery. Below, details of land
surveying equipment and methodologies are described.

Settlement survey was conducted during all the field seasons of Holtun Archaeological
Project (Guzman 2010; 2011; 2015; 2017a; 2017b; 2019; 2020; 2021). Pedestrian survey
covered areas of interest and documented the location of excavations. Between 2010 and 2014,
land surveying focused on the epicenter of the site. From 2015 to 2019 land surveying was
performed in the periphery of the site. Land surveying was conducted with the aid of several
types of measurement instruments, including GPS devices, Total Stations, Transit Level,
Compasses, and tape measure, and a laser distance measure.

Important locations were georeferenced with Global Positioning System (GPS)
navigation devices. The first point was a benchmark established in 2010 with a Garmin Colorado
300 navigation device. The coordinate of reference is E242106/N1878008 UTM16N at 340
meters above the mean sea level. A back sight point was established 26.290 meters north of the
benchmark with an azimuth of 358°03’10” (Guzman 2010). From 2011 points of reference were
taken with a GPSMAP Garmin 64s (Guzman 2011). Other locations georeferenced with a GPS
point are chultunes and water sources (Guzman 2016; 2019). Although these instruments have a
high degree of precision marking a location, accuracy may depend on the type of device, the type
of vegetation or forest canopy, and satellite acquisition. In addition, navigation devices are not
connected to an external network to achieve a high degree of accuracy and precision.

Between 2010 and 2017 a Total Station was used to collect surveying points for buildings
and excavation's location, and for topography. Points were taken from a network of surveying
stations connected to the central benchmark established in 2010 in Plaza B. However, it was not always the same instrument. In 2010, surveying was conducted with a Sokkia SET6F and a Sokkia SET 5 10/D21866 (Guzman 2010: 11). Between 2011 and 2014 the Sokkia SET5 10/10/D21866 used in 2010 was the only instrument used. At the end of the season, the project provided a cleaning and calibration service of that instrument. In 2015, the Total Station used was a Trimble M3 (Guzman 2016: 29). In 2016 and 2017, the instrument used was a Leica FlexField Plus TS06 (Guzman 2016: 33). Although these instruments offer a high level of accuracy and precision due to the capacity to rectify locations using surveying rectification methods, the accuracy still relies on the geographical references given by GPS navigator devices.

During the reconnaissance and mapping season of 2019 land surveying was conducted using two compasses, a tape measurer, and a laser distance measurer. The compasses used are a Brunton precision compass and Brunton navigation compass. The laser distance measurer is a STEREN model HER430. Although these instruments are less precise than a Total Station, they were selected to cover more area and add to the map more peripheral patio-groups. A point was selected in the estimated center of the patio/plaza groups found during the reconnaissance. This point was georeferenced with the GPSMAP Garmin 64s device. The dimension of the plaza and the buildings were taken with a tape measure or a laser distance measure when it was possible. The orientation of the plaza was measured with a precision Brunton compass. The GPS coordinates were displayed on the map and the patio-plaza groups were digitized based on the distances and orientation observations taken during the survey (Guzman 2019; 2020).

In the field season of 2021, a Transit Level SitePro model TL20X and Brunton compass were used to create a map of Group HTN19_20C. An altar was found during the excavations
conducted in this group. Therefore, the precision instrument contributed to the documentation of the context of the altar. The optic observations of distance and orientation taken with the Transit Level were converted into coordinates in Microsoft Excel using a spread sheet to calculate the trigonometric formulas. These coordinates were later displayed in cartographic software to use them as vertices of the polygons that represent the archaeological mounds mapped (Guzman 2022).

Finding Hidden Water at Holtun

Locating the water resources Holtun relied primarily on pedestrian survey. The landscape of Holtun lacks a substantial and permanent body of water, as commonly seen in other archaeological sites like other sites in the basin (e.g., Yaxha, La Naya, El Venado). Finding the water resources available at Holtun required collaboration with local informants. Although watershed maps were created based on satellite imagery, aerial photogrammetry, and digital cartography, the exact location of water was difficult to calculate. A network of ravines descends towards the valley of Yaxha-Sacnab basin but the surface in the bottom of the ravines remains relatively dry, even during the rainy season. We expected to find an accumulation of water in areas where the course of the ravines is flat, and water tends to run slower. However, this was not always the case. That is why I refer to the landscape of Holtun as a landscape of hidden water. However, people from La Máquina are acquainted to the landscape and have full knowledge about water source, since they have been a livelihood since the colonization of the village of La Máquina. Details of the process of finding these water resources are provided below.
Learning the history of La Máquina, the modern village surrounding Holtun, was essential to knowing the location of water reservoirs. These locations were visited after knowing the existence of water springs and natural ponds used in the village before the introduction of a modern water service. Several sources of water available in the landscape were re-discovered during three field visits in three different years. The first visit to water resources was performed during the field season of Holtun Archaeological Project in 2016 (Guzman 2017a). The second visit was performed during the season of reconnaissance and mapping in 2019 (Guzman 2019; 2020). Finally, the aguadas were re-discovered during the field season of 2021. They were noticed during a conversation among the project personnel, indicating that this is a good area for water catchment. A modern water reservoir has been excavated in a small portion of the first aguada observed as it is used as a cattle trough. However, the personnel indicated that the area collected more water and was used previously to harvest rice (Guzman 2022). Another aguada with these descriptions was found 100 meters northeast from the first one.

Satellite Imagery

Satellite imagery supplemented this research with layers of topographic and environmental information. This information was created to supplement pedestrian survey in the process of understanding the landscape of Holtun. Satellite imagery provided topographic information used in the creation of hillshade maps and topographic contours. This information was used for visual analysis and descriptions of the landscape. In addition, they were used in spatial analyses that required elevation data like Slope and Least Cost Path analyses.

Some aspects were taken into consideration during the use of satellite imagery. The resolution of the images is never less than 30 meters, missing topographic details to be smaller
than that. However, the resolution was enough to create elevation models, contours, and to perform Slope and Least Cost Path analyses. Using the thermal refraction images from the Landsat 8 mission requires an open window in the sky without cloud coverage. This may be a disadvantage in terms of finding the most up to date image. Although the image used in this project is from 2019, it meets the goal of describing forest versus grassland coverage when analyzing the vulnerability of water resources at Holtun. Therefore, open access satellite imagery was an important resource to understand the nature of the landscape of Holtun. Details about the satellite imagery used in this project are provided below.

Two types of satellite image were used for the analysis of this dissertation project: Advanced Spaceborne Thermal Emission and Reflection Radiometer ASTER Global Digital Elevation Model GDEM Version 3 ASTGTM and Landsat Data Continuity Mission LDCM or Landsat 8. This imagery was downloaded from the website Earth Data of the National Aeronautics and Space Administration (NASA) (Earthdata 2022) and the website Earth Explorer from the United States Geological Survey (USGS) (EarthExplorer 2022). Both websites contain user interfaces to allow free downloads for research purposes.

Topographic information was obtained from the ASTER GDEM V3 image. This imagery is the result of remote sensing observations taken from a radiometer in the Terra satellite from NASA in collaboration with the Ministry of Economy, Trade and Industry METI of Japan and the Japan Space Systems (ASTER 2012). The imagery consists of a digital elevation model (DEM) with a spatial resolution of 1 arc second, which is approximately 30 meters near the equator. The V3 package is an improvement in precision and resolution from the previous versions V1 and V2 of ASTER GDEM. Vertical accuracy of ASTER GDEM V3 has a root mean
square error (RMSE) of 8.52 meters and a mean error of -1.20 meters. Vertical error may be affected by the type of land cover type. Built or natural features above ground level may affect elevation measurements (Gesch et al. 2016). An image or tile of 3601 X 3601 pixels containing topographic information from the latitude N16° and longitude W90° was downloaded. A small portion of this image was clipped in ArcMap 10.8.1 to operate exclusively in the area of Holtun. This image was used in the elaboration of hillshade maps, contours, and least cost path analyses.

Environmental information was obtained from a Landast 8 satellite image of March 1st of 2019. The Landsat Project produces calibrated and high spatial resolution data of the Earth’s surface. This aerospace project has launched eight satellite missions during the course of 40 years. The image used in this project comes from the Landsat 8 satellite mission, launched on February 8th of 2011. The imagery comes from two instruments: the Operational Land Imager (OLI) and the Thermal Infrared Sensor (TIRS). The result is a collection of 11 bands that combined may produce images depicting the physical characteristics on the surface of the earth. Bands 1, 2, 3, 4, 5, 6, 7, and 9 (n=8) have a resolution of 30 meters, band 8 (n=1) has a resolution of 15 meters, and bands 10 and 11 (n=2) have a resolution of 100 meters (USGS 2018). An image or tile of 7531 X 7691 pixels containing the 11 bands of information was downloaded. A small portion of this image was clipped in the software ArcMap 10.8.1 to operate exclusively in the area of Holtun. Bands 1 (Coastal), 4 (Red), and 6 (SWIR 1) were combined to create an image that depicts the current environmental status of the Yaxha-Sacnab basin in terms of forest verses grassland coverage. The combination of these bands resulted in a better visualization and differentiation of the areas that have become grassland.
**Digital cartography and aerial imagery**

Digital cartography and aerial imagery were the first external resources used by Holtun Archaeological Project to supplement pedestrian survey. Digital cartography refers to cartographic information obtained through a digital interface. Aerial imagery refers to aerial photographs of the area of interests. This information has been used to understand the topography and environment of the area, as well as a reference to plan land surveying and mapping. Digital cartography and aerial photography were used in the initial analyses of the morphology of the tropical karstic hills and the ravines of Holtun. In addition, these maps were used as a reference to locate water resources and patio/plaza groups that I was unable to visit.

Some aspects were taken into consideration for academic rigor when using digital cartography and aerial photography in this project. The topography of the land is described with topographic contours with 20 meters of separation, missing small details on the surface. However, the level of detail was enough to understand the system of ravines and an elevation model was created based on this information. Aerial photogrammetry is not always updated, and forestry coverage hides details on the terrain surface. Aerial photogrammetry was used as a reference to find water resources and archaeological settlement. These images were supplemented by Landsat 8 satellite imagery. Below, details about the acquisition and use of digital cartography and aerial photogrammetry.

Digital cartography refers to the local cartographic information created by the National Institute of Geography of Guatemala and disseminated electronically through a Web Map Service interface. It was originally displayed in cartographic sheets scale 1:50,000 printed on paper. The landscape of Holtun is in the cartographic sheet 2366 IV Salpet. However, these
cartographic sheets were digitized and distributed electronically through the website of the Presidential Secretary of Strategic Planning of Guatemala SEGEPLAN. The cartographic information can be found in the web map service of the National System of Territorial Information SINIT. This information was accessed from a cartographic software using the URL address provided on the SINIT website.

Aerial imagery refers to images of a given area taken with a remote sensing airborne device and displayed in a photography often processed by photogrammetry procedures. Aerial imagery can accessed from a printed or digital photography, or via internet on interfaces such as Google Earth, Google Earth Pro, or imagery within cartographic software such as ArcGIS. The interface with the web map service of the SINIT also includes a source of areal photogrammetry from the National Institute of Geography of Guatemala.

Using the Geospatial Database of Holtun

The geospatial database of Holtun consists of the display of selected information collected from the different sources of cartographic information previously described. Topographic data constitutes the basic layers of information. This was obtained from satellite imagery, digital cartography, and pedestrian survey. These layers of information provided hillshade and slope maps, topographic maps with the option to switch elevation contour intervals, and elevation models. The planimetric map of Holtun constitutes a supplemental layer of information indicating the location, size, and shape of the elements in the settlement. Although most of the data was collected through pedestrian surveying, some locations were recorded with the aid of digital cartography. This information provides important details about
the location, shape, and orientation of the buildings that compose the settlement. In addition, the location of chultunes is also documented in the planimetric map of Holtun.

The corpus of information contained in the GIS map of Holtun was used to perform cartographic analysis. These analyses provided information to understand the relationship of the settlement with the landscape, supporting the central argument of this dissertation. The first set of analyses are land slope and settlement clustering and density. This supplemented information about the use of the land and the composition of the settlement. The second set of analysis was buffer zones and least cost paths. These analyses supplemented information about the spatial relationship of the settlement with the water resources. The use of this geographic analysis in this project is described below.

**Distribution of the settlement: Land slope and Settlement Density and Clustering**

The distribution of the archaeological settlement of Holtun reflects the strategies used by the ancient inhabitants of the site to take advantage of the landscape. Two analyses were conducted to understand the land use planning at Holtun. Land slope analysis indicated where the land is more favorable for use within a landscape of tropical karstic hills. In addition, this analysis depicted the level of susceptibility of ravines to natural and anthropogenic erosion. Density and Clustering analysis were conducted to understand the organization of the settlement across the landscape. The creation of clusters of patio/plaza groups may be forced by the nature of the landscape, but also can be the result of social organization within the site.

The slope analysis consisted of running the Slope tool in ArcMap to identify the gradient or steepness of the different areas of the satellite images prepared for this research. After identifying these values, the raster calculator tool was used to find areas with slope gradient
equal or above 15%. Areas with a gradient equal or above 15% were considered in this study as a slope. The value of 15% was used as reference of slope based on the classification of the United States Department of Agriculture. This value is in the threshold between the areas considered strongly sloping (4-16%) and moderately steep (10-30%) (Schoeneberger et al. 2017). Some governmental agencies in the United States have stated a gradient above 15% as the maximum slope for urban and rural planning (e.g. Pennsylvania Land Trust Association 2019; ITRAC 2007). Some archaeological case studies suggest steep slopes larger than 20% due to the anisotropic quality of the routes, meaning that walking down the slope often takes less energy than walking it up (Bell and Lock 2000; Field et al. 2006). However, a conservative approach of 15% was used in this research considering that it entails an area of residency and crops.

The output of the slope analysis conducted on the satellite image was a raster file with Boolean values (0 and 1) indicating the areas with a gradient equal or less than 15% (0) and the areas with a gradient larger than 15% (1). With this information, the areas of a deep gradient were indicated in the map. These areas represent physical barriers in the landscape that restrict the distribution of the settlement. Although slope analyses used ASTER GDEM V3 imagery, the resolution of 30 meters was still useful for this analysis because of the scale of the landscape (approx. 5 square kilometers).

The cartographic tools used to understand the density and clustering of Holtun landscape were Kernel Density (KD) analysis and Average Nearest Neighbor (ANN) analysis. Both of these analyses as well as the Slope analysis tool can be found in the toolbox resources of the cartographic software ArcMap 10.8.1. These analysis were successfully utilized by a community
of Maya archaeologists as part of a method to identify boundaries and neighborhoods within archaeological settlement (Thompson et al. 2021).

Kernel Density (KN) is a statistical analysis tool used to calculate the density of features in a group of units or neighborhood. In this case, the units represent the center of the patio/plaza groups, and the density is indicated by the distance among the groups. Closer groups will indicate more density. The results from this analysis indicate that Holtun has several clusters of high density and some dispersed settlement. One of these high-density clusters is Group HTN19_20, near one of the identified aguadas. This group was targeted for further research for this dissertation in order to understand the use and manipulation of water resources by the residents outside of the civic-ceremonial epicenter of Holtun.

The Average Nearest Neighbor (ANN) is an alternative statistical analysis tool used to determine if a group of units or a settlement is clustered or dispersed. The units tested are points located in the center of the patio/plaza groups of Holtun. After running this tool in ArcMap 10.8.1 a table with the statistical scores and statistical significance was provided. The results indicate that the settlement of Holtun has a high level of clustering in several sectors of the site with a low probability of being a random distribution pattern. This is the indication that patio and plaza groups were organized around focal points. It is possible that the compound of HTN19_20, including the water reservoir, was the focal point of that cluster of settlement.

Finally, it is important to consider that not all the elements of the settlement may have been included in the planimetric map of Holtun during the pedestrian survey or the cartographic reconnaissance. This means that not all the patio/plaza groups may be included in the map. A solution to this limitation is the use of Aerial LiDAR scanning, which was not available for this
project. Nevertheless, the use of all the cartographic available in conjunction with the intensive pedestrian surveying program may render this map as a good sample of the settlement of the site. Communication with the people from La Máquina was a substantial source of information about the location of archaeological traits and water resources, as described below.

**Access to Water Resources: Buffer and Least Cost Path**

The relationship of water resources with the settlement of Holtun was analyzed in terms of distance and accessibility. These variables were tested with the Buffer Zones and Least Cost Path LCP analysis tools available in the cartographic software ArcMap 10.8.1. The objective of performing a buffer analysis test was to understand the relationship of water resources with the settlement. In other words, it indicates how far water resources from the settlement are. On the other hand, performing a Least Cost Path analysis indicated the level of accessibility of water springs from the central plazas. In other words, it indicates which of the springs is closer to the central plazas and which route has a less energy cost. These routes may also indicate that patio/plaza groups located in the course of the route could have participated in the procurement and/or control of water.

Least Cost Path analyses have been successfully used in Maya archaeology to understand sociocultural connections within the landscape, including inter alia case studies of socioeconomic networks (e.g., Thompson et al. 2021), political relationships (e.g., Scherer et al. 2022), and social stratification (e.g. Richards-Rissetto 2012). In addition, associating archaeological settlement with the course of a LCP route was used on a larger scale to analyze the distribution of sites in the Bella Vista valley in the central Maya lowlands (Doyle et al. 2012). Therefore, an LCP route was considered as an analytical tool for understanding the spatial and
sociopolitical relationship between the cultural settlement and water resources in the landscape of Holtun.

