Fluid Metaphors: Exploring the Management, meaning and perception of Fresh water in Minoan Crete

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Laura Houseman

School of Arts, Languages and Cultures
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**Abbreviations**

EM: Early Minoan  
MM: Middle Minoan  
LM: Late Minoan  
LC: Late Cycladic  
LH: Late Helladic

**Aegean Bronze Age Chronology**

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*Approximate absolute chronology, based on Manning (2010a: 23, table 2.2)*

**Palatial Terminology**

Prepalatial: EM I-MM IA  
Protopalatial (1st Palace period): MM IB-MM III A  
Neopalatial (2nd Palace period): MM III B-LM IB  
Final Palatial: LM II-LM III B  
Postpalatial: LM III C
Abstract

This thesis explores the role of fresh water in Bronze Age Crete. It presents a catalogue of Minoan water management systems, and investigates the ways in which these systems were incorporated into broader social, political, economic, religious and cultural processes and practices. While the primary focus of this thesis revolves around the data collected on water management systems, it also explores the place of fresh water in Minoan art, iconography, and ritual action. While water is a fundamental resource, and the provision of fresh water on Crete is affected by special geological, geographic, and climatological issues, this has been a largely neglected area in the literature on Minoan archaeology. The thesis seeks to redress this neglect, and argues that the evidence reveals a culture that was deeply concerned with fresh water, developing technologically sophisticated solutions, and devoting considerable economic resources, and political and religious attention to it.

One of the key claims of this thesis is that fresh water was a meaningful and valued commodity in Bronze Age Crete, and certain sources of water were particularly revered. This status was exploited by elite groups, who invested in often monumental and highly visible systems for collecting and storing fresh water, in order to assert and reaffirm their special status. Fresh water was also incorporated into ritual practice, and – through its innate capacity to act as a conduit for complex meanings and metaphors – participated in the construction of Minoan religious and cultural beliefs. This thesis also draws out the ways in which water’s religious meaningfulness was incorporated into elite strategies of social control and the construction of an ideology of difference.
Declaration

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Acknowledgements and Dedication

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Finally, I would like to dedicate this thesis to my late father, Ray.
Introduction

1. Context and justification

In recent years there has been a body of work completed by historians and water and environmental engineers concerning the historic and pre-historic water management systems and techniques: some notable examples are *Elixir: A History of Water and Humankind* (Fagan, 2011) and *Evolution of Water Supply through the Millennia* (Angelakis, Mays, et al., 2012).¹ One of the primary objectives of these literatures has been to explore historical and indigenous water management systems and technologies that might inform modern approaches to the problems of water management in light of competing environmental, economic and social pressures. This research has highlighted, amongst other things, the number and the often surprising sophistication of many Minoan water management systems and techniques, which have been largely overlooked by scholars of Minoan archaeology. While this predominantly technical literature² has made some steps towards considering water management in a fuller historical and social context, the objectives and often technical emphasis of this literature means that it does not entirely engage with contemporary debates and methodological principles of Minoan archaeology today. This thesis seeks to examine the evidence for Minoan water management systems from the latter perspective, drawing on a long history of debates and discovery in Minoan archaeology, and situating water management techniques and technologies in a broader context of the Minoan geology, climate, and culture (including political, social, religious and artistic aspects). In seeking to contribute to an understanding of the importance of fresh water management on Minoan Crete, and its interactions with other arenas of Minoan society, this thesis aims to cover some neglected aspects of Minoan archaeology – especially the relation between water management and political power – that is well documented in other societies, such as the Mayan and Balinese cultures.

¹ *Elixir* presents a more global overview spanning many different time periods, whereas *Evolution of Water Supply* focuses mainly on the Mediterranean.

² *Evolution of Water Supply through the Millennia* draws upon a large number of academic backgrounds, including civil and environmental engineering, water science, biology and geosciences.
1.1 Fresh water: a neglected area of research

In Minoan archaeology there is a lacuna in our understanding of how the Minoans interacted with, and gave meaning to, fresh water, and yet, this is not the case in many other aspects of the Minoan natural world. Ever since Arthur Evans championed the Minoans as a people who revered and worshiped the natural world at the beginning of the twentieth century, scholars, by analysing archaeological evidence from frescoes, material remains and floral and faunal data, have investigated how the Minoans interacted with their natural world. They have considered how plants were used, portrayed and given meaning (for example Day, 2007, 2011; Sarpaki, 2000; Shaw, 1993); what their relationship to animals was like (for example Shapland, 2009a, 2009b); what ‘landscape’ and environment meant to them (for example Chapin, 2004; Moody, 2009); and what role the natural world played in Minoan religion (for example Herva, 2006a; Jones, 1999; Marinatos, 1993; Peatfield, 1987; Soetens, 2009; Peatfield and Morris, 2012; Soetens et al., 2003; Tyree, 2006).

One large area of scholarship regarding the Minoan relationship and interaction with their environment is the study of their connection with the sea and marine life. As an island culture, and one that has been considered to be a Thalassocracy (Hägg and Marinatos, 1983), scholars have argued that the Minoans had an intimate relationship with the sea. While the sea itself is rarely depicted in Minoan art, marine animals, vegetation and ships – all used to signify the sea – are common motifs in the Minoan artistic repertoire and have been studied in some detail (see for example, Saunders, 2008). The most studied aspect of this representation of the sea and sea-life is the LM IB ‘Marine Style’ ceramic tradition, which depicts numerous sea creatures and vegetation, including octopi, argonauts, tritons, rockwork and sea urchins (Berg, 2011: 123-124; Betancourt, 1977; Mountjoy, 1984). Some authors have argued for a strong link between Marine style wares and ritual beliefs and practices, with Mountjoy demonstrating a possible connection between marine motifs and Minoan cultic buildings (1985: 240). However, marine images from other media in a variety of different contexts – including domestic and funerary – suggests that marine motifs had a variety of functions and specific meanings with a long history (Berg, 2011: 132). The lack of lack of seafood in the Minoan diet might also suggest certain taboos surrounding the sea and sea creatures (Berg, 2011: 133).

What this very brief review illustrates is that a great deal of scholarly attention has been paid to Minoan attitudes and engagements with their natural environment – particularly with the sea – and what specific elements or places within that environment
may have meant to the Minoan culture, and yet there is little or no study on the meaning of the island’s most vital resource – fresh water. It must be noted here that Evans often gives detailed accounts of the Palace of Knossos’ water management systems, particularly the expansive drainage systems. These vast and often complex systems resonated with his vision and desire for the Minoans to be a thoroughly ‘modern civilisation’, often surpassing the achievements of some contemporary modern cultures (Hamilakis, 2002: 2-3, 5-7). He often refers to the Minoans’ “scientific methods of sanitation” (Evans, 1921: 230) and states that “...everything connected with the flow of water had been practically considered ... and abstruse hydrostatic problems empirically solved” (Evans, 1928b: 462). These systems are considered in a functional and pragmatic way, as sophisticated answers to the problems of sewerage, sanitation and drainage. Only at one point, when discussing the jet d'eau fresco fragment (Evans, 1928b: 462), does Evans concede any other relationship to water and water management than the purely practical. In many ways, Evans’ original conception of the water management systems of Minoan Crete, as being purely functional and merely part of a larger scheme or superstructure, can be seen to have had an impact on the work of later scholars, who so often either consider them unworthy of discussion (because they are lacking in grandeur), or look purely at the practicalities of their use (see for example Macdonald and Driessen, 1988). The potential meanings of, and interactions with, fresh water and water management systems are frequently overlooked. In recent years, however, there has been some recent work on one particular aspect of the Minoan interaction with fresh water: drainage systems. For instance, work by Shaw (2004) and Lenuzza (2013) has focused roof drainage, while several studies by Aufshnaiter have considered the Minoan drainage systems as a prestige artefact (2007, 2011, 2012). My thesis will contribute to this emergent area of archaeological discourse with Minoan culture and will add to the growing understanding of how the Minoans used, manipulated and gave meaning to their world. Not only will this study present the archaeological data for the management of fresh water, but it will also seek to understand how water was politicised and incorporated into their religious and ritual behaviours.

1.2 Water as a political and religious device

In seeking to contribute to an understanding of the importance of fresh water management on Minoan Crete, and its interactions with other arenas of Minoan society, this thesis aims to illuminate some neglected aspects of Minoan archaeology – especially
the relation between water management and political power – that is well documented in other societies.

As a fundamental resource, both biologically and economically, being able to control and manipulate fresh water is both a pressing concern and a great source of social power. Many authors have discussed how the historical study of water and water management highlights the manifest roles water plays in the social, cultural and political realms, and often how water management strategies held an important role in the development of ancient societies (Coopey and Tvedt, 2006; Tvedt and Coopey, 2010: 4).

Water’s role in this regard has interested scholars since the mid twentieth century, producing highly influential theories and such as those of Karl Wittfogel (1957) and Julian Steward (1955). Whilst Wittfogel’s hypotheses have now been abandoned by most modern scholars, the study of ancient complex societies by academics such as Scarborough (1998, 2003) and Lansing (1987, 1991) have further drawn attention to the many ways in which water management systems, whether they be irrigation systems, ‘water temples’, dams or reservoirs, whether as an economic, political or ideational force, “empowered ancient complex societies” and could be used in power relationships intended to maintain and reinforce a ‘coercive elite’ (Scarborough, 2003: 9). Importantly, it has been emphasised that the control of water through water management systems is not simply about economic power – the physical control of access to a fundamental resource – but equally about social power and social control (Swyngedouw, 2009: 56-57).

Many scholars have studied the ways in which fresh water is incorporated into the religion, ritual practices and social behaviours of a given society (see for example Håland, 2009; Oestigaard, 2009; Lansing, 1991; Scarborough, 1998; Strang, 2005) and many have noted how the control – whether physical or ideological – of fresh water sources is a key component of social control and the legitimisation of hierarchical order. The human experience of water includes a number of aspects which make it particularly conducive to being used in descriptions, metaphors and the construction of often complex meanings. Water is essential for life, and therefore possesses that familiarity which meaning so often requires. It appears in a number of different states and forms, making it a powerful analogy for a diverse set of mental states, concepts and complex relationships. As the uses and meanings of water are unavoidably incorporated into human activity on a daily basis, the associations that water acquires within a society are constantly strengthened. The combination of water’s capacity to bear complex meanings and its routine use provides fertile ground for the development of enduring metaphorical associations, passing from the
‘mundane’ rituals of washing and rehydration to more religious ritual activity, which express ideas around concepts such as purity, fertility, transition and the creation and maintenance of specific identities.

By thinking about water as a political and religious ‘key player’, this thesis seeks to add to our knowledge of how Minoan elites operated – how they constructed and maintained their power ideologically rather than physically – and how Minoan religion played a key role in this ideology, through the use of physical and metaphorical links with sacred spaces, places and elite contexts.

2. Research Questions

Within these contexts, this thesis aims to explore Minoan fresh-water management systems and the ways in which they were incorporated into the social, political and religious life of the culture, and in doing so, also aims to investigate the potential meanings of fresh water. As such, I will address the following research questions:

- What range of water management systems are to be found in Minoan Crete?
- How is fresh water represented and incorporated into Minoan art and material culture?
- What is the relationship between water management systems and socio-political structures on Crete?
- Is there a role played by fresh water and water management systems in Minoan religion and ritual action?

3. Thesis structure and overview

Chapter 1 of the thesis presents the geological, geographical and climatological data for Crete as a means to understanding the island’s unique geography and natural water. It looks at how the different landscapes of Crete are affected by water, or the lack of it, and how its often complex and diverse landscapes, in particular the karstic areas, not only concentrate precipitation in relatively few regions, but also redistribute rainwater throughout the island via large networks of underground rivers and channels. I also discuss the Cretan seasons, and how weather and climate can vary from one extreme to the other – from winters of plentiful supply of water, to the point of destructive deluges and floods, to the hot and summer months – resulting in very different seasonal pressures and problems. This chapter also explores, through geological and archaeological data from Crete and across the Mediterranean, what the Bronze Age climate of the island might have been like.
and how the Theran eruption could have affected the climate and water availability throughout the island.

In Chapter 2, I present and explore in detail the numerous water management systems of Minoan Crete (the full database of the water management systems can be found in Appendix 1), including cisterns, wells, spring chambers, dams and drainage systems. I investigate patterns of water management use, regional and temporal differences and similarities, as well as the materials and methods used in their construction. It also discusses the hydraulic knowledge and expertise manifest in many of the water management systems, and the possibility of water management experts being part of a ‘craft class’, which included other experts in areas of Minoan material culture.

Chapter 3 considers one of the most studied aspects of Minoan culture, their art and iconography, in order to look at the ways in which fresh water is portrayed in a number of different artistic media. I look at direct and indirect depictions of fresh water, as well as how the Minoans employed visual motifs and devices to overcome the problems of representing water, water environments and, more generally, ‘wetness’. Through my investigation, I argue that fresh water participates in a multitude of different meaningful contexts and was an active motif in itself, rather than acting as a ‘background’ element.

Chapter 4 discusses fresh water and fresh water management in terms of its socio-political use. In this chapter, I argue that certain fresh water sources played an important role in how Minoan elites marked themselves out as different from the rest of the community, and by virtue of this difference, ‘worthy’ of their power and privilege through the use of controlled access, conspicuous consumption, and the sharing of hydrological knowledge and expertise between elite groups. I discuss how the control, manipulation and display of fresh water helps to articulate an ideological message which helps to construct the idea of the elite as having a distinct identity within the community. This ideology of difference is one in which, I argue, water management systems played a significant role.

In Chapter 5, I look at the role religion plays in this elite ideological narrative and how water was used in Minoan religion and ritual practice to ‘tether’, consolidate and perpetuate elite social difference. This chapter presents a range of archaeological evidence which demonstrates an enduring and observable connection between water and Minoan ritual action. I argue for a strong spatial use of water and water-related objects such as water-worn pebbles, to identify sacred or ritual spaces and to physically and ideologically connect these areas to elite contexts. In addition, I also argue that the archaeological
evidence is indicative of a culture in which certain sources of water – namely springs – were ascribed high value and meaningfulness.

In the concluding chapter of this thesis, I present two site-based case studies from Minoan Crete, Kato Zakros and the Caravanserai at Knossos, which I believe illuminate my key ideas and arguments concerning water management systems, fresh water and their relationship to Minoan socio-political concerns and religious practices and ritual action.

Through this thesis, I hope to present not only the archaeological data on Minoan water management systems – which has not been presented in this way before – but to explore also the ways in which fresh water was used, manipulated and controlled for various social, political and religious purposes. In doing such, I hope I will illuminate some of the ways in which the Minoans understood and perceived fresh water.
Chapter 1: The Geography, Geology and Climate of Crete

1. Introduction

This chapter seeks to outline the major geographical, geological and climatological features of Crete that have an impact on the availability of fresh water, with a particular focus on conditions in the Bronze Age. Not only will this serve as a detailed background for subsequent chapters, it will also highlight the extent to which Crete’s physical environment presents certain pressures on organic life and human communities that are unusual, in the European context. Understanding the ways in which water is naturally stored and redistributed around the island, and the surprising regional variations that result, enables us to better comprehend Minoan water management strategies as responses to the specific challenges of the Cretan environment. Necessarily, reconstructing Bronze Age conditions remains highly speculative; however, ongoing debates around the Minoan climate especially have benefited from recent developments in interdisciplinary research, which this chapter will summarise.

The first section of this chapter focuses on the geography of Crete and its role in determining the availability of fresh water. It begins with a discussion of how the island’s limestone mountains produce a landscape of extreme diversity, with substantial regional variations in the availability of fresh water. Following this is a discussion of the peculiar effects of Crete’s geology, and in particular the abundance of karstic features which play a significant role in transporting water around the island through subterranean systems. Finally, the discussion turns to the nature of above-ground fresh water on Crete, such as rivers, springs, lakes and wetlands.

The second section deals with the Cretan climate, offering an overview of the weather systems, climatological features, and precipitation on the island, focusing again on the production of regional diversity in terms of water supply. This section then embarks on a detailed discussion of the available data concerning the Cretan climate during the Bronze Age including recent research into deep-sea and pollen cores. This discussion culminates in a tentative reconstruction of the different phases of the Bronze Age climate on Crete, with a special emphasis on the proposed ‘Minoan Little Ice Age’ between MM I and LM III.

Finally, the third section takes stock of the effects on Crete’s fresh water supply of the Thera eruption and the associated seismic activity. The effects of the Theran eruption on Crete, and particularly on Minoan society, have been hotly debated, especially as the date of the eruption remains a subject of some controversy. As such, this section offers an
overview of these pertinent issues, as well as a more detailed account of the probable effects of the eruption on Crete’s climate.

2. Crete’s geology and geography and their impact on water

Crete (35°13′N 24°55′E) (Fig. 1) is the largest of all the Greek Islands and the fifth largest Mediterranean island. It has an approximate surface area of 8,620 square kilometres and is approximately 245 km long and 52 km wide at its broadest point (its narrowest point is a mere 12 km). The island lies at the centre of the Hellenic Island Arc – a transitional zone where the African continental plate is forced under the Eurasian plate – resulting in some parts of the island being lifted, parts being collapsed, and areas cracked by faults (Rackham and Moody, 1996: 13; Grove and Rackham, 2001: 40). The result of this movement is an island full of interesting geological features. The most dominant of these are the mountain ranges which are formed by cores of hard limestone and surrounded by lower mountains of metamorphic phyllite and quartzite rock (Rackham and Moody, 1996: 12). Crete has a total of 15 mountain ranges, with three over 2,000m high (Fig. 2). The White Mountains (Lefka Ori) dominate the west of the island and have at least 20 peaks over 2,200 m (Rackham and Moody, 1996: 12); the Psiloritis range dominates the central landscape of Crete and has the highest peak of all the ranges, Timios Stavros, standing at 2,454 m; and to the east of the island lies the Dikti range, home to the largest flat area on Crete, the Lassithi plateau – a dramatic and picturesque area which stretches 11 km east-west and 6km north-south and is 850m above sea level.

Despite the fact that all of Crete is dominated by limestone and metamorphic rock, there is a spectacular array of different environments on the island; indeed, Crete is “a miniature continent with its Alps, its deserts and jungles, its arctic wastes and its tropical gorges” (Grove and Rackham, 2001: 11). Clearly, each environment presents its own unique opportunities and difficulties for collecting water, and so an understanding of the availability of water in different regions of the island depends on understanding what produces them. In particular, the nature of limestone plays a large role in producing Crete’s diversity, and significantly impacts upon the availability and nature of accessible water sources. This impact is best illustrated in the variations between the island’s three desert environments (see Fig. 2).

The High Desert, situated high in the southern half of the White Mountains, is a cold, jagged landscape of cliffs, valleys and sinkholes, with less than one percent plant cover. Despite annual precipitation being as high as 2,000 mm, falling mainly as snow, it is
exceptionally dry, due to the nature of the limestone that dominates the desert. Porous and prone to being dissolved by rain or melt-water, forming ridges and channels, the rock is incapable of retaining water. When the heavy snows eventually thaw, usually in May, melt-water disappears into the rock, and is funnelled into the scree, fissures and sinkholes that punctuate the landscape. The plants that survive in this environment of drought and cold are highly specialised with nearly half being endemic to this desert (Strid, 1995: 103), suggesting that the High Desert has remained relatively similar to its present state for most of the Pleistocene (Grove and Rackham, 2001: 312).

A second desert region, lying in the south-easternmost corner of Crete and dubbed the ‘European Sahara’, is also a product of Crete’s limestone mountain ranges. To the north-west of this rain-starved desert stand the Thryphti mountains attract a great deal of rainfall, giving the surrounding phyllite-quartzite regions small areas of relatively lush vegetation which can include the deciduous oak. These mountains cause a ‘rain-shadow’ stretching across a high arid plateau and down towards the vast and often bare gorge-slopped cliffs on the south-east coast. Rainfall here can reach as low as 200 mm per annum, resulting in the prominence of semi-desert plants such as *Camphorosma lessingii*, a plant more common to central and south-west Asia and south-eastern Russia (Grove and Rackham, 2001: 318). This dry and arid landscape is thrown into sharp relief by the adjacent area around Kato Zakros, a lush, green fertile oasis created by the emergence of much of the region’s groundwater and mountain runoff.

A third region, extending south and east from Heraklion and dominating the middle of the island from the north to the south coasts, is made up of a largely treeless, hilly landscape. While not technically a desert, with the ‘marly’ limestone retaining much of the area’s rainfall (about 600mm annually), it takes on an arid appearance due to an unusual feature of the rock. The frost-free climate produces a hardened surface which is resistant to both weathering and root penetration. This creates a barrier between many plants and trees and the abundant water stored within the rock creating the desert-like environment (Grove and Rackham, 2001: 323; Rackham and Moody, 1996: 17). In contrast to the High Desert, where abundant water is lost through a network of sinkholes and fissures, and the rain-starved south-eastern ‘Sahara’, this central Cretan desert environment, which includes the Minoan sites of Knossos and Archanes, merely withholds its water from the surface. For the plant species, and indeed human communities, capable of penetrating the hardened surface of the rock, the region is not nearly as dry as it appears.
2.1 Karst formations: Creating a unique environment

As the above examples illustrate, the Cretan limestone plays a prominent role in creating water-scarce environments; however this is only part of the story. The island’s geology also serves to redistribute water below ground, often in highly unexpected ways. Key to this subterranean activity is the prevalence of karst features in Crete’s landscape: various types of holes and depressions that occur when rainwater dissolves the crystalline limestone common to most of the island’s mountains. Initial depressions serve to collect water which then accelerates the dissolving process, over time producing sinkholes which then collapse and combine into elaborate underground fissures, caves and caverns. As a result of this process, the surface of Crete is pock-marked with sinkholes (Fig. 3) that connect to systems of underground channels which direct the flow of groundwater (Rackham and Moody, 1996: 24-25; Grove and Rackham, 2001: 323-324). Karstic landscapes perform two important functions: one the one hand, they serve as significant stores of water – as small pits on the surface or as large underground catchment systems; on the other, they redistribute groundwater around the island, creating springs and oases, as at Kato Zakros, often many miles from their original source.

One highly visible effect of this karstic landscape is the abundance of caves and grottoes on the island. Indeed speleologists have estimated that there are at least 2,000 caves, grottoes, caverns and cavities in the Cretan rock (Rutkowski, 1986: 9). Some of the larger caves are dramatic, labyrinthine chambers overflowing with stalactites and calcite drapery such as the cave of Psychro within the Dikti range. Many of Crete’s most famous caves are strongly connected to mountain plains; collected rain and melt-water forms into rivers which, if they cannot escape the plain over-ground, disappear into a cave in the mountainside known as a khóonas (Rackham and Moody, 1996: 27-8). Where the water has forged other routes over the centuries, such as through numerous sinkholes, the great khóonas caves become redundant as siphons, often becoming stranded several meters above the floor of the plain as the latter ‘drops’ relative to the mountain. The plain of Omalos Viannou in the White Mountains has one such redundant cave, and it is possible that the more famous caves of Mount Ida and Psychro were once the khóonas caves of the Nidha and Lassithi plains respectively. Even when divorced from the waterways that created them, Crete’s caves are frequently wet environments, collecting water from the surrounding rock in chambers and pools in substantially less evaporative conditions than on the surface.
2.2 **Rivers, Springs, Lakes and Wetlands**

The importance of subterranean water on Crete is reinforced by the relatively unreliable nature of more conventional water sources, such as rivers, springs, lakes and wetlands. The rivers on Crete are strongly seasonal, with the vast majority of them flowing only during the wet winter months. Modern-day Crete has very few perennial rivers that reach the sea; Rackham and Moody (1996: 41) suggest around ten (Fig. 4), with many of these arising from larger springs, such as the Koiliaris river, and even these are reduced to mere streams and trickles in the hotter summer months. This count is, however, dependent on subjective distinctions between rivers and streams, and indeed trickles. Professor Andreas Angelakis of the National Agricultural Research Foundation counts only three perennial rivers on the basis of a specified minimal perennial flow: Kourtaliotis in the central south-west of the island; Kakodikiaanos in the south-west; and the river Kiliaris in the north-west of the island, all three of which arise from springs. He also notes that there are a further three to four coastal rivers which flow all year round, but the waters here are brackish as they are supplied by *almyroi* (salt-water springs).

There is strong evidence that the number of rivers on Crete has declined dramatically in the last 500 years; Venetian records from 1625 list twenty-eight rivers “abounding in good water” even in the summer months (cited in Grove and Rackham, 2001: 133). This decline of rivers on Crete may be partly explained by the effects of modern irrigation which has ‘drunk them dry’, as in the case of the Myrtos river (Cadogan, 2007: 104); however, the Venetian estimate may have been a relative anomaly. In the 17th century, Crete was affected by the Medieval ‘little ice age’ which brought a far more temperate climate with greater annual precipitation, periods of intense rainfall, severe floods and heavy winter snows (Grove, 2001: 129-130). The relevance of present and Venetian counts of the number of perennial rivers to Minoan Crete depends heavily on the state of the Minoan climate, discussed below.

As an island with huge seasonal variation in terms of overground rivers, Crete’s appearance changes dramatically through the year as flora and fauna make the most of periods of abundance, before receding in drier times. Nowhere is this contrast more evident than in many of Crete’s spectacular gorges. There are over one hundred gorges on the island, including Samaria gorge, one of Europe’s largest gorges at approximately 16 km long, many of which contain endemic vegetation. While a few are bursting with vegetation

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3 Personal correspondence, August 2011
all year round (such as Therisso gorge near Chania), and others permanently arid (such as Pervolakia near Makrigialos), most oscillate between the two extremes. In winter months, their floors are transformed from dry, scree filled ravines to riverbeds, directing intense rains and seasonal springs towards the coast. Very few retain their waters into the summer months, and of those that do, the gushing waters of winter are transformed into barely trickling streams.

As mentioned in the previous section, Crete’s geology plays a distinctive role in transporting and redistributing precipitation through subterranean systems. As a result, Crete has an abundance of springs, where the water is forced out of underground waterways by natural nonporous barriers, through more permeable rock and faults. Cretan springs range from those that merely trickle out, to those which almost burst out of mountainsides, discharging as much as 70 million m$^3$ each per year (Grove and Rackham, 2001: 358), and remain important water sources for modern populations. There are several large perennial springs on the island, to include Ayia, Boutsounaria and Argyroupolis, along with a profuse number of smaller perennial springs which intersect the limestone hills. Crete is also well known for its salt-water inland springs, almyroí, where sea-water diffuses into the caves which supply fresh water springs. Acting almost as the complete opposite to the almyroí, Crete is also home to under-sea springs, where patches of icy cold, oily looking fresh water rises to the surface of the sea and can be drunk, if desired (Rackham and Moody, 1996: 42-43).

In an island with limited overground perennial water supply, it is unsurprising that lakes and wetlands are not a common feature of Crete’s geography. In fact, there is only one natural lake of any significant size, Lake Kournas, at the north foot of the White Mountains (Roberts and Reed, 2009: 263; Rackham and Moody, 1996: 43), measuring approximately one kilometre wide and twenty meters deep, and feeding the small Delphinos river (Bottema and Sarpaki, 2003: 734). Although the word for lake, limni, is a relatively common place-name on the island, the name usually refers to a sinkhole which either seasonally holds water or is thought to have held water at some point, although there are a couple of sinkholes which hold water year-round, namely at the hamlet of Limni near Elos and at Limnes near Tersana (Rackham and Moody, 1996: 43). There are some small areas of wetland on Crete, often found around coastal springs, such as that at Frangokastello, Chania (Bergmeier and Abrahamczyk, 2008: 433-431).
3. Crete’s climate and its impact on water

In the present day, the Cretan year is sharply divided into winter and summer months, with the former being mild and wet, and the latter hot and dry. This contrast is governed primarily by the influence of four great weather systems: in winter, Crete is held between the North Atlantic Low and the high-pressure belt over South-West Asia and North Africa, which interact to produce cloudy skies with intense rain and spells of bright sunshine. In summer, Crete lies between the Azores High and the Indo-Persian Low, creating a steady north-westerly wind (a meltémi) which brings dry, sunny and often hazy weather. North to north-west winds blow all year round, but are most constant during the summer months, and the Sirócco, the south-easterly wind which blows from the Sahara across the southern Mediterranean in spring and autumn, often brings intense heat to Crete.

3.1 Precipitation

Restricted largely to the winter months, rainfall begins in early October, often breaking the hot, windless weather of September with an abrupt deluge. Rainfall and snowfall increase steadily until January, after which precipitation declines to a gradual stop in April or May, with snow above 1,400m generally melting around May. As the strength of the sun and temperatures increase from June onwards, so does rate of evaporation, diminishing what little rain-fed waterways remain rapidly until the return of the wet season in October.

Rainfall can vary dramatically from place to place, varying from well under half the long-term average to nearly twice the average (Rackham and Moody, 1996: 35-36; Lyrintzis and Angelakis, 2006: 165) and is especially affected by Crete’s mountain ranges. Modern records range from 1,429 mm per year at Palaia Roumata in western Crete, 501 mm at Heraklion in north-central Crete, through to 432 mm at Ierapetra on the south-eastern coast (Rackham and Moody, 1996: 34) (Fig. 5). Precipitation also increases with altitude at a rate of approximately 0.6 mm per meter of ascent, up to about 1,000 meters, consequently averaging approximately 2,000 mm at the top of the White Mountains (Grove and Rackham, 2001: 26). In general, rainfall on Crete decreases from west to east and from north to south, making the north-west of Crete the wettest part of the island (Moody et al., 1996: 276). In addition, winter rains also tend to come from the north-west, creating strong rain shadows to the south and east of the island. As a consequence, the south and east of
the island is the most vulnerable to drought, while the north-west is more susceptible to frost and snow damage should temperatures become low enough (Moody, 2000: 52). The pressures of drought are exacerbated by the fact that Crete loses 65% of its precipitation through evapotranspiration – the loss of surface water into the atmosphere through evaporation and plant transpiration – especially during the summer months, when the heat, dry atmosphere and the *Sirocco* wind take hold (Lyrantzis and Angelakis, 2006: 166).

With 75% of annual rainfall occurring between December and February, precipitation during these times can be torrential and devastating (Lyrantzis and Angelakis, 2006). Deluges, defined as rainfall of more than 100 mm on one occasion, often in one or two severe bursts (Grove and Rackham, 2001: 247), are not uncommon to modern Crete. Deluges, which can release half of the annual rainfall in a couple of days, are highly destructive; they have the power to destroy land, animals and buildings and can ruin the season’s crops or even a lifetime’s investment in olive trees or grape vines (Berg, 2007: 35).

### 3.2 The Bronze Age Climate: Evidence from Deep-Sea Cores and Pollen Diagrams

There remain serious questions about the similarity between the weather and climate of present-day Crete and that of the Bronze Age, and many studies have been conducted in order to improve our understanding of the climate of the Aegean Bronze Age. Evidence from pollen analysis and soil samples have drawn some scholars to conclude that the climate of Middle and Late Bronze Age Greece was not substantially different from that of today, while others have suggested a more arid climate (cf. Bintliff, 1977; Davidson, 1978; McCoy, 1980). In recent years, the climate data for Early and Middle Bronze Age Crete has improved with the evidence from a new deep-sea core, LC21. This new information has added to data from two pollen cores from Crete and samples from Cretan flood deposits, which when combined, can detail the seasonal differences in temperature and rainfall over the last 10,000 years.

#### 3.2.1 Evidence from Deep-Sea Core LC21

A series of studies of the deep-sea core LC21 (Rohling et al., 2002; 2004; 2009), taken from just off the north-east coast of Crete, have shown that there are four periods when the number of warm-water species (namely warm-water foraminifera) drops by 20%-30% (Rohling et al., 2002: 588, Fig 1, graph d). These ‘cooling events’ date to circa 6500-6200 BC, 4300-3600 BC, 1150 BC and 900 BC (Moody, 2009: 243). Rohling and colleagues propose that the decline of warm-water species, when combined with other indicators,
suggests that the cooling events were seasonal only, consisting of longer, more widespread and more intense periods of wintry conditions – cold, dry continental /polar air – and lower temperatures (2002: 590). From about 6000 BC, summer temperatures were on the increase, with “Levantine type” conditions (2002: 590). Table 1 summarises Moody’s (2009) analysis of the information that has been extracted from the core, and illustrates its relationship to Minoan chronology.

<table>
<thead>
<tr>
<th>Date</th>
<th>Event identified from LC21</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ca. 3400/3300 BC</td>
<td>Summer evaporation levels first exceed Holocene average and then recover</td>
<td></td>
</tr>
<tr>
<td>Ca. 3100-2900 BC</td>
<td>Evaporation levels soar again</td>
<td>Late phase of Final Neolithic</td>
</tr>
<tr>
<td>Ca. 2700-2200 BC</td>
<td>Summer evaporation levels decrease and hover around Holocene average</td>
<td>This period is roughly contemporary with late EMI-IIB</td>
</tr>
<tr>
<td>Ca. 2200-2000 BC</td>
<td>Summer evaporation levels soar to an interglacial high</td>
<td>This period is roughly contemporary with EM II-MM IA</td>
</tr>
<tr>
<td>Ca. 2000/1900 -1800/1700 BC</td>
<td>Summers cool off yet remain evaporative</td>
<td>This period is roughly contemporary with MM I B – MM III B</td>
</tr>
</tbody>
</table>

Table 1 Summary of Rohling et al.’s findings as analysed by Moody (2009: 244)

3.2.2 Pollen core analysis

Further evidence as to the climate of Bronze Age Crete comes from pollen core data. There are two pollen cores from Crete which cover the Bronze Age, both of which come from the west of the island: Tersana (near Chania) and Delphinos (near Lake Kournas). The Tersana core has been studied in some detail by Moody, and colleagues (1996), with the Delphinos core having been analysed by Bottema and Sarpaki (2003).

Neolithic data from the Tersana core indicates that local vegetation was a mix of garigue – a type of soft-leaved scrubland – and mixed oak woodland and maquis (Moody et al., 1996: 289). In addition, the environment also supported the coexistence of olive and more central European trees as basswood/linden, hazel and hornbeam, suggesting that there were some constraints on the seasonal distribution of moisture and temperature range. Such evidence suggests that during the Neolithic, precipitation varied less between the regions of the island, with the climate being less arid than the present day (Moody et al., 1996: 289-290; Berg, 2007: 30).
Data taken from the core indicates that during the Bronze Age, more temperate European trees such as ash and hornbeam continue to coexist with olive, indicating an environment less evaporative than today’s. However, the data does suggest a steady drying of the climate by the Middle Bronze Age (Moody et al., 1996: 292), as evidenced by the disappearance of basswood/linden from the pollen record (which is present through all the pollen records of southern Greece), in addition to a general increase in deciduous oak pollen. There is also change from a predominantly woodland and garigue environment in the Neolithic to one of woodland and steppe in the Early to Middle Bronze Age (Moody et al., 1996: 292). These changes to Cretan vegetation may have been caused by an increase in temperature, increased seasonality of rainfall, lower annual rainfall, or a combination of these factors; however all point to the onset of drier, more seasonal conditions on Crete (Berg, 2007: 31; Moody et al., 1996: 292).

According to a number of scholars, around 2300/2200 BC much of the eastern Mediterranean became suddenly more arid (Moody, 2009: 245; cf. Dalfes et al., 1997), with Crete being no exception. Evidence from the Delphinos pollen core shows a decline in all tree species, while grass polens increase. This increase has been interpreted, in conjunction with the data from the LC21 deep-sea core, as signifying higher average summer temperatures (Moody, 2009: 245) - a period known as the ‘3rd Millennium Aridity Event’.

3.2.3 The ‘Minoan Little Ice Age’

While the first half of the Bronze Age saw a general shift towards higher temperatures and drier conditions on Crete, culminating in the 3rd Millennium Aridity Event, the second half appears to have bucked this trend. During the analyses of medieval flood deposits on Crete, earlier flood and debris flow horizons were discovered which could be dated to the early Middle Bronze Age through to Late Bronze Age III, coinciding with the 2nd Millennium Little Ice Age (as defined by the Löbben glacial advance in the Alps circa. 1870/1800 BC and 1370/1230 BC (Grove and Grove, 2004)). This has led scholars to tentatively propose a ‘Minoan Little Ice Age’, corresponding to approximately MM I - LM III, mirroring and probably exceeding the cooler and wetter conditions of the Medieval Little Ice Age recorded by the Venetians (Moody, 2000: 58). While a straightforward correlation between the medieval and Minoan climates would be simplistic and problematic, the idea of a Minoan Little Ice Age fits with the data from the LC21 deep-sea core which also attests to cooler summer temperatures during the period. In addition, finds of a troglodytic beetle species with a preference for leafy, damp
environments from Akrotiri, Thera, indicate a wetter and possibly cooler climate (Asouti, 2003: 482).

The probable effects of the Minoan Little Ice Age on the availability of water are significant, and would have had a double-edged impact on Minoan populations. On the one hand, we can infer from the Venetian accounts, mentioned above, that there may have been a greater number of perennial rivers than there are today. On the other, it is highly likely that precipitation would have been extremely uneven and unpredictable, consisting of severe floods and periodic debris flows, which would have substantially disrupted agriculture. As Moody observes, this wetter, but more volatile climate “is likely to have spawned a new approach to subsistence, as well as serious revamping of belief systems and ritual in an effort to control the perceived chaos” (Moody, 2000: 59).

3.2.4 Reconstructing the Bronze Age Climate

From the factors discussed, it is possible to draw some tentative conclusions about the Cretan climate in the Bronze Age. During the EM I period, the climate on Crete was fairly stable, with the presence of *Tilia* pollen indicating a climate which was less evaporative than at present, with more annual rainfall and slightly cooler winters (Moody, 2009: 247). During the EM III – MM I, winters become slightly warmer, whilst summer evaporation levels soar to a Holocene high, marking the 3rd Millennium Aridity Event on Crete. This period would have seen plant growing seasons constrained by long summer droughts (Moody, 2009: 244). Beginning somewhere around MM IB, summer temperatures cooled while winter temperatures remained warm, with evaporation levels slowly decreasing. Floral and faunal data suggest that this 2nd Millennium Little Ice Age (MM IB/II – LM IIIA/B) brought with it a generally wetter climate; however, this may have been accompanied by irregular temperatures and precipitation changes, leading to deluges, intensive erosion and debris.

3.3 The impact of the Thera eruption on the Cretan climate

During the second millennium BC, an earthquake triggered an eruption of the volcano on the Cycladic island of Thera (Santorini) 120 km north of Crete. The size and scale of the eruption had a profound effect not only for the island itself, but also for Crete, the Aegean and for the wider eastern Mediterranean. One of the most debated and controversial areas surrounding the Theran eruption is the dating of the event. While the relative dating of the eruption in the archaeological sequence is quite clear - falling towards
the end of the LM I (Marthari, 1984) – the absolute dating of the LM IA period, and therefore of the eruption, is a question that has occupied scholars from many different disciplines for over a generation. As such, there is insufficient space in this thesis to discuss in detail the many different and compelling arguments as to the absolute dating of the eruption; however, a brief overview of the different approaches, arguments and therefore absolute dates is offered (for a more detailed overview, see Manning, 2010b: 458-469).

3.3.1 Absolute Dating the Thera Eruption: Problems and Controversies

Within Aegean prehistory, the traditional approach to absolute dating relies on synchronisms between the dateable chronology of Egypt and the almost parallel sequences of the Minoan, Helladic and Cycladic cultures, derived from imported/exported pottery or from other dateable objects such as stone artefacts (Cadogan, 1978a: 209). Therefore a specific Aegean ceramic style exported to Egypt can be used to ‘date’ the same ceramic style in its archaeological context on Crete or elsewhere. So, for example, MM II Kamares ware is considered synchronous with Middle Kingdom Egypt and therefore can be dated to 19th – 18th centuries BC (Manning, 2010b: 459). When there are clear and plentiful trade/exchange connections, this system works well. However, this methodology can prove to be vague and is highly problematic when Egyptian evidence is scant which is the case for the LM IA period (Manning, 2010b: 459).

In contrast to this, scientific approaches to absolute dating, such as radiocarbon analysis, dendrochronology, dendrochemistry and ice-core sampling, have produced more specific dates for the eruption. Radiocarbon dating, based on organic materials from contexts buried by the eruption, has in recent years offered a dating range of 1660 – 1613 BC (Manning et al., 2006), while the identification of volcanic glass within an ice-core has produced a potential date of 1642 ± 5 BC (Vinther et al., 2006). In addition, initial dendrochemical research has associated a major volcanic eruption to a growth anomaly circa 1650 BC. These approaches are not without their problems, however. Probability fluctuations and the fact that different techniques do not point to one specific date, have raised doubts over their claims (Manning, 2010b: 468). Additionally, the volcanic signatures and markers that are identified in the various samples cannot be unequivocally identified as coming from the Thera eruption, leading to further scepticism.

As a result, a clear and absolute date for the Thera eruption remains elusive, with the issue being clouded by clashes between differing academic backgrounds and generational cultures (Manning, 2010b: 469). Nonetheless, scientific analysis (Friedrich,
2000: 82-93; Friedrich et al., 2006; Pearson et al., 2009) combined with archaeological data seems to suggest two convergences around the dates 1627 BC and 1642-1650 BC.

The eruption of the Thera volcano itself was on an epic scale. Recent research has revealed that the eruption was much larger than many of the original estimates and the eruption is now thought to have ejected in excess of 60 km$^3$ (14 cu mi) of material (Sigurdsson et al., 2006: 338) – approximately 30 km$^3$ more than previously thought (Driessen and Macdonald, 1997: 87) and four times as much as that which thrown into the air following the eruption of Krakatoa in 1883. As such, the eruption of Thera is considered to be one of the largest volcanic eruptions of the last several thousand years (Manning, 2010b: 458). The eruption and its associated tremors and earthquakes caused untold damage to the island. During the first (the plinian) phase of the eruption, which only lasted a few hours, a huge amount of ‘Rose Pumice’ was ejected from the volcano, with the eruption column reaching heights between 36 and 38 km (Friedrich, 2000: 72-73).

In the second (the ‘base surge’) phase, (Friedrich, 2000), magma which had been torn into tiny particles and suspended in steam created clouds of ash which quickly spread over the island. Approximately 2 cu km of pumice were deposited on the island during this second phase (Pitchler and Friedrich, 1980). During both these phases, huge pieces of lava were thrown out of the volcano in blocks: on some parts of the island “room-sized blocks” were found, whilst in others, the blocks were over a meter in diameter (Friedrich, 2000: 75).

During the third and final phase of the eruption, alongside tephra, the volcano generated pyroclastic flows – “turbulent clouds of ash and hot gas” – which were directed outward and at low angles (Friedrich, 2000: 75-76). In total, the ash layer deposited on the island was up to 60m thick and altered the original horse-shoe shape of Thera and divided into three segments – Therasia, Thera and Aspronisi (Friedrich, 2000: 77-78). One of the many consequences of the eruption was the complete burial of the Bronze Age city of Akrotiri, the ‘Pompeii of the Aegean,’ under tonnes of volcanic ash and pumice, entombing and preserving wall paintings, multi-storied buildings, and untold numbers of well preserved artefacts such as pottery and furniture, creating a pivotal and unique resource in the study of the Aegean and eastern Mediterranean prehistory.