It is important to consider that the buffer zones created around the water springs could miss settlement not included in the map. This settlement may have been excluded because of lack of permit to survey properties or because it was not physically evident on the surface. However, given the amount of information collected during pedestrian survey and Geographic Information Systems analyses, the sample of settlement may be significant. On the other hand, Least Cost Path analyses were conducted based on the slope of the surface as the cost of transportation. It may ignore sociocultural agency and other human factors that may have intervened in the decision of how to access a water resource. Details about Buffer Zones and Least Cost Path analysis are provided below.

Buffer Zones analysis was performed on the map of Holtun. The points selected as features of interest are the water sources. The Buffer Zone is a polygon automatically created around a point or a line of interest with a previously established dimension to cover an area of interest. Buffer zones are measure and analytical tools successfully applied in Maya archaeology (e.g., Moyes 2002; Schroder 2021). At multiple scales on the landscape, buffer zones have been used to conduct quantitative and qualitative analysis of cultural activity around a specific feature, group, or settlement. Three these Buffer Zones were created around each of the water sources documented at Holtun. The buffers had increments of 100 meters because this is the distance between the nearest settlement feature and a water spring. An automatic selection of patio/plaza groups within these Buffer Zones provided evidence about the level of closeness or isolation of the settlement with the water sources. This analysis was performed to support the argument that
water springs and still-water pools did not present an indication of human control through land modification or permanent settlement.

The Least Cost Path tool was used to find the most efficient routes between water resources and the epicenter of the site. The water resources selected as point of origin for the LCP analyses are the perennial water springs and the *aguadas* east of the epicenter. The point of destination was established in the center of plaza F-B, which is a focal point in the cultural landscape and a node of cultural interaction among the centralized elites of Holtun. The topographic information to perform the cost distance test came from the ASTER GDEM V3 imagery. The cost distance was based on a slope analysis conducted to the referred satellite imagery. The LCP analysis creates unidirectional routes or anisotropic, considering that walking down the slopes often requires less energy that walking up. In addition, walking from the water resources carrying water may have increased the energy used to complete the route. The results from LCP analyses indicate which water resource is closer or more accessible in a low-cost route and what is the path of that route. A buffer analysis was conducted on the lineal path of these routes to understand the spatial relationship of these routes with the rest of the settlement.

In the following chapter, Chapter 5, the maps and values resulting from the GIS analyses conducted in the landscape of Holtun will be presented. That information will be used as a reference in the discussions about the nature of water management and social complexity presented in Chapter 6. The following section describes the materials and methods utilized to analyze the archaeological context of Group HTN19_20.
The Establishment of Group HTN19_20

Understanding the establishment of Group HTN19_20 in the landscape constitutes an important piece of information in the understanding of water management and social complexity at Holtun. The chronology of the site supports the central argument regarding a shift in water management practices at Holtun between the Preclassic and Classic periods. The stratigraphy of the patios and plazas indicate that the establishment of this group happened simultaneously with other groups in the periphery of the site. In addition, some of the artifacts collected in the excavations indicate signs of social status. In this section, the methods to conduct archaeological explorations in HTN19_20 are explained. In addition, the methods used to determine the status of the group are provided. The description of Group HTN19_20 presented below explains why this group was selected as a marker of the heterogeneity in water management practices experienced at Holtun.

Group HTN19_20

This is a cluster of two patio groups and one plaza groups with residential and ceremonial functions located 1.3 kilometers east of the central plazas of Holtun (See Figure 18). It is composed of a sequence of three groups aligned on a topographic ridge and facing towards the northwest. Group HTN19_20A is a rectangular patio group located in the north of the compound. Group HTN19_20B is a rectangular plaza group in the middle of the compound. Finally, HTN19_20C is a rectangular patio group in the south of the compound. Groups 20B and 20C are adjacent, while Group 20A is isolated from the other two. This group is characterized by the closeness to the only yet known system of artificial reservoirs, or aguadas. In addition, the group is characterized by the size of its own central plaza. This plaza has a chultun at the central edge,
facing the north structure. The orientation of the group is also different from the architecture in the central plazas. As mentioned above, the group is oriented toward the northwest, which is different from the most traditional north-south orientation of patio/plaza groups in Holtun (Guzman 2020).

This group was selected for archaeological explorations due to the particular characteristics described above and its location in the landscape. Archaeological excavations revealed additional markers of social complexity, such as an altar, hidden caches, and exotic good. These markers of social power and status allowed us to use this group as a reference for the study of the complex social dynamics of Holtun and the strategies of water management implemented during the Late Classic period. Archaeological explorations conducted at Group HTN19_20 are described below.
Archaeological Explorations in Group HTN19_20

Archaeological explorations in Group HTN19_20 of Holtun consisted of the excavation of test pits in the plaza and one of the patios. These excavations were conducted between July 31 and August 13th of 2021. A total of 9 test pits were excavated in this group. From these, 6 were excavated in the plaza HTN19_20B and 3 in the patio of Group HTN19_20C. The dimension of the test pits is 1 by 1 meter, according to the requirements of the Institute of Anthropology and
History of Guatemala. However, n=2 of the test pits were extensions of a previous one and have a dimension of 1 X 0.5 meters.

The test pits were traced in the patio and plaza of their respective groups to avoid interacting with architecture. Excavating plazas and patios in the households produced results about the process of cultural settlement in previous excavations conducted at Holtun. Excavations of HAP documented the process of transformation of the surface by the creation of floors and structures to support human activity (Kovacevich et al. 2015). This methodology was replicated at HTN19_20 to understand the process of settlement of this group. No test pits were excavated in the water resources, which is a limitation of this study. The water spring of El Duende was inaccessible at the time of the fieldwork due to a land property dispute. The location of this spring may have influenced the configuration of the cultural landscape and the dynamics of power between the elites of HTN19_20 and the central elites of Holtun. On the other hand, the aguadas of HTN19_20 were not excavated because they were noticed and considered as a cultural trait until the end of the field season in 2021. The limitation of time and the type of sedimentation of the aguadas complicated the planning and execution of test pits in the location.

The results from the archaeological explorations in Group HTN19_20 allowed the interpretation of the stratigraphy and the chronology of the settlement, as well as the analysis of the markers of social power and status. This evidence will be discussed in the following chapter to assess the water management practices at Holtun. The methods to obtain stratigraphy, chronology and markers of social power and status are described below.
The Stratigraphy of HTN19_20

Understanding the stratigraphy of Group HTN19_20 was a resource to understand the process of establishment of this settlement. The excavation process followed the natural and anthropogenic stratigraphy of the pit. Each change in the soil composition or texture indicated a change of stratigraphic level. This allowed us to separate the materials extracted from the excavations. Each level was documented according to the composition, color, and texture of the soil. Each one of the pits reached the bedrock, which is considered the sterile level of archaeology in the Maya lowlands. After the test pit was finished, the profile of the excavation was drawn and photographed for documentation. This protocol allowed to document the process of settlement of HTN19_20 and compare it with other groups excavated in previous years. The stratigraphic sequence of Late Classic groups was documented through excavations of the HAP in peripheral clusters in the northwest of Holtun (Carwford 2016; 2017). This information provided a reference to understand the stratigraphy expected and found in Group HTN19_20.

Chronology of Group HTN19_20

The chronology of Group HTN19_20 was based upon ceramic markers found within the archaeological contexts excavated during the field season in 2021. Ceramic material was collected from all the test pits. However, most ceramics were poorly preserved, and some stratigraphic levels provided a small quantity of samples. Most of the ceramic sherds are eroded or un-slipped, which makes it difficult to diagnose. However, it was possible to recognize one type of ceramic with distinctive characteristics: namely, Chinja Impressed. This is a ceramic marker of the Late Classic Period at Holtun and in the Maya lowlands (Callaghan and Rivera 2011; Callaghan and Neivens de Estrada 2016). No period types were identified within the
ceramic samples collected in HTN19_20. These ceramic samples were classified according to the system used in Holtun Archaeological Project (Callaghan and Rivera 2011). This system of classification is Type: Variety-mode of the Maya lowlands (Callaghan and Neivens de Estrada 2016; Gifford 1976; Kosakowsky 1987).

Markers of Social Power and Status

Some of the materials collected during the excavations in Group HTN19_20 are considered markers of status and social power. Some of these artifacts are considered exotic goods that were processed by specialized artisans and/or transported throughout a complex trade system (as described by Aoyama 2009; Feinman 2001; Sydris 1976). Markers of social power and status are: an altar, hidden caches, imported obsidian artifacts, shell and shell artifacts, and the disk made of shell. In addition, the size of the plaza HTN19_20B is considered as well as a marker of social power. The methodology of analysis consisted of a description of the artifact and a comparison with similar artifacts documented at Holtun or other sites in the Maya lowlands. Due to the difference in type, use, and composition of these artifacts, each type was described and compared separately. Details about the descriptions, comparisons and analysis conducted to the markers of social power and status are provided below.

The altar was found in excavations conducted in Group HTN19_20C. The location was marked with a rock underneath the floor level and a pole hole carved in the bedrock gives evidence of a possible perishable structure. The altar was analyzed according to the function, location, and archaeological context. Therefore, the location within the group, the orientation, the position within the stratigraphy, and the materials accompanying this context were factors to consider when describing and analyzing this feature. In addition, a comparative analysis was
conducted referring to examples of household altars documented in the Maya lowlands. Some authors consider the presence of altars outside the epicenter of sites to be evidence of localized cults and are indications of a possible religious pluralism (Gonlin and Lohse 2007; Lohse and Valdez 2004; Gossen and Leventhal 1993).

Two hidden caches were found carved in the bedrock at the bottom of a *chultun*. The excavation of this *chultun* constituted the first unit of excavation of this project. Layers of fill were removed stratigraphically as in the test pits to separate the materials from different strata. The shape and content of the caches is compared with evidence found at Holtun and other sites. The caches contain pieces of flint, a material that is abundant in outcrops north of HTN19_20 (Guzman 2020) and was used in a local industry of lithic artifacts (Crawford 2017). The composition of this *chultun* suggest that the function was more ritual than utilitarian, according to the model of Brady (2004). In this case, the *chultun* is associated with the cult of caves and water, which is an allegory of the connection with nature, the creation of the universe, and the underworld (Brady and Prufer 2005).

Obsidian artifacts can be markers of status and social complexity because they are exotic good acquired from a complex trade system (Aoyama 2009; Sydris 1976). A total of 9 obsidian artifacts were found in the excavations. The analysis conducted on these artifacts were based on the variables: type of artifact, dimensions, weight, archaeological context, and provenance, according to the methodologies applied by the Holtun Archaeological Project (Kovacevich and Crawford 2016). A temporary visual analysis of provenance was conducted according to the physical characteristics in the pieces, following the descriptions of Carpio (2015).
The presence of shells and shell artifacts indicates social complexity and in some cases prestige and status. Mollusks are not only used as food, but also as personal decorations and ritual offerings. In the case of the offerings, they can be simple mollusks or worked shell (Halperin et al. 2003). In addition, shell and shell artifacts may be an exotic product resulting from exchange and trade. The shell and shell artifacts were analyzed according to the methodology implemented by Bishop (2015) at Holtun. Visual analysis was performed to estimate the species of mollusk and determine if it is local or imported. Marks of human modification in shell were considered to determine if the sample was transformed into an artifact.

One shell-made artifact that was considered individually is a disk of shell found in the corner of one of the buildings. This artifact is possibly associated with an unexcavated burial or cache. This is a unique artifact and uncommon in the inventory of artifacts made of shell in the Central Maya lowlands. The uniqueness of the artifact lies not only in the shape but in the use of an inlaid piece of obsidian as part of the composition. Besides obsidian eccentrics, which are obsidian blades with designs, it is not common to find obsidian artifacts for decorative purposes in the Central Maya lowlands. The type of analysis conducted on this artifact was descriptive and iconographic. The descriptions consisted of dimensions, shape, and design. The iconography analysis focuses on the design carved in the convex face of the disk with a comparison to other similar sites and artifacts.

The following chapter, Chapter 5, will include the results of all the methods described in this chapter. Results from the excavations conducted in 2021 are presented, indicating the outcomes from each of the test pits. In addition, the descriptive, quantitative, and qualitative analyses conducted on the archaeological artifacts listed above will be presented. The
information obtained from the artifacts of HTN19_20 supports the argument about a group controlling access to water during the Late Classic Period. In addition, the settlement of group HTN19_20 and the presence of exotic and ritual artifacts indicate a participation of the inhabitants of this group in the complex dynamics of negotiation of social power and status at Holtun. Water management practices at Holtun are local adaptations from strategies observed in other sites in the central Maya lowlands. The availability of freshwater supported large populations during the Preclassic period and provided a source of social power to elites outside the civic-ceremonial epicenter during the Late Classic Period. However, these external elites included new patterns of water management that resulted in social power and status, which is going to be discussed in the following chapter.
CHAPTER 5: RESULTS

Some of the water management practices observed at Holtun are common in the central Maya lowlands. However, there are also local adaptations to the landscape and sociopolitical dynamics. The results obtained from the studies conducted for this dissertation suggest that water management practices were not uniform at Holtun or in the rest of the Maya lowlands, either by region or by time period. The observations from Holtun indicate that water management practices supported the population of a modest-size site with a cultural apogee during the Preclassic period. However, these practices shifted during the Classic period, with an elite group consolidating power around the control of water sources at the site.

The archaeological studies conducted for this dissertation consisted of reconnaissance, mapping and excavation. The reconnaissance and mapping activities provided the information required to understand the nature of the cultural and natural landscape of Holtun. The analyses conducted with the spatial information of Holtun allowed me to understand the relationship of the settlement with the resources of water available in the area. In addition, these analyses provided basic information to support the investigations conducted in Group HTN19_20. This group is in a location that is directly adjacent to water resources and may have played a role in managing water and/or restricting access to it. The evidence obtained during the excavation includes markers of social power and prestige, possibly demonstrating status gained by control and management of water. This chapter is subdivided into two sections. The first one consists of the spatial analysis of cultural and natural features at Holtun. The second consists of the results of archaeological excavations conducted in Group HTN19_20.
The Settlement of Holtun

The settlement of Holtun was analyzed based on information obtained through pedestrian survey, digital cartography, and Geographic Information Systems (GIS). Conducting pedestrian surveying and digital cartography provided a detailed description of the location and orientation of the plaza and patio groups, as well as the location of water resources, as described in the map of Holtun. The analyses of the landscape through digital cartography using GIS analytical methods provided information about the topography of the landscape. In addition, the cartographic information of Holtun analyzed with GIS tools allowed a visualization of the distribution of the settlement and the relationship of the site with water resources.

The settlement of Holtun is comprised of a series of plaza and patio groups settled across a landscape of karstic hills, slopes, and ravines (See Figure 4). Water is available in several locations on the landscape, but the majority of the resources are concentrated in the southern portion of the site (See Figure 19). It is possible that the distribution of the settlement responds to a strategy of water management where a centralized segment of society had the capacity to restrict the expansion of the site near water resources. In addition, non-perennial water resources are located in the epicenter of the site and in a Late Classic neighborhood located 1.3 kilometers east of the epicenter (See Figure 19). This indicates that there were likely diverse water management strategies practiced at the site. A detailed description of the cultural and natural landscape of Holtun is provided in the following section.
Figure 19. Map of water availability in the landscape of Holtun (Map by Rodrigo Guzman).

**Topography and Distribution of the Settlement: Slope and clustering.**

As mentioned in previous chapters, the landscape of Holtun is characterized by karstic hills, steep slopes and ravines. The topography of the landscape was analyzed based on the slope of the terrain, obtained from the ASTER GDEM V.3 image. Surface with equal or more than 15% of slope gradient, considered a steep topography, were selected to separate the areas of plains and slopes in the landscape and identify areas of probable settlement. In addition, the pattern of dispersion of the settlement was analyzed with the geostatistical tool. Average Nearest Neighborhood and Kernel Density (ANN/KD). These analyses were conducted to understand the
practices of land use and the dispersion across the landscape, as well as relationships of settlements with water resources. Using ANN and KD as a method to determine the patterns of clustering and dispersion was the modification of a method utilized by archaeologists to determine the presence of boundaries and neighborhoods (Guzman 2021; Thompson et al. 2021)

Of the near 22 square kilometers selected as an area of study, 20.72% (4.55 square kilometers) is in a slope with a gradient equal or larger than 15% (See Figure 20). In addition, 41.53% (9.13 square kilometers) of that area is in a slope with a gradient equal or larger than 12%, which is still considered a slope for this study. This second calculation was conducted to understand the terrain undulation. Changing the gradient 3% duplicated the area of sloped terrain, which means that almost the half of the terrain is at least moderately sloped. Knowing this information help us to understand the relationship between the settlement of Holtun and the geography of the landscape. The epicenter of the site is located in an area with a concentration of steep slopes, probably using them as a land demarcation or boundary. However, the peripheral settlement of the east is in an area with less slopes. The location of the civic-ceremonial center is privileged in terms of elevation to observe and be observed from several points of the landscape. However, this higher area made the epicenter of the site to be far from perennial freshwater resources and water reservoirs.
Figure 20. Map of the landscape of Holtun indicating the areas with a gradient equal or larger than 15% (Map by Rodrigo Guzman).

Although the settlement near the epicenter appears to have more density than the settlement dispersed in the east, it is possible to distinguish clusters of groups or neighborhoods in the east. A Nearest Neighbor Analysis conducted on the settlement of Holtun indicates that it has a clustered pattern (ratio of 0.764817) with a low probability of being a random distribution (z-score of -4.431220) and a high statistical significance (p-value <0.00) (See Table 1). A clustering pattern is expected in a landscape with a limited plain area near the epicenter of the site. However, the Kernel Density (KD) analysis indicates that clustering is also happening in the east of the site, which originally appears to be more dispersed (See Figure 21). This is an
indication that groups of the community of Holtun were interested in areas far from the civic-ceremonial epicenter to develop their own sociocultural interaction, potentially related to water resources.