The earthquakes associated with the eruption were not confined to the island of Thera; archaeological evidence from Crete also demonstrates that a series of major earthquakes shook the island during the LM IA. At least 18 Neopalatial sites suffered from earthquake damage and a further 11 sites showed traces of some sort of disturbance during this same period (Driessen and Macdonald, 1997: 88). These tremors and earthquakes,
which also caused damage in the Cyclades and Dodecanese, appear to be related to events leading up to the eruption event, rather than being directly associated with the earthquake that triggered the eruption of Thera (Driessen and Macdonald, 1997: 88).

Of particular interest to this thesis is the potential effect that seismic activity could have on ground water supply. Gorokhovich (2005; 2010) notes that seismic activity can have a profound effect on the amount of water ‘held’ in the rock, which can move or drop to lower areas beyond reach (2005: 219), resulting in the drying up of wells and the disappearance of old springs and the appearance of new ones.

Of course, the eruption of a volcano the size of Thera had other significant effects and repercussions, both short-term and longer-term, some of which were felt on Crete. Both archaeological and geophysical evidence points to the presence of a tsunami impact on Crete. Palaikastro on the northern coast certainly appears to have several tsunami signatures, indicating that a wave approximately 9m high reached 300m inland (Bruins et al., 2008: 208). Scholars have suggested that other Minoan sites may also have been hit by significant tsunamis, including Malia, Gournia and Mochlos (Driessen and Macdonald, 1997: 89-90; Monaghan et al., 1994: 224). Pumice and ash-fall are additional side effects to a volcanic eruption. On Crete, there is plentiful evidence for Theran pumice reaching the island, having crossed the sea in large pumice-rafts (pumice does not travel great distances and Crete is too far away from Thera for pumice to have reached the island through the air) and then carried by human agency to new destinations.

With regard to tephra-fall evidence on Crete, there has been some debate over the years as to its spread and impact on the island. It has been demonstrated that the direction of ash-fall from the Theran eruption was in an eastwards or south-eastwards direction with winds carrying the tephra across the south-east Aegean and across to Anatolia and the Black Sea (Driessen and Macdonald, 1997: 93). On Crete, there is also evidence for tephra-fall coming from an easterly direction. At Palaikastro, Theran ash layers have been found in several locations across the site (MacGillivray et al., 1998), whilst at Mochlos, Soles has identified an ash layer of up to 5cm in an open court (1995: 386-387). Further west, however, geomorphological work at Malia has failed to produce conclusive evidence for any tephra fall (Driessen and Macdonald, 1997: 93). More recent work, however, has sought to clarify the exact direction of the tephra fall and therefore the impact on Crete. Johnston and colleagues (2012) concluded that while the direction of the tephra fallout was indeed south-easterly, evidence including wind patterning suggests that Crete would have actually received very little tephra fall (2012: 1504). Nonetheless, the impact of even the
smaller amount of tephra could potentially have been hazardous, for example if water supplies were contaminated.

In addition to the effects discussed above, some scholars have noted that an eruption on this magnitude could have both short-term and long-term effects on the climate such as the lowering of average temperatures (it is estimated that there was a decrease of 0.5° in the Northern hemisphere (Sigurdsson et al., 1990: 111)) and a decline in precipitation (Bottema and Sarpaki, 2003; Bruins et al., 2008; Driessen and Macdonald, 1997: 92). In the short-term, Sparks (1979) noted that the discharge of steam associated with large volcanic eruptions (generated through the interaction of water and magma) could generate violent and torrential rain storms (1979: 30). Indeed, evidence for flash floods have been noted on Thera, however, it is still unclear as to whether such a deluge would have affected Crete, although Sparks suggests it should be seriously considered (1979: 30).

4. Conclusion

The image of Crete that emerges from this chapter is one of considerable diversity and complexity. The mountains and karstic features conspire to not only concentrate precipitation in a few regions but also siphon off and redistribute rainwater in unpredictable and largely unseen ways, notably through springs. Cretan winters provide a plentiful supply of water, even to the point of deluges and floods; however, hot, dry and windy conditions during the summer months, combined with a landscape that retains little surface water, cause this plentiful supply to dwindle drastically. Within the same year, a single region may experience both floods and droughts. Crete’s water supply, then, is both seasonally and geographically variable, as illustrated by the large number of endemic plants whose survival consists in adapting to unique local conditions.

Added to this regional and seasonal variability, the available data suggests a high degree of long term climate change, particularly during the Bronze Age, which would have substantially altered the already unstable and unpredictable cycles that govern the availability of water on the island. During the full course of Minoan civilisation, Crete went through numerous fluctuations in temperature and aridity, which are likely to have manifested in long, alternating periods of the overabundance and scarcity of water, as the wet and dry seasons elongated and contracted. Water management, therefore, was not merely about collection and storage, but also minimising the destructive effects of floods and deluges. Long term climate changes are not the only factor affecting water supplies on
Crete. As discussed in the third section, the events associated with the Thera eruption, and especially the sequence of devastating earthquakes, are likely to have drastically shifted regional water tables. This, on an island that holds much of its water underground, would have had a significant impact on water management strategies that sought to exploit subterranean water stores and springs.

When looking at the Minoans’ relationship to fresh water it is imperative to consider the unique complexities of the availability of water on Crete. Amongst the many pressures and opportunities for water management on the island, this chapter has suggested that there is one key feature that stands out: namely, that the conditions governing the availability of water are extremely variable, regionally, seasonally, over the long-term, and typologically (for example, subterranean cisterns, springs, and rivers). Thus, for all life on the island, and for human societies in particular, survival depends on two key factors. On the one hand, survival depends on regional or local specialism, as can be observed in the island’s flora; on the other hand, it requires the capacity to adapt to changing and often volatile environmental conditions. To excel and even prosper in such an environment as a whole would require an entire repertoire of strategies and adaptations.
Chapter 2: Minoan Fresh Water Management Systems

1. Introduction

This chapter presents an overview of the Minoan water management systems of Minoan Crete (see Fig. 2 for the location of the sites discussed) (Appendix 1). The systems discussed include cisterns, wells, spring chambers, water basins/sunken baths, aqueducts, dams and drainage systems. Broadly, these classifications follow existing terminological conventions in the archaeological literature; however, as the treatment of water management systems varies considerably between excavators and commentators, I have sought to formalise the classifications by offering typological definitions and discussions of exceptions where necessary.

Rather than an exhaustive list of sites, systems and data, this overview presents key information for each management system, such as its classification (if required), key measurements (heights, widths, depths, diameters etc.) and dates, as well as exploring potential patterns in their architecture, construction technique, locations and functions through the highlighting of specific entries within each type of water management system. Following the archaeological summary of each system, a discussion of identified patterns (and exceptions) will be offered.

A key issue that cuts across all the different systems discussed in this chapter is the extent and sophistication of Minoan hydrological knowledge: while the various categories each attest to different skills and solutions to different problems, the question of the Minoans’ expertise in managing water is best illuminated by considering the full range of strategies and technologies employed. For this reason, I offer at the end of this chapter a discussion of the overall state of Minoan hydrological expertise suggested by the available archaeological evidence, focused especially on the strengths and also limitations of Minoan hydrological knowledge. This issue is of considerable significance for the wider purpose of

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4 It should be noted here that throughout the thesis I refer to architectural spaces and structures as they are commonly known, for example palace, lustral basin, and throne room. I acknowledge that these are constructed terms and do not necessarily reflect their use or construction. Rather, I have adhered to these terms for convenience only, as there is insufficient space in this thesis to address the concerns regarding terminology as raised by other scholars (see for example Driessen (2002a: 1-6) and Schoep (2002b: 18). Likewise, particularly regarding the evidence for water management structures where there is a lack of stratigraphic information or poor early excavation reports/techniques, it is not possible to revisit many the issues surrounding structural or construction assumptions made by some early scholars, such as Evans.
this thesis, in that my interest is in the social and political dimensions of water management: the development of hydrological expertise is potentially indicative of a degree of craft specialisation, not dissimilar to the well-documented Minoan craft classes of potters and fresco painters, for example (which discussed in more detail in Chapter 4, section 5.3).

2. Minoan water management systems: an overview

2.1 Cisterns

Cisterns are structures constructed to hold liquids, particularly but not exclusively to collect and store rainwater. Minoan cisterns are cylindrical in shape and have the capacity to collect and store rain or fresh water for household, agricultural and industrial use (Antoniou et al., 2006: 457). There are eight known cisterns (Nos. C1-C8; see Chart 1 and Table 2) at Anegyros (Driessen and Macdonald, 1997: 208), Archanes (Sakellarakis and Sapouna-Sakellarak, 1997: 112-115), Chamaizi (Davaras, 1972a, 1992; Lenuzza, 2011), Kato Zakros (Platon, 1971: 185-191), Myrtos-Pyrgos (Cadogan, 1978b, 2007), Nerokourou (Driessen and Macdonald, 1997: 125) and Tylissos (Hazzidakis et al., 1934: 62-64), which range in diameter from 2m to 5.25m (4.4m average), and in depth from 1.42m to 3m (2.4m average). The capacities of the cisterns range between 7,000 litres and 70,000 litres, with the average holding approximately 40,000 litres of water. The cisterns are generally constructed from local stone blocks, whereas the cistern at Chamaizi is cut directly into the bedrock and at Archanes, poros stone is used to construct the cistern. In many cases, a lining of some sort is used within the cistern to prevent the water from seeping out: five are lined with plaster (either white lime or another ‘hydraulic’ plaster or cement (lime and sand)). In three of the eight cisterns, stone steps (between five and ten) lead down into the cistern to provide ease of access to the surface of the water, but also to allow cleaning.

The cisterns are fed from two main sources, rain water and spring water; rainwater either falls directly into the cistern (meaning that the cistern itself was open to the rain, similar to a Roman impluvium when ‘inside’ a building) or is channelled into the cistern via conduits and drainage channels from an open surface such as a courtyard or roof-top, as is the case for the two cisterns Myrtos-Pyrgos. At Archanes and Kato Zakros, the cisterns are built ‘on top’ of a spring, and the water percolates up into the base of the cistern which is lined with either porous slabs (Kato Zakros) or pebbles (Archanes, Myrtos Pyrgos). At Tylissos, the cistern is filled via a complicated system of pipes and conduits which appear
to connect the cistern with an aqueduct providing spring water (Angelakis et al., 2006: 98-99) (see also section 2.5 below on Aqueducts).

With the exception of a very early and a very late cistern, the majority of the cisterns on Minoan Crete were in use during LM IA. Chamaizi is the oldest of the known cisterns, dating to MM IA - MM II and the cistern at Tylissos is the most recent, dating to LM IIIA – LM IIIB/C.
Chart 1 Visualisation of the comparable sizes of six of the Minoan cisterns (after Table 2)
<table>
<thead>
<tr>
<th>Cat. Number</th>
<th>Site</th>
<th>Date</th>
<th>Water Source</th>
<th>Diameter (m)</th>
<th>Depth (m)</th>
<th>Capacity (l)</th>
</tr>
</thead>
<tbody>
<tr>
<td>C8</td>
<td>Tylissos</td>
<td>LM IIIA-LM IIIA-C</td>
<td>Spring</td>
<td>5.4</td>
<td>3</td>
<td>68,734</td>
</tr>
<tr>
<td>C6</td>
<td>Myrtos-Pyrgos (2)</td>
<td>MM/MM IIIA/B</td>
<td>Rain</td>
<td>5.3</td>
<td>3</td>
<td>66,212</td>
</tr>
<tr>
<td>C2</td>
<td>Archanes</td>
<td>LM IA; LM IB</td>
<td>Spring</td>
<td>5.25</td>
<td>2.2</td>
<td>47,642</td>
</tr>
<tr>
<td>C4</td>
<td>Kato Zakros</td>
<td>LM IA – LM IB</td>
<td>Spring</td>
<td>5</td>
<td>1.42</td>
<td>27,892</td>
</tr>
<tr>
<td>C5</td>
<td>Myrtos-Pyrgos (1)</td>
<td>MM/MM IIIA/B</td>
<td>Rain</td>
<td>3.42</td>
<td>2.48</td>
<td>22,791</td>
</tr>
<tr>
<td>C3</td>
<td>Chamaizi</td>
<td>MM IB</td>
<td>Rain</td>
<td>2</td>
<td>2.2</td>
<td>6,914</td>
</tr>
<tr>
<td>C1</td>
<td>Anegyros</td>
<td>LM IA</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>C7</td>
<td>Nerokourou</td>
<td>LM IB</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Table 2 Summary of Cistern data (in order of capacity)

Interestingly, five of the eight cisterns occupy a dominant and/or central position within either the site or the building within which they are housed. At Chamaizi (Fig. 6), an unusual MM IA house that is thought to have been a multifunctional farmhouse inhabited by people of elite status (Lenuzza, 2011), the cistern lies at the centre of the courtyard which forms the very centre of the house. The location of the settlement is such that there were no nearby springs or wells and therefore the rain-water collected by the cistern, which probably collected water from an inward-sloping roof, would have been of vital importance (Davaras, 1992: 81; Lenuzza, 2011: 66). The choice to locate the cistern in the very centre of the building, instead of to one side for example, indicates that the building’s architects placed the cistern a) at the best possible place for access for all functional uses (domestic, industrial, religious); and b) is the simplest way to achieve maximum efficiency from the (proposed) inward sloping roof. In addition, Chamaizi is thought to be a defensible site (McEnroe, 2010: 34) and capable of being self-sufficient (to an extent). As such, the cistern is located in the most secure position in the entire building – right at the centre – whilst also ensuring a source of water should the residents be cut-off from outside.

The cisterns built during MM IB at Myrtos-Pyrgos (Fig. 7) are also prominently placed. Cistern 1 is situated five meters below the peak of the hill in a flat, paved courtyard on the southern side of a central building. While the exact nature and function of this building is unclear, as it was built over by a LM ‘Country House’ (Cadogan, 2007: 105), the
cistern is adjacent to a raised walkway\(^5\) that served as an approach to both the later Country House and the earlier central building, making the cistern “highly visible” to people using the path (2007: 107). Cistern 1 at the site was a much larger structure and while the cistern’s position is quite precarious – being partially built into the slope of the hill and projecting up from it – Cadogan suggests that this cistern (and indeed Cistern 1) may have played a significant symbolic and monumental role in the community, acting as a propaganda tool and even leading to “competitive, warlike reactions” from other communities (2007: 106).

Kato Zakros’ cistern is perhaps the most interesting of all in terms of its location, as it is the only example of a cistern being incorporated directly into the architecture of a palace, being centrally positioned in a hall named the ‘Hall of the Cistern’ (Fig. 8). Hitchcock notes that access to the cistern could only be gained via the central court and could be restricted though pier-and-door partitions, if desired (2000b: 174). In addition to its central and potentially private location within the palace, from within the fill of the cistern came two column bases which may suggest that the cistern was surrounded by a portico of some description (Platon, 1971: 187).

At Archanes, the cistern also appears to be within a palatial context, with Sakellarakis and Sapouna-Sakellaraki noting that the cistern was located within “an important part of the west wing” (1997: 113). However, as the vast majority of the palatial building at Archanes remains under the modern village, it makes placing the cistern’s exact context in palatial terms difficult.

### 2.1.1 Discussion

Despite the relatively small data set, there are some interesting patterns that can be identified within the group as a whole. These patterns focus, broadly speaking, on where a cistern is located within a site and how the cistern is accessed.\(^6\)

First, we can see a distinction between those cisterns that are ‘meant to be seen’ and those that are ‘hidden’ from ordinary view. At Myrtos-Pyrgos, both cisterns are noted by Cadogan to be in “highly visible” places; one cistern is placed in a courtyard of an earlier

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\(^5\) Raised walkways are also referred to as ‘Corridors of Procession’ (Marinatos, 1984, 1987) and are indicated to have had a ritual/ceremonial purpose. Palyvou notes, however, that such causeways also appear in more urban contexts and may have functioned as directional paths which lead a person to the ‘hub’ of a town or site via the most direct route (2004: 214). Their use in ritual is not negated, but it is not necessarily their raison d’être (Palyvou, 2004: 214).

\(^6\) Patterns in the capacity and date of the systems will be discussed in more detail in Chapter 4 with regard to the potential political function of the systems.
central building (2007: 107, 2011: 47-48) which, during its later life, is kept intact (despite
destruction/re-building of the central building) and remains visible on the approach to the
later Country House which goes on to occupy the space of the earlier central building.
During this time, the cistern has ceased to function as a water management system and is,
instead, filled with water-worn pebbles (presumably from the river below the settlement). 7

The second cistern at Myrtos-Pyrgos, is built directly into the slope of the hill, and surely
would have been a formidable sight to anyone looking up at the site from further down the
hill or in the valley below.

At Kato Zakros, however, the substantial cistern is located not only within palatial
confines but built inside and therefore would not have been visible to the public. The use of
pier-and-door partitions means that the cistern could also be closed off from the central
court as required. Perhaps then, we can see a distinction in function being made – between
those cisterns which are external and ‘public’ to those which are internal and ‘private’. At
Kato Zakros, its location within a palace building, but being able to be viewed from above
from an upper level or from the central court if the pier-and-door partitions were to be
open, suggests that whatever the role of the cistern, it was imperative that it could be both
public (in terms of being viewed by a number of people) and private. This could indicate
that the function of the cistern here could have had a semi-public purpose, perhaps having
a ceremonial or religious function.

Minoan cisterns clearly have a number of different functions: their size and
prominence is indicative of the time and resources put into their creation as well as their
relative importance. Not only do we see that cisterns could be used as a propaganda tool –
as a means of displaying wealth – but also, potentially, their use in public or private
ceremonial acts. These socio-political and the ritual and religious aspects of their function
will be discussed in more detail in Chapters 4 and 5 of this thesis.

2.2 Wells

Broadly speaking, wells are defined as a hole dug into the ground in order to access
groundwater (Misstear et al., 2006: 6, box 1). The evidence for Minoan wells is relatively
sparse; while at the more extensively excavated sites such as Knossos and Palaikastro the
number of wells seems to indicate that the Minoans favoured this water management

7 Cadogan notes that it would have been clear to the people of Myrtos-Pyrgos that this cylindrical feature was,
at one time, a cistern (2007: 107).
option over other systems, at small palatial and non-palatial sites, there is a paucity of evidence for their use. It is likely to be the case that many more wells exist however, they are difficult to detect in the archaeological record as many wells are dug straight into the bedrock and do not have a built well-head which would make them more easily recognised. Equally, if the well dries up and is filled in or built over, it makes it all the more difficult to detect. Lastly, it is feasible that many wells were built in the countryside surrounding settlements and are unlikely to be discovered unless part of a wider excavation or survey project.

In total, 21 Minoan wells are known (Nos. W1-W21; see Table 3, Chart 2), with eleven of these being at Knossos (Figs. 9 and 10) and five at Palaikastro (Fig. 11). The depths of these wells vary from 2m to 19.4m with an average diameter of 1.25m. The shaft of the well is dug directly into the bedrock, with the upper sections of the well-shaft finished with stone blocks or slabs. Usually, a stone well-head is constructed around the opening to prevent the well from eroding at the surface and to provide a platform from which the water could be drawn.

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8 It is worth noting that many of the wells both discussed here, and in the Database, are described in little or no detail by their excavators. Indeed, many of the smaller or less ‘architectural’ wells are merely noted in passing and basic details like their size, fill and exact location are not remarked upon.
<table>
<thead>
<tr>
<th>Cat. Number</th>
<th>Site</th>
<th>Date</th>
<th>Water Source</th>
<th>Diameter (m)</th>
<th>Depth (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>W1</td>
<td>Amnissos</td>
<td>LM I - LM III</td>
<td>Spring</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>W2</td>
<td>Chania</td>
<td>LM I B</td>
<td>-</td>
<td>-</td>
<td>-</td>
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<tr>
<td>W3</td>
<td>Kato Zakros</td>
<td>LM IA – LM IB</td>
<td>Spring</td>
<td>1.4</td>
<td>2</td>
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<tr>
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<td>MM III B- LM III B</td>
<td>Groundwater</td>
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<td>13.4</td>
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<td>EM III/MM I A</td>
<td>Groundwater</td>
<td>1.5</td>
<td>19.4</td>
</tr>
<tr>
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<td>MM I A</td>
<td>Groundwater</td>
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<td>2</td>
</tr>
<tr>
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<td>EM I</td>
<td>Groundwater</td>
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<td>17.2</td>
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<tr>
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<td>Knossos (5)</td>
<td>MM III</td>
<td>Rain</td>
<td>1</td>
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<td>Knossos (6)</td>
<td>LM I B</td>
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<td>-</td>
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<td>Knossos (10)</td>
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<td>-</td>
<td>1</td>
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<td>-</td>
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<td>10.4</td>
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<td>LM I</td>
<td>-</td>
<td>-</td>
<td>-</td>
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<td>W16</td>
<td>Palaikastro (1)</td>
<td>LM I B - LM III A</td>
<td>Groundwater</td>
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<td>6.2</td>
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<td>Palaikastro (4)</td>
<td>MM III B- LM I A</td>
<td>Groundwater</td>
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<td>4.5</td>
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<td>Palaikastro (5)</td>
<td>LM I</td>
<td>Groundwater</td>
<td>2</td>
<td>3.7</td>
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<tr>
<td>W21</td>
<td>Vasiliki</td>
<td>EM - EM III</td>
<td>Groundwater</td>
<td>1</td>
<td>8</td>
</tr>
</tbody>
</table>

Table 3 Summary of well data
Chart 2 Diameter and Depths of wells by site (after Table 3)
As is to be expected, the vast majority of Minoan wells are used to access groundwater, however, there are three exceptions to this in the corpus. At Amnissos, the LM I well is spring-fed (Knoblauch and Schäfer, 1992: 154); so too is the well at Kato Zakros. While at Knossos, the well in the ‘Court of the Stone Spout’ (Fig. 12) is thought to have been fed by rainwater, rather than by groundwater, or from an additional source via the stone conduit and stone spout which was found directly above and behind it⁹ (Evans, 1921: 380).

Wells are a consistent feature of Minoan water management practice from the earliest periods through to the very latest. The earliest constructed wells date to EM I (Vasiliki and Knossos), while the majority of wells were constructed between MM IB and LM I. While they are a relatively simple method of accessing groundwater, compared to other Minoan water management technologies, a number of wells were incorporated into other structures, employed quite complicated construction techniques, or were located in areas of significance. These wells deserve to be explored in more detail.

The well at Kato Zakros (Fig. 13), located in a room at the south-east corner of the central court, is contained within its own rectangular enclosure (leading Platon to call it The ‘Unit of the built well’ (1971: 196)). This small (1.4m x 2m) circular well is approached by a short set of stairs, at the bottom of which is a small platform for drawing water. Not only is this well enclosed, unusually it is also lined with small stones and its floor is paved with porous slabs. In a similar way to the cistern at Kato Zakros, the water in the well percolates up through the porous slabs from a spring below but the water was accessed via a pitcher on a hoist (Platon states that evidence for a wooden hoist was discovered, secured by the balustrade and the south wall, within the enclosure (1971: 196). This is certainly a possibility given the water logged nature of the site. However, it must be noted that this hoist is now lost. No other wooden hoists have been found at this or any other well-site). This well is therefore almost a hybrid between a cistern and a well; like the other wells, water was accessed via some kind of hoist and container and its primary function was the provision of water, unlike many of the cisterns, which could have had additional functions. However, like many of the cisterns, it is relatively shallow and is both lined and paved at its base.

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⁹ Indeed, Evans considers this well to be a ‘blind-well’ or ‘settling tank’ – a structure used to receive overflow water from drains and conduits and from its surrounding area – rather than a water-well in the traditional sense (1921: 380). Evans also hypothesises that the well itself must have also had some kind of overflow system in place which would have fed into the main drainage system at Knossos (1921: 380).
The enclosing of a well within another structure can also be seen at Amnisos (No. W1). Here, an unusual rectangular well shaft is ‘enclosed’ on three sides by a roughly triangular ‘raised walkway’ (an external wall of cut stones filled in with coarse rubble - approximately 3.5m wide) (Fig. 14). Knoblauch and Schäfer (1992: 154) envisage that the ‘well-house’ had a roof, with the walkway providing the foundation for roof supports (although there is no archaeological evidence for wooden beams or column bases in this area). They also hypothesise that the shaft was ‘closed off’ from three sides of the walkway to protect the shaft from debris and erosion (1992: 154). As such, access to the water in the well was via a set of conjectural steps which led down to the water level on the well’s eastern side. Alternatively, a ledge or ‘overhang’ on the northern wall of the well shaft could have provided the location for a pulley system to hoist up water pitchers (Knoblauch and Schäfer, 1992: 154). This unusual triangular enclosure or walkway surrounding the well-shaft could also be linked to a cave entrance nearby (approximately 12m north) which has been altered into a rough ‘pointy’ arch shape. While no Minoan archaeological material was found in the cave, it is possible that the well and the cave could have been connected via the boundary wall or walkway surrounding the well shaft (Knoblauch and Schäfer, 1992: 155).

At Knossos, one of the wells stands out as being unique in its construction. This MM III well (No.W14), is 10.4m deep and is lined with 17 terracotta cylinders or drums which effectively ‘line’ the shaft of the well (Fig. 15). Each drum is 60cm high and is constructed from three separate sections; each drum section is marked with an incised sign\(^{10}\), which presumably were used to indicate how the sections fitted together. Each drum has a triangular hole cut into it (Fig. 16), which Evans identifies as foot and hand holes which could be used so that the well could be easily accessed for cleaning purposes (1930: 256). Interestingly, the terracotta drums were not poorly made or crude in any way; indeed, Evans notes that upon first glance he thought the drums were made of a close-grained stone because they were so hard and so finely made (1930: 255), whilst Angelakis and colleagues remark that the terracotta was imitative of ashlar masonry (2012: 239). Whereas a very similar terracotta-lined Mycenaean well is known from a ‘palatial’ courtyard at Phylakopi, Melos (Evans, 1930: 257; MacKenzie et al., 1899: 13-14). To date, the cylinder well at Knossos is the only known example of a Minoan well which is lined in such a complex way and offers a sophisticated approach to both witholding the pressure of the

\(^{10}\) Evans identifies these signs as including “a sloping form of N and a kind of W – and a double X”. He also notes two other signs which have been recognized in later Minoan scripts (Evans, 1930: 256).
surrounding soil and to limiting the loss of water though seepage, whilst allowing for the well to be accessed for cleaning and maintenance.

Two other wells from Knossos have been found in prominent locations: one well (No. W4) appears to be sunk into the floor of the portico of the ‘Hall of the Double Axes’ – an area thought to be associated with processions and rituals of a religious nature (Macdonald, 2010: 538; Marinatos, 1993: 64-68); the second well (No. W8) is built within the ‘Court of the Stone Spout’ just off the north-west corner of the Central Court, the well being directly accessible from it.

At Palaikastro, two LM IB wells (Nos. W16 and W17), one considerably larger than the other, are located very near a space formerly occupied by Building 6 which was dismantled during the LM IA period (see Fig.11). This building was an unusual MM IIIA complex which included a monumental paved entrance, central court with plastered surface bordered by a paved colonnade and a large paved hall with pier-and-door system (MacGillivray et al., 1998: 233). Following its dismantling, and after the eruption of Thera, the building and the surrounding area becomes an open space. It only becomes enclosed by a boundary wall during the LM IA period (MacGillivray et al., 1998: 226). With the exception of the two wells, no other architectural feature is built in this demarcated area post LM IA. While Cunningham notes that this area could have served as an “urban pasture” (2007: 109), MacGillivray and Sackett consider the possibility that the area surrounding Building 6 was a ‘walled enclosure’ and set aside for “some special function” (2007: 223).

Two other wells at Palaikastro are also to be noted, as they are set either inside buildings or within a building’s confines. One well (No.W18) (Fig. 17) is located within Room 11 of Building 5 – this building, in its later phase (LM IB) is turned into a town shrine in which the famous Palaikastro Kouros was found (Driessen, 2000). During the period the well was in use, Room 11 was a large central room with pier-and-door partitions on three of its sides, the well being close to the centre of the room. It is thought that during the well’s period of use (early LM IA), this part of Building 5 could well have been an open area/open court yard (MacGillivray et al., 1991: 126). The second well (No.W19) is found within an open courtyard connected with House/Area 4 (Fig. 18) – an important building with a lustral basin, ashlar façades and a Palaikastro Hall.11

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11 A ‘Palaikastro Hall’ is a square or rectangular room which can be accessed from the outside but could also act as a transitional room to secondary apartments. It is distinguished, from ‘Minoan Halls’ by the presence of
2.2.1 Discussion

Minoan wells are a difficult group to assess and analyse. The majority of the data for this group comes from only one site, Knossos, and in many cases there is limited information on any finds from inside or around the wells or their precise location (particularly outside of palatial confines). However, we can draw some preliminary conclusions from the evidence we do have. First, there does appear to be a distinction between the public and private use of wells. Clearly, the wells within the palace at Knossos were for the sole use of palace ‘residents’, while the ones in the surrounding countryside are more likely to have been more public sources of water. The depiction of a well from the West House, Akrotiri, which is the only known Minoan or Theran representation of a water management system, appears to be in a more public location (see Chapter 3, 4.1 and Fig. 44). But within this division, we can also see a further distinction: the well in the Hall of the Double Axes, for instance, is perhaps for the specific use of the people using/inhabiting that hall. Similarly, at Palaikastro, the wells found within specific building complexes, such as Building 5 and House 4, were also for the ‘private’ use of these buildings. Aside from the wells’ more practical function, these distinctions are perhaps indicative of different and perhaps more specific functions, such as providing water for special rituals or for washing before entry to specific, perhaps sacred spaces. The enclosing of specific wells, such as at Amnisos and Kato Zakros, may also suggest that the water contained in these wells was special in some way. These ideas will be discussed in more detail in Chapter 5.

It is unfortunate that there is so little information on wells outside of palatial or large site contexts, as it is difficult to identify any substantial or consistent patterns that can be tested on a larger, island-wide scale. It seems highly likely that wells were also constructed in towns and villages where groundwater could be readily accessed, but these wells have either been ignored in the archaeological record, or have been filled in or used for other purposes, such as rubbish pits, if the water source dries up or other more productive water management systems are made.

four column-bases which are set at the four corners of a square or rectangular paved shallow ‘basin’ (to be discussed below in section 2.4) (Driessen, 1999: 229).
2.3 **Spring Chambers**

Though they are relatively few, the square, enclosed structures referred to in the archaeological literature as ‘spring chambers’ warrant their own separate category as they are an unusual and distinctive type of Minoan water management system. Like some cisterns, spring chambers are used to collect and store spring water, and provide the means to draw the water via steps. They have, however, considerably smaller potential capacities, suggesting that their function was less about amassing significant quantities of water, and more about providing a built space in which spring water could be accessed. The spring chambers at the Caravanserai, Knossos and Kato Zakros hold 378 litres and 7,752 litres respectively; quantities dwarfed by the contemporaneous cisterns at Archanes and Kato Zakros, holding 47,642 litres and 27,892 litres respectively. The most striking key to the identification of spring chambers as a separate category from both cisterns and sunken baths (discussed below) is that the rectangular basins, into which spring water percolates or is fed, are enclosed within their own small chambers. In both cases, these enclosures contain niches and ledges in the walls surrounding the draw basin, which appears to be unique to spring chambers.

The spring chamber at the Caravanserai, Knossos (No.SC1) is a gypsum chamber which encloses a sunken gypsum basin, the basin itself being lined with pebbles (the spring water percolates up from below though the pebbles into the basin) (Fig. 19). Access to the basin was via a small flight of three steps and surrounding the basin on three sides are gypsum slabs which form a drawing platform. At the rear of the chamber is a square niche cut into the stone which is flanked by two ledges. At Kato Zakros\(^\text{12}\) (No.SC2), the rectangular spring chamber is carefully constructed in ashlar masonry (Fig. 20). Here, a flight of fifteen stairs leads down to a water basin where water percolates up from below.

\(^{12}\text{It must be noted here that Platon’s description of the spring chamber presents significant difficulties. He tends to use ‘Spring Chamber’ and ‘Well of the Fountain’ to differentiate between a small room into which spring water emerges and the built chamber where this water was channelled (1971: 192-193). Elsewhere, he appears to use ‘Spring Chamber’ to refer to both installations (1971: 195). This issue is further complicated by an error in Platon’s numbering of his general plan of the palace (1971: 80-81), where the Spring Chamber (LXXI) and the Well of the Fountain (LXXII) are mislabelled LXVII (‘Storeroom’, which is located in the north-east of the palace) and LXVIII (‘Enclosure with service installations’, also in the north-east of the palace). This confusion is replicated in different ways by the subsequent literature (Gesell, 1985: 140; Schofield, 1996: 31). In my Database of water management features, the entry for the Kato Zakros spring chamber (No. 31) considers the main chamber and its ancillary chamber (previously the ‘Store Room’) as one, single feature.}\)
the paved floor (in fact the water is channelled in below the floor from an opening in the northern wall of the room). Again, like at the Caravanserai, a projecting ledge surrounds the water basin, possibly providing a platform from which to draw water.

It is difficult to draw any solid conclusions or note any significant patterns when dealing with only two known examples of spring chambers. However, some points of note can be made in terms of their location and their access. At Knossos, the spring chamber is the western-most structure of the Caravanserai, but is also separate from it. It stands alone and is unconnected with the main building. While at Kato Zakros, the spring chamber could be reached via a corridor from the Central Court of the palace, with the chamber itself being in an open-air space, perhaps a court (Schofield, 1996: 30).

While there is no evidence at Kato Zakros that admittance to the water in the spring chamber was controlled in any other way than how it was approached, water within the spring chamber at Knossos was restricted by a door at the bottom of the steps (Schofield, 1996: 29).

2.3.1 Discussion

Clearly, spring chambers are rare, and therefore to derive any patterns of use is very difficult. However, the most striking feature of these two systems is their similarity. They are very similar in construction and both appear in contexts which have further associations with water management and consumption. In both cases, the spring chambers are in open courts where it is unclear as to exactly who could access the water: at Kato Zakros, the spring chamber appears in an area of the palace which has been substantially damaged or is unexcavated. The court in which it sits could be part of the palace, but could equally have been an area which was open to the rest of the community. Similarly, at the Caravanserai, the spring chamber sits in an open courtyard at the front of the main building complex. Much like the rest of the Caravanserai, it is unclear as to exactly who could access the facilities and the water there. However, the architecture and fine materials used in the construction of both the spring chambers, along with their luxurious surroundings (the palace itself and the opulent Caravanserai building), suggest that the spring chambers were not intended to be used by the general public, but were to be used by more elite members of society. It is worth noting here that some scholars have suggested that Kato Zakros was under Knossian control or influence (Platon, 2002: 145-147,151-153; Warren, 1999: 902).13

13 Other scholars such as Cunningham (2001) and Schoep (1996: 85) argue for more regional control and the separate development of areas such as Kato Zakros.
If this were the case, we can see here the replication of Knossian style and architecture at Kato Zakros. If it is not the case that Kato Zakros was directly under Knossian rule, we could still envisage the style and perhaps function of the spring chamber from the Caravanserai being emulated at Kato Zakros, as they are so close in architecture and material construction. Further discussions on the spring chambers’ architecture, position and use and their potential socio-political and religious functions appear in Chapters 4, 5 and in the Conclusion.

2.4 Sunken Baths and Basins

Minoan sunken baths and basins are a difficult group of water management systems to address as they can be hard to distinguish from other built depressions in the archaeological literature, and in particular from one of the most well known features of Minoan architecture, the lustral basin. These rooms – with a sunken floor, often lined with gypsum, plaster or cement and reached via a dog-leg or L-shaped staircase – have been considered to be ritual bathing areas (Fig. 24). Scholars such as Graham (1987: 99-108) and Platon (1971: 183) argued, following Evans’ initial understanding, that they were used for ritual bathing or the pouring of libations. This perception has, however, been challenged with many scholars noting that all lustral basins lack drainage and are inconsistent in their use of water-resistant lining, meaning that bathing and the pouring of libations would be at the very least, problematic (Marinatos, 1993: 78). In addition, there appears to be a lack of finds associated with the specific act of libation within these chambers. As such, the idea that these enigmatic sunken rooms were areas for bathing, libation or ritual cleansing is now largely avoided. Rather, scholars such as Marinatos (1993: 77-87) and Gesell (1985: 25) propose that the room was used as part of a ritual which involved the physical separation of a person from the normal environment. While the exact function of the lustral basin or adyton is not yet known, evidence suggests that it was unlikely to be the location of ritual bathing or lustration. As such, I do not consider lustral basins to be a ‘water management system’ and will not include them in my investigation.

All of the identified basins or baths which I consider to be water management systems, appear within the MM III to LM I period and all share a similar basic construction (see Table 4): usually a rectangular ‘basin’ is sunk into the floor of a room or area. The

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14 Arthur Evans first coined the term based on a number of unguent flasks found at one example (Evans, 1930: 8-9).
basin is usually constructed out of stone slabs. Only two of the basins, Mochlos (No.SB2) and Palaikasto (No.SB3), are lined with plaster. The three basins at Palaikastro (Nos.SB3-SB5) are the most uniform: each square basin is set into the floor of a room and is lined with stone slabs (Fig. 21). The floor surrounding each of these three basins is paved with square slabs and at the four corner slabs are column bases (each basin, therefore has four column bases), and though all three are rain-fed, only one has any drainage. The column bases and their position within the large central rooms of houses suggests that these basins functioned mainly to catch rainwater from an open light well and formed the central feature of what Driessen terms the ‘Palaikastro Hall’ (see footnote 11) (1999: 229).

At Mochlos (No.SB2), a similar style of sunken basin can be found to those at Palaikastro. Here, a rectangular basin is located in the floor of a large room with two column bases, either side of a triangular slab of purple schist marked with shallow holes, at two of the corners of the basin (Fig. 22). While the basin is likely to be hand-fed, as the room is on the second floor of the building, it is unclear if the area directly above the basin was open (Soles and Davaras, 1996: 197-189). As such, it is possible that the basin could have been rain-fed in a similar way to the basins at Palaikastro. A drain leading from the basin and out of the eastern façade of the building emptied the contents of the basin into the street below.
<table>
<thead>
<tr>
<th>Cat. Number</th>
<th>Site</th>
<th>Date</th>
<th>Water Source</th>
<th>Drain</th>
<th>Shape</th>
<th>Dimensions</th>
<th>Approx. capacity if known (l)</th>
<th>Column Bases</th>
</tr>
</thead>
<tbody>
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<td>Caravanserai, Knossos</td>
<td>MM III/ LM IA</td>
<td>Spring water</td>
<td>Yes</td>
<td>Rectangular</td>
<td>Length: 1.52m, Width: 1.38m, Depth: 0.45m</td>
<td>943.92</td>
<td>No</td>
</tr>
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<td>Mochlos</td>
<td>LM I</td>
<td>Hand/Rain fed</td>
<td>Yes</td>
<td>Rectangular</td>
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<td>125 (min), 1000 (max)</td>
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<td>LM IA</td>
<td>Rain fed</td>
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<td>Yes</td>
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<td>Rain fed</td>
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<td>-</td>
<td>Yes</td>
</tr>
<tr>
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<td>Rain fed</td>
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<td>Yes</td>
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<td>Hand fed</td>
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<td>No</td>
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<td>Zou</td>
<td>MM IIIB/ LM IA</td>
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<td>Yes</td>
<td>Oval</td>
<td>Length: Unknown, Width: Unknown, Depth: Unknown</td>
<td>-</td>
<td>No</td>
</tr>
</tbody>
</table>

Table 4 Summary of sunken baths and basin data
The basin at Pseira (No.SB6) shares many of the characteristics of those at Palaikastro and at Mochlos. Here, however, a stone drain leads from the basin into the lower strata of the floor rather than out of the room and out of the building (Betancourt and Davaras, 1988: 212). Two low stone benches flank the basin on its northern and eastern sides, suggest that the pouring of liquids into this basin and subsequently into the floor of the room, had a performance element.

The two remaining basins are significantly different in character from those described above. At Zou (No.SB7), the basin is oval in shape with upright slabs making the basin freestanding compared to the sunken basins discussed above. The basin here is hand-fed and a slate-covered stone drain serves to remove liquid from the basin. At the Caravanserai, Knossos (No.SB1), the sunken basin is of a more monumental style and character than all the other basins. Contained within a narrow, open-ended hall adjoining the western edge of the ‘stepped pavilion’ of the Caravanserai, the large rectangular basin (1.52m x 1.38m wide; 0.45m deep) could be accessed from the north via an external court by three descending steps, and by a flight of five steps from the southern internal court of the complex (Fig. 23). The basin’s sides are constructed from fine ashlar masonry while the bottom is paved with gypsum slabs. A small stone trough on the northern edge of the basin is almost adjoined to the basin but appears outside the open-ended hall (Evans considered the trough to be a water-trough for use by animals (1928a: 119)). Unlike the other sunken basins, this example is fed by spring water via a complex system of conduits and pipes and could be plugged by a stone ‘bung’ to fill the basin to a higher, consistent level. Rather than being a system to manage the problem of rainfall in an open court or for the dispensing of water or other liquids, this basin seems to have had a much more active function, and appears more so than the others, to be a source of spring water.

2.4.1 Discussion

The relatively small data-set of Minoan sunken basins again presents difficulties in highlighting substantive patterns. That being said, the three basins at Palaikastro are undoubtedly part of a well established architectural format – the Palaikastro Hall. The function of these basins is clearly connected to the collection of rain-water from the open light well. However, it must be noted that only one of the basins had any means (a drain) to remove the water from the basin and to prevent it from overflowing during periods of heavy rain. The basins at Pseria and Mochlos could be related to a more religious function:
the basin at Pseira with its associated benches and drain leading into the floor of the room, rather than outside; at Mochlos, the basin which is on an upper floor is directly above a pillar crypt and could be associated with ritual activities associated with it. The sunken basins, as an architectural form, appear to have served a number of different functions, depending on their surrounding environment, ranging from the more practical aspects, such as the catching of rainwater, to more religious or ritual functions. At the Caravanserai, the basin fed by a spring appears to be the only sunken basin which provided water. The possible purpose of this basin is discussed in Chapter 5 and the Conclusion.

2.5 Aqueducts

While a number of scholars argue that Minoan hydraulic technology also included the transportation of fresh water across great distances using aqueducts at sites such as Gournia, Karphi, Malia and Mochlos (see in particular Angelakis et al., 2006; Angelakis et al., 2007; Angelakis, Dialynas, et al., 2012: 232-233; Mays et al., 2007: 3-4), the evidence for such Minoan aqueducts is problematic given that archaeological evidence is scant – simply a few terracotta pipes or stone conduits. However, more detailed archaeological evidence may suggest that a form of aqueduct was employed at the palace of Knossos and at Tylissos (see Table 5).

At Knossos (No.A3), a small collection of rectangular enclosed stone conduits (approximately 0.35m wide and 0.70m deep) were discovered approximately 400m south-west of the palace running along the western edge of the Vlychia ravine. Evans noted that the conduits lay very close to the Mavrokolybos spring, providing a steady supply of spring water, and would have also been ideally situated, being approximately 150m above sea-level, to take advantage of the natural downward slope towards Knossos palace and could have been the palace’s source of fresh spring water (1928b: 462-463). It should be noted, however, that there is no archaeological evidence for the continuation of the conduit closer to the palace.

At Tylissos (No.A6), a number of terracotta filtration pipes (filled with charcoal) found near the Saint Mama spring, approximately 1,400m north-west of Tylissos, may suggest that this location was the source of water for the cistern found within Tylissos, which is associated with a number of long stone conduits and pipes (Fig. 25). As with

15 In many cases authors simply state, without citing any archaeological data, or indeed any other form of reference, that there was an aqueduct (see in particular the discussion of an aqueduct at Malia by Angelakis et al., 2006: 99).
Knossos, no further evidence of pipes or conduits are found closer to the site which would directly connect the two locales.

<table>
<thead>
<tr>
<th>Cat. Number</th>
<th>Site</th>
<th>Date</th>
<th>Water Source</th>
<th>Total Potential/Approximate Length (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1</td>
<td>Gournia</td>
<td>-</td>
<td>-</td>
<td>7,000</td>
</tr>
<tr>
<td>A2</td>
<td>Karpfi</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>A3</td>
<td>Knossos</td>
<td>MM</td>
<td>Spring</td>
<td>700</td>
</tr>
<tr>
<td>A4</td>
<td>Malia</td>
<td>-</td>
<td>Spring</td>
<td>2,400</td>
</tr>
<tr>
<td>A5</td>
<td>Mochlos</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>A6</td>
<td>Tylissos</td>
<td>-</td>
<td>Spring</td>
<td>1,400</td>
</tr>
</tbody>
</table>

Table 5 Summary of Aqueduct data

2.5.1 Discussion

Given the relative paucity of, and lack of quality in, the evidence for Minoan aqueducts, it is difficult to make any substantive claims. However, what little archaeological evidence we do have, both from possible aqueducts and from other water management systems, would certainly suggest that Minoan engineers had the technology and hydraulic expertise to construct aqueducts and to use them to supply fresh water to their palaces and settlements (also see discussion below on Minoan hydrological knowledge). In some cases, such as the aqueducts serving Gournia and Malia, the sheer distance covered by the aqueduct was a substantial feat in itself and the aqueduct may have been a well-known landmark in the area. Potentially, therefore, the long-distance aqueducts could have been a symbol of the palace in more remote areas, or even considered as a mark of prestige. Despite these potentially interesting lines of enquiry, the lack of evidence means that I am unable to use the available aqueduct data further.

2.6 Dams

The classification of dams is more straightforward than other water management systems, as they are easily identified by their purpose. Dams impede the flow of surface water in order to protect low-lying land at risk of flooding, to create artificial reservoirs, or a combination of both. This dual purpose is well suited to the Cretan environment, in which both the scarcity and periodic over-abundance of water is an issue.

There are seven Minoan dams on Crete at four different sites – Chalinomouri, Choiromandres, Gournia and Pseira islet (Fig. 26) (Nos. D1-D7; see Table 6) all of which are constructed within valley ravines, which during the rainy summer months channel
torrential deluges down the valley and into the countryside. Minoan dam construction is relatively simple: a megalithic wall is built in a stream-bed, large enough to span the distance between the two sides of the ravine. The wall itself may be constructed from large boulders and rocks, which are held together with a packing of smaller stones and mud, or otherwise may be made of two outer walls with a packing in the middle (usually of small stones, broken pottery sherds, soil etc.) which together form a large singular wall. In order to withstand the powerful flow of the water, and the pressure created by the volume of water held behind them, dam walls must be of sizeable proportions: heights vary from 1m to 3.62m; widths range from 1.2m to 4m; and lengths vary from a modest 9.4m to a considerable 27m.

At Choiromandres (Nos.D2 and D3) and Gournia (Nos.D4 and D5), the dams form part of a wider water management system. Both of these sites have two separate dams within the same ravine. At the upper end of the Choiromandres valley ravine lies the first large dam wall, while at the lower end, a second wall bridges the stream bed. Between these two dams are additional short walls which project from the sides of the ravine parallel or perpendicular to the stream bed (Fig. 27). These walls slow the flow of water rushing down the ravine so as not to put too much pressure on the main dam walls. In addition, these walls create small pools of water – mini reservoirs – which can be utilised in addition to the main water reservoirs at the top and bottom of the ravine (Chryssoulaki, 2011). Indeed, steps and ramps found on the southern side of the ravine may have provided easier access to these small reservoirs (Chryssoulaki, 2011). The use of short walls in addition to the main dam is not restricted to the system at Choiromandres. On the islet of Pseira (Nos.D6 and D7) in the Gulf of Mirabello in north-eastern Crete, two separate ravines, ‘Dune Creek’ and ‘Middle Creek’, both contain a large stone and soil dam and smaller walls (from 2.24m to 11.02m in length) which jut out into the stream-bed of the ravine (Betancourt, 2012: 34, 43) (Fig. 28).

<table>
<thead>
<tr>
<th>Cat. Number</th>
<th>Site Name</th>
<th>Date</th>
<th>Construction</th>
<th>Height (m)</th>
<th>Length (m)</th>
<th>Width (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>D1</td>
<td>Chalinomouri</td>
<td>LM I</td>
<td>Earth dam</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>D2</td>
<td>Choiromandres</td>
<td>neo 1750-1430</td>
<td>Megalithic walls</td>
<td>3.1</td>
<td>27</td>
<td>-</td>
</tr>
<tr>
<td>D3</td>
<td>Choiromandres</td>
<td>neo 1750-1430</td>
<td>Megalithic walls</td>
<td>3</td>
<td>-</td>
<td>1.2</td>
</tr>
<tr>
<td>D4</td>
<td>Gournia</td>
<td>LM I</td>
<td>Outer walls of 'cyclopean' boulders with packing</td>
<td>1.4</td>
<td>-</td>
<td>4</td>
</tr>
</tbody>
</table>
Table 6 Summary of dam data

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th>Outer walls of 'cyclopean' boulders with packing</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>D5</td>
<td>Gournia</td>
<td>LM I</td>
<td>1</td>
<td>9.4</td>
<td>1.9</td>
<td></td>
</tr>
<tr>
<td>D6</td>
<td>Pseira</td>
<td>LM I</td>
<td>Stone and soil wall</td>
<td>3.62</td>
<td>15.5</td>
<td>2.65</td>
</tr>
<tr>
<td>D7</td>
<td>Pseira</td>
<td>LM I</td>
<td>Stone and soil wall</td>
<td>2.7</td>
<td>11.85</td>
<td>3</td>
</tr>
</tbody>
</table>

Betancourt notes that the pools created by the short walls could have provided a convenient place for livestock to drink but also could have been “cross-channel terraces” that were used as small plots for the growing of crops (2012: 35), while Chryssoulaki suggests that “small-scale manufacturing units” could have used the collected water during periods of mild flow (Chryssoulaki, 2011). Indeed, three of the four dam sites are also associated with terracing: at Choiromandes, there are approximately nine Minoan agricultural terrace walls along the ravine on either side of the streambed; to the east of the dam and streambed at Gournia are a number of Protopalatial-Neopalatial agricultural terrace walls which take up the vast majority of this space. On Pseira, terracing occupied large areas of the island (ca. 60-70% of the entire island (Clark, 2004: 49)) and indeed Minoan terrace walls are found uphill of the dam in ‘Middle Creek’ (No.D7) and 70m south-west of the dam in ‘Dune Creek’ (No.D6). While these three dam sites are closely associated with terracing, no form of irrigation system – which would directly link the provision of storing water with agricultural production – is present. However, Betancourt believes that water must have been carried by hand from the dam system to where it was needed in the fields (2012: 42).

Aside from their association with terracing, five out of the seven dams are linked with additional buildings or structures. At Chalinomouri, a LM IB farmhouse is located near to the earth dam which crosses the ravine; while at Choiromandes, a more substantial set of buildings and structures is associated with the two dams in the ravine (see Fig. 27). Here, a large megalithic enclosure wall (over 540m long in total) which encompasses an area of approximately 35,000 m² encloses all the terraced fields and the riverbed. While the dam at the top of the riverbed is not enclosed within this wall, the second dam further down the riverbed is constructed from the megalithic wall – in effect the wall crosses the riverbed and acts as a dam (Chryssoulaki, 2011: ‘water works’). At the western edge of the enclosure wall is a Protopalatial ‘guard-house’ (which during the Prepalatial period was a ‘rural shrine’ (Evely, 2008: 94)) which, at the time of the dam’s construction further up the
ravine, had a distinctively elite overtone with finds such as fine seal stones and pottery of palatial quality (Evely, 2008: 94). Interestingly, during a period when the guard-house was re-built following an earthquake (LM IA/LM IB), an additional enclosure wall was built to the south-west of the guard-house which terminated in a small ‘tower’ (Chryssoulaki, 2011: ‘timeline’). At Gournia, a very similar pattern is repeated: approximately 200m east of the dam and the riverbed is a promontory with a substantial wall (1.30-1.70m wide, 27m long) and ‘buttress tower’ which is built up against the north face of the wall (Watrous, 2012: 531). To the west of this tower on another promontory is the LM I ‘Shore House’ – a monumental building constructed in white limestone complete with two large galleries (Watrous, 2012: 527). Alongside the tower and the Shore House, and slightly further inland, are a number of ‘fortification walls’ which run in parallel to the coast line – behind these walls lie the agricultural terraces discussed above.

2.6.1 Discussion

With three out of the four dams discussed above being associated with terracing, it is clear that the two are connected in some way. Whether the dams were created to serve the terracing, or whether the agricultural terracing was created to make use of the stored water created by the dams’ retaining walls, is unclear. The lack of drainage channels from the reservoirs to the agricultural terraces is notable, but is perhaps explained by the steep and often uneven terrain. It should also be noted, that terraces do not necessarily require drainage channels, as the depth of the soil created by the terrace should be sufficient to retain more water (Betancourt, 2012: 54). The links with other substantial building works, such as enclosure and fortification walls, suggests that the dams may have been part of other complexes and architectural projects, perhaps associated with the increased pressure to provide, and perhaps secure, enough food for the growing community. Whether or not this is the case, the dams were clearly substantial investments into water management. They combat a number of problems associated with periods of deluge – slowing and directing water flow – whilst also collecting water in reservoirs for later use (if only for a few weeks), possibly to be used in the agricultural fields or to water domesticated animals. Betancourt suggests that the systems at Pseira were certainly a response to an increase in the local

16 Inner diameter 6m; outer diameter 12.30m (Chryssoulaki et al., 1990: 46). There are a number of towers or ‘watchtowers’ that have been identified by the Minoan Roads Project in the easternmost part of Crete. They appear at strategic points between towns and settlements, often associated with a Minoan road, and can stand alone or in with other structures such as enclosure walls (Reid, 2007: 42).
population and the change to a warmer, drier climate. The combination of the dams and the improved terraces were therefore an answer to the need to improve the islands farming potential (2012: 54). Out of all the Minoan water management systems, the dams are without doubt the largest overall system in terms of scale and must have had a dramatic impact upon the landscape. Their construction involves a degree of hydrologic knowledge (such as an understanding of water flow and the need for strong dam walls to resist the pressure of the water behind it) and access to a large labour source. While the dams at Pseira use local building styles and construction techniques, the knowledge of principles required to build successful dams is likely to have been brought to the island from elsewhere (Betancourt, 2012: 56).

### 2.7 Large Scale Drainage Systems

The drainage systems of the Minoan palaces are perhaps one of the most well-known and surprisingly sophisticated aspects of palatial architecture. The Minoan civilization is known for its ‘flushing toilets’ and opulent bathrooms – an image which was created and perpetuated by Evans’ excavation and interpretation of Knossos (1930: 388). Certainly, the Minoans had an extensive knowledge of a range of techniques which could be employed to dispose of both ‘grey-water’ (water that has been used for one purpose but can be used again without repurification) and sewerage. Evidence for some sort of drainage can be found at the vast majority of Minoan sites, ranging from relatively simple water conduits at houses and smaller buildings, which serve to drain away excess water, to vast and complex systems at palaces which have a number of different functions. Due to the constraints of this thesis, I have elected to focus on the larger drainage systems in order to give an overall impression of how the Minoans dealt with the problem of removing excess and unwanted water, as well as the collecting and storing rainwater from rooftops and open courts.

What becomes clear, even from the relatively brief assessment of Minoan drainage systems provided in my Database, is the great size of many systems. In many of the palatial systems, interior rooms, including workshops and basements, as well as external courts, 17 Unfortunately, there is insufficient space to discuss, in detail, all of the drainages systems that have been found on Crete. This area is often only addressed on a site-by-site basis, and discussed in little detail (an exception to this is provided by Macdonald and Driessen (1988) and recent work by Aufschnaiter (2007) (which unfortunately, could not be accessed)). The aim of this section, therefore, is to give an overview of Minoan drainage systems and their relationship to the management of fresh water.
passageways and streets, are provided with some sort of drainage. Internally, smaller tributary systems are used (often passing under the floor of rooms or covered by slabs) to carry waste water to larger ‘main drains’ which then pass out of the main buildings to be dispersed of. In the ‘domestic quarter’ at Knossos (No.DS4), the vast 150m drainage system consists of a large main drain (varying in height from 0.50-1m) with many tributary systems feeding into it (Fig. 29). At selected intervals, sluice gates and ‘manholes’ allow access to the main drain so that it can be cleaned and maintained. Similarly extensive drainage systems are found at Aghia Triadha (No.DS1), Kato Zakros (No.DS3), Petras (No.DS8) and Phaistos (No.DS9). Part of the overall drainage system of large areas, such as courts, are koulores 18 - the large, circular, subterranean structures found at the palaces of Knossos, Malia and Phaistos – which served to absorb excess water from open courts during rainfall in a similar way to a modern sump.

Another striking feature of Minoan drainage systems is the range of different types of drainage (Angelakis, Koutsoyiannis, et al., 2012). In almost all cases, a mix of open and closed conduits is used: the conduits, often of ‘U’ shape, are made of either stone or terracotta and can be found either ‘open’ or covered over using slabs (Fig. 30). These conduits have been found both above and below floor level. These relative simple conduits have been found within buildings, in courts and along streets and have also been used to feed other water management systems such as wells and cisterns (for example, the cisterns at Myrtos-Pyrgos (Nos.C5 and C6) appear to have been fed by open U-shaped conduits). Of particular interest is the prospect that open conduits, such as those around the central court of Knossos, perhaps combined with pipes, could have ‘pumped’ fresh water around the site. While it is not clear if this is the case, the care and attention given to these highly visible conduits in areas of clear significance, suggests that they may have an aesthetic purpose (Aufschnaiter, 2011: 51), as well as a practical function.

A number of more sophisticated, and perhaps unique, water drainage and conveyance solutions are also to be found. At Tylissos, a sedimentation tank is associated with the water-conveyance system and appears to connect directly to the cistern on the site (Chatzakis et al., 2006: 759) (Fig. 31). Terracotta pipes with a conical shape or with tapered ends (so as they can fit into each other precisely) – found at Myrtos-Pyrgos, Knossos and Tylissos – are thought to be evidence of a complex piping system (Angelakis, Koutsoyiannis, et al., 2012: 174-175), the likes of which are not known in many other

18 The debate surrounding the precise function of the koulores is discussed in detail in Chapter 4, section 4.1.
ancient societies of the Mediterranean. Elbow-shaped or bell-shaped pipes or elements found at Malia and Palaikastro appear to be unique solutions to the joining of vertical to horizontal conduits and are considered by Lenuzza (2013: 89-90) to be direct evidence for the removal and storage of rainwater from roof-tops.

2.7.1 Roof drainage

Following an assessment of the archaeological and iconographical evidence regarding roof types, Shaw (2004) and Lenuzza (2013) have suggested that rather than all roof-tops being flat, as they are usually reconstructed, evidence suggests that there is in fact a great deal more variety than first thought, including single slope and pitched roofs (Lenuzza, 2013: 79). In line with this argument, the authors have suggested that water conduits, spouts and drains found around the outside of buildings or in streets at a number of sites, including Gournia, Palaikastro, Petras and Malia, could in fact be part of roof-drainage systems: Lenuzza notes that

the archaeological evidence, especially that recovered at Akrotiri, seems to always connect the upper edge of the drainage system to parapets running around the top of the buildings and shed light on the existence of at least two different means for carrying away rainwater from the roofs: water spouts set below the parapets, which projected the water beyond the walls, and vertical drains placed within gaps in the parapets themselves and leading the water to the wastewater system running at ground level ... In a few cases, both these solutions were also employed not to simply discharge rainwater, but rather to drain and store it in cisterns for daily uses (2013: 84).

While more research is needed in this area, the work by Shaw and Lenuzza certainly fits with the water management data presented here in terms of the Minoan attention to collecting water, and the relative degree of sophistication applied to it. Of particular note is the potential for rain-water to be channelled off roofs and stored for later use in what Lenuzza calls ‘collector vases’ – which could be easily made, transported and positioned (2013: 86). While there is some data for such vases (for example at Phaistos, Malia and Knossos), their portability and fragile nature mean they are not always found in-situ, leading to issues in their identification as part of roof-top drainage systems.

Part of the Minoan drainage systems are ornamental stone and terracotta water spouts. There are four known examples: two stone spouts from Kato Zakros have an anthropomorphic design, one from Epano Zakros has a human or anthropomorphic design, while the spout from Apodoulou is in the shape of a rams head (Lenuzza, 2013: 85-86) (Fig. 32).
2.7.2 Discussion

The drainage systems of Minoan Crete discussed in this chapter and presented in the Database, demonstrate that the Minoans had a wide variety of techniques, materials and engineering solutions for the removal of excess or ‘grey’ water, the collection of rainwater and perhaps also the moving of fresh water around palaces. Although, in many cases only sections of the drainage system are preserved or have been excavated, the evidence we have for Minoan drainage is substantial and indicates that these systems were not only vast but also an essential element of Minoan infrastructure. The variety of techniques and approaches to different problems in drainage, water removal and storage, demonstrates a sophisticated understanding of water and water-principles (discussed below). The presence of drainage systems within buildings – such as within light-wells, under floors and potentially, from upper stories – is perhaps indicative of the Minoan attitude to ‘grey-water’ and sewerage – that it can and should be quickly and discretely removed and disposed of. Of particular interest to this study is the use of open conduits, especially those that are clearly visible and are in open or public areas, such as those in the central court at Knossos. While these conduits had a practical function, to remove excess water from the court and other areas, there is the possibility that they also added a pleasing aesthetic and auditory element to the area with the flow of water. The use of ornamental stone spouts to carry water from roofs and other areas also suggests the conveyance of water did not just involve practical and functional considerations, but also how the water would appear to a viewer. In a recent study, Aufschnaiter has discussed how the Minoans could hide or emphasise drainage for different effects, and raises the possibility that, like other aspects of Minoan architecture, drainage systems could be seen as a prestige item (2011). The importance of the ‘visibility’ of water management is discussed further in Chapter 4, section 3.4.2.

3. Conclusion: Hydrological knowledge on Minoan Crete

Taken as a whole, the set of Minoan water management systems display a wide range of practical and sometimes remarkably sophisticated approaches to solving the problems inherent in trying to control, store and manipulate fresh water. Despite the relatively small number of examples, spread across various sites on Crete, there are some clearly repeated solutions and technologies that comprise a loose repertoire of water management strategies, including hydraulic plaster or cement linings, open and closed conduits, and parabolic curves. The sophistication and efficacy of this repertoire has led some commentators to suggest that, rather than developing their water management
expertise on a trial-and-error basis, Minoan engineers acquired an abstract understanding of specific hydrological principles. For example, Angelakis states that “[o]n the basis of their accomplishments, it can be assumed that Minoan hydraulic engineers were, in a sense, aware of the basic hydrostatic law, known today as the principle of communicating vessels ... However, it appears that Minoans had only a vague understanding of the relationship between flow and friction” (2003: 1000). While there is certainly evidence of the Minoans using conduits to exploit the effects of gravity on flow, it is difficult to discern in the archaeological record the development of an abstract understanding of fluid mechanics. What Angelakis usefully draws attention to, however, is that the Minoans’ hydrological knowledge appears to have been concentrated around a certain set of problems.

The nature and scope of Minoan hydrological expertise has been the subject of some discussion in recent hydraulic engineering literature (Angelakis and Koutsoyiannis, 2003; Angelakis, Koutsoyiannis, et al., 2012; Tseropoulos et al., 2013; Webster and Hughes, 2010). Using experimental and computational methods, scholars have sought to assess the efficiency and primary purpose of the tapered terracotta pipes found at Myrtos-Pyrgos, Knossos and Tylissos. While Angelakis and others suggested that these pipes were designed with pressure and flow in mind, Tseropoulos et al. use advanced computational models to assess this claim. They find that the shape of the pipe sections is less efficient than simpler cylindrical pipes, implying that this design was chosen, in spite of its inefficiency in terms of flow, for more practical reasons (such as ease and simplicity of assembly) and for its usefulness in filtering out impurities in the water (2013: 2067). This is a useful intervention, as it challenges a tendency dating back to Evans to emphasise the similarity between Minoan technologies and “modern standards” (Angelakis and Koutsoyiannis, 2003: 1000; cf. Evans, 1921: 228-230), and instead draws our attention to the probable priorities of Minoan engineers in each specific case, including a broader context than just the hydrological problems being addressed.

Viewing the tapered terracotta pipes as suggested by the analyses of Tseropoulos et al. (2013) places them in a larger set of strategies concerning filtration and the removal of sediment and impurities. Other members of this set include the filtration tank at Tylissos, which was possibly fed by charcoal-filtered spring water (Angelakis et al., 2007: 98), the porous stone slabs and pebbles used in spring chambers and some cisterns through which spring water percolated, and also perhaps the conspicuous runnels and “sedimentation tanks” that flank the stairs at Knossos (Angelakis, Koutsoyiannis, et al., 2012: 173). While there is little evidence for a Minoan awareness of abstract hydrological laws, these examples
do at least suggest a consistent concern with, and a variety of creative and sophisticated solutions to, the problem of water filtration. More importantly, the evidence demonstrates that Minoan communities were willing to invest considerable time and resources into developing a range of different strategies to meet specific needs. Many of these strategies required a high level of understanding of how water behaves, which is reflected in the pipes discussed above but also in the parabolic curves, hydraulic cement linings and elbow joints found throughout the Minoan water management record.

This hydrological understanding is rarely, if ever, demonstrated in isolation from other forms of expertise and engineering problem solving. A particularly striking illustration of this comes from the well at Knossos (No.W14), which is lined with 17 terracotta drums which perfectly line the shaft of the well. The purpose of the drums is two-fold: first, triangular holes in the drums allow a person to climb down into the 10.4m deep well to clean or maintain it; second, the drums act as a brace – to shore up the sides of the well to ensure that they do not collapse. The unique way in which this well has been constructed needed the expertise of not only some sort of engineer but also of an expert potter to make and fire the drums so that they perfectly line the length of the well.

Feats such as this, along with the extensive hydrological knowledge demonstrated in numerous water management systems, provide evidence for a pool of hydrological knowledge that could be accessed by certain groups in Minoan society in order to design, construct and maintain water management systems. It is a well-established principle in Minoan archaeology that there was a class of experts such as architects, stone masons, potters, metallurgists, fresco plasterers and painters within Minoan society. Indeed, some scholars (for example Brysbaert, 2008: 166; Schoep, 2006: 51-52) have argued that such specialist craftspeople were seen as a commodity in themselves – something to be revered, traded and exchanged. Given the breadth and sophistication of Minoan water management technologies, it is not unlikely that hydrological experts could also be found in this craft class. Just as the work of expert potters and painters must be considered part and parcel of the social, political and religious life of Minoan society, so too must the repertoires associated with hydrological knowledge be understood as part of this broader cultural context. In this way, the water management systems discussed in this chapter cannot be considered as solely technological solutions to purely practical problems.
Chapter 3: Visual Representations of Water: Frescoes, ceramic decoration and portable artefacts

1. Introduction

The art and iconography of Minoan Crete is one of the most intensively studied aspects of Minoan culture, not least as the surviving archaeological record – and in particular the pictorial painted frescoes – presents a highly sophisticated and naturalistic artistic tradition. The symbols, characters and elements depicted in Minoan art have been used to explore Minoan attitudes, religious beliefs and cultural practices though the investigation of what is depicted (or not depicted), how it is portrayed and in what contexts. As such, this chapter aims to explore the ways in which fresh water is depicted in Minoan art, including ceramic decoration and other artefacts such as jewellery and seals and seal impressions, and how such depictions have been interpreted by scholars in the wider context of Minoan artistic language.

This chapter begins by exploring how Minoan frescoes, in particular landscape frescoes which depict a variety of flora and fauna in a seemingly ‘natural’ environment, have been interpreted by scholars past and present and explores what meanings, if any, have been ascribed to them. I offer a brief overview of how fresh water in particular has been treated as an element within landscape frescoes and outline how I approach the iconography of fresh water. I also highlight some of the methodological issues when looking for fresh water iconography in Minoan archaeology. The archaeological evidence for the iconographic representation of water is then presented, as well as an investigation as to how motifs linked to fresh water are portrayed in Minoan art. The conclusion offers a discussion of the significance of fresh water in Aegean art, with a focus on how considering depictions of water as meaningful in their own right might reconfigure the meaning of the friezes themselves, especially the much-discussed ‘landscape frescoes’. It is not my intention here to offer a fresh interpretation of Aegean art. However, I want to suggest that taking fresh water more seriously enables us to shine a different light on the frescoes themselves.

2. Approaching the Interpretation of Landscapes in Minoan Frescoes

The landscape frescoes of Minoan Crete were some of the first in the world to portray plants and animals in their natural environment without a human presence (Chapin,
2010: 225). Since their initial discovery at Knossos by Sir Arthur Evans at the turn of the twentieth century, they have been intensely studied and scrutinised as to their function and possible meaning, with each new generation of scholars adding to our understanding of the frescoes. Evans saw the Minoan landscape scenes at Knossos as a purely secular celebration of the natural beauty of the world. He interpreted the presence of such frescoes as evidence for a high standard of living in Minoan Crete, even amongst the ‘lower classes’ of society (Chapin, 2004: 48; Evans, 1928b: 406), reinforcing his notion of the Minoan civilization being culturally superior to other contemporary cultures.

In the 1960s, however, scholars such as Mark Cameron reconstructed many of the frescoes initially pieced together by Evans and his collaborator Gilliéron, such as the Monkeys and Blue Birds fresco from the House of the Frescoes, incorporating additional fragments which changed the composition of the fresco (Cameron, 1968). Such reconstructions sparked a renewed interest in the composition and ‘themes’ of landscape frescoes, and consequently new and more varied theories emerged concerning their interpretation. Marinatos has suggested that many of the floral and faunal elements depicted in the frescoes bore some religious significance, with elements such as the crocus and lily also appearing on the decoration of altars and offering tables (1993: 195). For Marinatos, monkeys and doves – which are prominent in many of the landscape frescoes – are likewise associated with the divine realm: monkeys are considered as ministrants of the divine in contemporary Egyptian and Near Eastern cultures (1993: 200) and birds such as doves, eagles and hawks are readily depicted in conjunction with Minoan religious structures on objects such as shrine models and larnakes. Extrapolating from the identification of some iconographic elements as the “celestial messenger[s]” (1993: 156) of the perceived ‘Minoan Goddess’, Marinatos explored the idea that the landscapes themselves were “religious landscapes” – areas populated with all kinds of plants and animals, where biotopes are deliberately mixed to create an “impression of totality and abundance” (1993: 193-194). In particular, this mixing of different plant species (some of which flower at different times of the year, such as the crocus and the lily) indicates to Marinatos that specific seasons are chosen for depiction – spring and autumn – which, in the Mediterranean world herald “the renewal of nature” (1993: 195). The landscape frescoes therefore take on a new interpretation, that of the depiction of a land of abundance, renewal and fertility – the symbolic landscape of the Minoan divine, specifically, the Goddess of Nature.
Heuristically, Marinatos’ work on the Minoan frescoes represents a significant shift. Where Evans’ secular interpretation tends towards taking the frescoes literally as decoration for decoration’s sake, which “seems curiously anachronistic when considered against the background of Egyptian and Mesopotamian art” (Immerwahr, 1990: 46), her approach aims at an understanding of the hidden or loaded meanings embedded in the frescoes. With the benefit of a more comprehensive archaeological record, Marinatos developed an analysis of recurring themes and iconographic associations, supported by comparisons with data from contemporary sites in the Mediterranean and Near East. This approach produced a greater sensitivity to the diversity and abundance of natural elements within the frescoes, within a broader frame of seeking a holistic interpretation.

Marinatos’ approach continues to form the basis of much scholarship on Minoan art. The themes of abundance and holism are explored by Herva (2006a, 2006b), who argues that landscape frescoes represent the Minoan expression of an ecological and animistic concept of nature: that the everyday world was “richly structured, inhabited by manifold social beings” (2006a: 593). Herva’s ecological perspective takes us even further away from Evans’ secular interpretations of nature scenes, by asserting that Minoan depictions of natural elements cannot be distinguished from religious art, as religion and art are equally conceived as active social interactions with the non-human world. In this way, Herva narrates the landscape frescoes, in spite of the lack of readily identifiable ‘divine’ characters, as saturated with religious belief and meaning. For Marinatos, natural elements possess a religious significance by virtue of their metonymic and metaphorical associations, whereas for Herva, each element is already innately religious as part of an animistic, ecological ‘relationality’ that he reads in Minoan art.

While Herva’s approach draws attention to particular elements as significant in their own right, not merely as ciphers for more prominent imaginaries such as the Goddess, every particular has the same essential content: irreducible, animistic divinity. Other scholars have sought to emphasise the individuality of specific elements, without collapsing their meanings into a general category. Authors such as Day (2007), Harte (2000), Porter (2000), Sarpaki (2000), Shapland (2009b) and Vlachopoulos (2000), have drawn attention to the significance of why certain species of animals, insects, birds and plants were selected for portrayal in the frescoes, as well as how they are portrayed. This more micrological approach, often concentrating on biological and zoological insights, moves interpretation away from seeking to reconstruct a unified, holistic Minoan imaginary – whether religious...
or not – and towards a focus on what the frescoes reveal about the Minoan’s material and cognitive relationship with their environment.

In accordance with this more modest and concrete approach, Angelopoulou (2000) has questioned the assumption that the frescoes express a unified or general imaginary, arguing that they may well have operated as independent compositions without a shared meaning. Further, she notes that individual motifs themselves have a “multiplicity of meanings” and that the interpretations of the compositions, therefore, must also be manifold (2000: 552). This is not to say that the project of interpreting the frescoes should be abandoned, but rather that we must be more circumspect about the kinds of information that we expect to retrieve from them. Zeimbeki (2005), for example, investigates the “mental skills and cognitive processes employed in the production of the imagery” (2005: 244), with a view to illuminating the extent and organisation of the painters’ zoological knowledge. Different degrees of knowledge may then serve as an index for the extent of the Minoans’ interaction with different aspects of nature, and therefore yield some insight into “otherwise inaccessible information on the cultural values and norms” concerning the environmental elements depicted (2005: 245).

Treating the frescoes as a source of information on Minoan cognitive processes and cultural practices opens up the possibility of considering the socio-political role played by specific artworks. Key to this endeavour is an awareness of the architectural context of specific frescoes, and the interaction of image and space (Zeimbeki, 2005: 245-246). The ‘meanings’ of the frescoes are not communicated solely by the images themselves, but also the architecture and function of the spaces in which they are displayed. A significant part, therefore, of the task of interpretation, requires an awareness of how the frescoes participated in elite practices of commissioning and consuming artistic works such as the landscape frescoes (Shaw, 1997; Palyvou, 2000). Chapin, for example, suggests that architecture, the positioning of the frescoes within buildings, and the restriction of access to view the frescoes (typically to the elites themselves and invited guests), functioned to reinforce socio-political norms and ideals within elite groups. The landscape frescoes in particular, may be interpreted as deliberately spectacular displays – whose effect was maintained by restricting access to or familiarity with fresco art – designed to further ingrain existing social hierarchies in the mind of the viewer (Chapin, 2004: 60-62). Along similar lines, Shaw (1993) explores the landscape frescoes simultaneously as a record of Minoan practices (especially the cultivation of desirable plants), and as tools in the preservation of social hierarchies. She argues that some Minoan landscape frescoes may
represent cultivated landscapes, such as gardens (whether religious or secular spaces), rather than natural environments (see also Morgan, 1988: 39-40, 149-150).

We may push this argument a little further, along the lines suggested by Zeimbeki: the landscape frescoes cannot be interpreted as simple depictions of a pristine, non-human environment, but rather a natural world that has been “nurtured to construct a symbolic world that was embedded in the Therans’ [and Minoans’] experience of landscape” (2005: 245). Nature is already incorporated into a symbolic order, full of cultural meanings and material human manipulation, before the artist picks up his brush. Artistic representation thus belongs to a broader material practice through which the natural is absorbed into a very human world.

In contrast to both the literal, decoration approach of Evans, and the universalising holistic approaches of Marinatos and Herva, this latter group of scholars have attempted to mine the frescoes for less speculative information, without abandoning the idea that they possess meaningful content beyond what is simply apparent (Knappett, 2002). Through a close attention to zoological and botanical specificity, alongside an emphasis on the socio-political context of each fresco, more recent scholarship has sought to investigate Aegean fresco art from a more ‘micrological’ perspective, emphasising the close relationship between artistic representation and other material practices.

2.1 Interpreting Fresh Water in Landscape Frescoes

The incremental development of a more micrological approach opens up a considerable opportunity for reassessing the role played by water in Minoan art. As interpretation has begun to consider the meanings of discrete elements in their own right as opposed to being subservient to a dominant narrative, there is greater scope for analysing depictions of water as possessing some independent significance. Similarly, while representations of water are not subject to scientific classification to the same extent as zoological or botanical iconographic elements, the micrological approach reminds us to avoid collapsing different types of water – such as streams, waterfalls and marshes – into one homogeneous category.

It should be noted that examining the significance of water as a discrete character in itself goes against the grain of how Minoan fresco art has been interpreted, even amongst more recent micrological approaches. Fresh water has overwhelmingly been consigned to the status of miscellaneous background, alongside rock and dirt. An illustration of this comes from a reasonably well-established convention of collapsing the
presence or indication of fresh water into a broad description of the type of landscape or biotope. For instance, rivers are rarely mentioned in their own right; instead, they are acknowledged through the use of phrases such as ‘riverine landscapes’ (Morgan, 2005: 36). Despite numerous direct depictions of water, discussed throughout the rest of this chapter, interpreters of the landscape frescoes have constructed a binary opposition between ‘characters’ (plants and animals) and ‘environment’, with fresh water confined to the latter pole: “The Minoans, like their Near Eastern neighbors, allocated specific biotopes to animals. ... Rivers and marshes are associated with reeds, palms, papyri, and, on the animal side, ducks and dragonflies” (Marinatos, 1993: 193). While this is an understandable binary, albeit one that likely reflects a distinctly modern, Western separation between ‘living’ organisms and ‘inanimate’ environmental features, viewing water as either mere scenery or as a functionally necessary element of certain biotopes forecloses any examination of it as having a specific or independent meaning.

At least in part, the reason for the dominance of interpreting water as merely an indicator of a biotope is that it is reinforced by comparisons with Egyptian art. Many scholars refer to landscape scenes containing fresh water to be ‘nilotic’ in character or refer to them as being a ‘Nile scene’, and it is commonly acknowledged that the theme of a river with its banks “teeming with life” has been borrowed from Egyptian conventions (Immerwahr, 1990: 71; cf. Morgan, 1988: 146-150). This analogy with Egyptian Nile scenes has influenced the common interpretation of landscape frescoes as expressions of heightened fertility:

It is interesting that some of the animals, like griffins and feline predators, may appear in connection with rivers. Crete does not have many rivers, nor any such animals, but the whole iconographic package, river plus plants and animals, was inspired by Egyptian or Near Eastern prototypes. We thus have transmission of concepts alongside the motifs; for in the iconographical code of the great river civilizations, rivers equal fertility (Marinatos, 1993: 193).

While certainly tempting, given the visual and botanical similarities between Egyptian Nile scenes and Minoan portrayals of rivers in landscape frescoes, there are a number of problems with transposing the meanings and overall significance of Egyptian river scenes onto Minoan art. To begin with, there are significant differences between the Minoans’ and Egyptians’ material relationships with water – differences that are effaced by conflating the two artistic traditions. As suggested in Chapter 1, the Southern Aegean may have been a wetter place than is conventionally expected, including deluges and floods, during the period of the frescoes’ creation, potentially implying a subtly but significantly
different set of meanings and connotations associated with water, especially compared to the Egyptian experience of a single, relatively predictable, and utterly dominant watercourse. It seems highly likely that the Minoan fresco painters were influenced by Egyptian traditions, but there are sufficient differences to doubt the validity of assuming the meanings and symbolism of the latter were simply adopted by the former.

Morgan offers a more detailed investigation of this issue, in the context of the Theran ‘Landscape Fresco’ from the West House, Akrotiri. She notes that this fresco incorporates a specific Egyptian genre – a riverside chase scene – while at the same time altering certain details: whereas the Egyptian prototype generally features a human figure as its primary protagonist, in the Aegean examples “the painter has naturalized the scene, for now the cat and bird are the protagonists” (Morgan, 1988: 147). Through the subtraction of the male figure, the salient message of the Egyptian examples – that of the powerful man hunting prey along the Nile and thus dominating nature – is effaced. In this way, the Aegean fresco simultaneously invokes an established Egyptian theme, whilst asserting some originality and independence from it. This critical distance between the two artistic traditions, which may get eclipsed by the striking similarities, further calls into question the assumption that Aegean painters approached the depiction of fresh water with the same set of ideas and beliefs as those of ‘great river civilizations’.

Morgan highlights a practice of hybridisation in Aegean landscape art, absorbing Egyptian elements and themes through forming new combinations and changing their emphasis to more closely reflect the Mediterranean locale. The Theran landscape fresco features two central themes that reflect this hybridity: a chase scene (which itself has undergone a transformation from the Egyptian prototype), and a cultivated garden or park (see above) which drew together native and exotic plants. Of interest here is Morgan’s insight that it is the figure of the river that connects the two thematic aspects (1988: 150) – a compositional function that she notes is visible elsewhere in Aegean art (1988: 34).

Although Morgan’s comments on the iconography of water are only a small part of a far larger project, there is much to commend her approach. By examining the subtle and often minute differences and variations within Aegean art (that is, by taking a ‘micrological’ perspective), Morgan is able to discern how different motifs and elements interact with and transform existing thematic and iconographic practices. In this way, the connections between the different moments of an artistic discourse are not lost, whilst avoiding the trap of asserting the unity and coherence of the discourse at the expense of the various textures and layers within it. The rest of this chapter attempts to emulate this balance, by looking at
the variety of means within Minoan and Aegean art of representing fresh water as a broadly coherent visual ‘grammar’, while at the same time taking stock of the diversity and peculiarity of the representations of water. In order to explore the way that this visual discourse is constructed, and in order to further explore Morgan’s insight into the connecting role played by water in Aegean art, this chapter focuses on the ways in which water interacts and forms associations with other, related elements and motifs. Rather than looking for a single meaning embedded in every depiction of water, or assuming that each representation of water refers to exactly the same thing, this chapter considers the ways in which the variety of different experiences of water in the Aegean, and on Crete in particular, find expression in art.

3. Methodological Issues

Due to the relative scarcity and fragmentary nature of surviving fresco art from Bronze Age Crete, this chapter also considers art from the island of Thera and the other Cycladic islands such as Keos and Melos. The deep connections and similarity between Minoan and Cycladic art make it possible to consider the discrete artistic cultures as being so closely related as to constitute a coherent artistic discourse in itself. This is reinforced by the contemporaneous evolution of recurring motifs and iconographic conventions on the islands. Indeed, the Minoan and Theran artistic traditions are interrelated to the point where it has become a common academic practice to study them together (see, for instance, Immerwahr, 1990; Morgan, 1988).

For many reasons, identifying direct depictions of water is not a simple task. The physical characteristics of water do not lend themselves easily to artistic or iconographic representation, and therefore the search for direct depictions of water, even in highly naturalistic art such as the frescoes, must revolve around the identification of schemes and conventions that might not necessarily be what modern eyes would see as resembling water. As such, this chapter also seeks to identify key motifs, strategies and conventions for the depiction of fresh water, including both stylised direct representations and inferences of water through its associated elements such as fresh water flora and fauna which commonly inhabit fresh water locales, for example, ducks and dragonflies.

3.1 Wavy blue lines: the problem of looking for fresh water

Aside from the fact that the vast majority of frescoes are in a highly fragmentary state, there are a number of challenges posed by looking for water-bodies such as rivers,
streams and pools in Aegean frescoes. Colour is certainly problematic; given the relatively limited palette used by Aegean painters, consisting of red ochre, yellow ochre, blue and black (Chapin, 1997: 4, n.12; Jones and Photos-Jones, 2005: 209), the pigments used are rarely specific to the figure or motif being painted (monkeys being painted blue is a good example\textsuperscript{19}) and in the depiction of landscapes in particular, the colours of natural elements are, as a result, somewhat skewed. This naturally leads to ambiguities in identifying with any certainty what specific design elements are intended to represent, and it is only when considering the motif/element within its wider context (where possible) that their identification can become clearer. This is most certainly the case when looking for elements such as streams or rivers, which are usually presented as wavy blue horizontal lines, as this design is also used to denote the top of mountain peaks or rocky outcrops; for example, the river portrayed in the Landscape Fresco shares many similarities with the mountain tops depicted in the Ship Fresco (Fig. 33). A very similar blue wavy line can also be seen in the House of the Ladies directly above the female figures (Fig. 34), however, this has been interpreted as part of a canopy, tent or textile enclosure (Immerwahr, 1990: 49; Murray, 2004: 125).

The iconographic conventions with which Minoan and other Aegean fresco painters depicted water compound the problem of identifying with any certainty bodies of fresh water. One such convention is that the depiction of water can utilise naturalistic, stylised and abstract elements. These elements can be used in various combinations that do not necessarily correspond to the degree of naturalism of each frieze as a whole. In highly naturalistic scenes, the ‘bifid’ motif (discussed below) and other such abstract and stylised conventions often play a prominent role in the identification of fresh water. However, the same motifs can be found on more stylised pottery designs, whilst not appearing on explicit depictions of water. A significant consequence of these ambiguities is that designs that resemble or incorporate elements of the visual language of fresh water which might otherwise be discounted for being too abstract for an otherwise naturalistic scene – for example, blue lines at the borders of frescoes – may credibly be interpreted as water

\textsuperscript{19} The monkeys commonly depicted in Aegean art have been identified as \textit{Cercopithecus Aethiops} – the African Green Monkey, a native group of the African savannahs and southern Saharan steppes. It is likely that this taxonomic group were the only monkey species known in the Aegean and were probably imported to the region via Egyptian trade links (Masseti, 2003: 275). Greenlaw (2011) has recently provided an in-depth study on the representation on monkeys in Mediterranean culture.
elements. Clearly, this becomes problematic very quickly, not least because blue borders are common in Minoan and Aegean art and decoration.