Table 1. Average Nearest Neighbor Analysis for Holtun plaza/patio groups.

<table>
<thead>
<tr>
<th>Value</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Observed Mean Distance:</td>
<td>94.2313 Meters</td>
</tr>
<tr>
<td>Expected Mean Distance:</td>
<td>123.2077 Meters</td>
</tr>
<tr>
<td>Nearest Neighbor Ratio</td>
<td>0.764817 Meters</td>
</tr>
<tr>
<td>z-score:</td>
<td>-4.431220</td>
</tr>
<tr>
<td>p-value:</td>
<td>0.000009</td>
</tr>
</tbody>
</table>
A Kernel Density analysis conducted on the settlement of Holtun indicates the presence of neighborhoods clustered in different locations of the settlement. The major concentration of settlement happens around the epicenter of the site. However, the analysis indicates a noticeable concentration of settlement around the water reservoirs at the east of the epicenter of the site. Group HTN19_20 stands out the rest of this neighborhood of groups.

Group HTN19_20 is in a highest position on the landscape, and it appears to demarcate a separation between the east settlement and an area of water resources, delimited by the topographic ridge in the south of the site. This strategic location will be tested in the following
section by the creation of a least cost path route between the epicenter of the site and the most
distant water spring in the southeast.

*Water Availability and Accessibility at Holtun*

Although water resources are not visible at first glance on the landscape of Holtun, water
is naturally available in at least 7 locations. From these locations, 6 constitute a perennial source
of water and 1 desiccates during the dry season. In addition, at least 4 artificially modified water
reservoirs were identified on the landscape. These reservoirs are two monumental *aguadas* that
are currently dry, but with a small portion serving as a cattle trough.

The natural water resources identified at Holtun are 4 water springs and 3 areas of still-
water pools within the ravines. Among the water springs, 3 of them are perennial and one is
seasonal. The 3 perennial water springs are located south of the settlement, and they are locally
referred to as *El Manantial, La Rejoya*, and *El Duende*. The fourth seasonal spring is located
within the settlement, west of Group B and is referred to as *La Pepitoria*. A large contention
platform was identified south of the *La Pepitoria* spring. The platform contains a *chultun*,
confirming its contemporaneity with Holtun. This is the only ancient artificial modification
identified in water springs at Holtun.

Two areas of still-water pools are located in a ravine south of the site. Water runs over
these pools during the rainy season, but it gets absorbed by sediments in lower courses of the
ravines in the low course and the surface remains dry. These still-water pools are referred to as
*Los Jutes* because of the abundance of freshwater gastropods from the species *Pachylus* spp.
known locally as *jute*. The third area of still-water pools is located north of the settlement, in the
lower course of the ravines. It is referred to as El Arroyo and it is characterized by the presence of small species of fish and crustaceans.

The artificially modified resources identified at Holtun are two cisterns and two water reservoirs. One of the cisterns was created east of the central edge of the plaza of Group F-C. It was excavated in 2016 and because of its location it has the potential to catch runoff water from the plaza and from human depositions. A second cistern was found east of Group A, a residential Group. This cistern is carved within the sediments in a low course of a ravine. Although this may be a contemporary cistern, it demonstrates the potential of water catchment of a small pit carved in the course of the ravines. Observations in the geological behavior of the ravines indicate that sediments tend to slide down the ravine. This cistern does not have any structure to support it, so it is vulnerable to fill up with sediments over time. However, local informants indicate that the cistern has not needed maintenance since they colonized the village decades ago. That is not the case with other areas of the ravines, where the sediments have filled in a good proportion of the ravines’ bed.

The aguadas identified north of Group HTN19_20 are two large depressions with apparent rectilinear edges and rounded borders. They are natural depressions in the landscape that were used to collect water from a natural catchment area caused by slopes in the karstic hills. Both of them have similar dimensions of about 8,000 square meters, comparable to the size of a soccer field. The surface soil has a sedimentary appearance, and it is darker than the soil in the hills. Small portions of these depressions have been modified to collect water for cattle troughs. Nevertheless, local informants indicate that water was naturally collected there, and the area was even used at a certain times in recent history to harvest rice.
In addition to the water features noted above, a series of 62 *chultunes* identified around the landscape still represent a potential resource for water storing. Especially those located outside of the groups and near water resources, as observed in the periphery of the civic-ceremonial epicenter. However, more research is required to confirm the use of these underground storage chambers as water reservoirs, as *chultunes* often had multiple uses (Cagnato 2017; Calderon et al. 2004).

A pattern can be observed in the spatial distribution of water resources. Natural water resources tend to be isolated from the settlement and most of them are located south of the epicenter of the site. The artificially modified water resources are directly associated with the settlement and tend to be enclosed by groups. These artificial resources are the cistern in group F-C, the cistern pit in *El Arroyo*, the spring of *La Pepitoria*, and the two eastern *aguadas*. To test this pattern, three buffer zones were created to cover an area of 100, 200, and 300 meters around the water resources described (See Table 2). Only the water spring of *La Pepitoria* and the *aguadas* of Group HTN19_20 have settlement within 100 meters, and within 200 meters. Of the 6 natural resources, only 4 have settlement within 300 meters. On the other hand, the artificial reservoirs (cisterns), artificially modified (spring with platform), or engineered reservoirs (*aguadas*) have a higher density of settlement within these distances. The water reservoirs of Group HTN19_20 are the resources with the closest proximity of settlement. As a result of the buffer zones analysis created for this dissertation, this settlement pattern can be observed in the site of Holtun (See Figure 22), as described in Table 2.
Table 2. Frequency of settlement within buffer zones around water reservoirs at Holtun.

<table>
<thead>
<tr>
<th>Water resource</th>
<th>Type</th>
<th>100 meters</th>
<th>200 meters</th>
<th>300 meters</th>
</tr>
</thead>
<tbody>
<tr>
<td>El Manantial</td>
<td>Perennial flow</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>La Rejoya</td>
<td>Perennial flow</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>El Duende</td>
<td>Perennial flow</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>La Pepitoria</td>
<td>Seasonal</td>
<td>0</td>
<td>3</td>
<td>12</td>
</tr>
<tr>
<td>Los Jutes 1</td>
<td>Perennial catchment</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Los Jutes 2</td>
<td>Perennial catchment</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>El Arroyo</td>
<td>Perennial catchment</td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Aguada 1</td>
<td>Seasonal Fluctuation</td>
<td>2</td>
<td>5</td>
<td>7</td>
</tr>
<tr>
<td>Aguada 2</td>
<td>Seasonal Fluctuation</td>
<td>0</td>
<td>3</td>
<td>8</td>
</tr>
<tr>
<td>Cistern El Arroyo</td>
<td>Perennial catchment</td>
<td>0</td>
<td>5</td>
<td>7</td>
</tr>
<tr>
<td>Cistern F-C</td>
<td>Water Feature</td>
<td>3</td>
<td>6</td>
<td>13</td>
</tr>
</tbody>
</table>
Figure 22. Map of Holtun indicating buffers zones with 100 meters increase from all the water resources identified (Map by Rodrigo Guzman).

Least Cost Path Analysis

To calculate the level of accessibility from the civic-ceremonial epicenter of the site to water resources, a Least Cost Path (LCP) analysis was conducted from the central plaza to each of the perennial water springs. In addition, Least Cost Path analyses were conducted from the central plaza to the two aguadas in the east (See Figure 23). The central point was located in plaza F-B where the “E-Group” compound is located. This point was selected as a reference because it is the location of the civic-ceremonial epicenter of the settlement, which centralizes most of the elite residential structures at the site (Callaghan et al. 2017).
The digital elevation model used to conduct the LCP analysis is a portion of the digital imagery obtained from the ASTER GDEM V3 mission. The slope analysis created for previous analysis was used to create the cost distance and the cost link of the landscape. These are calculations that indicate the accessibility to the reference point from every location on the landscape, taking as a cost value the slope of the surface.

The routes resulting from the LCP analysis between the epicenter and water springs coincide with the routes of pedestrian reconnaissance of the water springs conducted in 2016 and 2019 and guided by the local personnel. This ground truth information supports the routes selected by the software in the LCP analyses. The LCP route from the epicenter to the Aguada 1 crosses one of the ravines. The route is traced there probably because it requires less descending and climbing than going through the ridge that connects the epicenter with the water spring of El Duende. The LCP route from the epicenter to Aguada 2 also crosses a ravine in a lower course. This route coincide with roads and paths created by landowners to access their farms by car.
Figure 23. Map of Holtun indicating the Last Cost Path routes calculated from the civic-ceremonial epicenter of the site towards three water springs identified in the landscape (Map by Rodrigo Guzman).

Calculating the Least Cost Pathway (LCP) from *El Duende* spring created a route of 3269.44 meters. This route travels along an elevated ridge that runs east to west in the south of the site. There is a considerable change of height at the beginning of the route with a gradient of approximately 10%, but the rest of the route remains smooth (See Figure 24). Approximately halfway along this route lies a series of 3 small patio groups. These patio groups only have one or two mounds per patio.
The Least Cost Path (LCP) analysis from *La Rejoya* to Group F-B created a route of 1391.39 meters. This route descends to the bottom of the principal ravine and continues through one of the branches of that ravine. Descending to the principal ravine requires transiting through a slope with a gradient of 60% (See Figure 25). After leaving the epicenter of the site, no groups are found on the path of this route.

**Figure 24.** Profile of Least Cost Path route from Plaza F-B to *El Duende* (Elaborated by Rodrigo Guzman).
The Least Cost Path (LCP) analysis from *El Manantial* to Group F-B produced a route of 2184.52 meters. This route approaches the epicenter of the site through the same route of the least cost path from *La Rejoya*. The routes diverge in the bifurcation of ravines that lead to *La Rejoya*. The route to *El Manantial* descends to the first ravine on a slope with 60% of gradient. Later, it ascends karstic hills with a slope with 16% and descends to a different ravine with a slope with 45% (See Figure 26). Atop the hills and in the course of this route, two patio groups are located. One of these groups is within a 300-meter buffer of *La Rejoya* spring. The other group is within a 300 meter buffer of *El Manantial*.
Figure 26. Profile of Least Cost Path route from Plaza F-B to *El Manantial* (By Rodrigo Guzman).

The Least Cost Path (LCP) analysis from *Aguada 1* to Group F-B created a route of 1650.53 meters. The route travels to the west along an area of land with moderate to low slope until finding the ravine of *El Zapotal*. At this point it ascends to Group B through a steep slope. The route travels along the topographic ridge where the north section of the epicenter of the site is situated until reaching Group F-B. The route has to cross one of the ravines, which may represent a natural obstacle. However, this route coincides in several points with paths and roads created by landowners to access their land with trucks.

The Least Coast Path (LCP) analysis from *Aguada 2* to Group F-B created a route of 1612.45 meters. The route travels to the west through a topographic ridge where at least 5 patio groups are situated. After that, it crosses the ravine of *El Zapotal* and merges the same topographic ridge that joins *El Duende* spring with Group F-B until reaching the central plaza. Of the five Least Cost Path routes created in this study, this is the one that crosses through more
archaeological settlement. This route starts from a section of the *aguada* that has a small extension of land or peninsula that may have facilitated access to this water resource.

The distribution of the settlement suggests an apparent separation from water resources to the south, especially the freshwater resources. The Least Cost Path route that connects Group F-B with *El Duende* is traced over a topographic ridge that marks a separation between the area of dense settlement and the area of the freshwater resources. There are only three small patio groups with one or two mounds each. The orientation of these groups does not faces the east as most of the Preclassic groups. Therefore, it is possible that they are from the Late Classic period. The nature of these groups still remains unclear, but they seem less established than the larger groups in the civic-ceremonial epicenter of the site and Group HTN19_20.

The closest settlement to the Least Cost Path route from *El Duende* is the aforementioned Group HTN19_20, located approximately 400 meters north of the ridge (See Figure 23). This route, which transits over the topographic ridge, passes near the still-water ponds of *El Jute 1* and *El Jute 2*. The buffer zone analysis indicates that no settlement is in proximity of *El Duende* as well as *El Jute 1* and *El Jute 2*. However, Group HTN19_20 has privileged access to the path to *El Duende* because of its proximity to the ridge. By its part, *El Manantial* and *La Rejoya* are also isolated from the rest of the settlement with have only one patio group within a buffer of 300 meters. That patio group is situated atop a hill and the springs are at the bottom of the ravines. The deep slope between the patio group and the springs increases isolation.

The Least Cost Path routes indicate that accessing the water springs and the still-water pools from the central plazas did not require crossing a dense settlement or no settlement at all. Although southern patio groups of the eastern settlement of Holtun have privileged access to
these resources due to their proximity, these groups do not interfere physically with the access to freshwater resources from the central elite households. In this case, Least Cost Path routes support the argument that freshwater resources were deliberately isolated from the rest of the settlement. Accessing the area of springs and still-water pools in the south remained restricted by the plazas and large groups of the eastern settlement of Holtun. Although these water resources remain visibly open, the routes to access them seem to be controlled by the elite groups of the site.

The Least Cost Path routes also indicating that accessing the east *aguadas* from the central plazas required crossing some areas of settlement and ravines. The proximity of settlement indicates that the *aguadas* were not as secluded as the water springs and still-water pools. Although the *aguadas* were further than the spring of *La Rejoya* from Group F-B, they are closer than the *El Duende* and *El Manantial*. The location of the *aguadas* represents an alternative of water procurement for the central elites of Holtun.

*Contemporary Water Modifications*

The landscape of Holtun has changed in the past few decades. A large portion of the forest has been converted into grassland for cattle ranches. According to information from local informants, this has caused an increase in the volume of sediments in the ravines. This statement was confirmed when comparing the appearance of *El Manantial* spring between 2016 and 2022. The sediments have almost covered the modern concrete tank that was built to catch water from the spring. This information is important to assess features like the pit of *El Arroyo* and how much it may have remained opened without being filled again by sedimentation.
Several artificial water troughs have been created to supply water to the cattle. There are two types of troughs at Holtun: the *aguada* and the *pila*. The *aguada* type (See Figure 27), as well as the ancient *aguadas*, consists of an artificial reservoir carved in a depression to catch water. Mechanized machinery is usually used to create these troughs. The *pila* type (See Figure 28) consists of a modern small tank made of concrete supplied by pipes connected to the sediments of the ravines.

![Image of cattle trough type *aguada* in process of desiccation](image.jpg)

**Figure 27.** Photo of cattle trough type *aguada* in process of desiccation (Photo by Guzman 2019)
Accessing water from *El Duende* is prohibited at this time because of a land conflict between the former owner and the community. Although the area of the spring was granted to the community of La Máquina, the original owners are claiming property of the land again. In addition to this, accessing water from *El Arroyo* and the water troughs is not safe because of the risk of zoonotic diseases. The current condition of these locations indicates the environmental and political vulnerability of these resources. Conducting research directly in these resources will form the basis of future archaeological research at Holtun.

The following section in this chapter will address the excavations conducted in Group HTN19_20. This group was selected for archaeological exploration due to its strategic location near water resources, unique orientation, and large size. The analyses of the landscape conducted in this section contribute to identifying this group as a location where elites from Holtun
leveraged location in relation to water resources to increase social power and status. Archaeological evidence found in excavations of HTN19_20 support this argument, and suggest secondary elite groups in the periphery used water resources as a means to increasing social power during the Late Classic period at Holtun.

**Excavations in Group HTN19_20**

The excavations in Group HTN19_20 were conducted between July 31st and August 12 of 2021. The excavations consisted in 8 test pits traced in locations selected in the plaza of Group HTN19_20B and the patio of Group HTN19_20C. In addition, an excavation was conducted in one underground storage chamber, or *chultun*, located in the north of the central edge of Group HTN19_20B. The objective of the excavation was to understand the process of settlement, the sociocultural nature of this group, and identify symbols of the social power and status of its occupants and their relationship to nearby water resources.

The excavations in this group provided information regarding the construction of the patio and plaza associated with the residential structures. According to the evidence, the groups went through one event of leveling for the creation of the patios and plazas. However, it is possible that the floor was remodeled several times due to its fragility. The archaeological materials collected from the excavations suggest that the function of the group was combined between residential and ritual. Some artifacts found in the excavations are elements used in ritual contexts, are markers of status, and/or indicate the participation in a long-distance trade market. Combined, the evidence from this group suggests that residents enjoyed a relatively high status during the Late Classic period at Holtun, possibly due to control or manipulation of water resources.
Details of archaeological excavations are provided below. Excavations were divided into two operations to separate the information from each of the groups of the archaeological compounds (See Figure 29). Operation 1 consisted of the excavations conducted in Group HTN19_20B and Operation 2 addressed the explorations in Group HTN19_20C. Following the description of the excavation, a detailed description is provided about archaeological contexts and materials.
Figure 29. Map of Group HTN19_20 indicating the patios and plaza, and the location of the excavation units (By Rodrigo Guzman 2021).
Operation 1

Operation 1 consists of 5 1.00 x 1.00 meter units of excavation and 1 excavation extension conducted in Group HTN19_20B. This operation was planned in this location because of the size and orientation of the plaza. This group is the center of the three groups that compose the compound HTN19_20. The size (30 x 15 meters) and orientation (35° west) of the plaza made this location a point of interest to understand the social dynamics of this group located 1.3 kilometers east from the civic-ceremonial epicenter of the site. The orientation of this small plaza is an atypical factor in the settlement of Holtun because plaza-groups tend to have a solar or solstice orientation. This type of orientation means that the group is facing one point in the east where the sun rises within the solstices. A different orientation may indicate dissociation of the cultural identity in terms of building traditions.