The only realistic solution, therefore, is to interpret ambiguous design elements as either water, wetness, or not at all water-related according to contextual factors such as associated plants and animals. To interpret depictions of water on a contextual basis does, of course, correspond to existing archaeological practice, whereby patterns of association between motifs, particularly between different sources, are charted (Haysom, 2010: 39); however, archaeologists looking at the Minoan and Theran frescoes have produced some surprising and problematic results by not making the contextual interpretive operation explicit.

For example, Evans, in a 1900 report, described the ‘Throne Room’ at Knossos as including “a long landscape composition with wavy lines indicating running water below, amidst which in one place part of an eel is visible. On the banks of the stream grow rushes and sedge-like plants with red flowers” (Evans, 1900: 40). By 1935, in The Palace of Minos, the only iconography Evans mentions is a rocky landscape which “displays flowering reeds against waving bands, alternately ivory white and Venetian red ... a rocky landscape” (Evans, 1935b: 908), with the stream and eel described in 1900 completely excised. The discrepancy between the two interpretations revolves around a shift in Evans’ understanding of an architectural feature opposite the ‘throne’: in 1900, it is a ‘fish tank’ surrounded by a river and aquatic motifs, in 1935, it is a lustral basin simply decorated with coloured bands (Evans, 1935b: 907-908). Various doubts have been raised about Evans’ later reconstruction (see for instance Hopkins, 1963; Morgan, 1988: 180 n.77; and more generally, Chapin, 2004: 48) and it seems likely that water-related motifs were sacrificed in favour of reinforcing the overall ‘feel’ of the room. What is required, therefore, from contextual interpretations of ambiguous water motifs is a sensitivity to the juxtaposition of particular elements, as opposed to an insistence on the absence of incongruity. In other words, there is a danger of interpreting ambiguous artistic elements as either water or mere decoration according to whether or not we would expect to find water in this or that frieze. To do so, as Evans did, would be to obscure rather than illuminate the role played by water in the Minoan construction of artistic meaning. The only alternative we are left with is to approach depictions of water through a “syntactic awareness of the relationship between [ambiguous elements] and the surrounding elements” (Morgan, 1985: 9), such as common associations with flora and fauna.
With this in mind, this chapter will not deal with the ‘blue wavy lines’ that occur in Minoan art and iconography. Motifs such as blue spirals, blue borders or backgrounds or other elements which, because of their colour and form (such as the canopy), may represent water shall be disregarded in this instance due to the limitations of this thesis. The focus will therefore remain on direct depictions of fresh water (for example rivers, springs, waterfalls, marshes and pools) and indirect depictions of fresh water environments through the portrayal of fresh water flora and fauna (such as reeds, papyrus, ducks, geese and dragonflies).

4. Fresh water in Minoan Art

Following on from the interpretive and methodological discussions above, this section seeks to present an overview of the evidence for direct and indirect depictions of fresh water in Minoan and Aegean art. By ‘direct’ depictions, I am referring to instances where a body of water itself is visible, whether as river, waterfall, or marshy wetland. In order to build up a picture of the associations and interactions that representations of water take part in, this section also includes a discussion of those motifs and elements that are most frequently found in conjunction with direct depictions. Derived from the list of frequently associated elements, I identify a select group of motifs that correspond strongly with water and aquatic themes and environments: namely reeds, papyri, waterfowl and dragonflies. This group is then explored in terms of their potential function as indirect depictions of water, serving as metonymic signifiers of water and watery environments.

4.1 Direct Depictions of Fresh Water

Direct physical depictions of fresh water bodies are quite rare in Aegean art, especially when compared with the rich diversity of naturalistically depicted animals, plants and humans. Nevertheless, there is a clear set of conventions related to the depiction of water-ways in Minoan fresco art (see Table 7 for a brief synthesis of the conventions included in specific frescoes). One of the clearest conventions is their colour and movement: of the known depiction of rivers (seven in total) all are painted in a light blue-green colour with all but two outlined with a dark blue-black line (Fig. 35), whereas six of the seven rivers are depicted as an undulating, horizontal line ‘flowing’ across the fresco.

20 This aspect, however, could form the basis of a further study; for example, are there any connections between the blue spirals and fresh water iconography?
This follows a broader Bronze Age Aegean convention for depicting rivers as wavy line; on an inlaid dagger from Shaft Grave V at Mycenae (Fig. 36), a river is depicted running horizontally along both sides of the dagger blade (Morgan, 1988: 34), whilst an ivory comb from Rutsi near Pylos also depicts an undulating river (Morgan, 1988: 34-35). On a green jasper lentoid sealstone of unknown provenance (currently in the British Museum), a so-called ‘Mistress of Animals’ is shown standing on or just above a river depicted as a double undulating lines (Krzyszkowska, 2005: 4; Morgan, 1988: 65, fig. 50) (Fig. 37), whilst on another seal of unknown provenance in the Ashmolean Museum, two water birds are shown perched above a river illustrated as a wavy line (Kenna, 1960: 61, fig. 131).

In addition, there are also a number of elements used in the depiction of fresh water that occur regularly (see Table 7). In four of the seven cases highlighted, the rivers are shown bounded by a yellow border, perhaps used to denote a sandy bank-side. A ‘bifid stalk’ motif is employed on either the inside or outside of the river on five occasions. This motif (Fig. 38), as identified by Morgan (1988: 34-38), is the result of the synthesis and abstraction of a number of artistic conventions (including rivers, rocks, palms, seaweed etc.) which, over time, becomes a motif used to mean ‘water’ in both the frescoes and later in LM IB floral-style pottery. Morgan further notes that this motif is used not only to denote water, albeit having no physical resemblance to that element, but it is also used to denote rivers and more generally, ‘wetness’ (1988: 37). For example, the motif appears within a broad red wavy band which borders a deep yellow area considered to be a marsh; the fact that the sign appears in conjunction with riverine plants (to be discussed below) appears to confirm her observations that this denotes a ‘wet area’.

Naturally, many of the depictions of water vary from each other. For example, whilst in many cases the river is shown as a single, horizontal band, some frescoes depict the river as if flowing downwards from another location, such as in the Monkeys and Blue Birds Frieze from the House of the Frescoes, Knossos (Fig. 39) and the Departure Town frieze from the Ship Procession miniature fresco of the West House, Akrotiri, where a river is shown descending from the mountains and then forking into two rivers which are then shown in ‘aerial view’ encircling a town (Doumas, 1999: 68, fig. 35) (Fig. 40).

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21 For a full and detailed analysis of how this motif has been formulated see Morgan 1988: 14, 35-38.
Aside from the water-ways, there are two other examples of the depiction of fresh water bodies. Within the Monkeys and Blue Birds Frieze from the House of the Frescoes, there appears to be the depiction of two separate waterfalls which join the horizontal river

[22] Immerwahr (1990: 79, 212 n.3) maintains that the presence of the bifid motif indicates that the undulating lines throughout the Partridges and Hoopoes frieze depict a stream or river. However, Shaw (2005: 104) argues that what has been interpreted as the bifid motif may in fact indicate “some sort of little flowers or leaves”, although this “need not exclude the idea that streams of water were shown in the Partridge Frieze”.

<table>
<thead>
<tr>
<th>Site; Fresco name (if applicable)</th>
<th>Light blue-green colour</th>
<th>Dark blue-black outline</th>
<th>Undulating Line</th>
<th>‘Bifid motif’</th>
<th>Yellow border</th>
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<tr>
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<td>✓ Partial</td>
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<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>-</td>
</tr>
<tr>
<td>Knossos, House of Frescoes; ‘Monkeys and Blue Birds’</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>-</td>
</tr>
<tr>
<td>Ayia Irini, Keos, North Bastion Rooms 1 and 2</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>-</td>
</tr>
</tbody>
</table>

Table 7 Common conventions or motifs in the depiction of fresh water bodies in frescoes
at both ends. The waterfalls are painted in a similar format to the rivers, albeit that they are a slightly brighter blue and positioned vertically within the frieze. Most importantly, the artist has used small white dashes at each side of the water to denote the spray of water droplets (and thus the rushing movement of water), distinguishing it from the more gently flowing river below (Cameron, 1968: 11, fig. 4c; Morgan, 1988: 35, 183 n.180) (Fig. 41). In addition, Evans published a fresco fragment found in the House of the Frescoes’ ‘fresco dump’, which he considered to be a ‘fountain’ or ‘jet d’eau’ (Fig. 42): a vertical column of water, surrounded by ‘droplets’ emerging from a forked base (1928b: 466-461, fig.272). However, Cameron has shown that the fragment was more likely to be another waterfall, as he found no evidence for the forked base which Evans had described (1968: 2). Another fresco fragment, this time from the South House, Knossos, possibly depicts a ‘blue pool’ with a reed emerging from within it (Morgan, 1988: 39; Mountjoy, 2003). However, this relatively small fragment was found with no corresponding pieces making it difficult to confirm this interpretation.

At Ayia Irini, Keos, a selection of fresco fragments from Room 1 and 2 of the North Bastion appear to show, amongst other landscape and architectural vistas, a hunting scene which depicts several men in white knee-length garments, carrying spears as they climb over rocks and streams – possibly a marsh environment – in pursuit of deer (Abramovitz, 1980: 61). An added detail illustrates the blue ribbons of water overlapping the red of the men’s feet as they step into the stream (Fig. 43). Interestingly, this is the only instance of human-water interaction depicted in Aegean fresco art, perhaps with the exception of a well head depicted in the Theran miniature frescoes, discussed below. In addition to these fragments, several other small pieces appear to show elements of a marshy landscape; reeds or other grasses are depicted growing from within a dark-blue area. On another, possibly related fragment, a female figure is shown walking through grasses of a similar style to those in the potential marsh landscape, and to her left is the edge of a monumental ashlar stone building (Abramovitz, 1980: 76). It is uncertain if the marshy landscape, the female figure, the building and the hunting scene are part of the same narrative, however, they all share similar iconographic elements, namely a ‘watery’ or marshy landscape, which suggests that the fragments are thematically connected.

In the set of Minoan and Cycladic depictions of fresh water sources, there is one that stands out as entirely different from the others. In contrast to the convention of depicting naturally occurring sources of fresh water, the miniature frieze from the West House, Akrotiri, includes a small man-made structure that is widely perceived to be a well
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(Doumas, 1999: 48; Morgan, 1985: 8-9). Next to a large tree, a brick built structure is flanked by two jugs and directly below it women are depicted carrying similar jugs on their head, seemingly carrying the water-filled jugs away (Fig. 44). What is particularly important about this small section of a miniature fresco is that it appears to be the only depiction of a man-made provision for water from either Thera or Crete. Given the number and scale of water management installations discussed in the previous chapter – including dams and aqueducts – the fact that this is the only known depiction of a man-made solution to the problem of accessing fresh water must be considered significant, not least as this particular instance comes from Thera and not Crete. Speculation aside, what can at least be said of the uniqueness of the fresco well is that it highlights an overwhelming preference amongst the fresco painters to depict fresh water as a feature of the natural environment.

4.1.1 Plants and Animals Associated with Direct Depictions of Fresh Water

Aside from the physical similarities shared by depictions of water-ways, there are also a number of plant and animal motifs which re-occur in conjunction with the river or its immediate environment. Perhaps unsurprisingly, the depicted rivers are often accompanied by plants that would naturally be found in a ‘watery’ environment, including aquatic grasses, sedge and papyrus, as well as conceptual motifs such as a lotus-papyrus hybrid which incorporates two separate aquatic plants. Typically, plants such as reeds and papyrus are shown growing in the yellow sandy banks of the river (such as those in the Landscape Frieze) or emerging from the painted border of the river itself (Fig. 45). A less common way of depicting plant life in conjunction with rivers is to place reeds emerging from the ground alongside large stretches of the watercourse. In general, aside from the ‘bifid motif’ and the hunters depicted in the fresco fragment from Ayia Irini, nothing is depicted inside the boundaries of a water course.

Minoan fresco art displays a strong connection between water-ways and animal life, with some kind of fauna almost always present in scenes with a fresh water element. However, no clear pattern is discernible amongst the range of species depicted, with no one animal playing a particularly prominent role (see Table 8). Fauna depicted in conjunction with water are predominantly drawn from nature (although not necessarily indigenous, such as monkeys which appear in two such frescoes), with only one instance of a mythical or hybrid creature, namely the griffin from the Landscape frieze. An assortment of different mammals can be observed, including goats and deer as well as more exotic species such as lions and wildcats. While deer and monkeys both appear in frescoes from
different sites, there appears to be no significant correlation. In contrast, birds appear in over half of the depictions of rivers and water-ways from the Theran and Cretan corpus, often in some numbers: waterfowl,\(^\text{23}\) including ducks and swans, occur regularly along the banks of the river in the Landscape frieze; a swift or swallow glides over a rocky landscape with the river flowing beneath it in the Beta 6 frescoes; and rock doves are shown flying and perching amongst the rocks in the Birds and Monkeys fresco. At the Caravanserai, Knossos, we see a frieze almost entirely dedicated to the careful portrayal of partridges and hoopoes within a marshy or wet environment, possibly a cave (Fig. 46) (Shaw, 2005: 102-103).

<table>
<thead>
<tr>
<th>Site; fresco name (if applicable)</th>
<th>Water Element Depicted</th>
<th>Associated Plant Elements</th>
<th>Associated Animal Elements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Akrotiri, Thera, Beta 6 (I)</td>
<td>River/Stream</td>
<td>-</td>
<td>Monkeys</td>
</tr>
<tr>
<td>Akrotiri, Thera, Beta 6 (II)</td>
<td>River/Stream</td>
<td>Crocus Reeds Floral sprays</td>
<td>Goats/calves Swallows</td>
</tr>
<tr>
<td>Akrotiri, Thera, West House, Room 5; ‘The Landscape’</td>
<td>River/Stream</td>
<td>Cultivated plants and flowers Reeds Palms Papyrus</td>
<td>Waterfowl Deer Cat Griffin</td>
</tr>
<tr>
<td>Knossos, the South House (fragment)</td>
<td>Pool</td>
<td>Leaves Papyrus stems Reeds</td>
<td></td>
</tr>
<tr>
<td>Akrotiri, Thera, West House, Room 5; ‘Assembly on the Hill’</td>
<td>Well</td>
<td>Large tree Grasses/Plants</td>
<td>-</td>
</tr>
<tr>
<td>Akrotiri, Thera, West House, Room 5; ‘The Departure Town’</td>
<td>River/Stream, Marsh</td>
<td>Trees (various) Marsh plants Reeds</td>
<td>Deer Lion</td>
</tr>
</tbody>
</table>

\(^{23}\) See (Harte, 2000: 683-687) for a discussion on the identification of the different waterfowl depicted in the Theran frescoes.
### 4.2 Indirect Depictions of Fresh Water

#### 4.2.1 Reeds

The reed (most likely to be the giant reed *Arundo donax* or the common reed *Phragmites communis*) occurs in a number of frescoes from Thera and Crete, the most

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24 Vlachopoulos notes that the reed motif is not easily recognised in Aegean pictorial art; on sealstones, the reed is so small as to make clear identification impossible, whilst on frescoes and pottery, the reed is often generalised to a simple form, with reeds and other grasses becoming almost impossible to distinguish from one another (2000: 644).

25 The reed also forms part of hybrid motifs including the anemone-reed and papyrus-reed which appear in a number of frescoes from Crete including those in the Throne Room, Knossos, the Floral Fresco in the Unexplored Mansion, Knossos and the Monkeys and Blue Birds Fresco from the House of the Frescoes, Knossos (Chapin, 2004: 54-55).
explicit being a portrayal of a dense reed thicket from Room 3b in Xeste 3, Akrotiri (Fig. 47), in which ducks and dragonflies fly (Vlachopoulos, 2000).

The reed motif occurs more frequently, however, in Minoan pottery. It first appears in the MM IIA period in pre-Kamares wares as an abstract element (the ‘antithetic J-spiral’ (Walberg, 1976: 49)) and becomes a common pattern on a variety of wares (including later Kamares wares (Walberg, 1976: 66)) from the MM IIIA to LM IA, where the reed becomes part of the floral repertoire (Furumark, 1941: 155, 282; Vlachopoulos, 2000: 646-647). However, the most outstanding group of reed designs comes during the LM IB floral style, where the so-called ‘reed painters’ – thought to be no more than four people – produced ten delicately painted vases, found at Knossos, Phaistos and Zakros,\(^\text{26}\) which were finely decorated with dense thickets of reeds emerging from the water of a marsh or a river (Popham, 1967: 341-343; Vlachopoulos, 2000: 651-652) (Fig. 48). On Thera, the reed appears on a number of local pottery styles,\(^\text{27}\) either as a simple ‘grass-reed’ motif or as more elaborate, more identifiably certain reed patterns (Vlachopoulos, 2000: 648). These motifs appear on both light on dark/dark on light wares as well as some biochrome/polychrome forms. Two shapes – the jug with cutaway spout and the kalathos – are exclusively decorated with reeds (Vlachopoulos, 2000: 648-649).

The reed, including various forms of grass-reed hybrid, also appears on the local styles of Melos, from the site of Phylakopi (Atkinson et al., 1904: pl. xix, 9, 10; Barber, 2008: 140-141; Davis and Cherry, 2007: 270 n.5; Vlachopoulos, 2000: 651). Of particular note are two sherds from Phylakopi which come from large vases or ‘bath tubs’ which depict ducks or geese in a marshy landscape (Fig. 49); one sherd depicts the bird standing among papyrus or sea-daffodil, while the second sherd shows a duck or goose amongst red painted reeds (Atkinson et al., 1904: 141-142; Morgan, 1988: 65, fig. 47 and 48; Vlachopoulos, 2000: 651).

\subsection{4.2.2 Papyri}

The papyrus is a relatively common floral motif found in Cretan art and art throughout the Aegean (although the plant is not indigenous to Greece). There are approximately five instances from Crete and Thera of the plant appearing in frescoes with other plants and animals (Day, 2007: Table 2.4), with three instances of papyri occurring as

\(^{26}\) Incidentally, these vases have also been found on the islands of Rhodes, Melos and Keos, suggesting that these vases were prestige items ripe for export.

\(^{27}\) For a detailed investigation of local Theran pottery styles, see Marthari (1992).
a decorative motif in a fresco (Day, 2007: Table 2.5). Additionally, there are approximately ten fresco fragments which depict a papyrus or part of one (Day, 2007: Table 2.6). The papyrus motif appears both singly and in groups, for instance in the House of the Ladies, Akrotiri, where three enormous clumps of papyrus share the wall-space with the women of the main fresco (Fig. 50). Minoan painters’ familiarity (or perhaps unfamiliarity\(^{28}\)) with the papyrus motif is further demonstrated by the rendering of it in both naturalistic and stylised forms. In some cases, it is reduced to just its distinctive head, abstracted from the rest of the plant. An interesting feature of depictions of the papyrus in the Minoan fresco repertoire is that it is frequently combined with other commonly depicted plants such as reeds, lilies and irises, to form hybrids unknown to nature. In the Throne Room at Knossos, for example, a papyrus-reed hybrid flanks the Griffins on both sides of the ‘throne’.

Further to their depiction on frescoes, papyri occur on a number of material objects. MM I-II pottery styles and the LM I Floral Style feature both naturalistic and stylised forms of papyri (Furumark, 1941: 263-267); one particular piece, a ewer from Palaikastro, depicts the plants emerging from a wavy band (very similar to how the reeds are depicted in the reed-painters vases), below which is the bifid motif (Betancourt, 1985: 146) (Fig. 51). Papyri also occur on a number of LM III larnakes in association with other nilotic elements such as fish, water-birds and ships.\(^{29}\) In addition, the papyrus appears on a number of Minoan jewellery pieces such as the triple papyrus head pendant from the Knossos Temple Repositories (Fig. 52) (Morgan, 1988: 23). It is also represented on jewellery in fresco paintings from both Thera and Crete, such as the ladies and the ‘Goddess’ in the Xeste 3 compositions who wear hair bands and necklaces adorned with papyrus ‘tassels’ (Younger, 1992: 277-279) (Fig. 53).\(^{30}\)

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\(^{28}\) It has been hypothesised that the papyrus first entered into the Aegean artists’ repertoire through the Egyptian convention of the ‘waz’ motif, circa. MM I-II; later, the plant may have been cultivated on Crete, but remained sufficiently rare so as depictions of it remained somewhat confused (MM III- LM I). Finally, with familiarity, the artists were able to depict the papyrus accurately and it became incorporated into the pictorial repertoire depicting the plant accurately in its natural environment (LM I) (Morgan, 1988: 23).

\(^{29}\) These elements are often motifs found on XVIIIth Dynasty Egyptian tomb paintings and are frequently associated with the afterlife (Watrous, 1991: 298).

\(^{30}\) For a detailed account of Theran jewellery see Televantou (1984).
4.2.3 Water Fowl and Water-Birds

There are no frescoes concerning waterfowl or water-birds as the main subject matter. Indeed, they are usually portrayed with another motif, such as reeds, or they are used in a larger scene with a large number of figures or motifs (see, for example, the Landscape Frieze in the West House, Akrotiri). There is, however, one fresco which appears to focus on waterfowl in their natural environment. The ‘reed thicket’ fresco from Room 3b in Xeste 3, contains six or seven mallards within the 4m long composition including both the male and the female of the species along with nestling chicks (Vlachopoulos, 2000: 640-641) (see Fig. 47). The composition covered the west wall of Room 3b and two other smaller wall partitions and is almost a ‘life size’ portrayal of mallards in a number of poses, including taking off and flying in a skein (Vlachopoulos, 2008: 493). Despite some discrepancies in the colouration of the birds (Harte, 2000: 683-684), they are carefully observed and provide any prospective viewer with an ‘eye level’ portrayal of a realistic marsh environment. In addition to this fresco, a section of a large fresco from Room 2 of the same building, possibly depicts a blue duck flying between the branches of a palm tree (Vlachopoulos, 2008: 491).

While birds are a common motif on LM II-III pottery in both Crete and Thera (Furumark, 1941: 195; Vlachopoulos, 2000: 648), the distinction between ‘bird’ and water-bird/fowl is extremely difficult. Despite this, Shapland has noted that birds depicted with longer necks and those in more riverine settings are more than likely to be waterfowl of one species or another (2009b: 230). Regardless of the uncertainty surrounding the identification of aquatic birds, there are some much clearer depictions. Sherds from a clay vessel from Phylakopi depict ducks or geese set in a marshy landscape or amongst reeds (Atkinson et al., 1904: 141-142; Morgan, 1988: 65, fig. 47 and 48; Vlachopoulos, 2000: 651), whilst an LM IIIA incense burner from Palaikastro depicts five waterfowl around the base of the burner (Georgiou, 1979: 432, Pl. 62, fig. 7). Of the same period, a pyxis from a tomb at Alatsomouri near Gournia, Crete, depicts waterfowl flying though a riverine setting (Betancourt, 1985: 168, Pl. 120). One of the most vivid depictions, however, comes from a Palace Style jar found in a chamber tomb at Argos in the Peloponnese:31 the body of the vessel carries three panels of ducks, featuring both single birds and pairs. The birds are highly detailed, with each bird having a slightly different pattern, each finely painted and

31 Evans remarks that the amphora could well have been made on the Mainland by a potter expertly trained in the Palace Style – its sheer size making it very difficult to be transported overseas (1935a: 333-334).
supplemented by ornamental papyrus motifs (Crouwel and Morris, 1995: 170 fig. 7a, 173). Waterfowl are also incorporated into the very structure of some vessels: Zeimbeki notes that Theran domestic piriform teapots and jugs with cutaway spouts which are decorated with reeds feature ‘duck-like’ beaks complete with demarked eyes, adding to the aquatic symbolism of the pieces (2005: 249, fig. 3) (Fig. 54).

As with the papyrus, waterfowl also feature on Late Minoan larnakes, often appearing alongside other nilotic elements such as fish and palms. This is the case on the Vasiliki Anogeia larnax, where on one panel, waterfowl are shown sitting on a clump of papyrus (Watrous, 1991: 296).

With regard to seals and sealings, bird motifs peak between MM II and LM I. Amongst the numerous species of bird depicted, two of the largest groups are waterfowl and wading birds (Ruuskanen, 1992: 94) with several species which would naturally inhabit fresh water locales having been identified including cranes, herons, ducks, geese and swans, with the latter being the most commonly depicted of all the water-birds (Ruuskanen, 1992: 60). Wading birds are particularly dominant during MM II, whilst waterfowl are almost exclusive to the LM period (Ruuskanen, 1992: 94). Ruuskanen notes that a large number of the waterfowl depicted are shown with some sort of riverine plant, such as papyrus, indicative of the bird’s natural fresh-water environment (1992: 32). Interestingly, some seals depict human-waterfowl interaction; these seals tend to be “angular, stiff and heraldic” (Ruuskanen, 1992: 35) with the human (most likely to be a woman) holding or carrying the fowl to their side.

The carrying of waterfowl by a human figure can also be seen on the ‘Master of Animals’ gold pendant from the Aigina Treasure. This piece shows a human figure (presumed to be male) amongst lotus flowers and stylised bull-horns. The figure stands with arms outstretched, holding a goose by the neck in each hand (Fig. 55). Wildfowl, in particular, ducks, appear in two further gold pendants. The first is a gold filigree duck (Fig. 56) found below the floor of the Upper East-West Corridor at Knossos (Evans, 1902: 38-32)

32 The source or origin of the Aigina Treasure is a highly contested debate. In his consideration of the Aigina Treasure, Laffineur notes the technical and design similarities between the ‘Master of Animals’ pendant (and other pieces in the Treasure) to Protopalatial and Neopalatial examples from Crete (2009: 40). Aruz (2009: 48) believes that the pendant has Canaanite characteristics and was produced beyond the Aegean. However, both authors conclude that identifying the origin of the treasure, whether Aegean or Near Eastern, is highly problematic. Indeed, Laffineur notes that it is “ultimately impossible...to identify a single, precise geographical origin” for the hoard, and therefore the ‘Master of Animals’ pendant (2009: 42).
The second is a red cornelian bead in the shape of a duck which was found at Palaikastro (Evans, 1902: 39, fig.19). In addition to these two actual pieces of jewellery, a duck necklace is depicted in Room 3a of Xeste 3, Akrotiri (Doumas, 1999: 162-163). Here, the seated ‘Mistress of Animals’ or ‘Goddess’ wears three necklaces; one of these is a necklace of duck ornaments,\textsuperscript{33} alternating in unrealistic colours of deep orange, blue and pale orange (Fig. 57).

\subsection*{4.2.4 Dragonflies}

Dragonflies are a highly localised motif in Aegean art. There is an absence of dragonfly designs on pottery from Crete, Thera and other neighbouring islands, and they do not appear on any frescoes found on Crete. Even on Thera, where a number of dragonflies are depicted in fresco art, they are exclusive to Xeste 3. The ‘reed thicket’ fresco from Room 3b contains at least fourteen red dragonflies flying amongst the reeds and resting on leaves and reed heads (Vlachopoulos, 2000: 633) (Fig. 58). They are depicted with the same naturalism and detail as other elements in the frieze such as the ducks and the reeds themselves. In Room 4 of the same building, a red dragonfly painted in a similar style, is clearly visible caught in the beak of a swallow in the Frieze of the Swallows, and a further dragonfly has been identified in a large wall-painting in Room 2, accompanying a blue duck, palms and a lion with its prey (Vlachopoulos, 2008: 491). Xeste 3 also houses an indirect depiction of dragonflies in the form of a gold and blue necklace worn by the seated ‘Mistress of the Animals’ in Room 3b (see Fig. 57) (Doumas, 1999: 162-163), consisting of a string of gold beads from which five splayed dragonflies are hung, arranged wingtip to wingtip.

The connection between dragonflies and jewellery is in evidence in three pieces from Minoan Crete. The first is an LM IIIA gold ring depicting a scene involving three human figures, in the background of which is a cluster of images including an eye, a ‘colonette-like’ object, a butterfly, and a dragonfly (Younger, 2009: 45-46), from Archanes tholos A (Fig. 59). The second is a ring imprint from Kato Zakros, dated to LM IA-LM IB, which depicts a kneeling woman (interpreted by Marinatos as a ‘visionary’ (Marinatos, 2004: 36) attended by a large dragonfly (Fig. 60). The third, also an LM I ring imprint, is from Aghia Triadha and depicts a similar scene of a kneeling woman, this time with two dragonflies facing each other behind her (Marinatos, 2004: 36, fig.11). Each of the scenes

\textsuperscript{33} Harte notes that based on the feet and thin bills, the ‘ducks’ are more likely to be cormorants or shags (2000: 687).
on these pieces have been identified as ‘epiphanies’, with the dragonfly appearing either as a vision or an invocation of a deity (Marinatos, 2004). Alongside these examples, the dragonfly can be found on a number of Minoan seals or seal impressions, both as a prominent feature and in conjunction with other elements, especially butterflies. Krzyszowska notes that dragonflies become part of the repertoire of seal images in the Neopalatial period, persisting into LM II but vanishing thereafter (2005: 144, 208).

5. Conclusions

From the evidence discussed in this chapter, it is at least clear that fresh water and fresh water environments are a recurring theme within Minoan and Aegean art. While this may seem a simple and perhaps obvious point, it is worth observing that there is something of a disparity between the varied and creative attention paid to water by Minoan and Aegean painters, and the general lack of scholarly interest in depictions of fresh water, in comparison to more eye-catching motifs such as monkeys, human figures, and certain plants such as crocuses. The different ways in which Minoan and Aegean artists have solved the problem of depicting water, especially in the limited colour palette of the Bronze Age Aegean, demonstrate a high degree of thought and care. That some visual devices, such as the ‘bifid’ motif, appear in many different scenes and in different artistic formats, goes to show that the representation of water and its movement constitute a set of traditions or artistic discourses in itself. The stylisation visible in the bifid motif is remarkable, especially within the highly naturalistic context of Aegean fresco art, and points to a shared awareness among painter and audience alike of what is being represented. This is characteristic not of an incidental or unimportant figure within the paintings, but rather of something significant.

If we interpret the frescoes in particular as more than merely decorative or literal, and instead as containing meaningful connections, metonymic associations, and embedded concepts, then Aegean art is replete with fresh water or references to it. Far from being a mere assemblage of detached, self-enclosed motifs, the frescoes create constellations of associated characters, the bonds between which are reinforced through the repetition of their spatial association in various works. In this way, fresh water participates in a multitude of different meaningful contexts as an active motif in itself, rather than a part of the background or scenery. In contrast to those interpretations that would reduce the meaning of fresh water in Minoan and Aegean art to a single concept – for instance, fertility, along the lines of nilotic art – the evidence explored in this chapter overwhelmingly suggests that
fresh water was diversely represented, including rivers but also waterfalls, marshes, pools and a well. This diversity indicates a level of engagement with and curiosity in fresh water that is not captured by interpretations that relegate water to a functional or background element, unworthy of the same standard of attention given to other motifs and characters.

While this chapter has not attempted to establish a definitive interpretation of what fresh water means in Minoan and Aegean art, the evidence presented should at least highlight a need for more attention within the relevant academic literature on the presence and role of fresh water. With this need in mind, there are a few preliminary observations that I would like to make here, based on the evidence presented above. This preliminary discussion will inform the work of the remainder of this thesis.

The first relates to a common theme in the compositional role that fresh water plays in Minoan and Aegean art. In the depictions of rivers and marshes especially, there is a clear convention whereby watercourses run horizontally through the length of the fresco, serving to connect separate and often disparate elements. As Morgan observes, this connecting function of water operates thematically as well iconographically, with the common element of a river helping to unite two different genres (Morgan, 1988: 150). A similar idea runs through the discussions of the reed fresco, with fresh water – in this case indirectly depicted through ducks and dragonflies – forming a conceptual link between the ‘Goddess’ fresco in Xeste 3, and the reed scene on other walls in the same room (Angelopoulou, 2000: 549; Vlachopoulos, 2008; Zeimbeki, 2005: 245-246). Room 5 of the West House, Akrotiri, Thera is notable in this regard, as it includes the Ship Fresco, in which sea water is a connecting element, spatially uniting the two coastal zones, and the repetition of fresh water in each of the frescoes in this room: a river encircles the ‘departure’ town in the Ship Fresco on the South wall (itself connecting a ‘wild’ and an urban environment), another river dominates the Landscape fresco on the East wall, while a well is visible in a fresco on the North wall.

The second pertinent observation relates to the leitmotif of the literature on Minoan and Aegean art, namely the association between nature and religion. As discussed above, there has been a strong tendency to assert that all nature scenes are either religious or secular in character. Not only does this debate assume that the religious or secular content of a few friezes can be generalised to all nature scenes (Angelopoulou, 2000: 552), but the terms of the debate are themselves questionable: “it is unproductive to attempt to separate the ‘secular’ and the ‘sacred’, as this conventional distinction is often made for analytic purposes” (Zeimbeki, 2005: 250), and does not necessarily reflect the content of the works
themselves. Based on a more ‘micrological’ approach, the evidence presented in this chapter suggests that it is likely that religious meanings are embedded in at least some of the contexts that water participates in. A key example would be the relationship between the marsh-water of the ‘reed fresco’ in Xeste 3, Akrotiri, and the famous ‘Goddess’ of the same building, whose duck and dragonfly necklaces establish a visual, metonymic connection between the ‘divinity’ and wetlands. While it is plausible to generalise this apparent religious connotation to other depictions of fresh water, there is insufficient evidence to confirm or deny this.

A more productive way of navigating this issue would be to situate the motifs themselves in a more concrete context: specifically, the cultural experience of the elements to which the iconography refers. Rather than assuming that art was a unique means of communication in which the Minoans expressed their relationship with nature, we may understand artistic conventions to reflect and continue existing material practices of relating to nature (Zeimbeki, 2005: 244-245) – material practices that included both sacred and secular dimensions. When we look at artistic depictions of fresh water in Minoan and Aegean art, therefore, we must remain sensitive to the ways in which individual artistic works participated in existing material-cultural practices. This opens the door to considering the connections between, on the one hand, instances of the representation of fresh water in Minoan and Aegean art, and on the other, the symbolic aspects of other material practices involving the ‘nurturing’ or manipulation of water in Bronze Age Crete.

The following two chapters attempt to sketch this context of Minoan material-cultural practices relating to water. Chapter 4 looks at socio-political issues, in which water appears as a fundamental physical and economic resource, as well as a participant in strategies of ideological control and differentiation. Chapter 5 turns to ritual practice and the construction of religious meanings, and the roles played by water therein. Throughout these two chapters, but especially in Chapter 5, I seek to draw connections between the material-cultural practices relating to water and the reflections on art presented here. Having built up a picture of the material-cultural context (related to fresh water) that Minoan art reflects and participates in, I intend to re-incorporate Minoan art by highlighting the continuities and linkages that may be drawn between the social, political and religious practices involving water and the themes identified in this chapter: water as a linking element and potent metaphorical device, and water’s place in how the Minoan imagination understood and articulated the relationship between environment and society, nature and religion. Through exploring a selection of theoretical insights and comparative
case studies in the following two chapters, I also seek to delineate a broader approach to the Minoans’ relationship with fresh water that is rooted firmly in the archaeological evidence, presented in Chapters 1, 2 and 3, which is capable of shedding more light on the artistic representation of water surveyed in this chapter.
Chapter 4: The Socio-Political Role of Water on Minoan Crete

1. Introduction: Water as a political agent

Water is a fundamental resource, both biologically and economically and, as such, to be able to control and manipulate it is both a pressing concern and a great source of social power. There is a wealth of academic work which focuses on the way in which modern water is controlled, manipulated, dispersed and contested\(^{34}\) and we have become increasingly aware of how the control of a water supply is a means by which power can be secured and maintained (Mithen, 2012: 7-8). Both natural factors affecting water supply, such as droughts and floods, and artificial factors such as dams, irrigation, and the diverting of river flows, remain hotly contested throughout the world (see for example Kaika, 2003; Lebel et al., 2005; Swyngedouw, 2005, 2009). Political struggles over large-scale water management projects are fought along multiple lines: who should have control over this fundamental resource, how it should be managed, and who are the intended beneficiaries? These questions are set against an equally politicised backdrop of short- and long-term consequences, especially in relation to environmental issues, which draw in a much broader set of interests and stakeholders than those immediately affected.

As Mollinga successfully argues, water resource management is an inherently political process, involving the act of controlling, or intervening in, the hydrological cycle which affects the “time and/or spatial characteristics of water availability and/or its qualities” (2008: 10) and this process of intervention is something that humans have done for millennia. Although the study of ancient socio-political interactions with water, through its control and management, is still a relatively niche area of research, there is an emerging literature. Major archaeological journals such as World Archaeology (March 2009) have produced special issues relating to water and water management in antiquity, whilst specialist journals such as Water History and the multi-volume series A History of Water aim to show how the historical study of water and water management can highlight the manifest roles water plays in the social, cultural and political realms while also addressing

\(^{34}\) See, for example, the special edition of the Annals of the Association of American Geographers (2013) which highlights several key socio-political debates, including the privatisation of water, regionalism, water qualities and ‘waterscape’ interaction. Specialist journals, such as Water Alternatives also specialise in water, politics and development.
the significant position water management strategies held in the development of ancient societies (Coopey and Tvedt, 2006; Tvedt and Coopey, 2010: 4). This latter aspect of water management – its central role in the development or rise of complex societies – is one which has interested scholars since the mid twentieth century.

For more than fifty years, Karl Wittfogel’s ‘hydraulic society theory’ remained one of the most influential theories on the origin of ancient states. Wittfogel’s highly influential work Oriental Despotism (1957), among other writings (1955, 1972), posited that the provision of water was essential for burgeoning populations in arid and semi-arid regions: he describes a “dialectical relationship between large-scale irrigation systems and the centralized state power” (Linton, 2010: 64) in early irrigation civilizations such as Egypt, China and Mesopotamia and demonstrated that by developing a redistributive economy and through an association with religious leaders, elites were able to ingrain their power, eventually developing all-consuming, despotic regimes. Through Wittfogel’s theses, along with other influential scholars such as Steward (1955), “state centralization and resource management became a testable hypothesis using irrigation data” (Scarborough, 2003: 18). However, Wittfogel’s original hypothesis has been generally abandoned: often, his ideas are criticised for being essentialist and generalising, or that he simply “overstated his case” (Scarborough, 2003: 18). The two most critical arguments against the theory have been that a) cities and associated indicators of complexity often pre-date the canal systems Wittfogel championed (Adams, 1966); and b) many non-state groups have also developed sophisticated water management systems (Millon cited in Scarborough, 2003: 19).

While the ‘hydraulic hypothesis’ has now been challenged, and in many cases refuted, thinking critically about the importance of water control, its political impact, and how it influences the structure and development of a society, has remained a pressing academic concern. Through the study of numerous ancient complex societies, scholars such as Scarborough (1998, 2003) and Lansing (1987, 1991) have drawn attention to the manifest ways in which water management systems, such as Mayan ‘water mountains’ or Balinese ‘water temples’, are sites of intense social and political struggles, through which practical issues become intertwined with hierarchy, cultural meanings, and the articulation of identities. This interaction between economic organisation, elite power, and cultural

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35 Within this chapter, I make reference to other ancient societies’ political use of water management systems. It should be noted here that I use these analogies with great caution and they are only used to highlight the potential impact that water management can have within the political sphere and are not intended to inform
meaning, which is embedded in the politics of water management, is by no means confined to ancient societies. Recent episodes, such as the struggles over the privatisation of water in Cochabamba, Bolivia, highlight that today water management systems are not simply of economic importance but equally about social power and social control (Swyngedouw, 2009: 56-57).

2. The Politics of Water on Crete

In the light of this enduring connection between water management and power, this chapter aims to explore how Minoan water management systems can be thought of politically. Through using patterns, observations and exceptions in the data presented in Chapter 2, I aim to argue that Minoan water management systems are inherently political, used not only to control and manipulate local water resources for economic benefit, but also used by elites as a form of social control through ideology. The more social aspect of water management will be discussed in the next chapter.

Necessarily, any investigation of the socio-political dimension of water management on Minoan Crete entails numerous intersecting and complex dynamics and issues. For this reason, this section disaggregates the various issues into four broad themes, each of which viewing the socio-politics of water management from a slightly different angle. Inevitably, they intersect and blur together, and as such it has not always been possible to prevent repetition. However, by breaking down my argument into these broad themes, I hope to have organised the material according to the key questions that relate to the available data, and which to some extent mirror the presentation of Chapter 2.

The first two themes are the most general: an examination of what water management technologies reveal about the nature of political power in Minoan society, if it is to avoid falling into the traps of over-generalisation or reductionism, must take into account synchronic and diachronic differences in the evidence. Insisting on an awareness of regional differences and variability has been an increasingly important theme within the literature on Minoan political economy, as the traditional interpretations of a single, coherent island culture have been challenged and complicated (see for example, Day and Wilson, 1998; Driessen, 2002a; Reid, 2007; Schoep, 2002a, 2006, 2010). Likewise, contemporary research has drawn significant attention to the familiar structures of Minoan
archaeology being specific historical ‘events’ in the development of civilization in the Cretan Bronze Age. While this is by no means a recent observation, there has been an intensification of interest in the continuities and discontinuities in the Minoan archaeological record, especially in terms of architecture and innovation in response to significant changes to the social and natural environment (Driessen and Macdonald, 1997). With this in mind, the second theme discussed in this section seeks to offer some reflections on the connection between temporal changes in Minoan water management systems and strategies and significant environmental changes, especially the shifts in climate and the effects of the Theran eruption, both discussed in Chapter 1.

The third theme tackles a central question in the literature on Minoan political economy: the function of the ‘palaces’ and the extent of their power in Cretan society at the times of their use. No discussion of the socio-political situation in Minoan Crete can avoid talking about the palaces, especially as their scale and durability has made them by far the best preserved and best excavated sector. Recently, a growing literature has emerged which questions the foundations of Minoan archaeology’s interpretive assumptions: the palaces have long been considered sites of considerable political and administrative power, focused around the centralisation of economic functions. However, this view has met with increasing opposition, with some going further in questioning even the validity of the classification and label ‘palace’ (Schoep, 2002b: 18, 2006: 38-39). In order to discuss these issues with reference to water management, the third theme explores the possibility that the palaces with significant water management systems could have served as redistributive centres, through which elite power was maintained through the control of this vital resource. It also discusses how various water management systems were accessed and who could access them. In addition, through considering ‘inside’ versus ‘outside’ water management systems, I discuss what this can tell us about the status of water (or more specifically particular water) had on Crete at this time. The fourth theme relates to the form of water management systems, specifically, this section explores the degree to which various water management systems display signs of ‘monumentality’ – a well-established theme within Minoan archaeology – and technological sophistication.

2.1 Regional Differences

At first glance, there are two striking features of the distribution of water management systems on Crete (Fig. 61): first, with only a few exceptions, they are clustered into two relatively small zones, centring around the north coast in central Crete and the
peninsula that stretches out eastwards from Gournia. The two zones map onto two of the three major clusters of Minoan sites, with the Mesara plain (which includes Aghia Triadha and Phaistos) apparently lacking any major water catchment systems. Nevertheless, when considering the politics of water management this distinction between the South compared to the North and East may be of some significance. The second striking feature is that there is no discernible geographical pattern organising the different types of water management system discussed in Chapter 2. Were there a centralised and relatively homogeneous Minoan culture spanning the whole island, we may expect to see a more even pattern in the distribution of water management technologies (for a more detailed argument on the broader implications of regional diversity see Whitelaw (2004)). The case of Minoan dams, which appear to be highly regionally specific with all seven dams east of the Ierapetra isthmus, strongly indicates that water management techniques had a strongly local character. Socially and politically, this would seem to suggest that, at least based on water management data, Minoan Crete was highly heterogeneous with strong regional variability.

This view of heterogeneity does not, however, capture the whole story. As discussed in Chapter 1, the geography and geology of Crete produces a high degree of inter- and intra-regional variability in terms of the opportunities and necessity for water management systems. For instance, the way in which surface water is lost to and redistributed by Crete’s idiosyncratic geology, whereby groundwater is hidden by case-hardened rock, or springs forced up many miles from their origin, or the precipitation shadows cast by Crete’s mountains that effectively create deserts on an island equally prone to floods (Rackham and Moody, 1996: 34-36). To a large extent, the contrasting fortunes of different regions, in terms of the availability of fresh water, and the many different forms of that availability, preclude the development of a homogeneous ‘Minoan’ material relationship with water. In this way, it is possible to explain the regional variability in water management systems as adaptations to local pressures – which is then expressed through local hydrological knowledge (see Chapter 2), available materials and local, socio-historical preferences.

When we look at the archaeological record in more detail, an interpretation based on regional adaptations of a broader island model appears a more likely explanation of regional differences. In many ways, the surprising technological sophistication and hydraulic expertise employed in Minoan water management systems tell their own story: far from being unique to one specific site, the evidence for Minoan expertise in water
management, discussed in chapter two, is visible in geographically disparate sites. Moreover, while there is a strong local tradition in each of the water management systems – especially in terms of building materials – there are certain innovations that are echoed across the various sites. One such example is the use of hydraulic plasters and cements, often made with lime, in cisterns found in Kato Zakros in the East, Myrtos-Pyrgos in the South and Tylissos in the North. This is a concrete expression of a broader similarity between all the eight cisterns from Minoan Crete, in how they dealt with the unique difficulties of combating water seepage and the immense outward pressure of the large bodies of water held by the circular cisterns. Along similar lines, we may note the marked resemblance between the spring chambers at Kato Zakros and the Caravanserai at Knossos, which share a great many architectural features and dimensions (as discussed in detail in Chapter 2), as well as the repetition of certain features in Minoan dams. Betancourt notes that the construction of two dams on the islet of Pseira drew on engineering expertise from outside the local community, that had built similar dams and with whom the Pseirans “were in constant contact” (2012: 6). The dams at Choiromandres near Kato Zakros, and at Gournia likewise display numerous common features, including check-dams, fortification walls and ‘towers’ (see Table 9).

<table>
<thead>
<tr>
<th>Catalogue No.</th>
<th>Dam site</th>
<th>Date</th>
<th>Use of Check-dam</th>
<th>Terraces</th>
<th>Boundary or fortification walls</th>
<th>Towers</th>
<th>Other nearby structures</th>
</tr>
</thead>
<tbody>
<tr>
<td>D1</td>
<td>Chalinomouri</td>
<td>LM IB</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Farmhouse</td>
</tr>
<tr>
<td>D2, D3</td>
<td>Choiromandres</td>
<td>MM III-LM II</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>‘Guardhouse’</td>
</tr>
<tr>
<td>D4, D5</td>
<td>Gournia</td>
<td>LM I</td>
<td>-</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>‘Shore House’</td>
</tr>
<tr>
<td>D6</td>
<td>Pseira – Dune Creek</td>
<td>LM I</td>
<td>✓</td>
<td>✓</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>D7</td>
<td>Pseira – Middle Creek</td>
<td>LM I</td>
<td>✓</td>
<td>✓</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Table 9 Common features among dam sites

In much the same way as there appears to have been a shared artistic and symbolic culture on Crete, the archaeological evidence suggests some degree of knowledge sharing
and the communication of expertise in water management. While this is not to suggest that there was an overarching political or administrative system that spanned the entire island, we can at least discern some level of integration between specific regions. In this regard, the great many similarities between Kato Zakros and Knossos stand out as significant, especially considering the differences between the two sites in terms of the form of the availability of water. Where Knossos was probably well watered by rain, including deluges, and appears to have had ample access to fresh water through wells, a river and nearby spring, Kato Zakros is located in a precipitation shadow and was highly dependent on its springs (see Fig. 5). In spite of these different pressures and opportunities, the water management archaeology suggests both shared hydraulic knowledge and common architectural intentions.

In contrast to technological knowledge-sharing between regions, there is little evidence for the dispersal of water management expertise within the local polities themselves. Apart from the Middle Minoan settlement at Myrtos-Pyrgos, the more technologically sophisticated water management systems appear to be concentrated in and around buildings identified as belonging to elite groups, such as palaces, villas, and country houses (however, one must consider the archaeological bias towards the excavation of larger sites – see section 3 below for further discussion on this issue). Whereas wells and dams appear in a variety of social settings, serving whole communities, architectural features such as cisterns and spring chambers – and the associated technologies of ashlar masonry and hydraulic linings – occur almost exclusively in apparent elite settings. While this may be partially explained in terms of these groups having the necessary resources for such complex or expensive investments, the fact that such expenditures are rare in non-elite circumstances is suggestive: whereas knowledge relating to water management may have been exchanged between elite groups from different areas, specialist knowledge was, to some extent, restricted within the local setting. This idea is discussed in more detail below, however, it should be noted that in the difference between the flow of water management knowledge across regions and the restriction of that knowledge within them, a picture emerges that resonates with a certain view of Minoan Crete, namely, that of a collection of local elites, with varying degrees of contact and interconnection between them, and each maintaining some sense of social separation from their local community.

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36 Knowledge sharing can be seen in other aspects of Minoan culture, for example the sharing of certain pottery skills (Berg, forthcoming) and the art of plastering and fresco painting (Brysbaert, 2008). This will be discussed in more detail later in this chapter.
Particularly in those areas where water management was a pressing concern, as in the North and East, elites may have shared expertise, which was then adapted to local conditions, in order to cement and reinforce their social position.

2.2 Chronological Differences

The theme of adaptation raises a significant question of chronological changes in Minoan water management systems and strategies. Here, I offer some reflections on the connection between temporal changes in those systems and strategies and significant environmental changes, especially the shifts in climate and the effects of the Theran eruption, both discussed in Chapter 1. As discussed in some detail in Chapter 2, there are a number of chronological patterns that can be observed for each water management system.

<table>
<thead>
<tr>
<th>Date</th>
<th>No. of cisterns</th>
<th>No. of wells</th>
<th>No. of Spring Chambers</th>
<th>No. of Sunken baths/basins</th>
<th>No. of dams</th>
</tr>
</thead>
<tbody>
<tr>
<td>EM I-EM IIB</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>EM III-MM IA</td>
<td>1</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>MM IB-MM IIB</td>
<td>0</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>MM III</td>
<td>3</td>
<td>5</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>LM I</td>
<td>4</td>
<td>8</td>
<td>2</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>...Of which</td>
<td>(2)</td>
<td>(0)</td>
<td>(1)</td>
<td>(1)</td>
<td>(0)</td>
</tr>
<tr>
<td>confirmed LM IA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>...Of which</td>
<td>(2)</td>
<td>(6)</td>
<td>(0)</td>
<td>(0)</td>
<td>(1)</td>
</tr>
<tr>
<td>confirmed LM IB</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LM II-early LM IIIC</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>LM IIIC</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Table 10 Numbers of water management features over time

Generally speaking, the earliest known approaches to water management appear to focus on the use of wells (see Table 10): this is perhaps not surprising, as wells are often seen as a relatively simple and common form of water management which can be constructed using limited resources where the water table is easily reached (Scarborough, 2003: 43). This is not to say that these early wells were small: the EM I ‘palace well’ (No. W7) at Knossos is over 17m deep and the EM III ‘Upper East Well’ (No. W5) also at Knossos is an impressive 19m in depth. These wells must have been a substantial undertaking involving both a great deal of time and labour, both at their time of construction, and in their maintenance. The earliest cisterns, at Chamaizi (No. C3) (MM IA), and Myrtos-Pyrgos (Nos. C5 and C6) (MM III), share some common features. While

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structurally these three cisterns appear very different – Chamaizi’s cistern is considerably smaller than the two substantial cisterns at Myrtos-Pyrgos – they are all located in such a way as to be accessible only from inside the settlement. At Chamaizi, the cistern is at the very centre of the building and cannot be seen from outside. At Myrtos-Pyrgos, both cisterns are highly visible and are not ‘hidden’ from view, but are positioned in such a way as to prohibit access without gaining entry to the hilltop settlement. One is located in the very centre of the site, and the other on a steep slope overlooked by a tower-bastion and formidable terrace walls, which, in times of conflict or crisis, would have “repelled attackers...while providing military cover for the cistern” (Cadogan, 2007: 105-106). In these early examples, it certainly appears that there was a real or perceived advantage to the ability to restrict access to the cistern.

As we move on from MM III into LM I, we see a proliferation of different types of water management systems constructed (see Table 11). During this period, we see the emergence of sunken baths or basins at various settlements and building types: while the slightly earlier MM III basin at the Caravanserai, Knossos (No. 32) is clearly fed by a fresh water source, it is less certain how the other examples were fed, and so they could equally have been used in conjunction with other liquids (for example milk, blood, oil) rather than water. However, their potential use as water receptacles and dispensers can also not be discounted and their appearance during LM I may suggest an a growing concern with water activities, particularly those based around ritual, which will be discussed in more detail in the following chapter.

<table>
<thead>
<tr>
<th>Cisterns</th>
<th>Wells</th>
<th>Spring Chambers</th>
<th>Sunken baths/basins</th>
<th>Dams</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anegyros</td>
<td>Annisos</td>
<td>Kato Zakros</td>
<td>Mochlos</td>
<td>Chalinomouri</td>
</tr>
<tr>
<td>Archanes</td>
<td>Chania</td>
<td>Knossos, Caravanserai</td>
<td>Palaikastro (3)</td>
<td>Gournia (2)</td>
</tr>
<tr>
<td>Nerokourou</td>
<td>Knossos</td>
<td></td>
<td>Pseira</td>
<td>Pseira (2)</td>
</tr>
<tr>
<td>Kato Zakros</td>
<td>Nirou Chani</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Palaikastro (4)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Kato Zakros</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table II Sites with LM I Water Management Systems (based on earliest dates)

LM I also sees the application of dam technology spread throughout the eastern part of the island. The dam systems at Choiromandres, near Zakros (Nos.D2 and D3), which were probably constructed in the earliest phase of the Neopalatial period (MM III), appear to have been a precursor for the LM IA and LM IB dams at Chalinomouri (No.D1), Gournia, (Nos.D4 and D5) and Pseira (Nos.D6 and D7). Such large undertakings required
a significant investment in labour, time and resources and it is highly likely that such a development was overseen by an elite, not only due to the necessary investment of resources, but also the coordination of a relatively large labour force. Not only would the construction of the dams have been economically and agriculturally beneficial to both local people and local elites, but it would have provided a further demonstration of elite power: their ability to conceive of, and construct such large complexes, but also of their ideological power - to control the local environment and the forces of nature.

In the cases of sunken basins and dams, the data suggest an increase in communicability of water management strategies, intensifying particularly in LM I. In both cases, there appears to be a MM III precursor (the sunken basin at the Caravanserai, Knossos, and the dams at Choiromandres), which is later adopted at a number of different sites – concentrated in the East of the island – as the Neopalatial period matures. This pattern is echoed, albeit in a slightly different way, when we look at cisterns. As Table 10 shows, the construction dates of cisterns are distributed chronologically more widely than other water management systems (EM III–LM III), and there are as many cisterns constructed in MM III as there are in LM I. This precludes the ‘MM III precursor and LM I spread’ pattern as seen in dams and sunken basins; however, as Table 12 suggests, there is an overall increase in the capacity of cisterns on Crete as time moves on. Technologically, this is important, as increasing the capacity of a cistern increases the pressure the water exerts on the cistern37 and associated problems of water seepage and wall weakening, and therefore the overall increase in size indicates hydrological advancements that were not limited to one particular site, as mentioned in the discussion of regional differences. It is therefore of some significance that the only cistern (of those for which we have capacity data) that bucks the overall increasing capacity trend, namely Myrtos-Pyrgos 2 (No.C6), collapsed some time before LM I (Cadogan, 2007: 105). Barring this exception, we can observe a steady increase in cistern size across multiple sites, which suggests that the necessary improvements in technological understanding related specifically to cisterns were not developed at each site independently. Rather, we can infer some communication between certain settlements that allowed for the spread of new solutions to the technical problems of large cisterns, or at least background knowledge that could be applied to cisterns. While not as clear as the examples of dams and sunken basins, the chronological

37 The ‘hoop Stress’ of a cistern (or a cylinder) is the force exerted circumferentially on the cistern wall. This means that the larger the diameter of the cistern, the higher the stress exerted on the walls of the cistern, and therefore, the greater the need for stronger walls (Giles et al., 2009: 35).
pattern that is broadly observable in cistern technology supports the same overall picture: hydrological innovation on Minoan Crete appears to have been highly communicable – especially within certain regions, such as the Eastern peninsula – with successful strategies and systems being adopted over time at a number of different sites.

The dataset is of insufficient size, and the dating of water management systems is still too inaccurate, to say anything more detailed with much certainty; however, Tables 10 and 11 are at least suggestive of an intensification of this communicability in the Neopalatial period, from MM III to LM I. Politically, this is significant, as it implies a knowledge exchange network that was stable enough to allow for the spread of complex commodities, such as hydrological expertise. This fits with the common interpretation of the Neopalatial period as involving greater bureaucratisation and centralisation, which would allow for a more effective dispersal (and also control) of technological expertise and learning.

<table>
<thead>
<tr>
<th>Site</th>
<th>Date</th>
<th>Capacity (litres)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chamaizi</td>
<td>MM IA</td>
<td>6,914</td>
</tr>
<tr>
<td>Myrtos-Pyrgos (1)</td>
<td>MM/MM IIIA</td>
<td>22,791</td>
</tr>
<tr>
<td>Myrtos – Pyrgos (2)</td>
<td>MM/MM IIIA</td>
<td>66,212</td>
</tr>
<tr>
<td>Kato Zakros</td>
<td>LM IA / LM IB</td>
<td>27,892</td>
</tr>
<tr>
<td>Archanes</td>
<td>LM IA / LM IB</td>
<td>47,642</td>
</tr>
<tr>
<td>Tylissos</td>
<td>LM IIIA</td>
<td>68,734</td>
</tr>
</tbody>
</table>

Table 12 Cisterns in chronological order with their total (potential) capacities

In a similar vein, water management systems across the various sites generally become more complex and varied. The architecturally intricate spring chambers at Kato Zakros and the Caravanserai, Knossos, both appear during the LM I period, around the same time as a marked increase in large dam complexes in the East of the island, and of sunken baths or basins (Table 11). Later still, complex water filtration systems using charcoal appear (LM IIIA) at Tylissos, used in conjunction with the cistern and an aqueduct. Unfortunately, due to the lack of dating information for a large proportion of the water management systems (particularly wells, which are periodically cleaned out of debris which would have provided valuable dating materials), there is insufficient data to provide a more nuanced chronological analysis for each of the water management systems. However, we can say that during the mature LM I period and beyond, the provision of water
becomes a vital concern (Driessen and Macdonald, 1997: 48), as reflected by the digging of several new wells at some sites and the creation of new ones at others.

2.2.1 Chronology: Water management systems as a response to climate

As Table 9 shows, Minoan Crete saw a marked intensification in the construction of water management systems in MM III–LM I. One explanatory factor for the appearance in this period of these systems could come from the climate at this time, and what is interesting here when we compare the chronology of water management systems with available climate data is that the likely explanation has political overtones. Counter-intuitively, the LM I ‘spike’ in water management constructions does not appear to correspond to a particularly dry or evaporative period in the Cretan climate, which would make the collection and storage of water a pressing concern. Instead, LM I falls roughly in the middle of the ‘Minoan Little Ice Age’ which spanned MM IB to LM III (Moody, 2000). As discussed in Chapter 1, this event brought with it a generally wetter climate that was accompanied by irregular temperatures and precipitation changes, leading to deluges, intensive erosion and debris. It is likely that Crete had more rivers than today; however, the overall increase in the availability of water came at the cost of a considerable increase in the volatility of the weather at the time. Whereas the construction of numerous wells in the EM and early MM periods – which would have corresponded with the 3rd Millennium Aridity Event (see Chapter 1) – may be seen as a response to water scarcity, the MM III-LM I water management systems are a response to increased opportunities for the collection and storage of water, which coincided with a greater need to manage and limit the chaotic and volatile nature of fresh water.

The building of dams during this time certainly fits this picture: we can see here an investment in mitigating the destruction of agricultural land by deluges, as well as exploiting the abundance of water offered by the floods by controlling the speed and direction of flow. The size and scale of these projects, as mentioned above, is indicative of an elite strategy for the coordination and mobilisation of social resources. What we see in the development of dams – namely significant and probably elite investment in the control of nature – can be applied to the MM III-LM I ‘spike’ in water management systems more broadly. While some of the systems have a more practical dimension in terms of control, such as the increase in well digging and the development of complex drainage systems, others suggest an investment in the control of fresh water for more ideological or political reasons such as displays of mastery and monumentality (discussed below). The archaeology
of water management systems on Crete is strongly suggestive of the attempt to capitalise on the increased availability of fresh water, but also of the emergence of an ideology of control, in which elites sought to negate – and be seen to negate – the chaotic and volatile character of nature’s provision of fresh water. It is highly relevant in this regard that in addition to *longue durée* changes in climate patterns, there were also significant environmental events that contributed to the volatility and unpredictability of the availability of water during the period in which water management systems appear to proliferate.

### 2.3 The Effects of the Theran Eruption

As discussed in Chapter 1, the Theran eruption during the LM I period had a profound impact on Minoan Crete and it can be argued with little doubt that the eruption had a considerable effect on the water management systems of the island, alongside significant socio-political consequences of these disruptions and changes. While the precise nature of the effects of the eruption continue to be debated, it is at least clear that earthquakes, tremors, ash-fall and tsunami’s all had an impact on the island at some point. Earthquakes and tremors could certainly have had an effect on the water management systems: elements such as aqueducts, clay pipes and conduits could easily crack and break following such tremors, temporarily disrupting the supply of fresh water. However, these are relatively easy to repair or replace and perhaps would not have posed a great challenge to those maintaining the water systems on a day-to-day basis. A more pressing concern, however, would have been the potential impact that a tremor or quake would have had on the water-tables of local areas, especially those that rely or prefer to use wells as one of their main sources of water, such as Knossos and Palaikastro.

Earthquakes are known to have a variety of hydrological effects, including those on aquifers, water table levels and ground water supply (see for example King et al., 2006; Montgomery and Manga, 2003). Often water table levels will drop or disappear, resulting in wells running dry. During the 1998 Pymatuning Earthquake in north-western Pennsylvania, an earthquake of 5.2 magnitude resulted in the disruption of their water supply for over 50 miles, with the main cause being a significant drop in water table levels: in one local well, the level decreased by 12.2 meters overnight, while in other places, the water-level dropped approximately 30.5 meters (Fleeger et al., 1999: 8; Gorokhovich and Fleeger, 2007: 247-248). This decline was followed by further drops over a two month period, with some wells never returning to their original levels, whilst in other areas, old wells or low water-level
wells suddenly became renewed. Similar patterns have been observed in other countries around the world including China and India (Gorokhovich, 2005: 219-220). As there is clear archaeological evidence on Crete of significant seismic activity both before the eruption and following, it seems likely, that earthquakes and tremors would have affected the water management systems. Such an impact will be discussed shortly.

Further effects of the Theran eruption would likely have included significant ash fall, which can block water supply systems such as wells, open-air cisterns and aqueducts and can also pollute water sources, such as springs and rivers, alongside wells and cisterns.38 Ash layers of between 5 and 12cm have been excavated in some sites to the east of Crete, including at Mochlos and Palaikastro (Soles et al., 1995; MacGillivray et al., 1998: 242). It seems highly likely, therefore, that local water sources in this area would have been affected by the ash from the Thera eruption, which is significant as it is in this area that we see the highest density of water management systems.

Similarly, water supplies likely underwent salinisation following the tsunami generated by the eruption and associated earthquakes. Bruins et al. (2008) have identified a large tsunami deposit in the east of the island, again at Palaikastro, that would have been large enough to pollute and salinate local water supplies for some time. The geology of this area, porous limestone, would mean that sea water would have been absorbed into the land quickly and filtered easily into the groundwater, perhaps prolonging the effect.

While direct archaeological evidence for all these effects is not well documented, there are a number of sites on Crete where disturbances in the level and quality of the water supply may be discerned in local behaviour. At Palaikastro, two new wells (Nos. W16 and W17) are dug during the LM IB period. As MacGillivray and Sackett have noted the availability of local fresh water must have been the prime reason for placing these two new wells so close to each other in an area that had already been abandoned (2007: 222). They further note that one of the wells (No.W16) is significantly larger than the other, proposing that this well could have acted as a new source of public water, perhaps with the smaller well being restricted to drinking water only (MacGillivray and Sackett, 2007: 222). Clearly, the digging of two new wells at this site marks a point in time at which the demand for

38 See Stewart and colleagues (2006: 298) for a review of the main impacts on historic water supplies from volcanic ash.

39 The salinisation of water supplies following a tsunami is a well-documented phenomenon. For a recent case study, see Illangasekare et. al. (2006) on the salinisation of coastal water sources on Sri Lanka following the 2004 tsunami.
fresh water increased – its chronological proximity to the Thera eruption, and its location within a site that felt many of the effects described above (particularly ash fall and tsunami), suggest that they were dug in response to failing or destroyed nearby water sources. A similar situation can be seen at Archanes (No.C2), where an earlier LM IA cistern which had been abandoned and destroyed is re-built and revived during LM IB (Sakellarakis and Sapouna-Sakellaraki, 1997: 112-115) perhaps also following the loss of other water supplies in the wake of earthquakes and tremors associated with the eruption. Similar motivations may have been behind many of the LM IB water management systems constructed at Nerokourou, Amnisos, Chania and at Knossos.

It must be noted here that other motivations may lie behind the construction of these new systems. For example, an increase in population at a site would perhaps naturally lead to the search for, and construction of, new sources of fresh water. However, the majority of the ‘new’ systems constructed discussed above are from sites which are generally thought to have a declining population during the LM IA and LM IB period. Driessen and MacDonald note that large areas of the Palaikastro site are abandoned after LM IA and that during the mature LM IA, building programmes across many parts of the island either stop entirely or are finished with materials of poor quality (1997: 42,233). While these phenomena are certainly not island-wide, and indeed it has been noted that some large-scale building projects did continue in the LM IB period (Driessen, 2013: 5), they do suggest that populations at a large number of sites were declining rather than increasing.

2.3.1 The Socio-Political Impact

Phenomena associated with the eruption, such as earthquakes, tremors, ash-fall and tsunami will have had a substantial impact on the local water supplies and the sudden loss of wells and springs vital for everyday life, and for the economy as a whole, and therefore would have had significant consequences on the socio-political life of the island. We can certainly envisage an almost crisis-like situation at many of the sites across the island: Driessen has argued that the eruption of the Theran volcano was a likely catalyst of social, economic and political upheaval, and that the archaeological record for the periods following the eruption demonstrates an ‘archaeology of crisis’ (2002b), wherein the island undergoes numerous architectural, social, economic and religious changes from the late LM IA period onwards. A key theme that stands out from Driessen’s depiction of crisis archaeology on Minoan Crete is that the abandonment or repurposing of many spaces of
social and religious significance, including peak sanctuaries, central buildings and cultic rooms, with some spaces being closed off or restricted (Driessen and Macdonald, 1997).

Against this backdrop, the water management systems constructed after the eruption, which certainly includes those built in LM IB and many of those from LM IA may be interpreted as constructed, likely at the behest of elites, to provide fresh water supplies but also to try and re-establish a sense of order and ideological control at a time when their authority was being challenged, reconstituted and questioned.\(^{40}\) The politics of Minoan water management in the LM I period should be understood as simultaneously a question of controlling a resource that had become increasingly unstable or unpredictable, and a question of a strategic elite response to a crisis in legitimacy and the collapse of established social conventions. One important element of the crisis that elites may have faced after the Thera eruption is that the unpredictability of the water supply both challenged the validity of hydrological expertise – which may have been a prized commodity in itself – while at the same time the crisis heightened the need for hydrological solutions to emerging and possibly unfamiliar problems. Again, solving the practical problems associated with the provision of fresh water on Crete is only one aspect of the politics of water; being seen to solve these problems, in order to combat challenges to the legitimacy and sustainability of an elite political system, is at least as important. In what follows, I explore the ways in which these two aspects interact, through considering the extent to which Minoan elites were able and willing to control water as a material resource, and the extent to which water management systems also played a symbolic or ideological role, particularly in terms of monumentality.

### 2.4 Monumentality

As discussed already, there is a high degree of variation between the various water management systems, geographically as well as by type and construction. An important consideration that this chapter has not yet borne in mind, is the extent to which the architecture and design of the water management systems can be considered as having a visual (symbolic), as opposed to merely pragmatic or economic, function. While the intended visual effect of water management technology may take myriad different forms, it

\(^{40}\) The assignment of blame following a catastrophic event is well documented and elite groups, such as rulers or religious leaders are often assigned the blame leading to challenges of their authority (Driessen, 2002b: 256).
makes sense to focus especially on ‘monumentality’, as this is a well-established theme within the existing archaeological literature (Bretschneider et al., 2007; Trigger, 1990).

2.4.1 What is Monumentality?

The defining feature of monumental architecture, according to Trigger, is that “its scale and elaboration exceed the requirements of any practical functions that a building is intended to perform” (1990: 119). This simple, yet significant principle has been further developed to include several other features as argued by Moore, who notes that in general monumental buildings or architecture are:

- permanent structures and are intended to last several generations (*permanence*);
- either centrally located (at the heart of a settlement) or are set apart and isolated (*centrality*);
- highly visible or more visible when compared to surrounding buildings/features (*visibility*) and;
- less common than other features within a settlement, such as houses (*ubiquity*) (1996: 139-140).

The functions and purposes of monumental architecture are many and varied. First and foremost, monumental architecture is used as a visual language: not only does it have an instant impact, imposing upon the viewer or user a sense of grandiosity (in the same sense as ornate clothing and jewellery might), but it also expresses in a very public and enduring manner “the ability of an authority to control the materials, specialized skills, and labour required to create and maintain such structures” (Trigger, 1990: 12). Monumental buildings and structures thus have a strong communicative potential, often conveying the organizing principles of the society which constructed it (Letesson and Vansteenhuyse, 2006: 92). In order for this to be effective and legible, monuments must be highly visible, both within the natural and constructed landscape (Letesson and Vansteenhuyse, 2006: 93) and be ‘readable’. One of the ways to achieve this is for monument builders to incorporate materials into the structure which have specific meanings for different people. For example, in Minoan monumental construction, various local stones were used alongside more ‘expensive’ stone such as gypsum (Vavouranakis, 2007: 276). At Knossos and Phaistos, gypsum is the preferred ‘exotic’ stone, whereas at Mochlos, sandstone and schist slabs contrast highly against the more commonly used white, buff or grey limestone (Vavouranakis, 2007: 274). In doing so, elites could express their wealth and power but also
their connection with the local community and the local landscape: it demonstrated both their connection to an island-wide koine but also promoted “a discourse which favoured local identities” (Vavouranakis, 2007: 276).

This sense of identity and the creation of a sense of place is also a major aspect of the function of monumentality. Many scholars have noted how the physical creation of a monumental piece of architecture is just as important, if not more so, as the look of the monument (see for example Kolb, 2012: 138; Richards, 2009, in press: 3): the creation of a monument brings together local communities through labour, time and communication, uses local knowledge of materials, places and conditions and can create a sense of place and community through the construction of an often large, and architecturally striking monument or building (Bretschneider et al., 2007: 1). In many cases, monuments or monumental buildings are linked with identity through the creation of a shared memory or commemoration of an event, place, space or person (Rowlands and Tilley, 2006: 500). Often, ritual or ceremony, linked with cosmological order, ancestors or sacred landscapes, is used at the site which helps to cement the monument as something to be interacted with and as part of the social order of a society.

2.4.2 Minoan Water Management and Monumentality

Monumentality is a consistent theme in Minoan archaeology, in that Bronze Age Crete was home to a number of colossal façades and huge building complexes that dominated the local landscape, with Knossos being an outstanding example (McEnroe, 2010: 69-71). For many scholars, monumental architecture on Crete is seen as one of the principle defining features of the palaces; ashlar masonry, orthostats, column bases, light-wells, polythyra and lustral basins, Western and Central courtyards, grand staircases and upper storeys are seen by many as distinctly palatial characteristics (Hitchcock, 2012: 191-194; McEnroe, 2010: 83-92), whereas others have noted the use of some of these features within earlier, pre-palatial buildings (Schoep, 2004). What is evident from the study of Minoan architecture is that monumentality is the preserve of elite groups and is used to express “an investment of social resources and ... the embodiment of political, social religious and economic power” (Bretschneider et al., 2007: 1). Viewing water management systems with monumentality in mind, allows us to explore the extent to which we can speak of Minoan water management as more than a technical question of the control of a certain resource. If this is found to be meaningful, as I argue here, Minoan water
management systems can only be partially understood by an approach restricted to engineering, technical, and economic questions.

Like a great many other civilizations, both ancient and modern, Minoan Crete’s largest and most impressive water management structures are dams. As discussed in Chapter 2, there are seven Minoan dams on Crete and its islands, all clustered in the eastern peninsula, and designed to deal simultaneously with the problem of collecting water and of managing deluges and erosion. Ranging from 9.4 to 27 meters long, and up to 3.6 meters high, the main dam wall would have been impressive in itself, especially when constructed from megalithic masonry, such as at Choiromandres (Nos.D2 and D3). Added to this is that these walls formed part of larger structures involving subsidiary check-dams, enclosure walls and even some fortification structures (also at Choiromandres). The sheer geographical area these structures covered may be considered monumental in themselves, not least in terms of the ambition and investment required to construct such massive and durable installations, which had to exert human control over water at its most powerful. The visual impact of the reservoirs created by the dams – especially unusual in the drier, eastern part of Crete where lakes and pools are very rare – must also be considered.

Given these features, it is very tempting to conclude that the dams are an example of Minoan strategy of monumentality. However, the archaeological record contains little evidence to suggest that the size and scale of the dams is not wholly a product of their function. Only at Choiromandres, where the dams are incorporated into a large site, enclosed by walls and defensive structures, is monumentality indicated by the surviving architecture, in that the lower check-dam plays a dual role as both dam, over which the water flowed, and part of the large enclosure wall. The proximity and historical connection of Choiromandres to the palace at Kato Zakros may have some bearing on this issue, as the resources and ambition of this region’s elite is likely to have contributed to this being the largest of all Minoan dams, and built with the same sense of grandeur that is visible in the nearby palace. Nevertheless, if a key feature of monumentality as an elite strategy is that the investment is disproportionate to the material or economic benefit, then it is very difficult to categorise dams in this way. The numerous benefits that dam technology offered – which were sufficient at Pseira to rescue the settlement from an agricultural crisis (Betancourt, 2012: 9-62) – made them a worthwhile investment, even in spite of the necessarily massive scale of such projects.

Aside from sheer scale, one of the ways in which water management features can be considered as monumental is in their ‘visibility’. There are a number of systems,
including cisterns such as those at Archanes, Kato Zakros and Tylissos, which are substantial structures and must have had a great visual impact. Two of the earliest Minoan cisterns known, at the hill settlement of Myrtos-Pyrgos, stand out especially in terms of their visibility. Cadogan argues that the decision to make the considerable labour investment in constructing two massive cisterns, in a settlement perched nearby a river which would have provided ample water for at least most of the year, is best interpreted as having a “competitive display/propaganda role” (2007: 110). Of particular note is that one of the cisterns is built into the slope of the hill; this is an exceedingly precarious position to build a cistern, which, when filled with water, would have been very heavy and prone to collapse (indeed, this very fact happened in later years). It appears that the decision was made to place this cistern here for reasons other than the ease of water collection or access. As Cadogan notes, this cistern suggests a desire to “express itself to other contemporary communities through building such rare and remarkable reservoirs” (2007: 110).

A similarly spectacular cistern exists at Kato Zakros. The large cistern in the ‘Hall of the Cistern’ was constructed with an obviously monumental intent (Fig. 62). This was a large, finely constructed cistern made of large stone blocks and slabs, which dominated a chamber of its own and was surrounded by a portico creating an impluvium-like effect if the hall had an open roof, as conjectured by Platon (1971: 185-191). Even if the column bases found here were not part of a portico, their use in this area along with the fine construction of the cistern adds to the feeling of grandeur in this hall, which was also carefully constructed using fine stone work and paved with tarazza paving.

Whereas the cistern on the hillside at Myrtos-Pyrgos appears to have been designed to be impressive to those outside of the settlement, the visual impact of the one at Zakros would have been reserved for those who had access to this part of the palace. What is discernible here is a slightly different politics of monumentality: rather than being admired from the outside, as a statement of domination, this is the monumentality of opulence – architecture as conspicuous consumption. Again, as at Myrtos-Pyrgos, the existence of the Zakros cistern cannot be accounted for merely in terms of the need for water, as water is also available in the nearby Spring Chamber and Unit of the Built Well. The economic investment in terms of the elaborate and fine construction of the Zakros cistern can only be explained socially, in terms of visual impact and architectural expressions of power and wealth.

Perhaps the clearest expression of a water management system being monumental is at the Caravanserai, Knossos. This is an exceptional building and unique on Crete (Fig.
It has been described as having “exceptionally numerous and sophisticated waterworks” (Schofield, 1996: 27) and is set within “elegant and pleasant surroundings” (Schofield, 1996: 32). The Caravanserai itself houses numerous water systems, including a sunken bath, various conduits, pipes and drainage channels, as well as terracotta ‘bath tubs’ and a nearby spring chamber (only the second known on the island). What is particularly notable about this structure is that, unlike all other locations where water management systems are found, its emphasis is clearly on water and its provision. While its exact function remains unclear, the care and attention given to the building and its water management systems cannot be disputed.

If we first consider the Caravanserai’s water management systems, we can see that they are carefully constructed: the basin (‘sunken bath’) at the front of the building is constructed of fine ashlar masonry and uses gypsum slabs to line the sides. The spring chamber, to the west of the main building, is equally well made and also constructed out of fine gypsum blocks and slabs. While the construction of these two water management systems may not alone be indicative of ‘monumentality’, when combined with their unique setting, we can certainly say that the Caravanserai as a whole is ‘monumental’. The sunken basin at the front of the building is surrounded by ornamental features: at least one of the walls above the basin was painted with representations of pillars supporting an architrave (Schofield, 1996: 29) and adjoining it to the east is a portico and stepped pavilion, the walls of which were decorated with similar representations of pillars, above which is the well-known Partridge and Hoopoe frieze (discussed in Chapter 3). While the second storey of the building is lost, there are certain elements about its design that have been observed. Schofield notes that the upper floor, which probably extended above the stepped portico and sunken bath, likely matched the opulent feel of the rooms below. She notes that fragments of white and blue plaster were found, indicating that at least some walls were decorated, and that pieces of “fine polished tarazza pavement” (1996: 29), as used in the stepped portico, are likely to have fallen from the upper story. That tarazza flooring is also used in the upper floors at Kato Zakros, as well as in the Hall of the Cistern, indicates that this special treatment was used where the floors were likely to get wet: if this is the case, it seems likely that water also played a role in the upper floor of the Caravanserai (Schofield, 1996: 29).

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41 Schofield notes that the Caravanserai has received relatively little scholarly attention either because of, or in spite of, its uniqueness, with her study being the only one since Evan’s considerations to question its use and identification (1996: 27).
What can we say, then, about the monumentality of this special, water-focused building? If we are to understand monumentality as defined at the outset of this section, that “its scale and elaboration exceed the requirements of any practical functions that a building is intended to perform” (Trigger, 1990: 119), then this building is most certainly monumental. Clearly great care and attention has gone into the construction of this building, as well as the construction of the water management systems themselves. The sunken basin and the spring chamber are constructed out of fine materials, and the more functional elements of the Caravanserai, namely the conduits and piping systems which bring water into the building are highly sophisticated. While a great portion of the façade of the building is missing to the east, the stepped portico and pavilion alone provide a suitably impressive ‘public face’ for the building. And, while it is unclear exactly how the Caravanserai was accessed, especially given its position bordering the presumed course of the Minoan road, the scale of the building and its luxurious interior suggest to many that access to this building would have been limited and it is unlikely that it functioned as a public building as envisioned by Evans (who believed the building could have been some sort of ‘travellers rest’ – providing food, water and bathing to those travelling along the road (1928a: :117)). With all this in mind, then, we can suggest that this is a special and monumental building which had a focus on water, water management and water provision, and as Schofield concludes, was “a unique, splendid, and exclusive prestige symbol” (1996: 32).

Even in seemingly more functional aspects of water management systems, such as drainage, we can see that a great attention was paid to visibility. In many cases, great care and attention is paid to the complex drainage systems, such as those at Knossos, Phaistos and Tylissos, to ensure that grey-water and other un-needed water is removed from the site discretely: most systems use covered drainage conduits and pipes, to ensure that the grey-water cannot be seen in ‘public’ areas, and in many cases drainage systems run below floor level when within buildings.

The complex drainage system at Knossos is perhaps the most well-known of all these systems (Macdonald and Driessen, 1988, 1990), and it is clear that an extraordinary amount of time, labour, knowledge and investment was put into the creation of this system. What is particularly interesting, however, is that in some instances conduits were left uncovered and not hidden from view. These conduits and runnels are likely to have collected rain-water (which could be used to wash, cook or drink) from roofs or open flat courts, and would have provided a pleasant aesthetic in those areas where they were used.
While it is certainly possible that technical issues prevented the ‘capping’ of these conduits (especially along staircases), it cannot be ruled out that a decision was made to have some conduits open so that rainwater could be seen flowing around various areas of the palace. For example, in the staircases around the East Bastion, water flowing from the runnels which course down the steps flow through what Evans termed ‘settling basins’ (Evans, 1930: 243) – small rectangular basins which Evans believed were used to remove sediment from the water which would go on to be used in a conjectural tank for washing linen further down the hill. Whether or not the water was in some way filtered in these small basins, or even if the water did go on to serve some functional use, the aesthetics of this design – runnels, conduits, basins – cannot be denied. Perhaps we can see in this example water being used in an ornamental way – adding to or improving the look of this area of the palace (Fig. 64). In a recent paper, Aufschnaiter discusses how Minoan drainage systems, including open channels, water spouts and pipes, served not only practical function, but could also be “aesthetic water features” depending on how they were arranged (2011: 51). One can easily imagine the stark contrast in the appearance of these spaces between the drier summer months and the wetter winter months, with the open conduits and water spouts potentially providing an almost overwhelming display of the abundance and power of water during these times. The sensory experience of the water gushing around the conduits during heavy rainfalls is potentially a powerful one, and could have symbolised the end or beginning of a new season, the power of nature and ultimately its seizure and control by man.

The monumentality – *permanence, centrality, visibility and ubiquity* (Moore, 1996: 139-140) – of water management systems expresses numerous elite strategies for socio-political control on Minoan Crete. Generally speaking, monumentality is about the spatial construction of power and reaffirming status. When considering the monumental architecture of the palaces, for instance, we can say that the large, grand façades, the opulent architectural forms and use of space are not only a public display of wealth (access to labour, materials and time) but that they also say something about control: Hitchcock has argued that the palaces’ architectural form “...embody a programmatic discourse of social control, in which the landscape was appropriated and reproduced within a refined and artificial environment that was promoted by one or more central authorities” (2007: 91). This control over and reproduction of nature can be seen in the water management systems – water is not only controlled, but natural flows and settings are reproduced on a grand scale. Water is not just brought into settlements and buildings; it is done so in often
elaborate and decorative ways which far exceed the needs of the system. Water management’s monumentality expresses not just the wealth and status of those constructing them in terms of their access to materials, labour and engineering skill, but also their power and control over the natural and the inherent meanings associated with it. In particular, their control over a metaphorically potent element, water, (discussed in detail in Chapter 5) enables the Minoan elites to associate themselves with specific socio-religious concepts associated with water, such as transition, transformation, boundaries and other worlds, which is a very powerful tool. There is a parallel here with Mayan ‘water mountains’, such as Tikal, where huge reservoirs are located next to some of the site’s most complex architecture, such as major civil-ceremonial building complexes (Scarborough, 1998: 144). In these spaces Mayan elites strengthened their control over the population by promoting the extensive use of water in social activity, such as public theatre, which united the people physically and emotionally around a common concern (Lucero, 1999: 43). Water was thus incorporated simultaneously into architectural and performed expressions of elite power. While the analogy between Mayan water mountains and Minoan palaces is tenuous for various reasons, it is not difficult to envisage a similar interaction between water, architecture and spectacle being played out in the open conduits and paved courts of Knossos and other palaces.

The second way in which water management’s monumentality is political concerns the intended audience. Not only are these monumental structures used to impress, and to some extent dominate, those lower down in the social order, they are also used to confirm, consolidate and maybe even differentiate between elite groups. What is clear from investigating the monumentality of water management systems is that it helps to construct both the ideology of water and the ideology of the elite who are seen to control it. The role of ideology will be further explored in the following section and conclusion of this chapter.

3. Water Management as Resource Control

When looking at the control of water on Bronze Age Crete politically, the most immediate question is the extent to which, like the Mayan and Balinese examples mentioned above, Minoan elites exerted physical control over their populations’ access to water for drinking, production and other material needs. This form of social organisation resonates strongly with a well-established interpretation within Minoan archaeology, namely, that of the palaces being redistributive centres (see for example Renfrew, 1972: 51). From this perspective, it would make sense to talk about Minoan water management
systems as installations through which elites could provide, but also restrict, local populations with fresh water, thus materially reinforcing elite power.

While this would provide a neat economic explanation of the considerable resources that certain regional elites invested in water management systems, the idea of the palaces as the main source of fresh water for the entire local population is not reflected in the archaeological record. While the palaces of Knossos and Kato Zakros certainly contain multiple water management technologies, including the possibility of sourcing fresh water from further afield via aqueducts, there is little evidence for the extensive storage that would be necessary if they were to play a redistributive role. Likewise, climatological data suggests that the year-round availability of fresh water would not have been as pressing a concern as it is today on the island, or as it was for civilizations such as the Maya.\(^\text{42}\) However, it is worth noting that the Theran eruption may have complicated this availability on some scale. The likelihood of the palaces functioning as centres for the collection and redistribution of water is further decreased when we consider that recent research has cast doubt on the whole idea of redistributive palatial political economies (Christakis, 2011).