The excavation units were located in points of the plaza to study the process of settlement, function, and transformation across time of this segment of the cultural landscape. In the Maya region, plaza floors were often remodeled sequentially and cyclically. The artifacts incorporated in the materials of the floors can be used for dating purposes. The stratigraphy of the plaza can also be compared to other known construction sequences throughout the site. The first unit of excavation was placed in the chultun located in the north of the central edge of the plaza. The second unit was located in the east of the plaza, in front of the east building. The third unit was placed in the north side of the plaza, in the southeast corner of the north building. This unit has an extension towards the west to understand the relationship of the plaza with the building. The fourth unit was placed in the south of the plaza, in front of the south building. Finally, the fifth unit was placed east of the plaza, in the back of the eastern building. All
excavations focused on exposing plaza floors or construction modifications and no excavations were conducted in buildings at this time. A description of the 6 units excavated in Operation 1 is provided below.

**Unit HTN21_E01_01: Chultun**

This unit was excavated between July 31st and August 8th, 2021. It consists of the excavation of the underground storage chamber, or *chultun*, located in the central edge of the plaza of Group HTN19_20B, which may have served as a water catchment feature (See Figures 30, 31, and 32). The excavation entailed removing levels of backfilling inside the *chultun*. This is a modest sized *chultun* that does not measure more than 2 meters in depth, width, and length. Accessing the *chultun* was done through the entrance hole exposed in the surface. The chamber has two extensions, one towards the south and the other towards the southeast. These extensions are the result of the natural erosion of the soil instead of human modification, which means that the *chultun* could have originally been smaller. At the end of the *chultun*, two caches carved in the bedrock and covered with rocks were discovered. The excavation was subdivided in 4 levels and 3 lots. The description of levels and lots is described below. At the end of the description, a table with the frequencies of materials is provided (See table 3).

Level HTN21_E01_01_00 was a layer of collapsed material starting at 0.81 meters below the entrance of the chamber. The material consisted of gray soil with fragments of limestone of approximately 0.40 to 0.50 meters of dimension. The material turned from dark grey (Munsell 7.5R5/1) to light gray (Munsell 10YR5/1) as the excavation continued. This may be the result of the natural erosion of the chamber caused by gravity and rainfall.
Level HTN21_E01_01_01 consisted of a backfill of collapsed material. This is a layer of loose soil with a gray color (Munsell 10YR5/1). Removing this layer exposed small extensions of the chamber towards the south and west. It is possible that these extensions are part of the erosion process experienced by the chamber. Therefore, the excavation focused on the area directly beneath the entrance of the *chultun*.

Level HTN21_E01_01_02 consisted of an excavation approximately 1.00 X 1.00 meters placed on the surface of the previous level of the chamber. This excavation focused on the area below the entrance, which is near the carved walls of the chamber that were not eroded. This level is composed of grayish brown loose soil. The excavation of this unearthed two large boulders right below the entrance of the *chultun* and a group of rocks lying together east of the boulders.

Level HTN21_E01_01_03 was subdivided in two lots: Lot 03A and Lot 03B. Lot HTN21_E01_01_03A was differentiated to excavate around the group of rocks lying together discovered during the excavation of the previous level. This lot consists of white soil, probably coming from limestone. Lot HTN21_E01_01_03B was excavated next to 03A. This is a backfilling of dark-brown soil with a sandy texture. The soil is mixed with limestone fragments.

Level HTN21_E01_01_04 was also subdivided into two lots: Lot 04A and Lot 04B. Lot HTN 21_E01_01_04A consisted of the rocks lying together and the materials around it. This level exposed a window in the wall of the *chultun*. This window was filled with a material composed of sandy dirt and rocks. Originally, it was thought to be a water canal, but it was later shown to be an extension of the cache carved under the rocks. Lot HTN21_E01_01_04B is
composed of materials removed from inside the window found in the wall of the *chultun*. The window ended 0.10 meters inside the wall of the *chultun*.

Lot HTN21_E01_01_05 is below the entrance of the *chultun*, beneath the big boulders removed during the excavation of Lot 3A. It consists of a cache carved in the bedrock beneath the location of the boulders. The cache was filled with sandy material with a greyish color. Mixed with these materials, five fragments of chert were found. This suggests that the nature of the *chultun* was ritual, at least after the creation of this cache. This rules out the possibility that this chamber was always utilized as a water catchment source, but had other ritual purposes. The cache will be discussed more in the section of special contexts at the end of this chapter.
Figure 30. Drawing of the *chultun* indicating the sections depicted in the drawings below (Drawing by Rodrigo Guzman).
Figure 31. Sections A-A' and C-C' of the *chultun* indicating the levels of excavation (Drawing by Rodrigo Guzman).
Figure 32. Section B-B’ of the chultun indicating the levels of excavation (Drawing by Rodrigo Guzman).
Table 3. List of artifacts in Unit HTN21_E01_01

<table>
<thead>
<tr>
<th>Level/Lot</th>
<th>Ceramics</th>
<th>Obsidian</th>
<th>Chert</th>
<th>Shell</th>
<th>Bone</th>
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</tbody>
</table>

Other artifacts: no additional artifacts were found in this unit.

Unit HTN21_E01_02

This unit was excavated between July 31st and August 1st, 2021. This unit consists of a 1.00 x 1.00 meters test pit in the northeast of plaza HTN19_20B. It was placed here to study the stratigraphy of the plaza and understand the process of settlement of this group. The excavation was subdivided into 5 levels. This excavation provided a guide of the stratigraphy expected in the following test pits and matched with the stratigraphy observed in Late Classic peripheral groups excavated by the Holtun Archaeological Project in previous years (See Figure 32). One of the most important characteristics of this unit is the discovery of a leveling of stones, which is thought to be the base of a floor. The description of levels and lots is described below. At the end of the description, a table with the frequencies of materials is provided.
Level HTN21_E01_02_00 is the surface layer or humus. This is composed of dark-brown (Munsell 7.5R5/1) loose soil mixed with small rocks and organic material from grass and roots. This level had a depth of 0.06 meters from the surface. This level also includes the last layer of sedimentation in this part of the plaza.

Level HTN21_E01_02_01 was composed by brown-grayish (Munsell 7.5YR3/1) soil with small fragments of limestone. This level had a depth of 0.13 meters from the previous level. The excavation of this level reveals traits of occupation in the plaza. The first snail shell *trapdoor operculum* used presumably as an ornament was found in this level. More details will be provided in the section of shell and shell artifacts.

Level HTN21_E01_02_02 was a layer of compacted dark-brown (7/5 YR3/1) soil mixed with rocks of approximately 0.08 to 0.10 meters. This level had a depth of 0.08 meters from the previous level. It is possible that this level contains the upper part of the cobbled floor of the plaza. This was the first indication of the type of floor utilized in this group, which is similar to the floors observed in the Late Classic households north of Holtun (Crawford 2017).

Level HTN21_E01_02_03 consists of a layer of grayish brown (Munsell 10YR4/1) soil mixed with fragmented pieces of limestone. The fragments of limestone are larger than the ones seen in the previous level. This level had a depth of 0.07 meters from the previous level. The leveling of cobbles ends with this level. It is possible that this level was the base of one of the floors of the plaza. No archaeological materials were found in this level.

Level HTN21_E01_02_04 was a layer of compacted grayish (Munsell 10YR6/1) soil mixed with small rocks of approximately 0.10 to 0.15 meters. This level had a depth of 0.175
meters from the previous level. The bedrock was exposed at the end of this level. A small quantity of ceramic sherds was found in this level with no evidence of Preclassic types.

**Figure 33.** Drawing of profiles north and east of unit HTN21_E01_02 (Drawing by Rodrigo Guzman).

**Table 4.** List of artifacts in Unit HTN21_E01_02

<table>
<thead>
<tr>
<th>Level/Material</th>
<th>Ceramics</th>
<th>Obsidian</th>
<th>Chert</th>
<th>Shell</th>
<th>Bone</th>
<th>Other</th>
</tr>
</thead>
<tbody>
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<td>HTN21_E01_02_02</td>
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<td>-</td>
</tr>
</tbody>
</table>

Other artifacts: no additional artifacts were found in this unit.
Unit HTN21_E01_03

This unit was excavated between August 2nd and 8th, 2021. This unit consists of a test pit of 1.00 x 1.00 meters in the southeast corner of the northern building of plaza HTN19_20B. This test pit was placed here to study the stratigraphy of the plaza in relationship to the buildings. The results of this excavation indicate a complex system of leveling to prepare the area for the plaza floor (See Figure 34). In addition, it indicates the practice of ritual offerings in contexts associated with social status. No excavation was conducted inside the structure of the building. The excavation was subdivided in 6 levels. The description of levels and lots is described below.

At the end of the description, a table with the frequencies of materials is provided.

Level HTN21_E01_03_00 was the surface layer or humus. This was a layer of dark-brown loose soil. This level had a depth of 0.10 meters from the surface. The surface has an inclination towards the south because this unit is adjacent to a mound. No archaeological materials were found in this layer.

Level HTN21_E01_03_01 was a layer of dark-brown (Munsell 10YR3/1) loose soil mixed with a small proportion of little rocks. This level had a depth of 0.335 meters from the previous level. The excavation of this level revealed blocks of the southeast corner of the building and the leveling of a cobbled floor.

Level HTN21_E01_03_02 was a layer of grayish brown (Munsell 10YR4/2) soil mixed with small rocks. The proportion of these rocks was larger than the previous level. This level had a depth of 0.065 meters from the previous level. The level ends on a surface of material mixed with limestone. The unit continued to reveal the southeast corner of the building.
Level HTN21_E01_03_03 was a layer of grayish-brown (Munsell 10YR5/1) soil. The gray color was more evident as the excavation continued. This level had a depth of 0.22 meters from the previous level. A deposit of charcoal was found near the northwest corner of this unit. A disc of shell and obsidian was found beneath the deposit of charcoal. The disc had a design carved resembling a Maya cosmogram (as described in Freidel et al. 1993; Mathews and Gaber 2004) and the piece of inlaid obsidian was modified from a prismatic blade. No additional archaeological materials were found around this piece. More details about this piece will be provided in the section of shell and shell artifacts.

Level HTN21_E01_03_04 was a layer of grayish-brown (Munsell 10YR5/1) soil mixed with small rocks dispersed within the layer. This level had a depth of 0.09 meters from the previous level. The excavation of this level unveils a leveling made with a mortar mixed with fragments of limestone.

Level HTN21_E01_03_05 was a grayish (Munsell 10YR5/1) solid fill probably used to level the surface above the bedrock. This was a mortar mix or building paste made of limestone and mixed with entire fragments of stone. It seems like a leveling similar to that the used over bedrock in the area of excavation unit HTN21_E02_01. This level had a depth of 0.13 meters from the previous level. Archaeological materials were minimal in this level.
**Figure 34.** Drawing of profiles north and east of unit HTN21_E01_03 (Drawing by Rodrigo Guzman).

**Table 5.** List of artifacts in Unit HTN21_E01_03

<table>
<thead>
<tr>
<th>Level/Material</th>
<th>Ceramics</th>
<th>Obsidian</th>
<th>Chert</th>
<th>Shell</th>
<th>Bone</th>
<th>Other</th>
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</thead>
<tbody>
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<td>3</td>
<td>1</td>
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</tr>
</tbody>
</table>

Other artifacts: 1 disc of shell and obsidian.
Unit HTN21_E01_03A

This unit was excavated between August 5th and 8th, 2021. This unit consist of an extension of 0.50 x 1.00 meters located adjacent to the unit HTN21_E01_03. This test pit was placed to study the rest of the corner of the north building of plaza HTN19_20B, based on the findings in level 03 of the adjacent unit that include a possible feature of ash and shell disc exposed. The excavation found another portion of the corner of the building but no excavation was conducted inside the structure (See Figure 35). The excavation was subdivided in 9 levels. The description of levels and lots is described below. At the end of the description, a table with the frequencies of materials is provided.

Level HTN21_E01_03A_00 consisted of a layer of dark-brown loose soil. This level had a depth of 0.05 meters from the surface. There were few archaeological materials. Level HTN21_E01_03A_01 consists of a layer of dark-brown (Munsell 10YR4/2) loose soil mixed with very small stones. This level had a depth of 0.21 meters from the previous level. The excavation of this level unearthed a portion of the corner of the structure.

Level HTN21_E01_03A_02 consisted of a layer of brown (Munsell 10YR4/2) compacted soil mixed with small stones. This level had a depth of 0.23 meters from the previous level. This level was excavated next to the levels of stone that are part of the structure of the building. The excavation of this level did not include a portion in the south that featured a different color. It was excavated later as levels 06 to 08. Level HTN21_E01_03A_03 consists of a fill of gray (Munsell 7.5YR5/1) sandy soil. This level had a depth of 0.215 meters from the previous level. A deposit of charcoal was found at the same level of the charcoal deposit in level 03 of unit HTN21_E01_03.
Level HTN21_E01_03_04 consisted of a fill of grayish (Munsell 7.5YR5/1) compacted soil mixed with a sandy material. This level had a depth of 0.135 meters from the previous level. The excavation of this level unearthed the surface of a gray mortar similar than the observed in the level 5 of the adjacent unit HTN21_E01_03 and in the level 06 of unit HTN21_E02_01.

Level HTN21_E01_03_05 was excavated in a pile of soil left in the south of the unit due to a difference in color and texture. It consisted of a layer of grayish brown (Munsell 10YR3/1) compacted soil. This level had a depth of 0.11 meters from the previous level. Level HTN21_E01_03A_06 consists of a layer of grayish brown (Munsell 10YR3/1) soil composed of sandy soil. This level had a depth of 0.095 meters from the previous level. This level contains more materials than the previous level and it was next to level 04.

Level HTN21_E01_03_07 consists in a layer of grayish brown (Munsell 10YR3/1) compacted sandy material. This level had a depth of 0.075 meters from the previous level. This was the last portion of the pile of soil excavated separately in the south of this unit. The excavation of this level discovered the surface of the layer unearthed by level 04.

Level HTN21_E01_03A_08 consisted of a layer of gray mortar mix placed on top of the bedrock as a leveling. This level had a depth of 0.075 meters from the previous level. This mortar mix was similar than the observed in the level 05 of the adjacent unit HTN21_E01_03 and in the level 06 of unit HTN21_E02_01. The mortar mix seems to be a mix of limestone with other sandy materials.
Figure 35. Drawing of profile west and north and the plane of the portion of the southeastern corner of the structure excavated in unit HTN21_E01_03A (Drawing by Rodrigo Guzman).
Table 6. List of artifacts in Unit HTN21_E01_03A

<table>
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<th>Level/Material</th>
<th>Ceramics</th>
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<th>Chert</th>
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</table>

Other artifacts: No additional artifacts were found in this unit.

Unit HTN21_E01_04

This unit was excavated between August 2\textsuperscript{nd} and August 8\textsuperscript{th}, 2021. This unit consists of a test pit of 1.00 x 1.00 meters in the south of plaza HTN19_20B facing the southern building of this group. This test pit was placed here to study the stratigraphy of the plaza and understand the process of settlement of the group (See Figure 36). This was the only area where a recognizable stucco floor was found (See Figure 37). This finding was significant to confirm the presence of stucco floors in the plaza of Group HTN19_20. The floor was around 0.02 meters thick, which differs with the thickness and strength of the Preclassic floors in the central plazas and central households (studied by Kovacevich 2011). However, it was similar to the last version of the floor
found in groups in the core of the site (Rivera 2011). This suggests that this floor likely dates to the Late Classic period in Group HTN19_20. The excavation was subdivided into 4 levels. The description of levels and lots is described below. At the end of the description, a table with the frequencies of materials is provided (See Table 7).

Level HTN21_E01_04_00 consisted of a layer of dark-brown loose soil with some small stones mixed. This level had a depth of 0.10 meters from the surface. No archaeological materials were found at this level. The following level, HTN21_E01_04_01, consists of a layer of dark-brown (Munsell 10YR3/1) loose soil with rocks mixed in a larger density than the previous level. This level had a depth of 0.10 meters from the previous level. A stucco floor was discovered at the end of this level.

Level HTN21_E01_04_02 consisted of a fragmented stucco floor sited on top of a layer of a sandy material. This level had a depth of 0.10 meters from the previous level. This stucco floor was similar to the later versions of floor found in Late Classic contexts in plazas and households in the epicenter of the site (c.f. Rivera 2011; Crawford 2017).

The last level, Level HTN21_E01_04_03, consisted of a layer of grayish-brown (Munsell 10YR/1) soil mixed with small stones of 0.02 to 0.04 meters. This level had a depth of 0.11 meters from the previous level. This was the last level of excavation before finding bedrock a couple of centimeters below.
**Figure 36.** Drawing of the profiles south and West from the excavation unit HTN21_E01_04 (Drawing by Rodrigo Guzman).

**Figure 37.** Photo of Level HTN21_E01_04_01 depicting the surface of the fragmented stucco floor (Photo by Rodrigo Guzman).
Table 7. List of artifacts in Unit HTN21_E01_04

<table>
<thead>
<tr>
<th>Level/Material</th>
<th>Ceramics</th>
<th>Obsidian</th>
<th>Chert</th>
<th>Shell</th>
<th>Bone</th>
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</table>

Other artifacts: No additional artifacts were found in this unit.

Unit HTN21_E01_05

This unit was excavated between August 4th and August 5th, 2021. This unit consists of a test pit of 1.00 x 1.00 meters located east of Group HTN19_20B and outside of the plaza. This test pit was placed here to study the process of settlement from a perspective outside of the plaza of the group. A special characteristic of this unit was the discovery of a portion of a structure behind the building (See Figure 38). This could be a basal platform, a banquette or a walkway. These types of architectural details are often found in elite or ritual complexes (c.f. Hutson et al. 2007; Yaeger and Robin 2021). The excavation was subdivided into 3 levels. The description of levels and lots is described below. At the end of the description, a table with the frequencies of materials is provided (See Table 8).

Level HTN21_E01_05_00 consisted of the surface level or humus. It was a layer of dark-brown (Musell 10YR5/1) loose soil mixed with organic materials. This level had a depth of 0.09 meters from the surface. The layer was darker than the humus observed in other units within the plaza.
Level HTN21_E01_05_01 consisted of a layer of dark-brown (Munsell 7.5YR5/2) loose soil mixed with small fragments of stone. This level had a depth of 0.15 meters from the previous level. The excavation of this level unearthed a portion of a surface structure that may be a walkway, banquette or basal platform. This structure was in the ground level and it was possibly an extension to the east from the eastern building of Group HTN19_20B.

Level HTN212_E01_05_02 consisted of a layer of grayish dark-brown (Munsell 10YR4/2) soil mixed with small pieces of stone of approximately 0.02 to 0.04 meters. This level had a depth of 0.35 meters from the previous level. The excavation of this level exposed the bedrock, which has a gradient towards the east.

Figure 38. Drawing of profiles north and east of the excavation unit HTN21_E01_05 and the plane of the excavation depicting the walkway or banquette (Drawing by Rodrigo Guzman).
Table 8. List of artifacts in Unit HTN21_E01_05

<table>
<thead>
<tr>
<th>Level/Material</th>
<th>Ceramics</th>
<th>Obsidian</th>
<th>Chert</th>
<th>Shell</th>
<th>Bone</th>
<th>Other</th>
</tr>
</thead>
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<td>-</td>
<td>80</td>
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</tr>
</tbody>
</table>

Other artifacts: No additional artifacts were found in this unit.

Operation 2

Operation 2 consists of 1 unit of excavation and 2 excavation extensions conducted in Group HTN19_20C. The operation was planned in this location because of the proximity of this patio group with the plaza group HTN19_20B (See Figure 28). Although group HTN19_20 has three subgroups, groups HTN19_20B and 20C are adjacent to each other. In addition, Group HTN19_20C has the most elevated position of the compound HTN19_20 and the patio appears to be more restricted by the structures surrounding it. Architectural restriction can be associated to elite status in other Maya sites, which make these locations important to study elite culture (e.g., Hendon 1991; Newman 2019; Yaeger and Robin 2021). In addition, the orientation of the patio has a slight declination towards the west, which was also coincidental with the atypical orientation of the whole group.

The excavation units were placed to understand the process of settlement, function, and transformation of the patio over time. The unit was placed in the north of the patio, in front of the northern building. From this location it is possible to view the Yaxha lagoon and most of the basin. The lagoon of Yaxha is 12 kilometers north of Holtun and it is the largest local water
source. The primary center Yaxha, namesake of the lake, is located on the eastern shore of the
lagoon.

The first extension of this unit 01 was placed adjacent to this unit to the east. The second
extension was placed adjacent to the south from the first extension. These excavations focused
on studying the floors of the patio and no excavations were conducted in architecture. A
description and discussion of the single unit of excavation with the two extensions in Operation 2
is provided below.

**Unit HTN21_E02_01**

This unit was excavated between August 6th and August 12th, 2021. This unit consisted
of a rectangular test pit of 1.00 x 1.00 meters located north of the patio group number
HTN19_20C facing the northern building. Lake Yaxha is visible in the north from this unit. This
test pit was placed here to study the stratigraphy, process of settlement, and status characteristics
of Group HTN19_20. The excavation was subdivided into 5 levels and 3 lots (See Figure 39).

This unit provided significant information regarding ritual activity and the process of
establishment of the group. An altar was discovered in the floor level and it is associated with the
first stages of development of this portion of the settlement (See figure 40). The description of
levels and lots is provided below. At the end of the description, a table with the frequencies of
materials is provided (See Table 9).

Level HTN21_E02_01_00 consisted of the surface level or humus. It was a layer of dark-
brown (Munsell 10YR5/1) sandy soil. This level had a depth of 0.095 meters from the surface.
The next level, level HTN21_E02_01_01 consists of a layer of dark-brown soil with a loose
consistency. This level had a depth of 0.175 meters from the previous level. The first portion of a
flat altar surface was found in the southeast portion of the unit. Among the artifacts, one chert core was found apparently as a dedicatory offering. These types of artifacts are commonly associated with areas of production or households (Johnson et al. 2025; Shafer and Hester 1984) but in this case it was located in a ritual context as seen in other sites like Tikal (Moholy-Nagy 1997).

Level HTN21_E02_01_02 consisted of a layer of dark-brown (Munsell 10YR4/1) clay soil mixed with a small proportion of sandy material. This level had a depth of 0.09 meters from the previous level. The excavation of this level uncovered the side of the altar and was discontinued as the soil turned a different color and texture.

Level HTN21_E02_01_03 consisted of a layer of dark-brown (Munsell 7.5YR4/2) sandy soil mixed with small fragments of stone. It was also mixed with a grayish sandy material. This level had a depth of 0.14 meters from the previous level. Apparently, the altar was originally set in this level. The excavation of this level reached a compacted surface mixed with stones, which is the level over which the altar is embedded. The altar was temporarily removed when this level was reached in the adjacent extension of the test pit.

Lot HTN21_E02_01_03A consisted of the soil that was adjacent and below the altar. This material was removed separately when the altar was removed temporarily. The soil was a composition of dark-brown (Munsell 10YR3/2) loose soil mixed with stones that measure between 0.04 to 0.10 meters.

Level HTN21_E02_01_04 consisted of a layer of dark-brown (Munsell 10YR3/2) sandy soil mixed with stones. This level had a depth of 0.11 meters from the previous level. This was a
level where the altar was located. Apparently, this was the base of a floor that originally covered the part of the altar.

Level HTN21_E02_01_05 consisted of a layer of brown (Munsell 10YR5/2) sandy soil mixed with small rocks. This level had a depth of 0.08 meters from the previous level. The excavation of this level exposes a large stone placed right beneath the altar. It is possible that this stone was placed to mark this location during the first stages of development of this patio. This level had less rocks mixed in the soil in comparison with the adjacent levels excavated in the subsequent extensions.

Lot HTN21_E02_01_06 consisted of a very compacted layer of grayish brown (Munsell 10YR5/2) sandy fill, probably a mortar mix. It was mixed with fragments of limestone that measure between 0.10 and 0.20 meters. This level had a depth of 0.11 meters from the previous level. This was a leveling on top of the bedrock, similar to that observed in the levels 05 and 08 of units 03 and 03A in operation 1. The large rock was embedded in this layer of mortar mix. In addition, a post hole was found in this layer and was carved in the bedrock.

Lot HTN21_E02_01_06A was composed by the material inside the pole hole found in Level 06 and carved in the bedrock. It consists of a dark-brown (Munsell 10YR5/2) loose soil that turns grayish as it reaches the end of the hole. The pole-hole measures 0.18 meters of diameter and 0.29 meters of depth.

Lot HTN21_E02_01_00A was composed of the loose soil that resulted from the removal of the stone beneath the altar. It had mixed materials from the south vertex of the test pit. After removing the stone, no archaeological materials were found. However, the removal of the stone revealed that it was embedded within the mortar mix and did not reached the bedrock.
**Figure 39.** Drawing of profiles west and north of excavation unit HTN21_E02_01 indicating the location of Lot 03A (Drawing by Rodrigo Guzman).

**Figure 40.** Drawing of plane of excavation unit HTN21_E02_01 with the extensions AB and C indicating the location of the atlar (Drawing by Rodrigo Guzman).
Table 9. List of artifacts in Unit HTN21_E02_01

<table>
<thead>
<tr>
<th>Level-Lot/Material</th>
<th>Ceramics</th>
<th>Obsidian</th>
<th>Chert</th>
<th>Shell</th>
<th>Bone</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>HTN21_E02_01_00</td>
<td>10</td>
<td>-</td>
<td>15</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>HTN21_E02_01_01</td>
<td>33</td>
<td>-</td>
<td>26</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>HTN21_E02_01_02</td>
<td>140</td>
<td>-</td>
<td>71</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>HTN21_E02_01_03A</td>
<td>95</td>
<td>0</td>
<td>60</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>HTN21_E02_01_03B</td>
<td>11</td>
<td>1</td>
<td>13</td>
<td>1</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>HTN21_E02_01_04</td>
<td>33</td>
<td>-</td>
<td>12</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>HTN21_E02_01_05</td>
<td>73</td>
<td>1</td>
<td>168</td>
<td>1</td>
<td>-</td>
<td>2</td>
</tr>
<tr>
<td>HTN21_E02_01_06A</td>
<td>17</td>
<td>-</td>
<td>24</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>HTN21_E02_01_06B</td>
<td>4</td>
<td>-</td>
<td>3</td>
<td>1</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>HTN21_E02_01_00A</td>
<td>14</td>
<td>-</td>
<td>14</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Other artifacts: 1 piece of stucco, 2 small samples of charcoal.

Unit HTN21_E02_01AB

This unit was excavated from August 7th through August 12th, 2021. This unit consisted of a test pit of 1.00 x 1.00 meters located north of the patio group number HTN19_20C. This was an extension of the unit HTN21_E02_01 that was adjacent to the west. The objective of this extension was to uncover the rest of the altar found in the adjacent test pit. In addition, the excavation intended to explore the floor beneath the altar (See Figure 41). The code of the extension is AB because it was originally two different extensions.

This unit provided significant information regarding the process of settlement of this patio and supplemented the information collected in the adjacent test pit. The rest of the altar was
unearthed during the excavation of this unit. The excavation was subdivided in 6 levels and 4 lots. The description of levels and lots from top to bottom is described below. At the end of the description, a table with the frequencies of materials is provided (See Table 10).

Level HTN21_E02_1AB_00 was composed of lots A and B. Lot HTN21_E02_01AB_00A consists of the west portion of the unit. It was the humus, composed of a dark-brown (7.5 YR3/1) soil mixed with organic material. This lot had a depth of 0.12 meters from the surface. Lot HTN21_E02_01AB_00B was the eastern portion of the unit. It was also humus composed of dark-brown (7.5 YR3/1) soil mixed with organic materials. This lot had a depth of 0.08 meters from the surface.

Level HTN21_E02_1AB_01 was composed of lots A and B. Lot HTN21_E02_01AB_01A was the west portion of this unit. It was a layer of brown (Munsell 10YR4/3) clay soil. This lot had a depth of 0.12 meters from the previous level. In the excavation of this lot, the surface of the altar was reached. The lot was characterized by a high frequency of archaeological materials. Lot HTN21_E02_01AB_01B was the east portion of the unit. It was a layer of dark-brown (Munsell 7.5YR4/3) sandy compacted soil with small fragments of stone. This lot had a depth of 0.10 meters from the previous level. A high frequency of archaeological materials was also a characteristic of this lot. Excavating these two lots revealed the surface on which the altar was lying.

Level HTN21_E02_01AB_02 enclosed the whole dimension of the 1.00 x 1.00 meters test pit. It consisted of a layer of dark-brown (Munsell 7.5YR4/2) soil mixed with small stones of 0.05 to 0.10 meters of dimension. This level had a depth of 0.09 meters from the previous level. This was the level where the altar was located.
Level HTN21_E02_01AB_03 was a layer of dark-brown (Munsell 10YR3/2) sandy soil mixed with small stones of 0.05 to 0.10 meters. The soil was less sandy than the previous level. This level had a depth of 0.09 meters from the previous level. This was the level with the largest frequency of ceramic sherds and fragments of chert among all the excavations conducted in Group HTN19_20. The excavation of this level ended in the surface of a layer of compacted soil and stones.

Level HTN21_E2_01AB_04 consisted of a layer of grayish grown (Munsell 10YR5/2) compacted soil, less sandy than the previous level. This layer was mixed with small stones of 0.05 to 0.10 meters and large stones of 0.10 to 0.40 meters. This level had a depth of 0.125 meters from the previous level. This was probably a leveling below the floor of the patio and above the bedrock. The frequency of archaeological materials reduced drastically.

Level HTN21_E02_01AB_05 was a layer of grayish brown (Munsell 10YR5/2) compacted soil. This level had a depth of 0.07 meters from the previous level. This level was characterized by the lack of archaeological materials. It was possibly a layer of materials deposited in the process of leveling the bedrock in preparation to build the patio.
Figure 41. Drawing of profiles north and east of the excavation unit HTN21_E02_01AB (Drawing by Rodrigo Guzman).

Table 10. List of artifacts in Unit HTN21_E02_01AB

<table>
<thead>
<tr>
<th>Level-Lot/Material</th>
<th>Ceramics</th>
<th>Obsidian</th>
<th>Chert</th>
<th>Shell</th>
<th>Bone</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>HTN21_E02_01AB_00A</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>HTN21_E02_01AB_00B</td>
<td>12</td>
<td>-</td>
<td>6</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>HTN21_E02_01AB_01A</td>
<td>110</td>
<td>-</td>
<td>47</td>
<td>4</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>HTN21_E02_01AB_01B</td>
<td>226</td>
<td>-</td>
<td>49</td>
<td>3</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>HTN21_E02_01AB_02</td>
<td>234</td>
<td>2</td>
<td>32</td>
<td>1</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>HTN21_E02_01AB_03</td>
<td>561</td>
<td>-</td>
<td>332</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>HTN21_E02_01AB_04</td>
<td>1</td>
<td>-</td>
<td>18</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>HTN21_E02_01AB_05</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Other artifacts: 2 fragments of undetermined materials.
Unit HTN21_E02_01C

This unit was excavated from August 8th through August 11th, 2021. This unit consisted of a test pit of 1.00 x 0.50 meters located north of the patio group number HTN19_20C. This was an extension of the unit HTN21_E02_01AB that was adjacent to the north. The objective of this extension was to study the floor of the patio and determine if the high frequency of ceramics was only located next to the altar or it continued in a larger area (See Figure 42).

The excavation of this unit contributed to the understanding of the cultural features of the ancient inhabitants of this patio. The archaeological evidence found in this extension indicates that most of the cultural activity in the area was condensed around the altar. The excavation was subdivided in 6 levels. The description of levels and lots from top to bottom is described below. At the end of the description, a table with the frequencies of materials is provided (See Table 11).

Level HTN21_E02_01C-00 was the surface level or humus. It consisted of a layer of dark-brown sandy soil mixed with organic materials. This level had a depth of 0.08 meters from the previous level. The next level, Level HTN21_E02_01C_01 consists of a layer of dark-brown (Munsell 7YR4/3) compacted sandy soil with small fragments of stone. This level had a depth of 0.095 meters from the previous level.

Level HTN21_E02_01C_02 consisted of a layer of brown (Munsell 7YR4/2) compacted soil mixed with a gray sandy material and small stones of 0.02 to 0.10 meters. This level had a depth of 0.095 meters from the previous level. This level had fewer ceramic materials than the adjacent level in unit HTN21_E02_01AB.
Level HTN21_E02_01C_03 consisted of a layer of dark-brown (Munsell 10YR3/2) sandy soil. This level had a depth of 0.10 meters from the previous level. The proportion of sandy materials was less than the previous level, but the proportion of small stones was larger. The excavation of this level ended with a compacted level of soil and stones.

Level HTN21_E02_01C_04 consisted of a layer of grayish brown (Munsell 10YR5/2) compacted soil mixed with stones of 0.05 to 0.10 meters and stones of 0.10 to 0.40 meters. This level had a depth of 0.125 meters from the previous level. This was a leveling of stone similar to the observed in the adjacent unit. It was also characterized by the drastic decrease in frequency of archaeological materials.

Level HTN21_E02_01C_05 consisted of a layer of grayish brown (Munsell 10YR5/2) compacted soil. This level had a depth of 0.06 meters from the previous level. It was a leveling layer above the bedrock and below a level of stones.

Figure 42. Drawing of profiles south and west of the excavation unit HTN21_E02_01C (Drawing by Rodrigo Guzman).
Table 11. List of artifacts in Unit HTN21_E02_01C

<table>
<thead>
<tr>
<th>Level/Material</th>
<th>Ceramics</th>
<th>Obsidian</th>
<th>Chert</th>
<th>Shell</th>
<th>Bone</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>HTN21_E02_01C_00</td>
<td>8</td>
<td>-</td>
<td>7</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>HTN21_E02_01C_01</td>
<td>123</td>
<td>-</td>
<td>18</td>
<td>3</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>HTN21_E02_01C_02</td>
<td>56</td>
<td>-</td>
<td>12</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>HTN21_E02_01C_03</td>
<td>47</td>
<td>-</td>
<td>95</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>HTN21_E02_01C_04</td>
<td>4</td>
<td>-</td>
<td>16</td>
<td>1</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>HTN21_E02_01C_05</td>
<td>2</td>
<td>-</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Other artifacts: No additional artifacts were found in this unit.

Artifacts From the Excavations at HTN19_20

The excavation of the 9 units at HTN19_20 produced a series of artifacts collected from the different levels and lots. These artifacts include fragments of ceramics (n= 2546), artifacts of obsidian (n=9) and chert (n=1362), shell and shell artifacts (n=71), bone (n=1 sample), charcoal (n=3 samples) and a small number of artifacts of undetermined material (n=4). The artifacts were washed, marked, and stored for further analysis.

The artifacts from HTN19_20 was analyzed to support the objectives of this study. Ceramic artifacts provide information regarding the chronology of the group, the frequency of cultural activities in the areas, and the nature of these activities. Obsidian artifacts provide information about the exchange dynamics experienced by ancient visitors and inhabitants of the group. Chert artifacts indicate the use of local resources for utilitarian and ritual purposes. The samples of bone, charcoal and undetermined materials were saved for later analysis due to the
small quantity obtained. A detailed description of the artifacts collected in the excavations of HTN19_20 is provided below.