One way to address the question of the palaces' function as centres for water redistribution is to consider the availability of fresh water outside of palace confines. It must be noted that there is a lack of evidence for water management systems outside of palatial contexts: there is very little data on the provision of water within towns, villages or farmsteads, and while we may speculate that non-elite communities made use of local fresh water supplies such as perennial springs and rivers as well as more seasonal inundations, it is impossible to determine the extent to which these sources were sufficient. Small, hand-dug wells are also highly plausible but are extremely difficult to detect in the archaeological record: many wells may have been later used as pits, obscuring any former use as a water source, while other wells may have dried up, collapsed, or have been filled in or used as rubbish pits when they no longer provide water, making them undetectable, especially if there is no architectural or built aspect to their construction, such as a stone well-head.

\(^{42}\) During the Classic Period (c. AD 250–900), the Maya occupied the central Yucatecan lowlands (extending through modern day Belize, central and northern Guatemala and adjacent parts of Mexico and Honduras). The subtropical climate and landscape of the region is defined by a marked absence of permanent natural water sources and restricted rainfall (Scarborough, 1998), to which the famous water mountains were a particularly effective response, employing very large catchment areas and reservoirs to collect and store vast quantities of fresh water and restrict access to it. These installations are a paradigmatic example of resource control, as they conferred on the elite an effective monopoly over water, and the power to dictate who in the community had access to water, and to how much.
There is a growing body of evidence which suggests that the rooftops of houses, in conjunction with drainage pipes, water spouts and large vessels such as pithoi, or other stone or clay receptacles such as troughs, could have been used to collect and store water during wetter months (Lenuzza, 2013; Shaw, 2004), but again it is not possible to assess how successful such strategies were in meeting the fresh water needs of ordinary people.

These factors, combined with a bias towards the excavation of larger and palatial sites, make it difficult to discern the true picture of Minoan water management practices, especially with regard to the access of fresh water outside of palatial contexts. There are certainly very few candidates for identifiably public water-works, such as the large communal wells, cisterns or drinking troughs that are found in later Archaic and Classical periods in Aegean settlements. The disparity between the highly technological solutions to water management in palatial or elite contexts and the more basic strategies outside those contexts suggests that ‘ordinary’ people would have had less of a safety net in terms of stores of water during crises in the availability of water, such as prolonged drought. At the very least it is clear that elite water management strategies, if only because of their very scale, could compensate for longer periods of scarcity than smaller, more basic strategies.

This disparity would have been heightened by the often monumental aspect of many of the water management systems, further advancing the status of the elites as those with ready access to fresh water. Complex and varied water management systems would have provided a buffer against the extremes of water availability on Crete, meaning elites could withstand longer and more severe periods of drought. In this way, elite water management systems may not have functioned as a basis for palatial redistribution of water to the populace on a regular or systematic basis, but may have acquired a limited role in this direction during times of crisis in terms of the natural availability of fresh water.

3.1 The Kouloures Debate

Aside from looking at the extent to which fresh water would have been available to ordinary Minoans, independently of palatial water management systems, the question of the palaces functioning as centres for the redistribution of water can also be addressed by looking at palatial capacity for storing water. In this regard, there is a crucial debate concerning the function of the kouloures – the large, circular, subterranean structures found at the palaces of Knossos, Malia and Phaistos (Fig. 65). Upon excavating the Middle Minoan strata at Knossos, Evans first uncovered these structures which he believed to have functioned as ‘blind wells’ or ‘rubbish pits’ (Evans, 1935a: 63, 65, 66). Subsequently,
these enigmatic structures have been explained as cisterns (Watrous et al., 2004: 288), granaries (Halstead, 1997; MacGillivray, 1994: 52; Marinatos, 1987: 135-138), receptacles for ritual offerings (Platon, 1983: 275) and as tree-pits, around which ceremonial dances took place (Preziosi, 1983: 85). The diversity of explanations can in part be accounted for by the number and variety of structures labelled kouloures. Four have been found at Knossos; three in the West Court and one by the Theatral Area; while at Phaistos, four (or perhaps five) kouloures have been identified, two of which are also immediately adjacent to the West Court of the palace. It is, however, particularly tempting to group them together, as intriguingly, it appears that all the kouloures are in some way associated with the raised causeways found in the courts, and often the West Courts – perceived to be “ceremonial meeting places” (Marinatos, 1993: 46) – in particular.

Some kouloures, however, can be relatively conclusively separated from the class as a whole. It is now commonly accepted that the kouloures at Malia – a set of eight structures that project above the ground, four of which are internally plastered – were granaries (Cadogan, 2007: 108; Halstead, 1997: 103-107; Strasser, 1997: 89). They are markedly different to the kouloures at Knossos and Phaistos in size, number, location, design and construction; similarly, more so than the other kouloures, those at Malia bear parallels with contemporary silos in the Near East and Egypt (Strasser, 1997: 84-89).

As Cadogan acknowledges (2007: 108), the interpretation of the remaining kouloures is seen by all as problematic. In a relatively recent debate, Strasser (1997) argues that the kouloures at Knossos and Phaistos could not have stored grain based on ethnographic studies, archaeological data and their unsuitability for keeping grain dry. Rather, Strasser prefers the interpretations of Evans and Preziozi – that the kouloures were ‘blind wells’, rubbish pits or ‘tree-pits’. For McEnroe at least, Strasser’s detailed argument “makes a great deal of sense” (2010: 60), at least from an architectural point of view. He notes, “[a]nyone who has visited a shopping mall will have noticed the large catchment basins built to receive the runoff from the mall roof and parking lots. The architects of Knossos and Phaistos may have foreseen a similar problem with drainage from the roofs of the palaces” (2010: 60). If this idea is correct, and the kouloures at Knossos and Phaistos were not in fact granaries, this would have serious repercussions for the argument that the palaces acted as redistributive centres (as made by Branigan, 1987, 1988; Halstead and O’Shea, 1982; Renfrew, 1972), which relies heavily on the kouloures’ capacity to hold substantial amounts of grain (see in particular Branigan, 1987: 247-258).
In terms of my research, the kouloures debate presents a rather difficult problem. As the archaeological record has not yet provided any conclusive explanation as to what the kouloures were used for, firmly including them as part of the water management systems corpus is risky. The presence of a raised stone duct leading into one of the Knossos kouloura, gives weight to Evans’ initial interpretation that, this structure at least, could have acted as a blind-well, collecting surface run-off from the court but not storing it, as a cistern would (Evans, 1935b: 65-66). It is interesting to note that all the kouloures go out of use in MM III (McEnroe, 2010: 60). At Knossos at least, this is the period in which a great deal of restructuring and building takes place and also when the vast majority of the large and complex drainage system was developed (Macdonald and Driessen, 1988: 258). Perhaps, then, if the kouloures at Knossos acted as blind-wells, which are a relatively simple solution to excess water in the courts, the new drainage systems provided a better, neater solution to storm waters in the area, rendering the kouloures unnecessary. As such, I consider the kouloures as part of the Minoan drainage solutions employed at the palaces, as McEnroe suggests (2010: 60), rather than as wells or cisterns. With the kouloures excluded from the set of water management systems for the collection and storage of usable or potable fresh water, the idea of the palaces as centres for the redistribution of fresh water appears highly unlikely, at least outside of times of severe crisis in the natural availability of water.

4. Access to Water Management Systems

It is clear that Minoan elites did not exert an exhaustive control over water, in terms of organising and managing the distribution of water within society, in the same way as the Mayan water mountains or the Balinese water temples. The water management data does, however, suggest an element of restricting access to a number of cisterns, wells and spring chambers. At Chamaizi, access to the cistern at the centre of the building would have been extremely restricted to those living in, or perhaps visiting, the building itself. While this is perhaps an extreme example, access to other cisterns can also be seen to be restricted, where at both Archanes and Kato Zakros the cisterns are within the palaces themselves (Table 13): at Kato Zakros, the large cistern is located within its own room with it only being accessible from the central court or from the ‘royal apartments’ just to the north; at Archanes, although the layout of the palace is less certain, its excavators note that the location of the cistern is likely to be within the West Wing of the palace, and as such, access to it was likely to be highly restricted in a similar way to that at Kato Zakros.
similar picture emerges when looking at wells: at Palaikastro, two wells are found within specific buildings (Building 5 and House B), Kato Zakros contains a well that can only be accessed from the central court, while at Knossos, there are several wells within the palace confines, either within courts or halls (see Figs. 9 and 11).

The two spring chambers, at Kato Zakros and the Caravanserai, Knossos, present two different pictures in terms of access. At Kato Zakros, the spring chamber is set within a court to the south of the palace: the chamber can be accessed via a long corridor from the central court, but it can also be accessed from the south-eastern court in which it sits (see Fig. 20). This court has not been fully excavated, and it is unclear if the court formed part of the palace complex, as at Knossos, or if it was ‘open to the public’. At the Caravanserai, access to the spring chamber, which is itself set slightly apart from the main building, was restricted by a doorway. While the Caravanserai does not appear to have any formal access restrictions, such as boundary walls, the palatial nature of the building suggests that access was controlled in some way and was not open to everyone that passed.

At Palaikastro, two further wells (Nos.W16 and W17) are contained within a boundary wall (see Fig. 11). Constructed at roughly the same time as the wells, the wall marks out a large proportion of Area 6 in which the wells are contained. There is no other construction in this area at this time, and as such, we can surmise that the boundary wall was constructed to specifically ‘contain’ these two new wells, or to demarcate this area in some way. At Amnissos (No.W1), the well is found within a triangular area – a zone marked out by a slightly raised wall of cut stones (see Fig. 14). While it does not appear that access to the well was formally controlled, we can see some effort to mark the area around the well out, as being different or special, as in the case at Palaikastro.

<table>
<thead>
<tr>
<th>Site</th>
<th>Location of Feature</th>
<th>Level of Access</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cisterns</td>
<td>Archanes: Within conjectural part of the west wing of the palace</td>
<td>Likely to be restricted to those with access to the West Wing</td>
</tr>
<tr>
<td>Chamaizi</td>
<td>At the centre of the building</td>
<td>Highly Restricted</td>
</tr>
<tr>
<td>Kato Zakros</td>
<td>South-East corner of palace within palace building and in its own room; only accessible from the central court or 'royal apartments'</td>
<td>Highly Restricted</td>
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The discussions in this section leave us with a conundrum when thinking about the politics of Minoan water management system: on the one hand, there is insufficient evidence to conclude that Minoan elites exerted an exhaustive control over their populations’ access to fresh water. On the other, the archaeological record strongly suggests the restriction of access to water management technologies, implying some degree of political and economic control. The politics of Minoan water management therefore hinges on how we interpret this restrictive and exclusory behaviour which relates to a resource that would likely have been naturally available in non-elite contexts. In the remainder of this chapter, I argue that this conundrum can be solved by considering elite investment in water management systems as strongly ideological. In particular, the archaeological evidence supports the theoretical interpretation that Minoan elites
constructed an ideology of social difference, through which they articulated an elite identity that could be distinguished from other groups, marked out by social practices such as ‘conspicuous consumption’ and access to privileged knowledge and environments.

5. Water Management and an Ideology of Difference

As Schoep (2006: 50) notes, “at a general level, elites may be defined and identified on the basis of their differential and unequal access to social, material and symbolic resources”. While I have argued above that Minoan elites did not exclusively control their local populations’ access to fresh water, the presence of numerous and often elaborate water management systems within palatial confines is strongly suggestive of differential or unequal access to fresh water. Minoan elites certainly had a privileged access to water: there was little need, or a reduced need, to travel distance to acquire water, in comparison with non-elite groups. This convenience, or more specifically the investment in such convenience, is significant especially as a marker of social difference. It means that elites have a visibly different relationship with nature, compared to most ‘ordinary’ people, and this difference is characterised primarily by a reduced dependence on and vulnerability to the natural availability of water, which is of course significant on an island where this availability can be temperamental at best.

The construction of social difference may be a product of elite activity, but is also a precondition of stable or durable elite social relations: “when elites are accepted as legitimate … it is because commoners regard and accept them as qualitatively different types of beings from themselves and vice versa” (Helms, 1998: 5). Helms’ point here is that whatever its original basis, whether coercive force, religious status, or alliances, elite power must be ingrained into the culture of the society. The power of elite groups, if it is to survive social and environmental changes, depends on the effectiveness of elite strategies of entrenching their privileged status into the accepted norms, ideals, and imagination of the societies they inhabit. This understanding of the necessity of ideological strategies enables us to ‘read’ elite practices – such as the water management systems of Minoan Crete – politically, by exploring the ways in which elites used such practices to articulate their qualitative difference from other social groups.
5.1 Special Water[s]

In the preceding section on water management as resource control, I argued that it is unlikely that Minoan elites were able to restrict ordinary people’s access to fresh water, at least to the extent of the Mayan and Balinese examples discussed in the introduction. Taking ideology into account, and not mere survival, allows us to consider the possibility of meaningful distinctions between different types and instances of fresh water, ascribed different values, and to investigate the restriction of access to such instances. Put differently, while Minoan elites could not hold exclusive control over fresh water in their territories, except perhaps in times of severe crisis, they may well have been able to control access to ‘special’ water by either enclosing culturally valuable water sources (such as incorporating them into palatial architecture) or elevating the status of waters that were already subject to controlled access, for instance through ritual.

There are a number of examples from the archaeological record that stand out in this regard. At the Caravanserai, Knossos, not only do we see a spectacular installation geared around fresh water, which must reveal the status of water at this site, but, also the presence of a different type of water. As Evans noted, the source of the water for the Caravanserai was the Vlychia spring whose waters are brackish and have a gypsum-flavoured taste (Evans, 1928a: 104). These properties may well have conferred upon it a special status, such as having healing or medicinal attributes, and as such were to be marked out as special or simply different. At Kato Zakros, we again see great attention paid to formal architectural development around spring water, the large and ornate cistern and spring chamber being the most obvious examples, which again attests to the significance of the water contained within. Whilst the area around Kato Zakros is famous for its spring water (Platon suggests that the fecundity and clarity of the spring water in this area are one of the main reasons for building the palace at this location (1971: 36,82)), there are no remarkable properties to the water.

In addition to these examples, other sites of ‘special’ water may be identified. At Amnisos, the unusual rectangular spring-fed well is ‘contained’ within a triangular area, and may be architecturally connected with the mouth of a cave some 12m away via a boundary wall (Knoblauch and Schäfer, 1992: 158). At Myrtos-Pyrgos, the water contained within the cisterns there could have been considered as different or special in some way, especially given that a source of water, a river, lay at the bottom of the hill. Further, there are number of sanctuaries which are associated with springs or spring water, in particular, the sanctuary at Kato Syme, where the sanctuary has been chosen so as to incorporate a spring which
cuts through part of the shrine (Peatfield, 1995: 5). The association between fresh water and Minoan cult places will be discussed in more detail in the next chapter.

These examples illuminate two important features about the ideological construction of social difference at these sites. First of all, it is clear that there is some relationship between tangible properties of certain types of water and their cultural status as special. Spring water seems to hold a particularly significant status, suggested by a strong connection to palatial architecture, finely crafted water management systems, and the likely attempt to transport it over considerable distances via aqueducts. Through the veneration of spring water which, unlike rain- and river-water, tends to be spatially confined, elites are able to appropriate a valuable cultural commodity which may be distributed or restricted at their discretion. The cultural value of ‘special’ waters also confers added value on the activities associated with them, as well as the individuals who consume the water or participate in such activities. This links especially to ritual activity, and the ways in which Minoan ritual practice uses privileged or special waters to confer status and meaning on certain actions and actors. This will be discussed in the subsequent chapter.

The second feature that is illuminated by the examples above is that, if we interpret them through the lens of the construction of social difference, the intended audience is often other elites as much it is the wider population. In certain cases, such as Myrtos-Pyrgos, the visibility of a special, reserved water source, appears to be directed towards the community as a whole; however, in the more explicitly palatial example of the Caravanserai, Knossos there is a clearly demarcated ‘special’ water being used and perhaps displayed away from the view of the general public. A similar picture emerges with at least one of the water management systems at Kato Zakros: the ‘Hall of the Cistern’ was certainly not designed to be visible to individuals outside the palatial elite, and only those invited in from the Central Court could have witnessed whatever took place in the cistern itself. This closed practice reveals a particular dimension of the construction of social difference, namely the reinforcing of the difference between elites and non-elites in the minds of the elites. Having access to shared, but restricted ‘special’ water such as the Hall of the Cistern, may have played a role in reaffirming and cementing the bond between elites – especially if there were divisions and gradations between them (such as different levels of hierarchy). This may have also reinforced social distinctions within elite groups, with the different levels of importance articulated through access to special waters. Practices involving a private use of special waters may have been a particularly important and perhaps formalised way for elites to recognise and express hospitality towards elites.
from other territories (Schofield notes that visitors to the Caravanserai were limited to a “select group of people” (1996: 32)). As with monumentality, discussed above, what is important here is that the elite use of special waters played subtly different roles, in terms of the construction of social difference, depending on the intended audience. Privileging specific types and instances of water as special, especially where they could be enclosed or protected, enabled Minoan elites to produce a complex narrative through which ideas such as unity and difference could be articulated and superimposed onto specific identities.

5.2 **Conspicuous Consumption**

Tied in with this audience-focused use of water is a concept that is well-rehearsed in Minoan archaeology: ‘conspicuous consumption’ (see for example Borgna, 2004; Day and Wilson, 1998; Schoep, 2004). Conspicuous consumption refers to a social and political practice wherein being seen to possess or consume a commodity forms part of its value, and consumption becomes an act of display, designed to express status and wealth. In archaeology, this concept usually applies to expensive or prestige items, such as exotic materials or finely crafted wares; however, conspicuous consumption applies to even a basic or biological necessity such as water under certain conditions. Water consumption becomes ‘conspicuous’ when consumed in vast quantities amidst relative scarcity, consumed frivolously or lavishly, such as in aesthetic displays, or when consumed as rarefied or ‘special’ water (such as premium bottled spring water today). These features resonate strongly with the archaeological record of water management systems in Minoan Crete, and especially those associated with elite architecture or contexts (Lyrintzis and Angelakis, 2006: 171).

There are a number of water management features which fit into the category of conspicuous consumption, many of which have already been discussed within the section on monumentality above, and as such, I will not explore them in great detail again here. Once again, the site of Kato Zakros and the Caravanserai at Knossos prove to be the most appropriate examples of conspicuous consumption. Water at both sites is both displayed and consumed in vast quantities within unique and sophisticated surroundings. Similarly, the large cistern at Archanes is thought to be contained within pleasant settings. At Myrtos-Pyrgos, it has been argued (both by myself in this thesis and by Cadogan (2007: 110)) that the cisterns there were being ‘displayed’ both to those within and those on the ‘outside’. This display can also be seen, I have also suggested, in a number of conduits and
shallow basins around the palace at Knossos which could have had a significant aesthetic impact.

In many ways, the conspicuous consumption of water also marks elite users out as being different or special. In much the same way as identified ‘special’ waters, consuming water in the ways identified above – through architecture, abundance, display and use - reveals a particular dimension of the construction of social difference, namely the reinforcing of the difference between elites and non-elites in the minds of elites. Such a practice is well attested to within Minoan archaeology, with material culture such as ‘palatial’ pottery, fine crafted stone wares, metal work and even the storage of vast quantities of food and drink being used to maintain (and change) social difference both between elites and between elites and non-elites through what Baines and Yoffee term ‘high culture’ – the manifestation of elite ideology through the production and consumption of material culture (2000: 16-17). Practices like the conspicuous consumption of water help to fuse together notions of difference and superiority by making lavish consumption and exotic or prestige possessions part of the difference.

5.3 Knowledge-sharing

Earlier in this chapter, when discussing regional differences in the evidence for Minoan water management systems, I noted that the sharing of hydrological knowledge appears to have been a specific elite strategy. The expertise needed to successfully locate, construct and maintain water management systems appears to have been restricted to elite groups, and likely shared between such groups across certain parts of the island. As discussed in the first section of this chapter, this restricted sharing contributed to a strategy of social differentiation, through which the elite was identified as different from their local community, and as similar (though not necessarily the same) as elites in other areas.

As Schoep notes, the exchange of knowledge “plays an important role in strategies for obtaining, consolidating, and/or legitimating power” (2006: 51). Likewise, Helms demonstrates that a great deal of prestige can be acquired through controlling skilled craft activity (1993, 1998). Specialised crafts are recognised by scholars as belonging to Minoan elites’ repertoire of legitimising and furthering their power, such as pottery production (Day et al., 1997; Knappett, 1999, 2004), in particular ‘palatial style’ wares such as Palace Style Jars, metallurgy, and fresco painting (see for example Brysbaert’s (2008) work on painted plaster as a specialised craft). Clearly, there is a broad spectrum of different ‘specialisations’ (Clark and Parry, 1990; Costin, 1991); however, I believe that hydrological expertise, which
shares the same requirement of a tradition of skill-learning and knowledge, fits into this broader dynamic of craft specialisation.

Across Minoan Crete, but also more broadly in the Bronze Age Aegean, the products of these specialised crafts were exchanged to varying degrees, and through the exchange of goods, certain practices and styles could be copied and adopted, thus explaining some of the similarities and continuities in material production. Certain productive practices and methods, especially where a high degree of skill and technical know-how is required, could not be transmitted in this way, however, suggesting that some skills could only be communicated geographically by direct learning and demonstration. Indeed, there is evidence for a high degree of technique sharing amongst Minoan potters, to the point where we can speak of a “community of practice” (Berg, forthcoming). Most crafts associated with water management systems could only be transmitted through the second, more direct and discursive form of knowledge sharing, as water management systems do not lend themselves to being ‘bought and sold’ and therefore craftspeople would not have had access to hydrological technology from other areas unless by visiting them or by training. Smaller elements of water management systems, such as pipes, may have been exchanged and copied; however, as Angelakis and Koutsoyiannis (2003: 1000) have suggested, many Minoan pipes and conduits suggest the application of known hydrological principles rather than experimental or ad hoc problem-solving (see Chapter 2).

The technical knowledge necessary to produce sophisticated water management systems, that is visible across and between sites, is indicative of a socio-political environment in which elites participated in the exchange of knowledge (Schoep, 2006: 51-52), and perhaps even craftspeople, between them (Brysbaert, 2008: 166). As mentioned already, this exchange contributed to the construction of an elite identity as visibly different from non-elites, with access to restricted hydrological knowledge conferring both real power over water and the (ideologically more important) appearance of power and influence, through unseen or un-comprehended technologies and devices. It is likely, given the immovable nature of the water management systems themselves, that the sharing of hydrological knowledge between geographically separate elites, would have taken the form of visits and demonstrations of hydrological principles in situ. Skilled individuals may well have been travelling experts, transmitting hydrological skills by invitation or trade – indeed,

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43 The identification of certain water management systems as a product of craft specialisation is difficult as, at the moment, there is insufficient archaeological data to help construct a better understanding of how more complex systems were constructed, how production was organised or the potential for workshops etc.
such individuals may have themselves been a prestige commodity (Brysbaert, 2008: 166-167) – or perhaps local craftspeople would have been sent by their elites to study existing water management systems, to see hydrological principles in action. In either case, the exchange of individuals may have been incorporated into visible expressions of elite otherness: hosting emissaries and engineers from outside the local area would have reinforced that the elites belonged to a broader community, functioning in much the same way as the display of exotic items and goods from distant locations (Schoep, 2006: 51-53).

6. Conclusion

This chapter has explored how Minoan water management systems can be thought of politically and how they can be manipulated by elites, not only for economic benefits, but also as a form of social control through the creation of an elite ideology based around difference. As I have demonstrated, water management and water management systems are significant investments despite the relatively little material control that could be achieved in providing and maintaining them. Although it is clear that Minoan elites did not control populations’ everyday access of water, unlike the Mayan and Balinese examples I have referred to, I have demonstrated that certain fresh water sources played an important role in how elites marked themselves out as different and ‘worthy’ of power and privilege, most notably though monumentality, access control and the sharing of hydrological knowledge and expertise.

I have demonstrated that water management features easily fit into the four main principles of monumentality outlined in this chapter – permanence, centrality, visibility and ubiquity – making them potentially strong communicators of an ideological message (Letesson and Vansteenhuyse, 2006: 92). This ideological potential is mirrored in the ways in which access to certain water management systems is controlled and how water is conspicuously consumed and displayed by elites. These factors, along with the sharing of hydrological knowledge between elites, ensures that while everybody had access to ‘regular’ and ‘everyday’ water for drinking, washing and cooking, elites’ water management systems ensured that their use of water marked themselves out as different from others. It should be noted here that the ideology of social difference and elite social relations are mutually reinforcing: each both requires and produces the other. This circular relationship of the ideological legitimation of power and the power to legitimate is a precondition of a stable hierarchical society, yet it is also very fragile. The failure of any one element in this circular production of legitimacy may result in the collapse of the whole system, and so they must
be constantly maintained and strengthened in the face of social and environmental change. Many of these elements are based on beliefs and their practice, often through ritual, and so ritual and religion become incorporated into elite strategies that seek to consolidate and perpetuate their power (Bell, 1992: 193-196). Minoan ritual and religion, and in particular, the role of water therein, will be discussed in the next chapter, with the aim of developing a better understanding of the use of an ideology of difference by Minoan elites.
Chapter 5: Water and Religion in Minoan Crete

1. Introduction

At the end of the preceding chapter, I argued that through the management of fresh water, elites articulate an ideology of social difference that sets them apart from ‘others’ within society. To develop this idea further, this chapter aims to explore the role religion plays in that ideological narrative and, more specifically, how water is used in Minoan religion and ritual practice to ‘tether’, consolidate and perpetuate this social difference.

The link between ritual and socio-political relations has already received significant attention in theoretical literatures within archaeology and the social sciences more broadly. In her highly influential work *Ritual Theory, Ritual Practice*, Bell surveys a broad and ongoing theoretical discussion about the relation between ritual practice and hierarchy, political legitimacy, and social control (1992: 171-181). She points to contentions made by Gluckman (1965) and Douglas (1973) that there is a correlation between ritual activity and small-scale, relatively homogeneous and highly structured societies (Bell, 1992: 177-178), and focuses especially on Douglas’ claim that ritual is a potent strategy of social control, functioning to “exercise a constraining effect on social behaviour” (1973: 42-43).

Bell’s important contribution is to question the validity of assuming, with Douglas, that ritual action is politically expedient for specific groups, defined by pre-existing social relations. Instead of being a mere “instrument’ of more basic social purposes, such as power, politics or social control”, Bell argues, “ritual practices are themselves the very production and negotiation of power relations” (1992: 196). This is not to say that ritual action precedes and determines other forms of social relation, such as political hierarchies or economic interactions. Instead, ritual is a key site of human activity, wherein shared meanings and beliefs are constructed, communicated, and negotiated. This provides a subtle meaningful context against which political relationships are played out. In other words, ritual action helps to construct a web of social meanings through which actors make sense of their political place, struggles, and interactions. These political relationships, in turn, affect and transform the ritual practices.

In the context of this thesis, this nuanced approach to the politics of ritual action requires that we understand the role of water in Minoan ritual action as more than just a device employed by elites to reinforce their status. Instead, we must explore the capacity of ritual action involving water to participate in the construction of social and culture
meanings, paying attention to the ways in which this capacity was then exploited by powerful social groups, as made visible by the archaeological record. The central premise of this chapter is that water’s innate potency for constructing complex meaning makes it a particularly effective medium for constructing and articulating beliefs, concepts and cosmologies through ritual action.

This chapter begins by looking at how and why water often plays a key role in the generation of complex social meanings. I discuss how the human experience of water, through the bodily senses, shapes our interpretation of it, and how water is an appropriate medium for the articulation of often complex metaphorical concepts. I then explore some of the conceptual and metaphorical functions of water, specifically in the context of ritual practice and belief, by looking at three key recurring themes: boundaries and other worlds, altered states, and transition and transformation. I then return to the Minoan context, beginning with an overview of Minoan religion and then moving on to discuss the role water plays within it. In order to investigate how fresh water can be interpreted within Minoan religion, I return to the three key metaphorical themes. I look into how the evidence for the ritual use of water fits into these themes, and as such, how water may be interpreted and, perhaps more importantly, how elite groups harness these meanings and use them to help construct the ideology of difference, discussed in Chapter 4.

2. Water and Meaning

In order to elucidate more fully the role of water in Minoan religion, as both an element in ritual practice and as a vehicle for the conceptualisation of cultural ideas, it is worth investigating how and why water often plays a key role in the generation of complex social meanings. The use of the observable environment in the construction of meaning is a well-established principle in the study of material culture (for example Bourdieu, 1977; Geertz, 1993 [1973]; Ingold, 1986, 2000), especially in terms of how societies conceptualise themselves and their place in the environment:

[People] use themselves to describe the world, and the world to describe themselves. The result is flowing patterns of linguistic and visual association, meaning and value. Although every cultural context contains a particular arrangement of these, it seems that there are some persistent undercurrents generated [...] by common sensory experiences, cognitive processes and physiological needs, and the recurrent qualities or characteristics of aspects of the environment (Strang, 2004: 61).
The human experience of water includes a number of aspects which make it particularly conducive to being used in such descriptions and the construction of meaning. It is essential for life, and therefore necessarily possesses that familiarity which meaning clings to; it is experienced in a number of different ways: as something to drink, to use, to be immersed in, and as a powerful elemental force in itself; it appears in a number of different states and forms, making it an almost uniquely potent analogy for a diverse set of mental states, intangible concepts and complex relationships.

In terms of water’s potential and suitability as a nucleus for the construction of meaning, perhaps its most significant and unusual aspect is the way in which it allows for the direct, somatic experience of contradiction. Visually, water can completely change its character according to light and context: at different times of the day, bodies of water can appear as either translucent or opaque; it “meets the eye in shapes and forms too diverse to enumerate, and which range in scale from the immediate to the infinite” (Strang, 2004: 50). Likewise, the perception of water as something tactile is often surprisingly contradictory. Depending on the temperature of the skin, the same water can seem very hot or very cold, which can be either pleasurable or painful; similarly, the experience of submersion can be a stressful and frightening experience or a pleasant one, depending on the context. Taken to its extreme in the modern world, the somatic experience of water can be used in both therapeutic situations (a hot shower, sensory deprivation tanks) and as a form of torture. In more mundane circumstances, this bipolarity of water persists; the pleasure of swimming, for instance, is not unconnected to the fear of drowning.

Understanding metaphor as something that can “provide a means by which we can connect together objects, events and actions that appear to be empirically (factually) disparate and unconnected” (Tilley, 1999: 8), makes this contradictory dimension of water particularly significant. As something that is familiar yet strange, mundane yet mysterious, water is a perfect medium for the operation of metaphor. Indeed, abstract and difficult notions, such as transformation and paradox, can be more easily grasped through analogies with water. Heraclitus, for instance, routinely deployed water and rivers as metaphors for an ever-changing universe in which all that appears fixed and permanent is imperceptibly but irresistibly in flux: ‘all things are flowing’ and ‘no man ever steps in the same river twice’ (Russell, 1961: 63).

So far, I have suggested that water has an immense capacity to accommodate and articulate various and complex meanings. Crucially for this chapter, human interaction with water also produces a strong tendency for water to fulfil this capacity, in that our regular
and frequent encounters with water often take the form of habitual or ritualised activity. In most, if not all cultures, routine activities that involve water involve a high degree of repetition, such as drawing water, acts of washing and bathing. There is often a specific place, either public or private, where these activities are performed, at particular times of day, and sometimes by certain individuals. The act of washing one’s hands, for example, can be seen as a ritual act that precedes important junctures in a community’s daily routine, such as meals. In both Islam and Hinduism, for instance, ritualised bodily washing is incorporated into acts of prayer and meditation (Insoll, 1999: 33).

Encountered in a frequently ritualised context, the meanings and metaphors conferred on water based on its physical and sensory properties are continually reinforced, especially where those meanings are invoked by the ritualised practice. The combination of water’s capacity to bear complex meanings and its routine use provides fertile ground for the development of enduring metaphorical associations, passing from the mundane rituals of washing and rehydration to more religious ritual activity. Indeed, as Vernon Scarborough notes, “[i]t is the everyday routines within a society that foster significant aspects of religious ritual, everyday tasks based on subsistence-level activities” (1998: 145).

The fact that water is an exceptionally capable vehicle for social meaning, and that its meaningfulness is often ritualised and embedded in cultural practices, does not necessarily imply a fixed set of associations that can be ‘read off’ from any society’s use of and interaction with it. However, the necessity of water for human survival entails that it is likely to be present in the conceptual systems of all societies and cultures, alongside other fundamental elements such as sun, fire, and earth. This universality, along with the necessary continuities in how human beings from different cultures and societies interact with water at a somatic and physiological level, implies the possibility of “some cross-cultural commonality, some recurrence in the major themes of meaning that emerge from this interaction” (Strang, 2004: 61).

Throughout this section, I explore some salient conceptual and metaphorical functions of water, specifically in the context of ritual practice and belief, through an analysis of the sensory experience of water. I seek to supplement or augment the insights that can be gleaned from sensory experience with some recurring themes in the way water is incorporated into ritual practices in a variety of cultural contexts. There is an implicit danger in using cross-cultural comparisons in this way, namely that the analysis risks

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44 The human experience of the past is an area of increasing academic interest (see for example Hamilakis et al., 2002: one of the first cross-disciplinary books on the subject).
illegitimately transposing heterogeneous systems of meaning onto Minoan society. This would likely obscure any possible insights into the culturally-specific Minoan relationship with water underneath a dubious universal anthropology of religion. However, confining my analysis to only the somatic experience of water carries a greater risk: making the analysis insensitive to the extensive interactions between sensory encounters and complex and often abstract cultural constructions of meaning. In order to strike an appropriate balance between these two risks, this chapter uses comparative examples to illustrate the routes through which the experience of water becomes a basis for the articulation and ritualisation of complex meanings. This provides a starting point, rather than the solution, for understanding the role of water in Minoan religion and ritual action.

2.1 Boundaries and Other Worlds

One of the most immediate sensory contradictions that water displays is that it is neither opaque nor straightforwardly translucent: although it allows the perception of things beneath its surface, the image is distorted; objects can appear bent, blurred and often closer to the viewer than they are. The movement of water can effect the impression of objects moving, and can create and recombine colours and shapes to hide things under the surface and even invent new images. The experience of the illusions and refractions created by the surface of a body of water thus provides a sensory anchor for the articulation of certain ideas that conjure other worlds or dimensions beyond immediate experience, of spaces and places where nothing is quite what it seems. Similarly, the accurate but nonetheless inverted, warped and shifting reflection of objects on the surface of water connects strongly to notions of multiple versions or aspects of things, such as ‘evil twin’ mythologies or even Platonic ‘forms’.

Reflection also confers upon water a more personal significance. As Strang notes “until relatively recently in human history, water was the major ‘mirror’ for many people, providing a singularly powerful opportunity to see a visual image of themselves, and thus observe themselves reflexively” (2006: 101). The surface of water thus becomes a gateway to certain types of self-awareness, and may become metonymically associated with those concepts of identity and difference articulated in the mirror-image (Leader and Groves, 2005: 18-22).

Below the surface of water, be it a river, lake or even the water in a bathtub, the ears are able to pick up on a range of unusual sounds, comprised of quite ordinary noises
that are elongated and magnified through their transmission through water.\textsuperscript{45} Underwater, therefore, sound is a very different experience, muffled and often unrecognisable and unintelligible. This natural and accessible experience of otherworldliness, of a different plane of existence in which familiar sensations become disorienting, serves as a basis for making extramundane or supernatural places imaginable and intelligible.

Aside from the physical border that a body of water can constitute, water’s appearance and movement – whether it is a still, reflective pool, or a gushing and foaming waterfall – create a visual frontier, a boundary and a sense that what lies beyond it or below it is somehow different. In this way, water is seen as a “potent symbolic agent of transition and division” (Richards, 1996: 324). Not only does water’s physical presence create boundaries and divisions that must be crossed or traversed, but also its sound (or lack thereof) can suggest a barrier between a ‘normal’ space and one that is considered different in some way. For example, the rushing sound that a fast-moving body of water creates may function as “a metaphoric liminal curtain” (Goldhahn, 2002: 38), separating one area from another, or one group of actors from another. In this way, water is a liminal element,\textsuperscript{46} a metaphorical boundary between two or more locales, realms or states, which belongs to neither. It is a transitional zone and as such provides the perfect medium for notions of transition, separation and passage. As such, water and watery-places are often places where the dead are taken (such as the Hindu cremations which take place at the River Ganges), or the channel through which the newly deceased journey to the next world (such as the River Styx in Ancient Greek religion).

Related to this theme of water as a boundary is another common practice in which water becomes a marker delineating sacred or special areas. Richards (1996) notes that several Late Neolithic henge monuments from around the British Isles have a very close association with water, and in some examples are surrounded by standing water or by a river, such as the Stones of Stenness and the Ring of Brodgar, and the henge at Marden, Wiltshire, where the River Avon forms part of the enclosure. Richards also observes that,

\textsuperscript{45}The speed of sound in air is 343.2 m/s, whilst in fresh water it is approximately 1500 m/s, and in sea water, sound travels at approximately 1560 m/s (Denny, 2007: 56). These differences in speed have the effect of refracting, distorting and elongating sounds which can change their character completely.

\textsuperscript{46}The sea (and associated environs such as shorelines and beaches) as a liminal boundary or zone has been discussed by a number of authors (Kamash, 2008; Van de Noort, 2004; Westerdahl, 2011), who note the liminal nature of the sea make it an ideal landscape for rites of passage, events of social cohesion and as an expression of the binary between life and death.
in certain examples, the entrance to the henge necessarily involved the crossing of a water boundary which may have in turn “embodied aspects of purification and separation through that physical movement” (1996: 325).

2.2 Altered States

The many and varied ways in which water moves, sounds and feels can often have a deep impact on the human psyche and emotional state. Watching water can mean being entranced or mesmerised by it. Two properties of water combine to produce this mesmerising effect: its constant movement and its ability to reflect and distort light. The interplay of light and movement such as that which occurs on bodies of water, elicits an ‘affective response’ (Vernon, 1962: 134) from human visual perception as the eye is automatically drawn to moving stimuli. For this reason, water prompts us to gaze at it as opposed to simply looking, in much the same way as fire, which often produces a mesmeric effect. As such, there is a clear link between the visual properties of water and hypnosis; the mesmeric effect of gazing at water is conducive to the achievement of meditative and even altered states of consciousness (Laughlin et al., 1990: 131–132, 136), in which counterintuitive links and relationships may be conceived. The auditory experience of water as something mesmeric (Dennis, 2008: 96; Winkelman, 1986: 178) is also significant for many of the same reasons as the mesmerising visual qualities of water. There are two ways, however, in which the sound of water can be conceived as a more potent inducer of altered states of consciousness. Combined with its immersive character, the rhythmic and repetitive sound of water can produce a particularly powerful affective response; indeed, ample ethnographic evidence suggests that, cross-culturally, repetitive sound is crucial aspect for the induction of trance-like states (Strang, 2004: 53), and that there is a “concomitant brain response to the repetitive auditory experience of running and lapping water” (Dennis, 2008: 96). This rhythmic stimulation induces a specific phenomenon in the brain referred to as ‘auditory driving’ which triggers visual sensations of colour, pattern, and movement (Winkelman, 1986: 178) which in turn can promote far more creative thought and imaginative leaps, including ‘organized hallucinations’ and ‘abstract experiences’ (Winkelman, 1986: 178) than the reflective meditation induced by the mesmeric effect in the visual experience of water alone.

The repetitious nature of the sound of water puts it in a certain category of olfactory experience, a category which also includes speech, singing, chanting, music and the heartbeat. In this way, water lends itself to being understood as something which speaks,
a metaphor that is reinforced by the different volumes at which water creates sound: the whispering stream, babbling brook and the roaring rapids. Just as soft words and slow, gentle music can have a tremendously calming effect on us, the sound of waterfalls or raging torrents may have a physiological effect on the listener – raising heart-rates and so on – in much the same way as loud, fast drum beats (Strang, 2004: 52). In addition, as Goldhahn has noted, a loud and repetitious noise such as a waterfall or water-rapids can often have a debilitating effect on the listener:

The Laxforsen rapid is extremely noisy and over a few hours the endless roaring begins to sap the strength from your body. A numbed feeling develops, a skewed sense of perception, especially in hearing. It is an extremely burdensome place to visit and quite possibly a dangerous place as well (2002: 41).

Likewise, the feeling of weightlessness and of being completely surrounded or ‘contained’ by liquid makes submersion in water perhaps the only way to experience something similar to being in the womb. This link is attested to by that fact that new born babies appear to find being submerged in water both familiar and comforting. Even if we reject the importance of the link between the experiences of being underwater and being in the womb, it is clear that the feeling of being in water can be a powerful one that affects human beings in many different ways. At almost no other time is every area of the skin confronted with the same sensation, providing an unusual feeling of coherence where the soles of our feet report the same stimuli as our face and hands. Immersion in water involves the contradictory experience of sensory bombardment via the skin at the same time as sensory deprivation, in that only one stimulus is present, and one that the skin quickly adjusts to. It is worth noting that immersion in water, as part of total sensory deprivation, has been used to evoke visual and auditory hallucinations, with some participants experiencing altered states of consciousness, interference in thinking and concentration, and sexual and aggressive fantasies, as well as more pleasant and relaxing feelings (Suedfeld et al., 1983: 147).

47 In some cultures, such as in an African context, the feeling of being ‘contained’ is very important (T. Insoll pers. comm., 16th July 2013).
2.3 Transition and Transformation

One of water’s chief characteristics is its ‘transmutability’. It is special in its natural existence on Earth in all three states of matter – solid, liquid and gas – states which include both interchangeable and contradictory qualities (Oestigaard, 2010: 299), for example the “highly visible, concrete solidity of ice, and the fleeting dematerialisation of steam” (Strang, 2004: 49). These characteristics link water with more abstract concepts such as transformation and transition, a link which is reinforced by the observable and reversible transformations of water or the transformations the lack of it produces in the environment. For example, a lush and green environment, for want of fresh water, can become a dusty, dry and ‘dead’ place in a matter of days. Conversely, a sudden or prolonged period of rain can ruin landscapes, turning fields into mulch and destroying agricultural crops. The more positive side of this coin, however, is one of the most celebrated and revered events in nature.

2.3.1 Regeneration and Fertility

For many cultures, successful food production revolves around, and is dependent upon, seasonal rains and rivers. It should come as no surprise then, that water is often closely associated with fertility and regeneration, as without a plentiful supply of it, adequate food production is difficult or impossible. This association with fertility is closely linked with concepts of periodic regeneration and abundance, and by extension with the cycles and rhythms of life itself. Oestigaard highlights the intimate connection between these intertwined concepts and the belief in deities or supernatural forces, as seen in a remarkably common ritual practice: rainmaking. “Humans are dependent upon water, and if seasonal rain does not come when it should, the gods are invoked to modify nature for the creation of life-giving water. Turning absence into presence is an enterprise that necessitates all cosmic forces” (2006: xx). The rituals or rites involved in rainmaking are many and varied, ranging from appeals to gods through prayer to dance, sacrificial ritual and community festivals. They are prevalent in many societies, both ancient and modern, with numerous studies of rainmaking practices reported from Africa, Southern America and Australia (for a South African perspective, see Aukema, 1989). In a European context, Håland has traced the continuities and similarities in rainmaking rituals in modern Greece to local traditions, folklore and ancient Greek ritual practice (2001; 2009). Importantly, rainmaking rituals practiced in different cultures and locations repeatedly stress the
fundamental importance of water to fertility, regeneration, the start of a new season and the beginning of a new cycle of life.