*Ceramics*

A total of 2546 fragments of ceramic were collected from the excavations conducted in Group HTN19_20. The highest concentration of ceramics was found in the layers associated with the floor of the patio and the plaza. The context with the highest amount of ceramic was the floor around the altar in the patio of Group HTN19_20C, which denotes a high level of cultural activity. The plaza of Group HTN19_20B presents a smaller amount of ceramic artifacts according to the two excavations conducted there.

Most of the ceramic samples collected are un-slipped, too small, eroded, or have a poor preservation. Despite the presence of fragments of vessel rims, it was difficult to identify types to determine the chronology of the settlement. One of the main characteristics of the ceramics collected in HTN19_20 was the lack of samples from the Preclassic period. To date the Preclassic period, it would be expected to find ceramics from the Mamom and Chicanel complexes. Ceramic types dating to these complexes are characterized by the hardness of the paste and the glow of the slip, and lack of polychrome paint. Some examples of ceramic types from these complexes are Juventud Red and Sierra red respectively.

A sherd of the Late Classic period diagnostic type, Chinja Impressed, was identified in level 3 of unit HTN21_E02_01AB (See Figure 43 and 44). This type is a strong marker of the Late Classic period in the central Maya lowlands (Callaghan and Neivens de Estrada 2016; Forsyth 2002). In addition, two fragments of a censer were found in levels 2 and 3 of the same unit. These fragments reinforce the ritual character of this context during the Late Classic period.
In addition to Late Classic period construction techniques noted in all excavation units, the presence of Late Classic period ceramic types and lack of Preclassic period types indicates that this group corresponds to a Late Classic period residential complex.

**Figure 43.** Photo of ceramic fragments collected in unit HTN21_E02_01AB depicting a sample of the type Chinja Impressed (Photo by Rodrigo Guzman).

**Figure 44.** Photo of ceramic fragments collected in unit HTN21_E02_01AB depicting a sample of the type Chinja Impressed (Photo by Rodrigo Guzman).
Obsidian

Obsidian artifacts are considered an exotic material because its procurement requires being imported from the Guatemalan highlands, hundreds of kilometers away (See Figure 45). That process is often associated with a complex dynamic of exchange possibly including both reciprocal and market mechanism (Aoyama 2014, Golitko et al. 2012). In Group HTN19_20 of Holtun, a total of nine pieces of obsidian were found during the excavations conducted during the season 2021 (See Figure 46). From these pieces, seven were fragments of prismatic blades, one was a fragment of prismatic blade modified to be inlayed within a shell ornament, and one was a modified blade turned into a graver or burin. More details about the piece of obsidian inlayed in a disk of shell are provided in a section below.

The obsidian pieces were analyzed visually to find out the type of artifact it came from, the segment of the artifact, as well as the texture and color of the material. In addition, dimensions and weight of each artifact were measured to analyze the volume of this exotic material found in the excavations (See Table 12). The texture of the artifacts may indicate the provenance of the obsidian. It is probable that the blades with a mate finish (n=4) correspond to the San Martin Jilotepeque source, while the samples with a glassy texture (n=5) correspond to the El Chayal source. This proportion is coincidental with the proportions of obsidian provenance found in other Late Classic contexts of Holtun (Kovacevich and Crawford 2016; Kovacevich 2014a; Guzman 2017).
Figure 45. Map of obsidian sources in the Maya Highlands (Guzman 2017b).
Figure 46. Drawing of the obsidian pieces found in the excavations conducted in HTN19_20. Drawings shows the dorsal, side, and ventral portion of the all the pieces (Drawing by Rodrigo Guzman).
Table 12. List of obsidian artifacts found in HTN19_20

<table>
<thead>
<tr>
<th>Provenience</th>
<th>Type</th>
<th>Fragment</th>
<th>Dimensions</th>
<th>Weight</th>
<th>Color</th>
<th>Texture</th>
</tr>
</thead>
<tbody>
<tr>
<td>HTN21_E01_01_03</td>
<td>Prismatic Blade</td>
<td>Medial</td>
<td>13 x 9.1 x 2.5 mm</td>
<td>0.4g</td>
<td>Opaque light gray</td>
<td>Matte</td>
</tr>
<tr>
<td>HTN21_E01_03_03</td>
<td>Prismatic Blade</td>
<td>Medial</td>
<td>7 x 7.6 x 1.7 mm</td>
<td>0.1g</td>
<td>Translucent dark gray</td>
<td>Glassy</td>
</tr>
<tr>
<td>HTN21_E01_03_04</td>
<td>Prismatic Blade</td>
<td>Medial</td>
<td>13.5 x 9.8 x 1.9 mm</td>
<td>0.4g</td>
<td>Opaque light gray</td>
<td>Matte</td>
</tr>
<tr>
<td>HTN21_E01_3A_06</td>
<td>Prismatic Blade</td>
<td>Medial</td>
<td>9.2 x 7 x 1.9 mm</td>
<td>0.1 g</td>
<td>Translucent dark gray</td>
<td>Matte</td>
</tr>
<tr>
<td>HTN21_E01_05_01</td>
<td>Prismatic Blade</td>
<td>Medial</td>
<td>15 x 12.4 x 2.6 mm</td>
<td>0.7g</td>
<td>Translucent dark gray</td>
<td>Glassy</td>
</tr>
<tr>
<td>HTN21_E02_01_03A</td>
<td>Prismatic Blade</td>
<td>Proximal</td>
<td>33.4 x 7.8 x 2.7 mm</td>
<td>0.9g</td>
<td>Translucent dark gray</td>
<td>Glassy</td>
</tr>
<tr>
<td>HTN21_E02_01_05</td>
<td>Prismatic Blade</td>
<td>Proximal</td>
<td>29.8 x 8 x 2.1 mm</td>
<td>0.7g</td>
<td>Translucent dark gray</td>
<td>Matte</td>
</tr>
<tr>
<td>HTN21_E02_01AB_02</td>
<td>Projectile</td>
<td>Proximal</td>
<td>33.2 x 14.8 x 4.9 mm</td>
<td>1.9g</td>
<td>Translucent dark gray</td>
<td>Glassy</td>
</tr>
<tr>
<td>HTN21_E02_01AB_02</td>
<td>Prismatic Blade</td>
<td>Medial</td>
<td>20 x 9.2 x 2.6 mm</td>
<td>0.6g</td>
<td>Translucent dark gray</td>
<td>Glassy</td>
</tr>
</tbody>
</table>

Chert

Chert is one of the most abundant materials in the excavations at Holtun. Pieces of this material have been found in different contexts of the site, including floors in households or fill of buildings in central plazas. Fragments of chert are abundant in the humus and the ground surface of the site (Crawford 2017). The abundance of fragments of chert dispersed across the site may be the result of the local availability of this material. A chert outcrop was found in the east of the site and north of Group HTN19_20. Several nodules of chert can be found stacked on the surface (Guzman 2019; 2020). In addition, a chert tool production area was found in Group 33 located north of the central plazas (Crawford 2017).
A total of n=1362 fragments of chert were found during the excavations conducted in Group HTN19_20 during the field season in 2021. The majority of the samples were flakes and fragments of blades and projectile points. A core chert flakes was found in the first level of excavation in the unit HTN21_E02_01 (See Figure 47). In addition, five fragments of chert were found inside a cache within the chultun excavated in the plaza HTN19_20B (See Figure 48). These fragments were partially modified to have similar dimensions. However, they were not transformed into a sharp artifact as usual. The presence of these fragments inside a cache within a chultun may be a ritual associated to the presence of chert sources in the landscape of Holtun.

Figure 47. Photo of a chert flake core found in unit HTN21_E02_01 (Photo by Rodrigo Guzman).
A sample of n=81 pieces of snail shell was collected during the excavations conducted in Group HTN19_20 in 2021. Shell is abundant in archaeological contexts at Holtun and previous analysis provides an important source of reference. Near n=10,000 shell samples were analyzed in previous seasons. The majority of samples of Holtun correspond to gastropods that could have been collected and even harvested locally. However, there are a small proportion of pieces made from sea mollusks (Bishop 2015; 2017). The most common species identified from this sample are specimens of *Pachychilus* spp., *Eugladina* sp, *Neocyclotus dysoni*, and specimens from the family *Annulariidae*, among others. The shell collection of Group HTN19_20 is small in proportion with the samples collected in Holtun and it presents a different pattern.

The specimens of *Pachychilus* spp. are traditionally known as *jute* and at least 2 species have been identified at Holtun: *Pachychilus glaphyrus* and *Pachychilus indiorum* (Bishop 2017). Two samples of *Pachylus glaphyrus* were identified in small proportions within the contexts of
Group HT19_20 (See Figure 49). An additional sample was found on the surface. According to the local informants, this species of jute is only available at least 4 kilometers south in the river Arroyo Salsipuedes or Arroyo de la Loca as named by locals. This is a tributary of the river Mopan, which is part of the hydrological system located south of the Yaxha basin. A complete sample of this species of jute was found in the test pit HTN21_E01_05. It has a fissure on the side. These types of fissures have been interpreted as intentional perforations to transform the shell into an ornament (Bishop 2017). However, it may have been also used to extract the content of the snail. The second sample is a fragment of the columella of a Pachychilus glaphyrus. It was found in within the context of the patio floor in the unit HTN21_E02_01C.

The samples of the specimen Pachychilus indiorum are also limited. At least $n=2$ of them is identified from the excavations. One full shell and fragments of a second were found.
associated to the cache or burial found during the excavations in unit HTN21_E01_03A. This species is abundant in the still-water pools less than 1 kilometer south of Group HTN19_20, that is why these water resources are referred as *Arroyo del Jute*.

It was common to find samples of shells used apparently in ornaments or decorations. A collection of n=9 specimens of the family *Annulariidae* were found in the excavation of unit HTN21_E01_03 and the extension towards the west HTN21_E01_03A (See Figure 50). This specimen has been found previously in archaeological contexts of Holtun. It is noteworthy that some of them had small perforations, which may indicate the use of these samples for decorative purposes. An additional sample of perforated shell was found on the surface of unit HTN21_E02_01C but the species has not been identified.

**Figure 50.** Samples of specimens from family *Annulariidae* collected from the excavations in Group HTN19_20 (Photo by Rodrigo Guzman).
In addition, a collection of 35 snail shell *operculum* was found in several contexts during the excavation of Group HTN19_20 (See Figure 51). These are small natural shell disks previously identified at Holtun as part of the structure of the species *Neocyclotus dysoni* (Bishop 2017). This species was found in archaeological excavation, but it is also endemic at the moment at Holtun. Although most of the samples present a puncture in the center, the use for ornament and decoration is still uncertain. An obsidian artifact like the one modified as a graver or burin described in the previous section could have served to perforate some of the shell samples described above. The *opercula* pieces were found in the units from the operation 1: HTN21_E01_02, HTN21_E01_03 and 03A, and the units of the operation 2: HTN21_02_01AB, and 01C. However, only n=2 samples of the *Neocyclotus dysoni* snail shell were found in the excavations of this group in levels below the floor of patio group HTN19_20C.

![Figure 51. Samples of *opercula* from *Neocyclotus dysoni* snail collected from the excavations in Group HTN19_20 (Photo by Rodrigo Guzman).](image-url)
**Disc of Shell and Obsidian**

A disc of shell and obsidian was found in the northwest corner of the Unit HTN21_E01_03, within level 3 (See Figure 52). This is a disc of shell from an undetermined species carved in a concave shape and designs on the interior. The disc measures approximately 34.5 millimeters of diameter and weighs 7 grams. It has 10 indentations carved along the border. Each of these indentations has a “W” shape and they seem to follow a symmetric pattern. Inside the disc, an apparently symmetrical design was carved. It consists of four lines of three dots making a cross. Within these dots, 4 larger cavities of approximately 5.5 millimeters were carved. In the middle, a fifth cavity was carved, and a fragment of obsidian was inlaid. This last cavity has a small puncture towards the back of the disk. Around the central cavity, a double ring was carved to supplement the design (See Figure 53).

![Figure 52. Photo of Shell disc with an obsidian piece inlaid (Photo by Rodrigo Guzman).](image-url)
It is probable that the disc had a decorative purpose. If that were the case, it would be a rare case where obsidian and shell are combined for decorative purposes, and where the piece of obsidian is modified from its original function. The piece of obsidian was knapped to acquire a circular shape. The piece was modified from a fragment of prismatic blade. The piece could be an earspool or the decoration of a headdress.

Samples of shell discs have been found at the site of Altun Ha and others have been documented from private collections with no provenience. Based on the samples from Altun Ha and in private collections, some archaeologists suggest that these discs allude to royalty because they documented scenes of royal personages with paraphernalia carved into the design (cf. Helmke et al. 2018). Although the disc of Holtun does not have a personage carved, the quadripartite design of the carvings may indicate an association with ritual and status. The carved design resembles the caches carved in the bedrock to represent the four cardinal points.
and the *axis mundi* (Aoyama et al. 2017; Callaghan et al. 2017; Estrada-Belli 2006). In this case, the obsidian piece would represent the center of the universe.

In addition, the design resembles the Maya glyph *Lamat*, which is associated with Venus and the 8th day of the Maya calendar. In Maya iconography, the carving in the disc may also resemble the cross-band of the quadripartite badge portrayed in the headdress by several personages depicted in sculptures and iconography during the Late Classic period (Ingalls 2012; Mathews and Garber 2004). The quadripartite badge is a symbol represented in carved monuments associated with ritual, status, and symbolism of ancient Maya royalty. One of the elements that compose this badge is a dotted cross-band (Ingalls 2012).

**Special Contexts**

Two special contexts stand out from the excavations conducted in Group HTN19_20. The first is a *chultun* with two caches used at the end of their use lives for ritual purposes. The second is an altar that denotes veneration rituals from the time the group was established. The importance of these contexts is that they support a partial ritual function at each compound.

Among the ancient Maya, ritual contexts outside the epicenter of the site can be indicator of localized rituals performed by groups competing with the hegemony of a site (Davis-Salazar 2003; Gonlin and Lohse 2007; Gossen and Leventhal 1993). The evidence of these contexts combined with other symbols of social status (obsidian, shell disc, etc.), and the presence of localized water resources, support the idea that cultural activities performed in this group were a considerable source of social power and status among the inhabitants of Holtun.
The Caches in the ritual Chultun of HTN19_20B

Two caches were found in the bottom of the underground chamber, or chultun, excavated in the north of the plaza of Group HTN19_20B. Before the excavation, it was thought to be a water cistern similar to one found in the plaza of Group F-C. However, it turned out to be a small chultun with two caches, or ritual/dedictatory offerings. The first cache is located right beneath the entrance of the chultun and the second cache is located west of the first one (See Figure 29). Given the location of the entrance of the chultun and the presence of caches, it is possible that its nature was more ritual than utilitarian. It is expected that an underground storage chamber for water catchment would be deeper and more expansive.

The first cache consists of a stepped inverted cone carved approximately 0.60 meters into the bedrock (See Figure 54). It was covered by two sharp edge stones and filled with sandy material. Within the sandy material, five pieces of chert were found (See Figure 47). Because of the quantity of chert pieces, this cache resembles the cruciform caches found in the E-Groups of Ceibal (Aoyama et al 2017), Cival (Estrada-Belli 2006), and Holtun (Callaghan et al. 2017), where the Maya cosmogram is carved in the ground in each cardinal direction including the center or axis mundi and the five directions are marked with jade or polished greenstone. Because chert is an abundant local material widely used in the site, it is possible that it may have replaced the sacred function of jade in this particular case.
The second cache consists of a cavity carved in the bedrock west of the first cache (See Figure 54). This cache was filled with a sandy material and covered by a group of stones. However, no artifacts were found inside the cache. The cache was carved a few centimeters inside the wall of the *chultun*. One piece of bone was inlaid in the wall of the *chultun* above the cache, but it has very poor preservation. It was not possible to remove it or determine the origin of the bone. If both of these caches contained perishable materials, these should be already decayed.

Figure 55. Photo of cache found in the west of the *chultun* excavated as unit HTN21_E01_01 (Photo by Rodrigo Guzman).
The Altar Cult of HTN19_20C

This context consisted of the altar found in the north of the patio of Group HTN19_20C. The altar was discovered through the excavation of the units HTN21_E02_01 and 01AB (See Figure 56). The altar is a piece of limestone of approximately 0.50 x 0.50 meters with rounded edges. The piece is fissured, and some fragments have already broken off. A portion of the altar was set in the floor of stones and compacted soil. The altar faces the north building of the patio and the location has a direct sight to Lake Yaxha. A high concentration of ceramic pieces and chert was found in the north and east of the altar, in the levels lying on top of the compacted soil mixed with stones. Two fragments of censers confirm the use of this context for ritual purposes.

Figure 56. Altar in Group HTN19_20C (Photo by Rodrigo Guzman).

Beneath the altar, and within the compacted layer of soil and stones, a large stone was placed (See Figures 57 and 58). This is a large piece of limestone with sharp edges. It was probably located here to mark the location of the altar as a benchmark. This stone was embedded
in a layer of a mortar mix used, presumably to level the bedrock. Approximately 0.70 meters northwest, a post-hole was carved in the mortar and in the bedrock. This indicates that the cult dedicated to this altar may be as ancient as the first modification of the landscape for the creation of this patio group.