2.3.2 Metaphorical Purification

Flowing from its physical transformations, water is also deeply connected to metaphorical or metaphysical concepts of transformation and purification. Water’s capacity to clean or cleanse has become one of the most common, and in many cases, most powerful, ritual acts. As discussed above, the assemblage of meaning and repetition associated with acts of washing with water are highly conducive to a passage from mundane and simple acts to religious ritual activity. In many societies the physical act of washing has become ritualised in spatial, temporal and social terms. Spatially, washing tends to occur in specialised places – whether rivers, wells, or bathrooms – that are removed from the sites of other activities; temporally, acts of washing may be reserved for specific times of day, especially after particularly dirtying tasks, or before activities requiring cleanliness. Socially, washing may be a communal event, or indeed, an intensely private one.

Bodily washing, therefore, often acquires its own spatial and temporal location and social connotations, reinforced through repetition, and thus becomes a significant event in itself. Perhaps inevitably, the significance thus associated with the act of washing is metonymically transferred to the processes implied in the act. In this way, the transformation of the body from dirty to clean is grounded and situated in specific social and spatial places in the life of the community. These places may easily become populated with more complex formulations of the same ideas (not least as this is something encouraged by the properties of water), as a place of bodily washing may lend itself to a space of mental or spiritual cleansing. The accumulation and concentration of many different spheres of meaning around the practical motif of washing can also imbue special properties on water itself, such as a metaphysical resistance to contamination wherein water removes impurities and yet remains ‘pure’ itself. For example, water used in baptism does not cease to be ‘pure’ once it has been used to ‘wash’ the participant. This capacity of water to remove impurity and still remain pure is “at a structural level essential in all religions revealing the divine capacities in holy waters” (Tvedt and Oestigaard, 2010: 14).

Following the example of ‘mundane’ bodily washing set out above, the very same act is a fundamental ritual – in one way or another – for many of the world’s religions. In Islam, for example, the act of washing is a fundamental prerequisite for prayer as set out in the Qur’an (5:6):
O you who are faithful! When you undertake ritual worship, then wash your faces, your hands to the elbows, rub your heads and legs to the ankles ... God does not want place a burden on you but He wants to cleanse you and complete His benefaction for you, perhaps you will acknowledge your obligation.

This ritual act of washing must be performed in a strict order and must contain the following aspects:

1. To declare that the purpose is for worship and purity.
2. To wash the hands up to the wrists three times.
3. To rinse the mouth with water three times.
4. To cleanse the nostrils of the nose by sniffing water into them three times.
5. To wash the whole face three times with both hands.
6. To wash the right arm three times up to the far end of the elbow and then repeat with the left arm.
7. To wipe the whole head or any part of it with a wet hand once.
8. To wipe the inner sides of the ears with the forefingers and their outer sides with the thumbs. This should be done with wet fingers.
9. To wipe around the neck with wet hands.
10. To wash both feet up to the ankles three times beginning with the right foot.

Washing in this particular instance is linked to both physical cleanliness and dedication to one’s religion; it is “a means to complete one’s faith, the perfection of God’s brilliance, and the gateway to prayer and reading the Qur’an and hence to attain God’s love” (Haleem, 1999: 33 cited in Oestigaard, 2005: 93). It is also therefore an act of physical and mental cleansing - ridding oneself of pollutants that would otherwise ‘contaminate’ the act of prayer. Washing is also an ablution that is frequently practiced by Jews before prayer and before the breaking of bread at a meal (Dennis, 2008: 92), while the washing of the whole body (often through whole body submersion in water) is the most frequent form of ablution mentioned in Jewish scripture (Oestigaard, 2005: 72), with the aim of the ritual being to “strive for holiness and communion with the Deity” through the cleansing of the physical body and to “prepare the body for a higher degree of holiness”, ultimately preparing the participant to be able to approach God (through prayer) in a “proper and pure condition” (Oestigaard, 2005: 72). Ritual washing is also an important concept in funerary practice. In Christianity, Islam, Judaism and Hinduism, the body must be washed
and cleansed before either being buried or cremated according to custom. In the same way as washing before prayer, the washing of the body both physically and spiritually purifies the body in preparation for ‘the next life’, in whatever form that may take.

Another key concept related to ritual washing is the Christian practice of baptism, whereby the participant in the ritual is either anointed with ‘holy water’ within a church, or other place of Christian worship, or is fully submerged in a body of water by a religious officiate. Although fundamentally similar to the practices of ritual washing discussed already, baptism includes a subtle modification of the washing principle. Where ritual washing is often concerned with preparation, baptism constructs water as having a symbolic power, directed against a specific conceptual pollutant: sin (Oestigaard, 2006: xxi). In some practices, ‘holy water’ is considered so potent that the full act of washing is no longer necessary; anointment with a small amount of water is often sufficient to symbolically purge the individual of sin. The idea that water is capable of washing away intangible or spiritual phenomena is common to many cultures. However, this property is not necessarily a positive attribute. As Kamash notes, “in inner New Guinea ... water is deemed to wash away sacred power” (2008: 224) and as such, a number of taboos are associated with the drinking of this potent element.

Baptism also makes explicit what is only implicit in most forms of religious washing, in that it signifies entry into a community. The baptism of babies and new converts involves the use of water in an initiation rite that asserts the identity of the participant with the religious community, each of whom has been initiated in the same way. Similarly, as re-enactment of the baptism of Jesus by John, Christian baptism ceremonies are a way to assert the ‘continuity’ of the modern church with the life of Jesus. Aside from purifying individuals of sin, therefore, water participates in the articulation of the spiritual community and a religious identity.

2.3.3 The Power of ‘Holy Water’

One of the most potent ways in which water is used to transform or change is in its use as ‘holy water’. While there is insufficient space in this chapter to engage in a full discussion regarding the many facets of and roles holy water plays in different religions and cultural beliefs, it is important to examine briefly the different ways in which holy water is conceived, and what characterises it as being ‘holy’. In a concise summary, Tvedt and Oestigaard (2010: 12-14) highlight that holy water can be a mediator between man and the divine (such as in Judaism where holy water is considered to bring man closer to God), or
as a medium for the divine to transfer blessings or healing powers into water and thus to humans (as with the water at Lourdes\(^{48}\)); but also, holy water is considered as a divinity in itself, for example the river Ganges is thought to be the Mother Goddess of Hinduism.

Alongside these three principles, Tvedt and Oestigaard identify two intertwined and key concepts which recur throughout beliefs and rituals concerning water, many of which are concerned with transition or transformation in some way.

The first is the concept of holy water having the capacity to purify and annihilate human sins. As previously noted, water is used in a number of religions as a purifier, as something capable of washing away a person’s sins – as in the case of baptism – or as something which can prepare somebody’s body for life after death. In addition, many purifying water rituals aim to reduce the chances of any “[o]therworldly punishments for perpetrated sins” (Tvedt and Oestigaard, 2010: 12-13), and to reduce the chances of misfortune in this world. As such, for those that partake in purifying rituals involving holy water, the water itself has the ability to transform. It changes the moral character of the participant from potential sinner to somebody imbued with the spirit of the divine (Tvedt and Oestigaard, 2010: 13). One of the largest gatherings of people in the world, the Kumbh Mela festival in India, sees millions of Hindu pilgrims journey to the confluence of three holy rivers – Ganga, Yamuna and the mythical Saraswati – to celebrate, amongst other things, the spiritual awakening of the self, and thus the transformation of oneself, through bathing in waters blessed by the divine.\(^{49}\)

One of the most dramatic examples of the power of water to purify and to eliminate sin is the Christian flood story\(^{50}\) (Genesis: 6-9), whereby God, having seen the

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\(^{48}\) Lourdes in France is one of the most visited Christian pilgrimage sites in Europe. The spring water in the grotto at the Sanctuary of Our Lady at Lourdes is thought to have healing properties and is reputed to have brought about many miraculous cures (http://en.lourdes-france.org/ accessed September 2013).

\(^{49}\) ‘Kumbh’ literally means water pitcher. The official Indian government’s Kumbh Mela website for 2013 states that “the pitcher, its mouth (opening) symbolizes the presence of Vishnu, its neck that of Rudra, the base of Brahma, all goddesses in the center and the entire oceans in the interior, thus encompassing all the four Vedas. This itself establishes the significance of the Kumbh as symbolized by the pitcher.” http://kumbhmelaaallahabad.gov.in/english/about_kumbh.html (accessed August 2013).

\(^{50}\) Flood myths are attested to in most of the mythologies around the world, from Africa, the Near East, India, Australia, Scandinavia, China, Greece and so on (Doniger, 2010; Dundes, 1988), with their wide-spread nature being attested to by such varied arguments as flood are common to most countries and cultures, to the flood myth as a projection of the human experience of being born (Dundes, 1988: 1). It must be noted, however, that not all such myths are examples of the purifying power of water.
wickedness of Man, resolves to send a great flood to the earth to purify it of all sin. In doing so, the deluge kills all life on earth with the exception of a man called Noah, his wife, his sons and their wives, and one pair of each other species on Earth, who are saved by a wooden ark that God tells Noah to build. The flood is the ultimate purification ritual, a “saving rite ... on a collective level”, the “baptism of the world” (Oestigaard, 2010: 309).

The second key concept relates to the healing and promissory nature of holy water, which is seen as god’s grace onto humanity, giving prosperity and life to humans. Tvedt and Oestigaard note that “water may be seen as neutral and as having no divine qualities and properties, but since it is given by the divinities for the benefit of humanity, it is part of a greater cosmological scheme” (2010: 14). This aspect of holy water is not specific to any one religion, and is an aspect shared despite theological differences. There are numerous sources of holy water which are deemed to be healing e.g. the spring water at Lourdes, France, the sacred Spring of Panayia at the Acropolis, Athens (Håland, 2009), the Ganges in India, and the Well of ZamZam in Mecca, Saudi Arabia. In each case, the water has the capacity to transform the participant either directly through the healing of an ailment, or indirectly through the receiving of divine grace. This divine grace is also manifest in water as it enables human beings to live and to prosper. As such, water is incorporated into the religious realm through our dependence on this divine grace.

2.4 The Power of water and elite ideology

Throughout the discussion so far, I have talked about how human communities make sense of their relationship with nature (for example, rainmaking), of their social bonds with both water and with each other, and how identities are forged and communicated. Through the meanings and beliefs associated with and belonging to water, those with the power to control (or to appear to control) water and how a community interacts with it, may exercise the capacity to embed themselves and their interests within the shared meanings and beliefs associated with water, making them fundamental or even sacrosanct. Therefore, in an analysis of water and religion in the Minoan context, what must be looked for are the ways in which water is related to systems of meaning, and how this relationship is incorporated into ritual action. As I discussed in the introduction to this chapter, ritual action is inherently political, and is used by elites to legitimise and consolidate their power. Combined with the powerful meanings water can hold, it is an ideal medium for elites to manipulate and to incorporate into an ideology of difference.
3. Water and Religion on Minoan Crete

Having explored how and why water often plays a key role in religion, ritual and the generation of complex social meanings, I now turn to water in the Minoan religious sphere. I return to the three main metaphorical and metonymic themes explored above – boundaries and other worlds, altered states, and transition and transformation – to organise and structure this section. I explore how the archaeological evidence for Minoan religion and ritual practice concerning fresh water can be understood and how these possible meanings could have been used and manipulated to the benefit of the elite through the creation and continuation of an ideology of difference.

3.1 A Brief Overview of Minoan Religion

The archaeological data for Minoan religion on Crete is rich, and has been extensively researched, debated and explored (see Lupack (2010) for a good general and recent overview or Marinatos (1993) for a more detailed, if slightly dated exploration). While there is no room in this thesis for a detailed exploration of the debates around Minoan religion and all its facets, what follows is an overview of some of the key practices, places and themes within it.

While it is not clear exactly how Minoan religion functioned, a number of potential ‘deities’ have been identified. The most numerous in terms of representation, in various forms, is a female figure, dubbed the ‘Mother Goddess’, the ‘Mistress of Animals’, the ‘Great Goddess’ and even the ‘Guardian of Cities’. While it is not clear if this is one goddess or many (see Moss (2005) for an exploration of a possible Minoan pantheon), it is clear that that a female deity was the major focus of Minoan religion (Marinatos, 1993: 147-166). This goddess, or goddesses, is depicted in art and other material culture as being associated with numerous animals (such as lions, griffins, snakes, goats, deer, monkeys and birds) and different environments (such as mountains and groves) along with various plants and flowers, in particular crocuses and lilies. There have been numerous interpretations as to what this female figure might be the deity of. Evans hypothesised that the female deity was a Mother Goddess, but Marinatos prefers to see the deity as a ‘Goddess of Nature’ (1993: 166). In recent years, however, scholars have emphasised the role of animism and

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51 In fact, there are numerous names for female figure with these names being seemingly interchangeable.
52 Morris (2006) has highlighted that Evan’s view, and those of his generation, were a product of Victorian social ideologies surrounding motherhood and the ‘nurturing Mother figure’.
the complex relationship between human deities, animals, plants and environments (see for example Goodison and Morris (1998), Goodison (2012) and Herva (2006a)).

While not as prevalent as female deities, male deities have been identified (Goodison and Morris, 1998: 128-132). Though Evans initially thought representations of a usually young man to be simply of the consort of the female deity, other scholars have interpreted this figure as some kind of deity. Marinatos prefers to see the male figure as the ‘Master of Animals’ as he is often depicted, usually on seal impressions, as holding animals in positions of submission (1993: 167-170). A figure known as ‘The Young God with Staff’ has also been identified, whom Marinatos sees as a protector, particularly of towns or urban areas (1993: 171-174). In both cases, the male deity is seen as a controller (of nature and animals) and in control of urban environments.

It must be noted here that there are numerous representations of male and female figures in both Minoan art and material culture. Many of these figures have been identified as adorants of the deity, or as priests or priestesses (Berg, 2004: 29-31; Marinatos, 1993: 127-146), who are shown in numerous activities including evoking the deity (through epiphany or dance (Marinatos, 2004)), in procession or with religious symbols such as the double-axe (discussed below). Animals, both natural and imaginary, also feature heavily in Minoan religion (see Shapland (2009b) for a detailed study of the role of animals on Minoan Crete, both in religious spheres and in ‘daily’ life). One of the most famous of these animals is the bull, which appears to have been a key figure in Minoan religion and ritual practice. As well as the well-known ‘bull-leaping’ frescoes of Knossos and other palaces (Shapland, 2009a: 207-209; Younger, 1976), the bull appears in numerous figural representations and as a vessel shape (bucrania). ‘Horns of consecration’, a ubiquitous Minoan religious symbol, is also thought by many to be based on bull’s horns. Other animals have been identified as adorants or attendants of deities, namely monkeys, Minoan ‘demons’ or Genii and griffins, or as signifying the presence of a deity (butterfly, bird). Some scholars have also noted that animals themselves may have been worshipped in their own right, as well as other natural elements such as the sun, sky, moon and even specific environments or places (Goodison, 2012). While it is not exactly clear what or whom is being worshiped on Minoan Crete, or indeed if several divinities were worshipped at the same time, there is a clear emphasis on particular themes, those of cyclical regeneration,

53 For a discussion on the problems of identifying gender in Minoan figural representation, see Hitchcock (2000a).
seasonality, and fertility as embodied through the natural world – plants, animals, places such as specific mountains and caves.

Evidence for the practice of Minoan religion has been found all over Crete and in numerous contexts. While there is some evidence for the practice of ritual and religion in towns and in individual households (Gesell, 1985), it is the palaces which have provided the most data: there are a number of ritual and religious spaces such as pillar crypts, bench sanctuaries and lustral basins (Gesell, 1985: 19-32; Lupack, 2010; Marinatos, 1993: 76-111), while the Central and Western Courts are also thought to have been areas in which festivals (such as agricultural or ‘harvest’ festivals), processions and ceremonies (such as the famous ‘bull-leaping’) are likely to have taken place (Driessen, 2004). Aside from urban environments, shrines can also be found on mountains, the so-called peak sanctuaries (Jones, 1999; Nowicki, 1994; Peatfield, 1983; Peatfield, 1992), as well as in caves (Lupack, 2010: 252-254; Tyree, 1975, 1994).

Minoan art and material culture such as seals, frescoes, larnakes and pottery depict numerous ritual and cult activities, such as feasting, processions and ceremonies. While we are unsure as to exactly the kind of ritual practices which occurred, archaeological evidence suggests that libations, offerings and festivals and feasting played an important role in Minoan ritual action (Warren, 1988). A great body of religious artefacts, equipment and ‘cult furniture’ has also been discovered, these include libation vessels (including animal-shaped vessels, such as bull, lion, boar and goat heads), ladles, altars and offering tables (Marinatos, 1993: 5-8), as well as numerous human and animal figurines. Religious symbols have also been identified with the double-axe being the most common, as well as aforementioned horns of consecration. Both these symbols have been used by scholars to identify shrines and religious areas (Marinatos, 1993: 5).

Even from this brief overview of Minoan religion, it is clear that water has received relatively little scholarly attention with regard to its use in Minoan religion and ritual action (notable exceptions are Peatfield’s study of water, fertility and purification (1995) and the limited discussion of ritual deposits in pools within caves offered by Tyree (1975)). This is something the remainder of this chapter hopes to address.

3.2 Water Management Systems and Ritual Practice

Having briefly looked at some of the general principles and actors within Minoan religion, I now return to the role of water within Minoan religion and begin by looking first at water management systems and the evidence for ritual practice at or within them, and
second at the different types of sacred activities and spaces that water is likely to have been incorporated into.

<table>
<thead>
<tr>
<th>Site</th>
<th>Catalogue number</th>
<th>Date</th>
<th>System type</th>
<th>Deposits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Caravanserai, Knossos</td>
<td>SC1</td>
<td>LM I - LM IIIB</td>
<td>Spring chamber</td>
<td>Several stone lamp fragments Stone lamps (heaped outside the entrance) LM III C hut-urn containing goddess Clay figurines Incense burners Numerous jars, cups and vases</td>
</tr>
<tr>
<td>Choirmandres</td>
<td>D2, D3</td>
<td>MM III-LM II</td>
<td>Dam</td>
<td>Foundation deposit beneath the megalithic enclosure consisting of a small storage vase, containing volcanic ash, placed in a hollow in the soft bedrock.</td>
</tr>
<tr>
<td>Kato Zakros</td>
<td>W3</td>
<td>MM IIIA-LM II</td>
<td>Well</td>
<td>Ordinary cups and dishes Food including olives and grape seeds Small branches of aromatic bushes Pieces of pumice in handleless cups Animal bones, some of which burned Fragments of three-legged offering tables One animal figurine</td>
</tr>
<tr>
<td>Kato Zakros</td>
<td>SC2</td>
<td>LM IA-LM IB</td>
<td>Spring chamber</td>
<td>Pumice Three-stepped pyramidal base Horns of consecration Olives</td>
</tr>
<tr>
<td>Palaikastro</td>
<td>W16</td>
<td>LM IB- LM IIIA</td>
<td>Well</td>
<td>Great quantity of animal bones as well as dogs deposited whole</td>
</tr>
</tbody>
</table>

Table 14 Systems containing deposits.

One way of exploring the relationship between water management systems and ritual activity is to look at the incidence of material in and around the systems themselves that might be considered ritual depositions. This is a complex issue in itself, as there is a perennial question of whether the act of deposition was part of ritual activity, a by-product of it, or even rubbish dumping after the system had gone out of use. Further, in the case of
water management systems, depositional behaviour is further obscured by the necessity of periodic cleaning and clearing of the systems to maintain adequate water flow and cleanliness. Similarly, the re-use of old systems in later centuries often saw ritual and other deposits being cleared out as debris, such as the well with the terracotta drums at Knossos (No.W14), which was reinstated during the Roman period (Evans, 1930: 255-259).

Nevertheless, a number of the systems discussed in Chapter 2 contain possible ritual deposits (summarised in Table 14). These deposits found within water management systems are quite varied and include numerous vessel shapes, which are commonly associated with a water source such as jars, cups and vases, as well as food offerings which include olives and grapes. Animal bones are also found, some of which are burnt. Deposits also include items more readily associated with Minoan ritual practice, such as animal and human figurines, horns of consecration and offering tables.

There are, however, some more notable deposits. Both the well and the spring chamber at Kato Zakros contained pieces of pumice which is likely to be attributed to the eruption of Thera. A vase containing Theran ash was also found in a foundation deposit below the enclosure wall at Choiromandres dam. The very rich array of deposits at the Caravanserai spring chamber, along with later post-Minoan artefacts which actually choked up the chamber itself, intimates a long history of ritual practice in and around the spring chamber (Evans, 1928a: 343; Schofield, 1996: 29). The niche and small ledges in the back wall of the chamber could certainly have held votive offerings such as those found in the chamber (while Gesell (1985: 46) and Shaw (1973: 106, 107, 1978: 446) both note that the design of the back wall resembles that of Minoan Tripartite Shrine).

At Palaikastro, along with various other animal bones, such as goat and cattle (regarded as debris, rather than as deposits), there is a large quantity of dog skeletal remains. In total, 28 individuals are represented, with 23 coming from one well (No.W16) (Wall-Crowther, 2007: 195). While it is unclear if some of these articulations were ritual in nature, a later LM IIIA deposit contained the remains of three carefully placed individual dogs. Their careful placing and lack of cut-marks (Wall-Crowther, 2007: 184-190) suggests that these are much more likely to be ritual deposits, placed in the well right at the end of the well’s life. Evans noted that the dogs were likely to be Cretan hounds, and based on Minoan iconography showing similar dogs, suggested that the hounds may have been

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54 Wall-Crowther also compares the dog skeletons with the modern Cretan Tracer Hound, *Kritikas Iknilatis* (2007: 196-197).
guardians of the goddess or companion of the ‘young male god’ (Evans, 1928b: 764-766). Perhaps then, the dogs were also designated guardians of these wells.

At Myrtos-Pyrgos, one of the cisterns (No.C5) appears to have been ritually filled with river pebbles. While there is no other evidence for ritual associated with this cistern, Cadogan recognises the link between the cistern’s function and the later filling of the cistern with fresh water-worn pebbles, likely from the river below the site (2007: 107). The use of water-worn pebbles is not an isolated incident, indeed numerous water management systems are lined with pebbles, and they are often found at peak sanctuaries. Their use and significance, particularly at peak sanctuaries, is discussed in more detail below.

In addition to the water management systems which contain direct ritual deposits, numerous systems are located near to cult rooms or spaces which have been deemed to have had a ritual function. At Chamaizi, where the cistern is at the very centre of the building, at least two of the rooms are associated with ritual paraphernalia (Lenuzza, 2011: 64). At Mochlos, a stone basin (found with a triangular kernos next to it) is situated in a room which directly connects to a pillar crypt on the floor below. At Palaikastro both a well and a basin are found within a building (House B) which is thought to have been significant, as it contained a lustral basin, a Palaikastro Hall, several store rooms and ashlar facades (Driessen and Macdonald, 1997: 228-230). At Kato Zakros, the spring chamber is connected to the central court via a long corridor which seems to have been crowned by horns of consecration, which usually denotes an area of ritual or religious significance (Platon, 1971: 98-99,195). At Knossos, a well is sunk into the floor of the portico of the ‘Hall of the Double Axes’, an area thought to be associated with processions and rituals of a religious nature.

These examples highlight how water management systems participated in the Minoan ritual repertoire. To understand the extent and character of this participation, this chapter places water management systems into the broader set of Minoan ritual action, including at peak sanctuaries and sacred caves, in which water was a key element. This will be discussed in the following section in terms of Minoan ritual practices involving water fit into the three established themes discussed above – boundaries and other worlds, altered states and transition and transformation – along with a discussion of how water in Minoan ritual practice can be read.

55 Platon is unsure as to exactly where the horns of consecration have fallen from – either the corridor entrance from the Central Court, or a corresponding corridor from an upper floor.
4. The Meaning of Minoan Water

Earlier in this chapter, I discussed the conceptual and metaphorical functions of water by looking at three broad themes - boundaries and other worlds, altered states and transition and transformation. Now, I wish to explore how Minoan ritual archaeology can be read in terms of these themes and how these concepts are used by elites to consolidate and perpetuate their power and influence. In addition, I want to explore the possible ways water could have been perceived – using the common themes and narratives explored earlier in this chapter – and how Minoan elites could manipulate these ideas to aid their own agendas.

4.1 Boundaries and Other worlds

From the above discussions of the sensory experience of water, and of the roles water frequently plays in belief systems, we would perhaps expect to see in the archaeological record some clues to a Minoan conceptuality of water as a boundary or threshold to another world. My argument here is that the Minoans emphasised the linking element of water’s boundary-like properties, rather than the idea of water as a ‘barrier’ that may be more familiar to modern minds. This section outlines the evidence for a Minoan practice of using water to identify and link together discrete and meaningful spaces and places, both in terms of linking real spaces that are geographically separate, and in terms of establishing enduring conceptual links between real spaces and imaginary or religious ones. My argument in this section is composed of four stages. First of all, I establish that specific locations which have been identified as focal points for Minoan ritual activity, such as peak sanctuaries, often have a clear connection with natural sources of water. Second, I argue that the incorporation of fresh water into palatial settings is best interpreted as an artificial continuation of this link. Third, drawing on the above discussions about the sensory experience of water, I offer an explanation of this practice of bringing water into the palaces in terms of a Minoan mindset in which water, both directly and indirectly, establishes the similarity or even identity of two distinct places. This mindset can be seen throughout a number of different media, including architecture, fresco art, and ritual paraphernalia, which together form a ritual and visual ‘imaginary’ that cements the interaction of place, memory, belief and water. Fourth, and finally, I discuss this imaginary in terms of its relation to the elite ideology of social difference introduced in Chapter 4.
Localised ritual activity at specific natural or rural places is a key practice in Minoan religion, especially at the well-documented shrines or enclosures on mountain slopes known as ‘peak sanctuaries’. In recent years, Steven Soetens and his colleagues have published numerous articles based on their use of Geographic Information Systems (GIS) to analyse “the proximity of peak sanctuaries to nearby settlements, the intervisibility of the sanctuaries and their visual quality as landmarks from both land and sea, and the diachronic changes of distribution of both Minoan ‘Palaces’ and the peak sanctuaries” as part of a larger GIS project, ‘Topography of Power’ (Soetens et al., 2003: 154). This project has yielded a connection between peak sanctuaries and water: Soetens lists 21 peak sanctuaries that were within a reasonable two-hour walk of a number of (current) fresh water springs (see Table 15), eleven of which were within two hours of more than 20 springs (Soetens, 2009: 268, table 22.1). At the peak sanctuary of Juktas, 77 springs were found within the two hour walking-radius; at Vorizi, 66 springs, Vrysinas (“the mountain of springs”) has 63, and at Kophinas there are 50 springs (Soetens, 2009: 264).

A summary of their work alongside a substantial bibliography regarding peak sanctuaries can be found at the project’s website: http://www.ims.forth.gr/peak_sanctuaries/gis_analysis.html (accessed July 2013).
For Soetens, the locating of a peak sanctuary within reasonable reach of a spring was of paramount importance for the Minoans, and the number of springs nearby, he argues, contributed to specific sanctuaries being particularly revered or ‘special’ (2009: 264-265). While this argument perhaps over-emphasises the importance of the springs in terms of the locating of a peak sanctuary - especially given that a large number of other landscapes or natural elements are within a two-hour walk of a sanctuary, including settlements – it does highlight the potential for spring water to be an important ritual player at peak sanctuaries, especially given the number of vessels and objects associated with the pouring of libations (discussed in more detail below in section 4.3.1) and drinking that are often found at peak sanctuary sites.

At the rural sanctuary of Kato Syme, however, a closer connection between the locating of a sacred space and a spring can be found. This sanctuary is unique in that it actually incorporates a spring, found in the northeast corner of an enclosed space (Building U) within the sanctuary itself (Fig. 66). While the spring at Kato Syme does not form part of the enclosure, Lebessi and Muhly note that the direction of the complex and its close proximity to the spring suggest that the water had some role in cult practiced at the site (1990: 328). Further, in an early phase of the Neopalatial period of the sanctuary, a road appears to have led towards the spring, suggesting a more direct connection between the spring and the central enclosure (Lebessi and Muhly, 1990: 328).

Caves are another important natural site of Minoan ritual activity. Like peak sanctuaries, sacred caves are often visible from nearby settlements or palaces and a large array of artefacts associated with Minoan ritual practice have been recovered from these caves (Jones, 1999: 5-14). The most common artefacts include human and animal figurines, symbolic items such as double-axes, pottery (particularly jugs and cups), as well as weapons and burnt animals and plant remains. Significantly, a large number of these sacred caves have, like peak sanctuaries, close associations with water. Both Moody (2009: 248) and Tyree (2006: 334) have noted that as well as being permanently dark and damp, many caves contain copious amounts of water either as pools (both large and small) or as constantly

57 In the Late Geometric period of the site, the spring water was channelled directly into the sanctuary (Lebessi and Muhly, 1990: 328).
58 Tyree’s (1975) study identifies 13 Minoan sacred caves in use from MM I to LM III. These are Psychro, Skoteino, Kamares, Amnisos, Stravomyti, Phaneromeni, Arkalochori, Chosto Nero, Tyliosos, Idaean cave, Patso, Mameloukos and Liliano.
dripping water from cave roofs or stalactites, which can in turn form puddles in the rock as well as small flowing rivulets of water.

Many of the caves cannot be linked directly to water-related ritual; however, there are some instances where it is much more likely. Psychro cave (Lasithi) – a large cave with three distinctive areas, a terrace, an upper chamber and a lower chamber – contains, at its lowest level, a substantial and deep pool surrounded by stalagmites and stalactites (Watrous, 1996: 17). During the MM III-LM I period, numerous dedications were made to the pool at the bottom of the cave including figurines, rings, pins and seals, while the crevices in between the stalagmites and stalactites surrounding the pool also received offerings of blades and miniature double axes (Watrous, 1996: 52). A similar, although much smaller pool of water can also be found within Kamares cave (Mount Ida). While the archaeology is not clear about which finds come from the pool or its edges, Tyree notes that the predominance of vessels such as small spouted jars suggests a preference for pouring rituals, rather than drinking rituals, with the pool of water in the cave being a likely source of (one of) the liquids being poured (Tyree, 1994: 45).

As to the ritual acts that were conducted at these sacred sites, further archaeological evidence suggests that the water itself may have played a crucial role. For example, Peatfield, argues that the incorporation of the spring at the sanctuary of Kato Syme provides not only clear evidence of the importance of water at the sanctuary, but also of ritual activity associated with water (1995: 223): numerous stone and pottery goblets, chalices (including miniature and over-sized versions), handle-less cups and pouring vessels, as well as libation tables, have been found within the enclosed space, suggesting that liquids, and quite possibly water from the spring, were both consumed and offered as part of the ritual practice here (Lebessi and Muhly, 1990: 323-327). Soetens, furthermore, believes that peak sanctuaries were the ideal location for rain-making rituals, arguing that the Minoans must have noticed that mountain peaks attract rain and snow (as well as the springs themselves) and were the sources of seasonal rivers. Ritual participants “may thus have believed that the peak was the appropriate location for the request for rainwater” (2009: 265). While this argument is logical, it relies on a rather one-dimensional account of the relationship between water and meaning, namely, the Minoans’ observation of the hydrological cycle at work. There is, however, ample evidence for considering more complex constructions of water and ritual action at peak sanctuaries and other natural sites.

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59 Finds also include a few bronze objects as well as substantial burnt deposits (animal remains).
4.1.2  Linking palaces and elite spaces with sacred places

What is particularly interesting about these two water-rich natural sacred spaces – peak sanctuaries and caves – is that a number of their key attributes are replicated or referenced within the palaces, and in particular, their water element. During his study of Minoan peak sanctuaries, Soetens noted that depositions of water-worn pebbles (possibly from the sea, but more likely to be from nearby rivers or larger spring sites)\(^{60}\) are frequently found at peak sanctuaries, and that 15 sites in total had such depositions\(^{61}\) (2009: 264). For example, at the peak sanctuary of Atsipadhes, water-worn pebbles form part of the focal point of ritual activities there (Fig. 67). On the upper terrace of the sanctuary, overlooking the drop to the lower terrace, excavation revealed what Peatfield terms a “pebble scatter” at the centre of which was a circular earth feature which marks the place where something stood, such as a “vessel for receiving offerings, a crude idol, or a baetyl or sacred stone” (Peatfield, 1992: 68). This area of the sanctuary (which had the highest density of finds from the site) also produced fragments of bridge-spouted jars, fragments of larger vessels, bases of rhyta and fragments of ceramic libation tables, suggesting that the rituals performed here included the pouring and dripping of liquids, amongst other activities. With regard to the function of the pebbles, Peatfield suggests that they were “either placed to define the area or did so incidentally if they were cast down by worshippers as part of the offering process, perhaps an act equivalent to the modern candles, memorializing the presence of the worshippers” (1992: 80).

The use of pebbles at peak sanctuaries is interesting in itself: Soetens comments that the pebbles could symbolise the water from which they came and that they were used as part of a ritual for the supplication for water (2009: 264). This is an appealing argument as it suggests that the water-worn pebbles took on a metaphorical role, symbolising not only the water from which they were taken, but also of the fecundity the water (particularly rain-water) brought with it. Along similar lines, Peatfield suggests that the pebbles at Atsipadhes could have acted as a memorialisation of the worshippers who attended the

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\(^{60}\) Of course, it should be noted here that it is very difficult to discern if the pebbles are from fresh water sources, such as rivers or larger streams, or from the sea. However, both Cadogan (2007: 107) and Soetens (2009: 264-265) argue that, given the location of nearby springs, streams and rivers, it is more likely that they are from fresh water sources.

\(^{61}\) These sites are Korakias, Vrysinas, Vortzi, Korfi tis Kerias, Juktas, Megalos Rozitis, Karphi, Korfi tou Stavromenou, Etiani Kephala, Skaft Prinias, Traostalos, Drapanokefalo, Kopida, and Alona (Soetens, 2009: 264 nt.19).
rituals (with the pebbles acting as tokens). He further suggests, that if the pouring or dripping of liquids was part of the ritual in this focal area (as indicated by the finds), then the pebbles “may have glistened as if in a watery setting” (Peatfield and Morris, 2012: 235). If this were the case, then Peatfield’s interpretation aligns closely with that offered by Soetens: that the role of the pebbles at peak sanctuaries was to memorialise or represent a fresh water source (a river or stream), physically and metaphorically. Interestingly, in addition to peak sanctuaries, there are a number of other instances in which water-worn pebbles can be found.

As I noted in Chapter 2, and in the discussion above (section 3.2), several water management systems incorporate water-worn pebbles into their architecture, for example the cisterns at Archanes (No.C2) and Myrtos-Pyrgos (Nos.C5 and C6), a well at Palaikastro (No.W17) and the Caravanserai spring chamber (No.SC1). Particularly in the case of Myrtos-Pyrgos, where the cistern is filled with pebbles after going out of use, the most likely interpretation is that water-worn pebbles are being used in a metaphorical way to symbolise water or a particular water source, as at peak sanctuaries. Cadogan hypothesises that the filling of the Myrtos-Pyrgos cistern with pebbles was a ritual act, a memorialisation of the water it once contained and of its importance to the site (2007: 107). Perhaps, then, we can see water-worn pebbles performing a number of symbolic roles involving fresh water: they could symbolise a water source, for example a particular river; they may act, therefore, as a memorialisation of the water and what it meant to the community (this could be secular and functional or spiritual – or indeed both these things at once); more abstractly, the pebbles could represent the power and necessity of water.

Water worn pebbles are also used in a number of other archaeological contexts, particularly in the construction of floors. While a pebble floor undoubtedly serves a practical and aesthetic function, their application in certain contexts may suggest the further use of this symbolic or metaphorical linking with fresh water sources. At the Caravanserai, for example, the use of pebbled floors in the eastern basement rooms may link the water-based activities of the rest of the Caravanserai with the function of some of the basement rooms, for instance the storage of water-related paraphernalia. Pebble floors are also found in more ritual contexts. For example, in the LM III Shrine of the Double Axes, Knossos, not only is the floor paved with water-worn pebbles, but so too is a bench.

62 Evans initially believed that the ‘cobbled’ floor of these rooms meant that they functioned as a stable (Evans, 1928a: 105). Schofield has noted that evidence from the basement areas suggest that at least some of the rooms were used for the storage of pithoi and barley bins (Schofield, 1996: 27).
(Gesell, 2004: 134). Further finds from the floor of this room, including storage jars, a pyxis, a stirrup jar and amphoras, suggest that liquids were part of the rituals performed in this room (Gesell, 2004: 134).

Perhaps then, what we can see here is the use of a metaphorical symbol – the water-worn pebble – in a number of ritual and mundane contexts. Not only could it symbolise a specific water source, such as a river, or a sacred location, such as the spring-laden mountains, but could also be imbued with the power that these things represent: the raw power of a river and the fecundity and fertility that seasonal waters bring each year. Through bringing symbolic items used in the peak sanctuaries, such as the water-worn pebble, down into the elite built environment, socially and politically powerful actors sought to bring with them the natural power of the rivers and the perhaps some of the power of the peak sanctuaries themselves, and imbue their own urban environment with it. In this way, through their use in water management systems, ritual rooms and perhaps also more functional courtyards, water-worn pebbles and other such metaphorically-charged objects, acted as visual reminders of an asserted connection or genealogy between an original source of water and power (which may be natural or mythological) and the bodies of water created and contained in the systems. As such, not only do the elites reference the sanctuaries in the mountains – linking themselves with the meaning and power they embody – they also lay claim to the power of nature.

A similar act of spatial referencing can be identified for sacred caves. Minoan pillar crypts, which are small dark rooms containing a stone pillar often found in palatial contexts, have been thought of by a number of scholars as “architectural and aniconic representations of the stalactites and stalagmites worshipped by the populace in sacred caves” (Hitchcock, 2007: 92). While the pillar may have been the focus of the shrine, the environment created sought to replicate the dark, damp atmosphere of the sacred caves. Archaeological evidence suggests water, or at least liquids, played some role in the ritual activity in these rooms. Hitchcock notes that in nine cases, pillar crypts have ‘cists’ cut into the floor, possibly for the receiving of libations, while the majority of the crypts have the double axe symbol engraved upon them or contained stand for holding them – an element which is frequently repeated in the sacred caves, carved into stalactites and placed in crevices (2007: 92).

While not specifically linked to Minoan ritual or religious beliefs, the open water conduits found in courts, particularly at Knossos, and potentially aqueducts, are additional elements of spatial referencing in a palatial context. If, as Angelakis proposes, fresh water
was ‘piped’ around the palace at Knossos (2012: 240), we could perhaps envisage artificial streams and rivulets, possibly from springs further afield, built into the architecture of the courts themselves, thus creating a spatial link and reference to other environments – real or imaginary. On a more basic level, it is certainly possible for water from sacred water sources, such as the springs near the peak sanctuaries, to be carried in amphorae and other vessels from the source to the palaces. This act may even have formed part of a procession: the Procession Fresco at Knossos, for example, which depicts numerous male and female figures in a ‘ritual’ procession, shows kilted men carrying various vessels including jugs and rhyta (Evans, 1928a: plate XXII) (Fig. 68).

Clearly, there is an element of spatial referencing here through the replicating of symbols, environments ritual acts and meanings within the palaces that were used, performed and felt within both the peak sanctuaries and the sacred caves. The important point I want to emphasise is that water in particular plays a tangible role in the palaces’ construction of what Hitchcock (following Tilley, 1994: 24-5) calls an “architectoniced landscape” (2007: 97). What I argue below is that the role water plays in this broader Minoan practice of spatial linking is not accidental. Rather, it is intimately connected to the sensory experience of water, and the conceptual or metaphorical potency of that experience.

4.1.3 Water and Spatial Referencing

So far, I have established that there is a frequent connection between the practice of spatial referencing and water, through the construction of ‘architectoniced landscapes’, the physical transport of water from specific places into palatial complexes, and the use of metonymic objects such as water-worn pebbles. While it can be argued that spring water played a significant role in the ritual practice at peak sanctuaries, for example libation pouring and drinking, Soetens (2009: 265) is too quick to assume that the participation of water in these ritual spaces implies that water is itself the referent object of the ritual, in this case, that water is the thing that is to be summoned or requested. Instead, water is highly capable of sustaining a more intimate connection to ritual practice, through its ability to articulate and embody the complex ideas on which religious beliefs rest. Thus, it is not necessary to speculate about the particular meaning of peak sanctuary rituals, or of the special locations such rituals were performed at, in order to account for the presence of water at the peak sanctuaries or, indeed, at other ritual sites.
What is important is that peak sanctuaries, as well as caves, are clearly significant places of themselves, as indicated by the ritual action located there, and that these places can be linked with relationship with fresh water. The water may not necessarily, as Soetens assumes, be the source of these places’ meaningfulness, but rather, it acts as a marker or participant in the rituals enacted there. As I have already claimed, the incorporation of water into urban ritual spaces, via water management systems and the use of portable water, constructs a sensory link between these built spaces and the natural places, such as rivers, springs and other ‘wet’ environments that are already invested with religious or sacred meanings. What is significant here is that the role of water in marking this similarity or identity between different spaces – natural and artificial – is already present within the ‘natural’ spaces themselves: the prevalence of water-worn pebbles at peak sanctuaries suggests a similar logic of referring to other places through water (invoked through the pebbles). Thus, just as the palaces ‘bring in’ sacred places that cannot share the same location (as caves and mountainsides are not suitable terrain for palace building), so too do peak sanctuaries ‘bring in’ elements from heterogeneous places such as riverbeds or coastal areas. Whatever the precise meaning of the various places and the rituals enacted there, the Minoans use water in a consistent way throughout: it references and incorporates other spaces and locations, and helps to transmit the meaning and power of those other places to the new site of ritual action.

Two interlinked corollaries spring from this claim. First, that this referential practice of water can be seen as not merely linking built and natural places, but also real and imaginary spaces. The capacity of water to make the links between heterogeneous and distinct locations derives from its liminality, discussed in section 2.1, that is, the ways in which water distorts, reflects, refracts and even conjures images and ‘tricks of the eye’ which challenge our perceptions of things either being present or absent. Water’s liminality lends itself to being associated with ideas of separation, otherness, and the extramundane, with water frequently acting as a conduit between worlds in many belief-systems. In this way, the same properties that allow for the linking of different real places also lend themselves to the expression of ideas about communing with other worlds or spaces that cannot be experienced directly. The second corollary is that this referential practice may not be isolated to defining ritual locations, but instead is identifiable in Minoan artistic conventions, architecture and material culture.