Figure 57. Stone and post hole in the base of excavation HTN21_E01_01 (Photo by Rodrigo Guzman).
Chapter Summary

This chapter presented an analysis of landscape and archaeological settlement for the site of Holtun. In addition, the results from the excavations of Group HTN19_20 were described. The spatial analyses indicate that the community of Holtun adapted to the conditions of the landscape and used these conditions in their favor to locate their settlements. Water resources are important in the distribution of the settlement. Managing these water resources could have played an important role in the development and maintenance of social complexity at Holtun. Archaeological explorations in Group HTN19_20 provide evidence of social power and status.
displayed through material culture and location. The proximity of Group HTN19_20 to water sources indicates that water management was related to social power and status. The difference in cultural practices as well as elements of cultural autonomy suggests that Group HTN19_20 could have been an alternative epicenter of social status and cultural demonstrations in the Late Classic period. Group HTN19_20 complicates our understanding of Holtun because it demonstrates that social power and status related to water management was a complex and diverse dynamic that changed through time.

In the following chapter, Chapter 6, the spatial analyses conducted on the map of Holtun, and the evidence obtained in the excavation of Group HTN19_20 will be discussed in terms of the objectives of this dissertation. The objective of this discussion is to support the argument that water management practices constituted a resource of social power at Holtun. In addition, water management practices in the Late Classic period may have involved traditional practices inherited from the Preclassic period, as well as water management practices introduced by secondary elites. The cultural landscape of Holtun offers a unique perspective to understand the complexity of social dynamics among the ancient Maya. It shows us that while cultural practices and natural resources are similar across the Maya lowlands, how groups manipulate them to gain and maintain social power and status vary through time and from site to site.
CHAPTER 6: DISCUSSION AND CONCLUSIONS

Water management practices implemented at Holtun resemble practices observed at other sites in the central Maya lowlands. This may be the result of similar environments producing similar cultural traits. However, local variations in water management practices at Holtun were also present due to the particular characteristics of the landscape and the social dynamics experienced internally by the community. The availability of freshwater resources supported the development of a large population and a social apogee during the Preclassic period. It also supported the development of social power and secondary elites outside the epicenter of the site during the Late Classic period. Water management practices at Holtun shifted from the Preclassic to the Classic period, transforming the nature of social complexity (social power and status) at the site. The evidence from Holtun supports growing evidence from other Maya sites, like Caracol, Copan, La Corona, Tikal, and others in that ancient Maya water management practices show some similarities but were incredibly diverse. Holtun represents a unique case in the study of how water management contributed to the development and maintenance of structures of power among the Maya.

The case of Holtun indicates that social power and status associated with water management strategies were more diverse and variable than previously thought. In this chapter, I present a discussion about the negotiation of the landscape of water at Holtun based on archaeological research conducted in and around the site. In addition, a discussion about the implications of Group HTN19_20 in the development of social complexity at Holtun is developed. The chapter ends with a reflection about traditional models of water management.
used in Maya archaeology, advocating interpretations based on household-level perspective and considering cultural diversity and human agency.

**Negotiation of Water Resources in the Landscape at Holtun**

The community of Holtun was settled in a strategic position that grants access to natural water resources available on the landscape. This community developed social complexity at some point during the Middle Classic period, ca. 800 BCE (Callaghan et al. 2017). Although the site is small in proportion compared with other central polities like Tikal, Yaxha, and Caracol, it developed important markers of social complexity because of this landscape. Some of these markers are the monumental architecture and plazas created in the civic-ceremonial epicenter of the site described in Chapter 2.

Water sources are not visible at first glance from the epicenter of the site, as it is settled on a landscape of elevations, hills, and slopes. A network of ravines carved by centuries of erosion runs through the landscape descending towards the valley of the basin. These ravines remain dry in most of their courses. Nevertheless, several natural sources of fresh running water and naturally filtered water are available within a perimeter of 3 kilometers of the epicenter of Holtun. Despite the dispersion of water reservoirs on the landscape, the core of the site is settled in the northern hills. This is an area of steep slopes that demarcates a separation between the valley and the zone of hills. According to the dispersion analyses conducted for this dissertation (KD/ANN), most of the household settlements concentrate in this area. The dense settlement is in the north of the central plazas, while the area of freshwater springs remains in the south. The location of the settlement on the highest elevations at the site and away from water resources may be the result of a defensive strategy as well as ideological practices.
Two water features have been identified within the context of the civic-ceremonial epicenter of Holtun. The first is a 1 cubic meter cistern with a drainage located east of the central edge of the plaza F-C, adjacent to the ceremonial E-Group in plaza F-B. This cistern seems to have the capacity to catch water from the rain runoff in the plazas. However, the dimensions of the cistern are too modest to supply a large population. Due to the location, the function may be ceremonial and for the use of a small elite group. The second feature is the seasonal water spring referred today as La Pepitoria, located west of groups B and C. South of the spring, a contention platform was created with a chultun in the northeast. This spring is partially centralized due to the proximity to the monumental groups of the northern section of the epicenter of the site. However, the buffer zone analyses conducted for this dissertation indicates that the settlement of Holtun is not always close enough in proximity to the water springs and water pools to potentially claim land appropriation and water control during the Preclassic and Classic periods.

The water resources available in the perimeter of Holtun may have supplied the population that experienced a cultural apogee during the Preclassic period. At least 3 freshwater springs are located within the range of 1 to 3 kilometers: El Duende, La Rejoya, and El Manantial. Water springs are not a common source of water procurement among the ancient Maya, because they were considered sacred places often used for ritual pilgrimage (e.g., Ashmore and Brady 1999; Halperin et al. 2003; Moyes and Brady 2012). Although there are not formal caves associated with water springs at Holtun, two of the springs, El Duende and El Manantial, flow from cracks in the limestone which could be considered as small caves. Least Cost Path analysis routes indicate that the least energy demanding routes from the core of the site
to these 3 water springs have remained relatively open, with minimal or no settlement located over the course of the route.

In addition, at least 3 areas of still-water pools are within the course of the ravines in the east and south of the landscape. The water pools are supplied by water from the springs and meteoric water filtered through the sediments of the ravines. The filtration of water through the sediments of the ravines can be observed in the cistern of *El Arroyo* carved in the sediments of the low course of one of the ravines. This suggests that carving a temporary cistern or well may have been an option for water procurement. In addition, the availability of *chultunes* around the landscape presents the possibility to store water collected in the springs, ravines, or from rainfall. The Least Cost Path route from the core of the site to *El Duende* reaches a point near the pools of *Los Jutes*, suggesting that these may be resources accessed from this route.

A series of at least two *aguadas* were identified 1.3 kilometers east from the epicenter of the site. These are monumental *aguadas* of approximately 8,000 square meters located in an upland within a cluster of patio groups. However, based on archaeological excavations in one of the closest groups, this settlement is associated with the Late Classic period. These groups are contemporary with the period of repopulation of Holtun observed in archaeological contexts in the epicenter of the site (Callaghan et al. 2017) and the dense settlement of households north of the epicenter (Crawford 2017). This new community may have initiated new social dynamics and water management strategies according to the cultural practices implemented by the ancient Maya of that period. One of the strategies is the centralization of water reservoirs, as seen in the case of Tikal (Scarborough 1998). Another water management strategy is the use of water
reservoirs as a node/neighborhood community-based resource, as seen in the case of Caracol and Copan (Chase A.S.Z. 2019; Davis-Salazar 2003).

A buffer zone analysis conducted in the cluster of households around the eastern reservoirs of Holtun indicates a high density of settlements in the vicinity of aguadas 1 and 2. This would allow occupants of these patio groups to gain control over the territory and the access to the eastern aguadas, especially Group HTN19_20, which stands in the south of these reservoirs. However, the geographical control of water resources is only focused in the eastern aguadas. Other water resources remain open and were potentially supplying the rest of the community, including the community of HTN19_20 as well.

It is important to mention that the site of Holtun did not have a continuous population throughout the history of its pre-Columbian occupation. The site of Holtun may have experienced abandonment and a possible collapse at the end of the Late Preclassic period. This abandonment coincides with a cycle of droughts experienced all across the central Maya lowlands, where other sites also experienced abandonment (Ebert et al. 2017). Holtun maintained a small population during the Early Classic period, but it was not until the Late Classic period that signs of social complexity start to manifest again (Callaghan et al. 2017, Fialko 2011). Therefore, the settlement around the aguadas constitutes a water management practice of the Late Classic period. Although these aguadas could have been exploited during the Preclassic period, it was not until the Late Classic they were included within a compound of the settlement.

A general overview of the settlement of Holtun indicates the spatial relationship of the Late Classic community with their water resources. A pattern of separation and demarcation can be observed in the water sources. Some of these practices may have started during the Preclassic
period, but were intensified and modified by the practices of the Late Classic groups. A salient characteristic of the settlement is the concentration of the resources of permanent availability of water in the south of the landscape. While these resources remain in the south, density of households is highest in the north of the central plazas and Group HTN19_20. This pattern is also observed in Group HTN19_02, which is group of multiple patios east of Group HTN19_20.

This pattern could represent a demarcation of the landscape created with groups with ritual and social status connotations. It is noticeable that the area with most density of settlement is located north of the plazas of the compound F (the location of the E-Group). The neighborhoods of the northeast settlement are also concentrated towards the north of the groups previously mentioned. The purpose of Group HTN19_20 could have been mixed between residential and ceremonial. Artifacts and architecture found in excavations indicate the occupants of the group may have been of high status. The status of the group is consistent with its privileged location near water resources, as described below.

The Status of Group HTN19_20

The status of Group HTN19_20 can be inferred by its location and the materials remains found in the excavations. The location of this settlement constitutes a position almost as privileged as the plazas of the epicenter of the site. This is a group in an elevated position with immediate access to at least two aguadas and the system of ravines with the freshwater resources. In the west, it has the head of the ravine El Arroyo. In the east, it tops the ravine that descends from El Duende. In the south, it has the topographic ridge that connects El Duende with the epicenter of Holtun. In addition, the area of still-water pools of El Jute is in a ravine adjacent to this topographic ridge. All these water resources are within a perimeter of 800 meters from the
center of the group. In addition, the spring of *El Duende* is 1.3 kilometers southeast of HTN19_20.

A slope analysis of the terrain indicates that the area occupied by HTN19_20 and its neighborhood is not as steep as the area occupied by the epicenter of the site. These patio groups are located on small hills across the landscape. The density of the settlement observed in the cluster analysis conducted (ANN/KD) suggests that the terrain was convenient for the settlement. Observing the density within a buffer zone of 300 meters of the eastern reservoirs indicates that it may be one of the motivations to settle these patio groups in this location. Group HTN19_20 delimits this neighborhood of groups in the south. A distance of almost 800 meters separates the ridge that connects the epicenter of the site with *El Duende* spring. The Least Cost Path route created during the analysis of the terrain runs over that ridge. Therefore, it is possible that Group HTN19_20 had the function of delimiting household settlement, as the central plazas do in the core of the site.

Group HTN19_20 is a compound that denotes economic and social status due to the physical characteristics and the materials found within the archaeological contexts. The central plaza of the compound measures approximately 30.00 x 15 meters, which is almost 30% of the size of plaza F-B (the location of the E-Group, the first monumental and ceremonial structure at the site). The composition of Group HTN19_20 is denser and with more area of construction than other compounds in the east settlement. The near 482 square meters of buildings makes this group one of the larger compounds of the east settlement. In addition, although the group is located in a small plateau, it has an orientation with a drastic decline of between 30-40 degrees towards the west. This declination denotes a lack of identification with the solstice orientation of
the plazas in the civic-ceremonial epicenter of the site, suggesting a lack of similar ceremonial and political alignment between the groups, as observed by Ashmore (1986) in her studies of household settlement identities within the ancient Maya.

Status markers in the compound include pieces of obsidian and the disc of shell and obsidian. The pieces of obsidian are exotic goods obtained from a transaction that involved a long-distance trade. In addition, the value of the disc of shell included the importation from two different long-distance resources plus the intervention of a specialist for the manufacture who was fluent in the esoteric knowledge of Maya cosmology. The use of a quadripartite cosmogram may indicate a deep level of identification of the crafter with ritualism and power, and authority, as seen in the design of glyphs, deities in Maya art, offerings, and the display of Maya settlement (Ingalls 2012; Mathews and Garber 2004). A similar status artifact has not yet been recovered at the site of Holtun, although the cosmogram symbolism is present in a cache between the first monumental and ritual structure in the epicenter of the site, the E-Group (Callaghan et al. 2017).

The symbolic status of this group is evidenced by the presence of an altar and caches inside a *chultun* in the edge of the central plaza of the group. An altar for public veneration is located at Holtun in the open plaza of Group B. Similar altars are observed in elite households of Group A and Group I. However, the altar of Group HTN19_20 presents a different pattern. This is not located in the middle of a patio but in front of a structure. The alignment towards Lake Yaxha may indicate a cult associated with the landscape and the environment. The presence of fragments of utilitarian ceramics and pieces of censer may indicate the practice of local rituals of veneration. The presence of an altar may indicate a level of autonomy from the ceremonies performed in the epicenter of the site.
The caches in the chultun in the edge of the plaza may also indicate rituals of veneration and connection with nature. The presence of fragments of chert within one of the caches could be indicative of the attachment of the occupants of the group with their land, as chert was a local resource and a chert outcrop identified during pedestrian survey was located in the north of this group. The presence of 5 fragments of chert may be also associated with the perception of the universe, using one piece as a center and the rest as the quadripartite design of the cosmos, as seen in the foundational offering at Holtun and other sites like Ceibal and Cival (Aoyama et al. 2017; Estrada-Belli 2016), again representing the sacred cosmogram of the Maya universe and similar to the cache beneath the E-Group.

Group HTN19_20 manifests social status in the materials and symbols contained in the archaeological contexts. In addition, the proximity to water resources, especially the *aguadas* indicates a privilege in a landscape where water is not directly accessible. The presence of a group of this nature outside of the epicenter indicates that dynamics of social power and status experienced by the community of Holtun during the Late Classic period were complex and diverse. However, it also raises a question about the relationship of this group with the epicenter of the site. Was this an outpost of the central elites or the epicenter of a small faction within the landscape? This question is discussed in the following sections.

**Water Management at Holtun: Two Possible Strategies**

The combination of water resources at Holtun offers at least two complementary, yet alternative strategies of water management. The first strategy relies on the water springs and still-water pools that are naturally supplied resources. The only apparent water management strategy is the lack of intervention and isolation from the rest of the settlement, as observed in the
buffer zone analysis. In other words, these natural water features rarely have settlement nearby. Use of water cisterns, *aguadas*, and springs constitute the second strategy, along with the *chultunes* located within the cultural settlement at Holtun. These features required multiple levels of human intervention, from maintenance to supplying water manually (e.g., the cistern in plaza). Although the *aguadas* from group HTN19_20 have the capacity to catch water from the adjacent slopes, their use and sustainability could have required some type of human intervention. Water from the *aguadas* may not have been enough during the dry season and needed to be maintained to produce more products like mollusks, crustaceans, and fish. Therefore, it is possible that the neighborhood of HTN19_20 participated in the strategy of water management of the springs, pools, and ravines.

The settlement distribution of Holtun suggests a deliberate separation of the naturally supplied water resources from residential areas. The locations of the plaza groups in the epicenter of the site as well as Group HTN19_20 demarcate a separation between the majority of the settlement and the area of the springs. This may also be the case for the neighborhood of patio groups east of HTN19_20 and north of *El Duende* spring, which remains unexcavated. Of these patio groups, Group HTN19_02 is the most monumental and comprises the largest of the settlement in the east of this area of the site. Only a small patio group is on a hill south of that group. These small patio groups could have served as a control point for the demarcation of water resources and the rest of the settlement. The central plazas in the epicenter of the site, Group HTN19_20, and Group HTN19_02 may have represented a symbolic boundary in the south between the freshwater resources and the rest of the settlement.
Water management practices at Holtun also changed from the Preclassic to the Classic period. My research suggests that water management practices during the Preclassic relied more on harvesting water from the springs and still-water pools. The lack of human intervention in this type of natural water resource is consistent with the sacred meaning allocated to water in Mesoamerica. The fact that at least two of these springs flow from small caves adds on to the symbolism of the locations. Caves are important elements in the landscape to venerate the origins and cycle of life (Brady and Prufer 2005). The importance of the symbolism of caves is confirmed by a Late Classic offering in the east building of plaza F-B, or E-Group. It consists of a speleothem, an elongated piece of minerals created from fluid depositions in a cave of an unknown location (Callaghan 2017). This ritual may indicate the symbolism of caves and the association of these locations with water as an essential but a vulnerable source for life (Moyes et al. 2009). The symbolism of caves and water was reified by the elites of Holtun through the deposition of the speleothem in one of the most important buildings of the site. This may have contributed to strengthening the sociocultural identity of the community of Holtun and emphasized the perception of the symbolic Maya cosmos.

Nevertheless, during the Late Classic period, the new group of settlement concentrated around the eastern aguadas emerged 1.3 kilometers east of the epicenter of the site. Enclosing aguadas within the settlement is a traditional strategy of water management among the ancient Maya to exploit all the potential resources from the natural reservoirs. The aguadas are not just a resource of water, they provide a harvest of local species and can be utilized for ritual purposes (Davis-Salazar 2003). The density analysis of the site indicates that this neighborhood is a secondary cluster of patio-groups. It is not as dense as the neighborhood north of the central
plazas, but it is clustered enough to suggest a nucleated pattern. The organization around the 

aguadas may have granted some level of autonomy and power to these groups.

The addition of new groups to the landscape during the Late Classic period added complexity to the strategies of water management at Holtun. According to the model of water management proposed by Scarborough (1998), Preclassic and Classic communities shifted water management strategies as the result of changes in their political dynamics and the interaction of the elite groups with the environment. Preclassic communities tend to take advantage of the concavity of the landscape. In other words, water that was naturally collected in areas of catchment like springs, rivers, lakes, aguadas, bajos, etc. was exploited passively. On the other hand, Classic communities tend to take advantage of a convex landscape. In other worlds, the water reservoirs or aguadas and artificial reservoirs are located in uplands and these areas are controlled by the community elites. Water tends to be managed in a more active way, with human intervention and maintenance.

The case of Holtun indicates that water management strategies using the “concavity” (water flowing down the landscape) and “convexity” (water resources in the uplands) of the landscape were exploited equally during the Preclassic and Classic period, but in changing ways. The combination of these two strategies allowed the elites of the epicenter of the site to compensate for monumental reservoirs within the area of the central plazas that are present at other large sites like Tikal (Scarborough 1993; 1998). At the same time, it allowed the small segment of the community around the aguadas to compete for resources of the landscape and achieve social power and prestige.
Group HTN20: A Faction or an Outpost of the Central Elites

The evidence presented in this dissertation suggests that Group HTN19_20 transformed social complexity in the community of Holtun, adding elements of social power and status to the landscape of Holtun outside of the epicenter of the site. Group HTN19_20 secured the management of at least one of the aguadas during the Late Classic period. This may have contributed to the enhancement of social power and status of this group, far from the epicenter of the site. It is not possible to determine with certainty yet if Group HTN19_20 was an outpost from the central elites located in the epicenter or a small emerging faction in the community. Nevertheless, the social complexity added by this group indicates that water management strategies may not have been as homogenous as once thought. In addition, the nature of Group HTN19_20 within the landscape of Holtun could point out that complex social dynamics that were variable than previously conceived, in that factionalism and heterarchy may have been present at the site in the Late Classic period.

The site of Holtun includes water management practices observed individually in other sites of the central Maya lowlands. However, the outcomes of these practices diverge from what is predicted by traditional models. First, Holtun, as a medium-sized site, depended more on freshwater springs in larger than the commonly observed at other sites in the central Maya lowlands. In addition, the use of water reservoirs in the Late Classic is a practice that only happened outside the epicenter of the site, whereas at other sites they were often centralized to facilitate control. Masson (2002) and others (e.g., Jackson 2003; Canuto and Fash 2004) have argued that secondary elites were also responsible for the maintenance and development of social complexity in sites of the Maya lowlands. However, the role of water management in the
development and maintenance of social status for secondary elites and commoners is still growing area of research interest (Davis-Salazar 2003; Chase A.S.Z. 2019; Wyatt 2014) and needs further documentation to understand its full variability and nature. In the case of Holtun, the development of a possible political faction outside of the epicenter to manage and maintain water systems when no centralized force existed before is unique.

The case of water management in Holtun may contribute to address and reformulate the interpretations of water management associated with the origins of complex societies in the central Maya lowlands. In ancient Maya archaeological literature, two socioeconomic dynamics are commonly associated to the implementation of water management practices. The first is political centralization (e.g., Scarborough 1998; Lucero 1999) and the second is the community cooperation (e.g., Davis-2003; Scarborough and Lucero 2010; Wyatt 2014). The models of water management for political centralization are commonly modifications, reinterpretations, and adaptations of the traditional models of Oriental Despotism (Wittfogel 1957) and the Urban Revolution (Childe 1950). For their part, models of water management that resulted from social cooperation are traditionally inspired by models from Southeast Asia. One model used is the Balinese system of cooperation for water management implemented outside of the state power (Lasing 2007[1991]). It has inspired models to address water management cases in the ancient Maya area due to similarities in the landscape and the importance that this civilization put into community and community cohesion (e.g., Coe 1957; Kunen 2006; Scarborough 1998; Scarborough and Burnside 2010).

These models of centralized vs. cooperative water management are consistent with the dual-processual models proposed for the development of social complexity in Mesoamerica
(Blanton et al. 1996; Feinman 1995; 2001). In these models, social power can be network-based or corporate. In the former, social power and authority relies on a centralized entity or individual. In the second, groups or agents of the community share the power temporary or permanently (Blanton et al. 1996).

These patterns of centralized versus cooperative dynamics could be applied to the water management strategies of Holtun and can be used to understand the nature of Group HTN19_20. If Group HTN19_20 was an outpost of the epicenter, social status of occupants depended upon the authority granted by the central elites. If this group was a faction, it may have developed its own source of social power to maintain the status within the settlement. However, the case of HTN19_20 may indicate that social dynamics among the Maya were complex, diverse, and variable, and may differ from the large-scale models.

Group HTN19_20 is close enough to interact with the sociocultural dynamics of the whole site and yet it could have developed its own dynamics of power within its own neighborhood. Therefore, network/centralized-based and corporate/cooperative-based models have the potential to operate simultaneously and organically according to the situation. This can be observed in the combination of rituals of water veneration, which may have attracted social cohesion and cooperation on a small scale. However, it may also represent a source of stratified authority by the administration of a privileged portion of the landscape. The group has a large patio or plaza that suggests potential for the congregation of a large number of people. However, the altar, which is one of the most ritually important elements of the group, shows signs of some religious autonomy from the epicenter of the site is located in a more restricted space. This may be indicative of dissociation between spaces to make the altar patio a sacred and private space.
with privileged access. These types of small characteristics define the agency and cultural particularities of the community at Holtun and the ancient Maya in general, with divisive and cohesive forces at work simultaneously.

The outcomes of ancient Maya social organization have been commonly analyzed in a large scale and compared with civilizations with similar environmental conditions. Archaeological research conducted in Southeast Asia has been highly illustrative to understand the development of complexity in the Maya lowlands due to the similarities in the topography, environment, and water availability (e.g., Coe 1961). In addition, outcomes are comparable because both regions developed monumental cities, complex dynasties, and a deep symbolism in these ecologically hostile regions (cf. Chase and Chase 1996; Demarest 1994; Fox et al. 1996; Kunen 2006 among others).

However, similar environments and similar processes do not necessarily produce similar outcomes. In this case, cultural diversity and human agency play a significant role in the development and maintenance of social complexity among communities. The study of development of social complexity as result of the implementation of water management practices has been addressed and criticized by Horower (2016). In his analysis, he compares the colonization of two deserted locations: the Arabian Peninsula and the west of the United States of America. The American case is well documented and romanticized while the Arabian case is less documented and stigmatized because of the violent history of the Middle East. The objective of that analysis is to demonstrate that similarities in environments and processes do not always result in similar outcomes. The romanticization and/or stigmatization of a region, culture, or community plays a detrimental role in the interpretation of a cultural process. Early studies may
have romanticized water management in complex societies, affording a great deal of control to centralized elites and assuming monumental strategies. The case of Holtun adds to the growing studies looking at the complex and messy nature of understanding how water management practices changed through time, and how power strategies associated with water may not have always favored centralized elites.

The study of Holtun offers a case of water management practices implemented during the Preclassic period that shifted through the Classic period. Water management strategies adapted to the availability of water that is characteristic of the region. However, occupants implemented strategies to exploit particular characteristics of the landscape, especially water. In addition, adapting the settlement to the landscape responded to political dynamics of the community. Holtun is a relatively small site with monumental markers of social complexity. This allows us to analyze social complexity from the perspective of the patio groups associated geographically but distant enough to question the nature of sociocultural relationships within the settlement.

Group HTN19_20 shared cultural values and cultural traits with the rest of the settlement at Holtun, and probably with other communities within the central Maya lowlands. However, it also has its own particularities such as the use of a local altar cult and the unique orientation of the group. The group could have been an outpost or the epicenter of a faction, or both at the same time. The most important contribution of the study of this group is that social complexity not just develop, but transforms, and can happen on different scales. In addition, dynamics of social complexity such as social power and status are relative to each community. Static binary/dual models can contribute to the analysis of the big picture of the civilization but also can fail to explain the particularities of each community. Analogies with other latitudes may contribute to
narrow down the interpretations of a case study. However, these analogies should be scrutinized when addressing the cultural diversity and human agency of each location.

**Conclusion: Holtun, a Landscape of Hidden Water**

The community of Holtun took advantage of the conditions of the landscape during the period of settlement and occupation of the site. The settlement in the uplands in a landscape of tropical karstic hills was convenient to take advantage of a network of ravines that contain water springs and filter spring and meteoric water down the valley through their sediments. In addition, some water reservoirs in the uplands were also utilized by the community. The availability of water in the landscape may have contributed to support to support the populations in the cultural apogee during the Preclassic period, and during the repopulation of the site during the Late Classic period.

The nature of water resources at Holtun could have played an important role in the development of social complexity. The distribution of the settlement indicates that water resources were taken into consideration. The symbolism found in features associated with water in the core of the site suggests that the symbolism of water was an important value in the local culture. The small cistern and a speleothem deposited in one of the most important buildings may be indicators of ritual activities associated with water. This could be associated with the nature of two water springs at Holtun that flow from cracks in the limestone.

The distribution of the settlement around the eastern water reservoirs is a marker of a transition in the strategies of water management, as well as the dynamics of social complexity. Group HTN19_20 and their neighboring groups had privileged access and probably territorial domain over these resources. The location, orientation, dimensions, and material culture of
HTN19_20 suggests that sociocultural and economic activities performed here enjoyed privilege and status, adding more complexity to the social dynamics of Holtun.

Assessing the status of Group HTN19_20 was instrumental to understanding the sociocultural dynamics around water management at Holtun. This group is part of a cluster of settlement that reclaimed control over the eastern *aguadas* by physical allocation in the land. This is a settlement pattern not observed at the epicenter of the site, where water procurement relies more on freshwater resources. The epicenter of the site was settled at some point during the Middle Preclassic period and Group HTN19_20 dates to the Late Classic period. That chronology indicates that control by allocation in the *aguadas* was a practice initiated during the Classic period outside of the epicenter.

Symbols of social power and status at HTN19_20 include exotic goods and ritual contexts. The exotic goods consist of obsidian fragments and a disc of shell with inlaid obsidian in the form of the sacred conception of the Maya universe. The acquisition of these artifacts is the result of a long-distance trade, and the symbolism of the disc indicates social status. The ritual contexts include an altar facing Lake Yaxha in the southern patio and a *chultun* with caches with cosmological significance on the edge of the central plaza of HTN19_20. The altar was presumably used for the performance of local rituals. This granted some restriction of access from the more public ceremonies performed in the central plazas of the group. The caches in the *chultun* indicate rituals of attachment with the land and the extensive availability of chert in the area. The quincunx pattern mimics larger caches that are often present in site epicenters (Aoyama et al. 2017; Estrada-Belli 2006), including the epicenter of Holtun (Callaghan et al.)
2017) and while this implies a connection with a similar ideology, it is also a usurpation of a powerful imagery.

The status of HTN19_20 indicates that a group directly associated to a water resource held some level of social power and ritual independence. This information raises the question about the nature of the group among the sociocultural and economic dynamics of Holtun. This group had the potential to be an outpost from the epicenter of the site that grants control over the landscape and the water resources. However, it may be also the epicenter of a small social faction or a secondary elite within the community of Holtun. Addressing this question requires further research and exploration. However, the organization and nature of this group at Holtun indicates that water management practices were more complex than previously expected.

Water management practices at Holtun were not homogeneous and static. Water management practices transformed from the Preclassic period through the Classic period. The Preclassic community of Holtun relied on freshwater resources and meteoric water, and probably they exploited the *aguadas* for water and products. A small portion of the Late Classic community of Holtun claimed the territory of the *aguadas*. Simultaneously, freshwater resources remain territorially unclaimed and geographically interconnected to the epicenter of the site. Although freshwater resources are distant and not directly associated from the epicenter, the natural paths towards these resources have minimum settlement. This indicates that water management practices were not uniform and homogenous, and multiple strategies could have been implemented at the same time by different segments of society.
Limitations and Future Directions

The dissertation research was conducted during the world pandemic caused by the Covid-19 virus. This directly and indirectly affected the development of the project and the subsequent activities. A travel ban prevented one of the field seasons in 2020 from taking place. Airports and borders were closed in Guatemala and the University of Central Florida banned research travel to protect the community. It caused a loss of funding for that research season due to time restriction to like execute the funding. In addition, the health hazards caused delays in administrative activities funding authorizations and excavation permits with local and international authorities.

Most of the research expectations were condensed in the seasons of 2019 and 2021. Fortunately, the site of Holtun has a complete corpus of research reports and paper presentations that supplemented the analysis conducted for this dissertation. Nevertheless, the excavations conducted in Group HTN19_20 had to be conducted in a limited amount of time. In addition, some of the excavations planned in one of the water springs were cancelled due to a land dispute over the area.

Future directions of this research include continuing exploring the eastern settlement of Holtun and the water reservoirs, which will contribute to support and improve the arguments presented in this dissertation. Archaeometric analysis on archaeological materials, such as X-ray Fluorescence, will provide information about the provenance and source of the artifacts and will contribute to the understanding of the dynamics of exchange and resources exploitation practiced in the east of Holtun. In addition, it will be necessary to promote monitoring the conservation of the cultural landscape and the involvement of the community. Land surveying with advanced
technology such as Light Detection and Ranging (LiDAR) aerial scanning would be instrumental to document the landscape of Holtun without interfering with the activities of landowners.

The outcome of this dissertation opens a venue for research of areas traditionally less explored in Maya archaeology. More research is necessary to understand the variability in water management practices among the Maya. A comparative analysis with same scale sites or small sections of large sites may illustrate similarities and differences in water management strategies to understand the process of developing and maintaining social complexity. The collaboration of modern experiences in the same landscape is a methodological approach to understand the potential and vulnerability of water systems. The study of water management at Holtun is still in its initial phases in comparison with other studies of water management in the Maya area. However, this study represents an opportunity to rely less on the cultural universalization, orientalization, and the romanticization of exotic forest civilization resulting when addressing water management from a comparative approach. It may encourage researchers to give credit to the complexity of an ancient civilization that expressed its own culture with impetus and ingenuity.

**Significance of the Outcomes**

Water availability and water management at Holtun were determining factors in the process of developing and maintaining social complexity, which resulted in the configuration of the settlement. Water springs and caves are fundamental symbols in Mesoamerican ideology due to its association with the origins of life (Moyes and Brady 2012), but their use for human subsistence has been less explored. In the central Maya lowlands, the ancient Maya communities preferred locations adjacent to larger bodies of water such as lakes and natural *aguadas*, and
practiced the harvesting of rainwater (Scarborough 1998; Scarborough and Galopin 1991). For that reason, the use of a system of karstic ravines as a source of water constitutes a novel research venue. In addition, the use of *aguadas* outside of the epicenter of the site suggests the availability of an alternative source of water procurement. The availability of water in several points of the site may have sustained the growing of population. At the same time, it could have made it difficult to centralize the process of water procurement. This is significant in the study, because it demonstrates how some water features played a crucial role in the development of social complexity at Holtun. Finally, it demonstrates that establishing social power and status through water could be a heterogeneous process that requires a local approach according to the local characteristics of the landscape and the solutions implemented in each site.

In Maya archaeology, studies of water management have explored sites associated with large-scale water features and complex management systems (e.g., case studies in Lucero and Fash 2002). The general topics addressed by these studies are: 1. Landscape adaptation and environmental vulnerability (e.g., Brenner et al.2002; Scarborough et al. 2012), 2. Social power acquired as result of water management strategies (e.g., Lucero 2006; Scarborough 1992), and 3. Water in the conception of the Maya cosmos (e.g., Ashmore 2015; Brady and Ashmore 1999). In addition, the characteristics of social complexity associated with water management has turned into dual-processual models: water management for the control and centralization of the society (e.g., Scarborough 1998; Lucero 1999), and water management for the development of cooperative endeavors (e.g., Davis-2003; Scarborough and Lucero 2010; Wyatt 2014).

This dissertation supplements these models of water management by presenting a case of social complexity achieved, transformed, and maintained in a modest-size community. The
community of Holtun had the availability to access water from freshwater resources across the landscape and some segments of the society were able to develop decentralized water management strategies outside of the epicenter of the site. In addition, this project documented the environmental capabilities and vulnerabilities of the landscape regarding water accessibility. Therefore, from the perspective of a small and focused perspective it is possible to infer that water management practices in the central Maya lowlands were complex, heterogeneous, and dynamic.

The results from this study provide support for interpretations about the value allocated to land and water resources according to the physical and symbolic properties of water. The involvement of water in the development and maintenance of social complexity at Holtun has the potential to support theoretical models that seek to understand the ideological connotations of water in the process of gaining social power and status, which was fundamental in ancient Maya social organization (i.e. Ashmore 2015; Lucero and Kinkella 2014). This project illustrates the relationship of a community with the local environment through the analysis of the settlement and the dynamics of social power and status experienced there. Holtun presents a particular case of centralization of water resources outside the epicenter during the Late Classic period without a previous centralization during the Preclassic. It has not yet been documented as a form of heterogeneity of water management practices in the Maya area.

The information compiled in this dissertation has the potential to demonstrate the connection between ancient and modern landscapes. As the landscape sustained water to the ancient community of Holtun, it also has sustained the modern community of La Máquina. Sharing water management strategies and challenges of the ancient Maya contribute to break
down the romanticized perceptions about the ancient Maya in the popular media. Linking the history of La Máquina with the history of a world recognized civilization promotes engagement of the community with the conservation of their cultural heritage. This connection between the ancient and modern shows how archaeology can transcend time to justify the need to investigate, conserve, and disseminate archaeological knowledge.
APPENDIX A:
COPYRIGHT PERMISSION LETTER
April 15, 2022

To Whom It May Concern:

Melvin Rodrigo Guzman Piedrasanta has the permission of the Holtun Archaeological Project to use all data, images, and copyrighted material presented in this dissertation presented for the fulfillment of the degree of Doctor of Philosophy in Integrative Anthropological Sciences at University of Central Florida.

Sincerely,

[Signature]

Brigitte Kovacevich, PhD
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