As I discussed in the concluding section of Chapter 3, water in Minoan fresco art has a compositional role wherein water, or water related motifs, act to unite and spatially
and conceptually link together seemingly disparate environments. For example, the long horizontal wavy blue lines in numerous landscape frescoes serve to give coherence to fresco scenes that contain an abundance of different elements that may not appear naturally together. The collection of Minoan and Theran frescoes is replete with such examples, of which the Monkeys and Blue Birds fresco in the House of the Frescoes, Knossos, is typical. In this scene, a great variety of different plants, including the hybrids discussed in Chapter 3, appear amongst rocks, and are accompanied by flying birds and monkeys engaged in a range of activities. Water, in the form of waterfalls and a number of rivers or streams plays a central compositional role across all three walls on which the fresco is painted, drawing the eye around the piece and connecting the various individual elements (see Figs. 39, 40 and 41). This situating role is reflected within the logic of the painting itself, with many of the exotic and hybrid plants appearing on the banks of the streams. In effect, one of the roles of water in these frescoes is to compose a single place or environment out of a variety of individual geological, floral and faunal elements – staging on a larger scale the same synthesising logic demonstrated in the fresco painters’ invention of new hybrid plant species (Day, 2007: 49-52; Morgan, 1988: 17-32). Again, then, we can see Minoan material culture employing water in order to construct new meaningful spaces by referencing existing elements, in much the same way as architectural spaces incorporated and mimicked features more familiar in natural spaces such as sacred caves, and the cultivation of gardens within palatial contexts in which exotic and domestic plants would have been nurtured and watered (possibly though architectural conduits) alongside each other (Day, 2007: 179-200).

What emerges here is a pervasive conceptual theme, running through art, architecture and ritual practice, in which new spaces are constructed from existing elements, with water acting in a referential way, but also as a glue which binds the various elements together. Whether the spaces constructed are intended to emulate or memorialise existing locations and environments, or to create and realise imagined or ideal places, it is clear that the Minoan imagination revolved strongly around the concept of place

63 The sense of place and the importance of a permanent sense of place is an identifiable theme throughout Minoan archaeology. Driessen, for example, has discussed this sense of place in terms of houses and their building and re-building in the same space “reinforces the localisation of the group and a continuity of place” (2010: 43). This re-building can be seen in Minoan building practices, with many having numerous occupation and building phases, several dating back over large periods of time, for example the palace at Knossos,
water played a significant and probably multifaceted role in marking, connecting, and defining certain places. What is especially interesting is that elites appear to have invested a great deal of time and effort in not only constructing their own special places but also establishing similarities and continuities between their built spaces and other (both real and imaginary) natural places. Water’s potent ability to embody and express complex ideas about identity and continuity, and about moving between worlds (as discussed above) no doubt made it a valuable conceptual resource in constructing these referential and reverent spaces. This is reflected in the investments in controlling and managing water in evidence at the palaces, including the complex and visible conduits at Knossos, the elaborate and often technologically sophisticated constructions incorporating springs, such as at Kato Zakros, and also perhaps the careful development of artistic conventions, such as the bifid motif, for representing water.

4.1.4 Spatial referencing and an elite ideology of difference.

The most obvious explanation for this elite investment in the construction of pseudo-natural spaces within the palaces is that it was part of a broader elite strategy of centralising and co-opting older centres of ritual action, such as the peak sanctuaries (Hitchcock, 2007: 92). By constructing environments within the palaces that mimicked and referenced sacred or significant natural places, elites could lay claim to what was special about those places and imbue some of their perceived importance and power. If, as the evidence I have presented suggests, Minoan religion had a strong sense of the specificity of particular natural places, then urban elites faced a difficult problem should they attempt to control or appropriate the power of such places as they would often be in remote or difficult to access locations. Practices of spatial referencing, which perhaps built on existing practices of memorialisation or metonymic signification (such as the use of pebbles at peak sanctuaries and sites like Myrtos-Pyrgos), represent a creative and resourceful solution to this problem, which enabled elites to install a flow of meaning between sacred natural places and palace buildings. Interestingly, this flow was not one directional, with elite contexts merely aping natural environments; rather, by simultaneously ‘architectonicising nature’ and by filling natural sacred sites with their own presence and symbols (such as double axes, bronze figurines and built enclosures) elites brought nature into their built spaces and superimposed their own material culture onto natural spaces (Hitchcock, 2007: remains almost constantly occupied during both the Neolithic and Minoan periods (Day and Wilson, 2002: 147).
This two-way referencing between the palaces and natural ritual locations serves to break down the distinction between sacred-natural and ritual-elite contexts.

In addition to displaying their affinity with and also mastery over nature’s power, this practice serves a distinctly social and ideological role. Through their spatial connection with sacred natural landscapes, elites are able to distinguish themselves as different from others through their privileged access to special places such as sacred landscapes, caves and peak sanctuaries. This is a further demonstration that the elite, by not entirely inhabiting this place but also other places simultaneously (through spatial referencing), have a qualitatively different existence and, as such, belong to an environment that is simultaneously built and natural – the palaces. This ‘naturalising’ of the built environment has been already been explored. Both Hitchcock and Driessen have argued that the architecture of the palaces reflects the natural Cretan landscape with the central courts being a reflection of the plains surrounded by mountains (Driessen, 2004: 77), in addition to the Minoan elites’ conscious rejection of bilateral symmetry in the Palaces in favour of “an architecture which monumentalised, imitated and appropriated the complexity of the natural world for ideological ends” (Hitchcock, 2007: 91). A similar role of appropriation and imitation (particularly of fertile, riverine and maybe even imaginary places) – might also be argued for the landscape frescoes discussed in Chapter 3.

By linking themselves both directly – through ritual action at peak sanctuaries and sacred caves, or more broadly, through ritual action in sacred environments – and indirectly to special, sacred or symbolically ‘charged’ places, the elites were able to create, manipulate and consolidate an ideology of difference wherein the power of nature (and the ability to control this power) was a key indicator of their worthiness to rule.

4.2 Altered States

As I have discussed in section 2.2, the sensory experience of water, in particular its sound and its feel are used by a number of different cultures and societies to help a person enter an altered state of consciousness. In the Minoan context, archaeological evidence from other areas of ritual practice certainly suggests that altered states of consciousness were practiced. For example, in a recent study, Morris and Peatfield have explored shamanic elements in Minoan religion and noted that many of the human clay figurines found at peak sanctuaries could represent ‘ecstatic body postures’ (2004: 53). Rather than representing “weak and generalised expressions of worship”, the authors hypothesise that the figurines “seem to have had a much more dynamic function to access the experiential
domain of Minoan ritual action – the most obvious examples being true visionary epiphany through trance, healing through the sense of energy, and divination through psychological insight” (2004: 53). The authors further argue that visionary epiphanies can also be seen on Minoan gold rings on which images such as birds, butterflies, abstract eyes and human bodily movement do not represent something “symbolising the arrival of a deity or as cult symbols confirming and defining the ritual context” but rather that the “iconic content represents the technique and experience of trance” (Morris and Peatfield, 2004: 42 italics). For example, a LM IA-LM IB ring impression from Kato Zakros depicting a kneeling woman attended by a large dragonfly (see Fig. 60) (discussed in Chapter 3) could be such a representation of trance; indeed, Marinatos names the image as a ‘visionary’ scene (2004: 36).

With this in mind, then, it can be suggested that fresh water sources in caves and at springs, and perhaps also their man-made counterparts such as large water cisterns and water conduits, may have been used by Minoan ritual practitioners to help them enter into an altered state of consciousness as part of a particular ritual or religious event. The sound of the spring at Kato Syme, for example, whether it was mere trickle or a louder gushing sound, may have provided the participants there with a natural rhythm which could be danced to (perhaps with other appropriate instruments or singing) or used in trance like states. In caves, the damp, and often cold air contrasts strongly with the warmer, brighter light of outside, creating an almost otherworldly ambience within the cave. This feeling, combined with the slow but regular dripping of water from cave roofs, could again have provided an atmosphere conducive to altered states of consciousness. At Kamares and Psychro caves, the pools within them may not just have provided water for ritual acts, such as libation and ritual drinking, but may also have functioned as a place in which sensory deprivation could be practised. It is worth noting here that both pools at Kamares and Psychro are at the deepest part of the cave where it would be very dark and cool, where sounds are transformed and altered into strange, echoing noises, and as such may have made the experience all the more profound.

The large indoor cistern at Kato Zakros (No.C4), which is certainly deep enough for a person to submerge themselves, could, therefore, have been used in the inducing of trance-like states through sensory deprivation. The participant could easily have entered the

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64 The change in sounds was something I experienced at Skotino Cave in June 2011. The noises of the resident pigeons and other birds within the cave changed and morphed the deeper we went into the cavity, changing from a recognisable ‘coo’ of a pigeon to a more haunting and unfamiliar sound.
cistern via the steps and undergone a ritual transition to an altered state of consciousness. If, indeed, the column bases found within the cistern are evidence for a portico surrounding the cistern, as Platon suggests (1971: 187), then it is possible that the event could have been observed by others from an upper floor. Rather than being merely secular space for the private consumption of water, as with interpretations of the Hall of the Cistern being a swimming pool or fish tank, it is possible to envisage a situation in which one or more actors could, through the sensory stimuli of the water, effect a trance-like state that would be both a personal rite and a public (albeit confined to palatial elites with access to the Hall or the upper floor) performance of rituals involving such states.

As with being able to access particular sacred landscapes, being able to access – and be seen to access – an altered state of consciousness is a very powerful thing. It enables the subject to tap into a knowledge that transcends ordinary experience. This could be the knowledge required to enter the altered state – for example knowing what rhythms should be beat out, what postures should be adopted, what sounds to listen to or what psychotropic plants should be consumed – or it could be the access to knowledge which is deemed to be ‘received’ during the altered state. Through relaying and interpreting the received knowledge, the subject is constructed as providing a living link to extramundane, and thus transcends the limitations of ordinary human knowledge and perception. This may well confer a great deal of prestige and power, either on those who experience the altered state, or on those with the authority to interpret the meaning of their experiences. This is particularly the case if the information comes in the form of messages or directions from a divine entity. Indeed, anthropological studies have documented the ways in which shamans, seers or mediums are considered to be powerful people. Often, they are key players in the socio-politics of a community, influencing important decisions and key calendrical events (such as harvesting or hunting times) and in some cases hold judicial or indirect political power (Winkelman, 1990: 333). In the Minoan context, particularly during the Second Palace Period, when peak sanctuaries become more centralised, Morris and Peatfield note that trance activity could have been monopolised by the elite and used as an “ideological component in support of their hierarchy” (2004: 54).

As such, water, whether it is the sounds of the springs found in or near sanctuaries, the dripping of water in caves or the bodily submersion made possible in large man-made cisterns or natural pools, could have been used in Minoan rituals involving altered states of consciousness. These rituals, and the knowledge that is derived from them such as messages from another world, from gods or goddesses or even messages from the
environment itself, were powerful tools which could be manipulated by an elite group to further their claims to superiority and authority.

4.3  Transition and Transformation

In section 2.3 above, I discussed the relationship between the sensory experience of water and the abstract concepts of transition and transformation. The observable transformations as water transitions between its different solid, liquid and gaseous states provide an experiential analogy for other cyclical changes on larger scales, especially those that water is already involved in such as the seasonal cycle of fertility and regeneration. In numerous belief systems around the world, water both symbolises and holds the key to this vital agricultural rhythm. Another strikingly common feature of different religious practices involving water concerns its use in physical and spiritual purification. Water’s fundamental importance in everyday acts of washing both reinforces the cognitive connection between water and cleanliness and, through the passage from repetition to ritual, raises this connection to a religious principle (Scarborough, 1998: 145). Finally, section 2.3 noted that the association between water and purity frequently culminates in beliefs about the sacredness of certain waters, whether specific rivers or sanctified bodies of water, where the water itself becomes a source of divine power able to confer upon those it touches acceptance into the religious community.

4.3.1  Water in Movement

Something that particularly stands out in the archaeological evidence for the Minoans’ use of water is a fascination with water in movement. There are numerous examples from Minoan water management techniques that imply a sophisticated knowledge of how water moves, including hyperbolic curves and pressurised pipes, as well as the hydrological expertise necessary for constructing aqueducts and other conduits, and perhaps even flushing toilets (Angelakis, Dialynas, et al., 2012: 232-242). Knossos in particular demonstrates this emphasis on water’s movement, with a number of open conduits and channels being built into the architecture, especially alongside steps and through paved areas, incorporating water into the spectacle and splendour of the palace’s aesthetic. Similarly, Minoan art betrays the same interest in moving water, often depicting bodies of water as undulating and almost serpent-like. The bifid motif discussed in Chapter 3 may also be interpreted as an abstraction designed to convey movement in a static scene. Even more clearly, there is a fresco – the Monkeys and Blue Birds Frieze from the House
of the Frescoes, Knossos – that attempts to depict waterfalls, devoting special attention to
capturing the movement inherent in them, through painting individual droplets of water
which indicate the direction and rush of the water (see Fig. 41) (Cameron, 1968: 11, fig. 4c;

This interest in water’s movement is deeply connected to concepts of transition and
transformation, as demonstrated by the ubiquitous use of water metaphors in later cultures
to articulate concepts of cyclical change and constant flux. Of particular importance is the
contradiction between the ever-changing visual character of moving water, with its eddies
and currents, and the unchanging identity of that water: Heraclitus’ river remains that river,
despite it not remaining the same. Through this contradictory fusion of change and
persistence, which perhaps is the conceptual basis of all cosmological ideas about cyclical
regeneration, the movement of water helps to articulate complex beliefs about the
fundamental identity and order ‘behind’ the appearance of change and transformation: the
oneness of a cycle that contains very different elements or moments within it.65 We may
thus interpret the Minoans’ emphasis on moving water as helping to articulate concepts,
such as order and disorder, identity and difference, persistence and change, through which
they engaged with their social and natural environment. This is especially relevant given
that, as discussed in Chapter 1, the Middle and Late Minoan periods coincided with a
climatological era of instability, including droughts and deluges, as well as social and natural
crises such as earthquakes, tsunami, and social unrest before and after the Theran eruption.

Thinking about the movement of water in this way illuminates a practice that
appears frequently throughout the evidence for Minoan ritual action, but remains
something of an enigma: libation. Libation vessels or rhyta are one the most common
shapes found within Minoan ritual contexts (Marinatos, 1993: 5-6; Peatfield, 1995: 223-
224). They are specialised vessels which have a subsidiary hole pierced in the bottom
through which liquids can pour or drip. As such, libation vessels cannot function as a
normal jug or other container, as the hole in the bottom prevents the long-term storage of
liquids, unless, of course, the hole is filled with some kind of plug. Though most commonly
appearing as conical and piriform shapes, rhyta are made in a variety of forms and materials
that is unparalleled by other vessel types (Koehl, 2006: 1). Zoomorphic shapes are also

65 This concept of a ‘oneness’ of a cycle, composed of radically different elements, is evident in a number of
religions, for example, the Christian concept of the Holy Trinity of the Father, the Son and the Holy Ghost,
as well as the Hindu concept of ‘Trimurti’ which combines the deities of creation, destruction and
maintenance: Shiva, Vishnu and Brahma.
common, such as bulls’ and lions’ heads, while comparatively few human-shaped libations vessels have been found (Peatfield, 1995: 223). Materials also vary from pottery through to stone, metal and faience. The large numbers of rhyta associated with varied ritual contexts indicates that they were central to Minoan ritual action and formed the key component of a “libration set” along with beak-spouted jugs, ‘dippers’ (ladles), chalices and libation tables (Koehl, 2006: 399). The act of libation can also be seen in a number of figurative representations including the Aghia Triadh sarcophagus and a stone rhyton in the shape of a triton shell from Malia which depicts two Minoan genii: one pours liquid from a ewer over the raised paws of the other (Fig. 69). Libation tables – small stone tables with round hollows or indentations in the top – are also a common feature of Minoan religious sanctuaries and ritual sites. In her 2004 study of the Knossos and Malia regions, Ellen Adams showed that they are the second most common artefact at ritual sites within this region, whilst also occurring in more elaborate buildings at both the palace of Knossos and Malia (2004: 36-37). Later libation tables have been found with Linear A inscriptions on them, perhaps indicating a dedication or words to be said when performing the rite (see for example Davaras, 1972b; Owens, 1993).

While there is a great deal of physical and figurative evidence for the ritual act of libation, exactly what was being poured is much more difficult to define. Many authors note that oil, wine, milk, blood, and drinks such as beer and wine, are the most likely of candidates66 (see for example Van den Kerkhof and Rem, 2007; Marinatos, 1986: 25-32; Martlew and Tzedakis, 1999; Sakellarakis and Sapouna-Sakellaraki, 1981; Warren, 1988: 28-29), with different liquids being used at different times or places and for different ritual acts – blood being used after the sacrificial killing of an animal, for example. Water, however, is often ignored as a potential candidate, unless significant sources of water are present (see for example Soetens, 2009: 264-265). Considering water as something more than a resource, and rather as a meaningful participant in the construction of beliefs, allows us to hypothesise that certain libation rituals may just as easily have centred around pouring or dripping water. If, as I have argued already, the movement and flow of water held a specific status for the Minoans, the idea of ritual libations involving the pouring of water becomes

66 In Minoans and Myceneans. Flavours of their time (Martlew and Tzedakis, 1999), a number of different residues were discovered from a wide range of vessel shapes from Minoan and Mycenaean sites. These include olive oil and other fats from a LM IA conical cup (1999: 1007, no. 76); chickpeas, oil and possibly meat from a LH IIIB bridge-spouted jar (1999: 126, no. 107); wine and a barley product from a EM IIB pithos, and a mixed fermented beverage from an LM III stirrup jar (1999: 173, no. 166).
easier to envisage. The different components of such ritual libation, including gathering water from a specific source (such as a spring, pool, or cistern), transporting it in ritual vessels, and pouring it into specific places – perhaps even back into the source of the water – may well have re-enacted natural cycles, such as seasonality or the hydrological cycle, or else expressed cosmological or mythological beliefs about transition and change.

4.3.2 Bathing, Washing, Cleansing

Some of the most important transformations associated with water are those involving cleansing and purification. While it is certainly plausible that libation rituals involving water took the form of acts of washing, there are a few water management systems that suggest ritual washing. The finely constructed ‘sunken bath’ at the Caravanserai, Knossos, has been interpreted as an installation for washing the feet and perhaps the body before entering the complex (Evans, 1928a: 116-117), which also included terracotta ‘bathtubs’ and numerous paved rooms and courtyards as befitting water-based activities such as washing and bathing. Evans insisted that the Caravanserai as a whole was intended as a utilitarian space, perhaps a complex for leisure activities, however, this interpretation appears to spring from an assumption that washing belongs to a non-religious sphere of human activity. Evidence for ritual action is explained away as concessions to the “devotional needs” of visitors (1928a: 139). More recently, Schofield has overturned Evans’ view of the Caravanserai, and argues instead for a strongly ritual function for the complex, revolving around washing or “some sort of purificatory ritual” (1996: 32). What is interesting about the sunken bath, in the context of this more ritual interpretation, is that it is located within an entranceway which granted access to further rooms within the complex, including the room with the ‘bathtubs’. Here, then, we may be seeing the use of water to invoke a sense of transition – this time between outside and inside – perhaps through an act of washing which served as a rite of entry. Clearly, this resonates with an imagination, discussed above, in which specific built spaces had very definite characters and conditions of access.

There are a number of other finely constructed installations where such purificatory rituals, associated with ‘special’ built spaces, may have taken place. The cistern at Kato Zakros, which is adjacent to a spring chamber and possibly connected via some stairs to a balcony which overlooked a court containing the spring chamber, was almost certainly designed to be entered, allowing participants to submerge themselves in spring water. The sunken basin at Mochlos, connected to a pillar crypt in the room below, may have been
used in ritual preparations in a similar vein to those prescribed by the Qu’ran as discussed in section 2 of this chapter. Other examples of basins and sunken baths, such as at Pseira and Zou, do not have such clear associations with ritual spaces, but do at least demonstrate high levels of investment in creating installations in prominent positions for washing, including the draining away of water after its use. The archaeological evidence, by its very nature, draws our attention towards architecturally fixed provision for washing; however we may also include the host of pouring vessels and containers made of pottery, stone, crystal and metalwork, as potential candidates for ritual washing paraphernalia.

While it is almost impossible to prove that the list of architectural features and artefacts that may have been employed in ritual washing were in fact used for this purpose, it is a tantalising prospect. Washing, especially at the threshold of religiously significant spaces, combines many of the conceptual associations discussed so far: acts of purification are in many religions necessary preparation for entering sacred spaces and, as I have argued, many Minoan sacred spaces already contained a strong association with water. Acts of washing, therefore, would have prepared participants to leave ordinary spaces and enter sacred or otherworldly spaces by cleansing them, physically and spiritually, of the residue of everyday life. Similarly, the concentration and repetition inherent in ritualised washing are highly conducive to the mental states necessary for religious experience and perhaps also rituals involving trances. Finally, certain types of washing that involve running water, including acts of pouring and libation, rehearse through the movement of water the associations with transition and transformation (indeed, washing itself has a transformative character) that form the basis in so many belief systems of water’s conceptual connection to regeneration and rebirth.

4.3.3 Special Water

In many cases of ritual or religious washing, belief is not confined to what is removed from the body, but also what is added to it. Where the water is itself considered special, such as the Ganges or sanctified Holy water, washing in it may confer upon the individual a certain status, identity and even abilities. While a number of different sources are potentially involved in Minoan ritual action involving water, there is a clear preference for spring water, with the location of many Minoan sites, especially those with a ritual element, including the Caravanserai, the vast majority of peak sanctuaries, and even the palace and settlement of Kato Zakros, appearing to have been determined by the presence of springs nearby. The reasons for a Minoan veneration of spring water may relate to the
way in which springs appear to come from the earth itself, prompted by unseen processes or forces, or from the way in which springs appear to be largely independent of seasonal shifts. Spring water is also firmly located, unlike rain water, which resonates with the Minoans’ place-centric imagination discussed above and by scholars such as Driessen (2004) and Hitchcock (2007).

In the context of ritual washing, however, there is a feature of spring water which makes it particularly appropriate: sacred waters are often held to confer specific benefits upon those who come into contact with it, such as health, youthfulness and fertility; spring water is conducive to such beliefs in that its quality is frequently regulated by the rocks it passes through. Geological percolation normally makes spring water unusually clear, but also high in mineral content, which may be tangible in the form of a distinctive taste or smell. It is this quality that makes bottled spring water big business today, both for its genuine benefits in replenishing vital vitamins and minerals and for its perceived superiority over tap and river water (Doria, 2006: 271-272). The importance of springs at certain sites may well have intertwined with, and been reinforced by, the noticeable uniqueness of the water they produced. Again, this resonates with the importance of specific places, environments and sites, as different springs would likely have a unique taste, smell, feel and other real or imaginary properties. Just as different regions of modern Crete are proud of their own particular and distinct springs (such as the famous springs at Zaros, Zakros and Samaria which are commercially bottled), springs may in Minoan times have provided a sense of local identity, each with its own specific properties and associations. It is impossible to say what properties were imputed to each spring, and in truth it may have been differing combinations of similar themes, such as health, prosperity, fertility or perhaps the beneficence of a specific deity; however, it is not implausible to suggest that, by becoming focal-points for such beliefs, the springs themselves became integral components of the prestige and identity of the communities that drew from them. It is, in this context, particularly important to note that springs are incorporated into elite architecture, and a great amount of elite investment and know-how went into enclosing and controlling springs.

4.3.4 Transition, Transformation and Elite Ideology

In this section, I have focused on more cosmological beliefs that may have been invoked by Minoan ritual action involving water’s association with transition and transformation. One of the key insights from water theory, discussed in section 2, is that
water metaphors are not exclusively cosmological but also social. To repeat the phrase used by Strang, people “use themselves to describe the world, and the world to describe themselves” (2004: 61). This is particularly relevant in Minoan religion, which appears to have been intimately connected with elite strategies of social control. The evidence for the use of water in Minoan ritual action, revolving especially around elite buildings and involving their sophisticated water management systems, confirms this.

Thinking about water as a potent medium for metaphors of transition and transformation in a more social or ideological context compels us to consider the ways in which elites in particular used ritual action involving water to narrate their social and natural environment. Rituals involving moving water, which, as I have argued, appeared to hold a special status in the Minoan imagination, may have helped express certain beliefs about natural or cosmological cycles. Enacting such rituals in an elite context, utilising finely manufactured ritual paraphernalia and dedicated, decorated spaces, would have enabled the elite to demonstrate the cohesion and unity between those natural and cosmological cycles, articulated through existing belief systems and practices, and their social standing (see also Earle, 1997: 52; and Helms, 1998: 74; and the ‘architectonised’ landscape discussed by Hitchcock, 2007: 97). Moreover, by displaying their ability to control the flow of water, especially in monumental constructions such as aqueducts and open architectural conduits, the elites also asserted their mastery over those forces that moving water represented.

A very different aspect of the relationship between Minoan elites and ritual action involving water is suggested by the evidence regarding ritual washing and lustration. The basins, sunken baths and perhaps some of the cisterns that likely had a washing function almost always appear in elite contexts, and do not appear to be open to the broader community (for instance the sunken bath at Mochlos and the cistern at Kato Zakros). These installations, therefore, do not lend themselves to the kind of display and spectacle associated with monumentality and impressing upon a populace that the elite were different from and superior to them. The more intimate confines of ritual washing areas, such as the bathtubs at the Caravanserai, Knossos, may instead suggest activities intended to strengthen social bonds within elite groups. In numerous cultures, ritual washing functions to establish and cement a communal identity, for instance baptism rites, also forms a vital preparation for other sacred acts which could only be performed by certain people who prepared in the right way. In the Minoan evidence for washing, therefore, we may be seeing a ritualised form of expressions of elite identity and anointment, which would have served
to impress upon the elites themselves a sense of their entitlement and unity. This idea of washing in order to enter or maintain a community resonates with the strongly spatial character of Minoan ritual practice, in that lustration may have been a precursor — at palaces and peak sanctuaries alike — to entering sacred enclosures such as pillar crypts or the interior court of the Caravanserai (Schofield, 1996: 30-32). Again, the uniqueness and differentness of the elite is expressed, reinforced, and embedded through their access to and participation in specific rites and ritual, in carefully delineated spaces.

In this context, the Minoan reverence of spring water takes on a particular complexion: springs, more so than rivers and rain water, are enclosable and therefore amenable to being monopolised and protected from unauthorised uses, which makes them conducive to an elite culture wherein exclusive access formed a major component of elite claims to difference and superiority. Insofar as springs appear in often surprising places, seemingly as a gift from the land itself, it is possible that the Minoans considered them as having a divine aspect. If this is the case, by enclosing and possessing certain privileged springs — and, indeed, incorporating them into their architecture — elites laid claim to this divinity and further associated their own wealth with nature’s provision. The presentation of a social group’s pre-eminence as in accordance with, or belonging to natural order, is a well-established theme, and perhaps the core, of almost all ideological forms of rule. Moreover, the construction of spring water as in some way special, conferring upon those who bathed in it or drank it with special properties (whether such beliefs predated palatial elites or were promoted by them), would have allowed the elites to construe themselves as imbibing such powers. This same logic may have enabled elites, by consuming sacred water, to become themselves sacred persons.

If this fusion of ritual, ideology, and sacred waters goes some way to explaining the archaeological evidence at sites such as Kato Zakros and Knossos, then the extent of the crisis following the Theran eruption may be even greater than previously thought. Following the eruption and the earthquakes accompanying it, sources of ground water — and in particular, springs — would likely have been severely disrupted by changes in the water table, including both changes in water levels and contamination (as evidenced by the later cistern at Tylissos which required a filtration system — which could be considered as ‘sleight of hand’ for pure water) (Gorokhovich, 2005; Gorokhovich and Fleeger, 2007). For an elite ideologically and religiously wedded to the power of fresh water, these changes may have been catastrophic, heaping political and religious crises of legitimacy on top of probable severe social and economic strife. Potentially, the disruption of ritual action
involving fresh water sources could have threatened an entire series of interlocking beliefs, including elite identity and superiority, the connection between elite social authority and natural cycles and stability, and the elite’s apparent mastery of natural forces.

5. Conclusion

The aim of this chapter has been to explore the place and role of fresh water in Minoan ritual action. Necessarily, Minoan ritual practice is bound up in a host of beliefs, customs and traditions that we no longer have access to, and so I have tried to anchor these discussions in common or recurring associations with water that stem from the bodily and sensory experience of water and reverberate throughout a number of world religions. This chapter has presented evidence for an enduring and observable connection between water and Minoan ritual action. Ritual sites including peak sanctuaries, rural sanctuaries, and spring chambers seems to have a connection with fresh water, especially spring water, with this water being incorporated into religious activity at these sites. Likewise, at numerous built installations, designed for collecting and storing water, we see ritual depositions and other ritual evidence, including in some cases ritual action at water management systems that have gone out of use as usable sources of water (see for instance Myrtos-Pyrgos and Palaikastro). As I have discussed, there is reason to believe that libation pouring – a fundamental component of Minoan ritual action – involved, in at least some cases, the pouring of water. While we can never know the precise meaning of fresh water on Minoan Crete, we can at least assert with some confidence that water’s religious meanings were incorporated into elite strategies for consolidating and legitimating their social power. This follows from the well documented and intimate relationship between Minoan elites and what evidence there is for ritual practice, and provides a key for deciphering the use of water on Bronze Age Crete. Considered as something not distinct from, but rather assimilated into, the ideological basis of a hierarchical society, Minoan ritual action involving water can be fruitfully examined for patterns and associations.

One of the most striking patterns that emerges from the evidence of ritual practice involving water is that the Minoans appear to have used water to delineate certain sacred spaces. My argument in section 4.1 is that, rather than considering water as a mere marker, Minoan religion includes the deployment of water, both directly and metonymically through artefacts such as water-worn pebbles, to establish the similarity and identity of built ritual enclosures, such as peak sanctuaries and palace rooms, and real or otherworldly places of significance. This linking function, which stems from bodily and sensory
experience, is paralleled in Minoan art and architecture, which use water to create or invoke
natural or supernatural environments through the combination of familiar elements, for
example, landscape frescoes and pillar crypts. Through this linking function, elites were
able to annul the difference and distance between their own built environments and places
of religious significance, both natural and transcendental. By enjoying privileged access to
these elaborate built spaces, ‘linked’ through water to other sacred sites, elites were able to
associate themselves, through ritual practice, with natural and divine sources of power. In a
similar vein, elites or their proxies could be seen as accessing privileged, possibly
transcendental knowledge, via the inducement of altered states of consciousness, to which
water (through submersion, or plays of light and sound) is conducive.

Finally, in section 4.3, I discussed some of the ways in which the Minoans appear to
have valued and perhaps revered certain types of water. There is clear evidence for an
interest in moving water, reflected in open conduits, fresco art and perhaps libation
ceremonies, which may have connected to concepts of natural and cosmological cycles.
Likewise, the evidence is highly indicative of a culture in which certain sources of water –
especially springs – were ascribed high value and meaningfulness. While it is difficult to
uncover the precise restorative, spiritual and cultural properties that the Minoans associated
with certain waters, it is at least clear that the privileged access to springs and the display,
consumption, and especially use in ritual washing, of ‘special’ water would have enabled
elites to articulate and reinforce their difference from and superiority to the rest of the
community. Water’s exceptional capacity to articulate, as metaphor, complex ideas and
cosmological beliefs – a capacity that springs from its contradictory sensory experience –
appears to have been thoroughly mobilised by Minoan religion and the material culture of
elite ideology.
1. Introduction

This thesis has explored the management, meaning and perception of fresh water in Minoan Crete. Numerous different issues and angles have been investigated during the course of this thesis, the outcomes of which are a series of new ideas and different approaches to fresh water in Minoan Crete. The purpose, then, of this concluding chapter is to present two site-based case studies that will bring together the various issues raised in previous chapters. I believe that these case studies highlight the utility of my approach, as well as my key ideas and arguments concerning water management systems, fresh water and their relationship to Minoan socio-political concerns and ritual action. I will then discuss how this thesis has made an original contribution to knowledge. Before addressing the two case studies, it is necessary at this point to offer a brief recapitulation of the key arguments presented in this thesis as a whole, if only to highlight the themes that have come out of my discussions, the case studies explore and illustrate.

2. Summary of key arguments

In Chapter 1, I surveyed the geological, geographical and climatological context in which the Minoans interacted with water. Notable features of this context include Crete’s complex and diverse landscape, and in particular its karstic features, which not only concentrate precipitation in relatively few regions, but also ‘siphon off’ and redistribute rainwater in often unpredictable and unseen ways. Similarly, Crete’s seasons provide a high contrast, in terms of the abundance and scarcity of water, which is exacerbated by its geology: Cretan winters provide a plentiful supply of water to the island, even to the point of highly destructive deluges and floods, while the hot, dry and windy summer months combine with a landscape which retains little surface water to cause the abundant water supply of the winter months to rapidly and often catastrophically dwindle.

Geological data from both Crete and from across the southern Mediterranean, combined with archaeological evidence from across the island, suggest that the Bronze Age climate went through many fluctuations in temperature and aridity, manifesting in long periods of water extremes with the elongation and contraction of seasons: the overabundance of water, such as during a deluge, particularly in winter months, and scarcity of water, such as a long term drought. Long term climate changes were not the
only factor to affect the water supplies of Crete during the Bronze Age. The Thera eruption, and in particular, the many destructive earthquakes which both preceded and followed the eruption, are likely to have drastically affected the water tables throughout the island and as such, the various water management systems the Minoans employed that depended on groundwater.

Aside from presenting the water management evidence discussed throughout the rest of the thesis, Chapter 2 also considered the issue of the hydraulic knowledge and expertise required to construct and maintain such complex systems. Tentatively, I suggested that such experts may have been part of a ‘craft class’, which would also include experts in other areas of Minoan material culture, such as fresco painters and plasterers, architects, potters and metallurgists.

This thesis also sought to explore the role of water in Minoan art and iconography. While there are comparatively few direct representations of fresh water in the rich collection of Minoan art, my argument in Chapter 3 is that, through visual devices such as the unusually abstract ‘bifid’ motif, the representation of water within Minoan art did not simply rely on depicting a ‘wavy blue line’. Rather, the representation of water constituted a set of traditions or artistic discourses that could be comprehended by painter and audience alike. Moreover, Chapter 3 argued that the representation of water extends well beyond direct attempts to convey wetness, and instead included a diverse repertoire of associations, built especially through metonymy, deployed to construct and reference visual representations of specific real and imaginary environments. Finally, I argued that there is a discernible convention wherein fresh water is used compositionally as a linking device, serving to connect separate and often disparate elements. In this way, water acts as a thematic and unifying iconographic element. Thus, far from being a mere background element, water plays an active and constructive role in producing meaningful iconographic schemes, and in connecting these schemes and meanings to broader material-cultural practices to which art belongs.

The focus of Chapter 4 was the political and social aspects of the Minoans’ relationship with water, as expressed especially by water management systems. As there is little evidence to suggest that Minoan elites had the capacity to control the broader population’s access to fresh water, the political content of Minoan water management systems must be sought in the social messages these structures articulated. I found that there is firm evidence that water management systems, especially as part of palatial architecture, belonged to strategies of conspicuous consumption, restricted access, and
monumentality. These strategies are intertwined with a broader strategy, discussed in some detail, of asserting an elite ‘ideology of social difference’, through which the elites constructed themselves as qualitatively different from others, and therefore legitimises their status and privilege. As the politics of water management at the palaces thus revolves around articulation and the communication of certain ideas, the key features of the water management systems include not just their functionality, but also what they represent.

Chapter 5 picked up these themes of ideology, social difference, and articulation, through exploring the role religion plays in the elite ideological narrative and, more specifically, how water was used in Minoan religion and ritual practice to ‘tether’, consolidate and perpetuate elite social difference. I presented a range of archaeological evidence that demonstrates that there is an enduring and observable connection between water and Minoan ritual action. In my exploration of the archaeological evidence, and using theoretical insights and contextual data from other cultures, I identified a number of patterns related to the use of water in Minoan ritual action. First, I noted that there appears to have been a strong spatial use of water and water-related objects such as water-worn pebbles, both to identify sacred or ritual spaces but also to physically and ideologically connect these areas to more urban elite contexts. Second, I argue for a Minoan preference for moving water, reflected in things such as open water conduits, rivers and waterfalls in fresco art and perhaps water-based libation ceremonies, with this preference perhaps reflecting beliefs regarding natural and cosmological cycles. In addition, I also argue that the archaeological evidence is indicative of a culture in which certain sources of water – especially springs – were ascribed high value and meaningfulness.

I concluded that while the precise spiritual and cultural meanings that the Minoans associated with certain waters cannot be determined, it is at least clear that their ritualised use of water and its incorporation into religious and ritual contexts suggests that certain water sources or ‘special’ water was used by elites to articulate and reinforce their ideological difference from the rest of the community. Water’s power to articulate complex ideas and cosmological beliefs was exploited by Minoan religion in order to further this elite ideological difference. While there is insufficient data to determine exactly how normal people used fresh water management systems, and as such, what meanings they assigned to fresh water, the fact that Minoan elites used water symbolism and the powers inherent in water, suggests that water held special meaning for all Minoans.
3. Two Illustrative Case Studies

In order to fully illustrate my main arguments and conclusions, I now wish to return to two Minoan complexes – the palace of Kato Zakros and the Caravanserai at Knossos. I have mentioned and discussed various aspects of these two important sites throughout this thesis, with the specific details of each water management system to be found in Chapter 2 and the Database (Appendix 1). Here, I explore them in the context of the sites to which they belong, to not only consider each site’s approach to water management, but to also consider the socio-political and ritual or religious function of water at each site.

3.1 The palace at Kato Zakros

Situated on the south-eastern coast of Crete, the Minoan site of Kato Zakros was first excavated by Hogarth in 1901, with the palace being discovered and excavated from 1961 onwards by Nikolaos Platon. The site as a whole consists of a harbour town, a “densely built settlement that utilized a well-planned grid of roads or passageways” (Platon, 2010: 512) which included private housing and industrial installations, and the palace itself. While the settlement was probably established in the MM IA period, including an “administrative centre” that was perhaps a precursor to the later palace (Platon, 2010: 516-517), and continued until the end of LM IIIA2, the palace appears to have had a relatively brief existence – constructed and destroyed around LM IB – however, it is highly likely that the palace was built on the site of a previous complex, possibly an administrative centre for the region (Platon, 2010: 517). Both the settlement and the palace of Kato Zakros are relatively small compared to Knossos, Mallia and Phaistos (Reid, 2007: 16, 21) and evidence from the town suggests a mixed economy based on agriculture and industrial activities (Reid, 2007: 16). Nevertheless, the evidence also suggests a developed bureaucracy, including archives, and the use of tablets and sealings to maintain records (Platon, 2010: 510).

There are two features of the palace which make it particularly interesting in this relatively humble context. The first is that during its brief span, the palace at Kato Zakros was wealthy, with an abundance of rich and exotic finds from around the Mediterranean surviving its destruction and later agricultural damage. The second is that the archaeological evidence suggests a strong relationship with Knossos evidenced in much of the palace’s pottery and archives. In addition, the architecture of the palace displays, with the exception
of some important idiosyncrasies (discussed below) (Reid, 2007: 19-21), many of the hallmarks of a ‘standard’ Minoan palace (such as at Knossos, Mallia, and Phaistos).

3.1.1 The Palace’s three water management systems

Aside from its proximity to the sea, the location of Kato Zakros appears to have been determined by the presence of a generous source of spring water, which still provides for the area today. The importance of this source is demonstrated by the fact that the palace (and the preceding administrative complex) was constructed on top of the spring, despite this being at a lower elevation than the harbour town, perhaps at the expense of the palaces privacy: as Reid observes, “everything that went on in the central court would have been visible from many parts of the town” (2007: 21). Taking control of the spring, which was, unusually, directly incorporated into the palace’s architectural design, appears to have taken precedence over such concerns.

<table>
<thead>
<tr>
<th></th>
<th>Cistern</th>
<th>Spring Chamber</th>
<th>Well</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dimensions</td>
<td>5m diameter; 1.42m deep (approx)</td>
<td>Basin: 3.1m (max) 2.0m (min) x 1.9m x 1.6m deep (approx) Chamber: 5.7 m (including stairs) x 3.1m (approx)</td>
<td>1.4m diameter (approx); 2m deep (from drawing platform)</td>
</tr>
<tr>
<td>Capacity (approx)</td>
<td>27,892 litres</td>
<td>7,752 litres</td>
<td>3,080 litres (approx)</td>
</tr>
<tr>
<td>Construction materials</td>
<td>Large stone blocks; Stone 'slabs'; Hydraulic plaster</td>
<td>Ashlar masonry; Poros stone slabs</td>
<td>Stone; paving slabs; small stones</td>
</tr>
<tr>
<td>Location</td>
<td>Hall of the Cistern, within the palace</td>
<td>In an open area in the south-east corner of the palace</td>
<td>In a room at the south-east corner of the central court; adjacent to workshop area south of the central court</td>
</tr>
<tr>
<td>Open or closed access</td>
<td>Closed and regulated</td>
<td>Unknown: possibly open access</td>
<td>Closed: access only from central court</td>
</tr>
<tr>
<td>Deposits</td>
<td>None</td>
<td>Pumice; Three-stepped pyramidal base; Horns of consecration; Olives</td>
<td>Ordinary cups and dishes; food; small branches from aromatic bushes; pieces of pumice; burnt animal bones; fragments of three-legged offering tables; one animal figurine</td>
</tr>
</tbody>
</table>

Table 16 Summary of data from the water management systems at Kato Zakros
The way that the spring water is incorporated is noteworthy, as it is directed into three distinct water management systems with different apparent uses: a large cistern, a spring chamber and a well (see Table 16) (Fig. 70). The cistern commands a central position in a hall – the Hall of the Cistern – situated in the eastern part of the palace which has been interpreted as ‘the royal apartments’, with the hall being adjacent to the ‘queen’s apartment’, the ‘king’s apartment’ and the central court. The cistern itself (Fig. 71) was elaborately constructed of large stone blocks, carefully lined with hydraulic plaster and could be entered via a set of eight large steps. Two column bases from the fill of the cistern suggest that a portico may have surrounded the structure meaning that the cistern could be viewed from an upper level of the palace. Access to the cistern is granted only via the central court, via a Minoan Hall, and additional privacy, or indeed visibility, could be ensured through the use of pier-and-door partitions between the Central Court and the Hall of the Cistern.

Directly to the south-west of the Hall of the Cistern, but not accessible from it, is a spring chamber (Figs. 72 and 73). Spring water is channelled from a small antechamber (under a set of stairs suggesting a second storey above the hall of the cistern) into a basin in a rectangular ashlar chamber surrounded by a narrow projecting ledge. The basin could be reached via fifteen stone steps, flanked by ashlar masonry walls. The spring chamber could be accessed via an indirect route from the central court through a corridor which is associated with horns of consecration, which possibly crowned the entrance-way from which people would emerge from the palace. The chamber appears to be in an open area, perhaps a southeast court; however it is unclear to what extent this would have been a palatial or public area as this section of the site has been largely destroyed by later activity. A number of offerings were found in the spring chamber itself, including food and ritual paraphernalia (see Table 16). The inaccessible under-stair antechamber which provided the spring chamber with its water contained a stepped pyramid.

To the west of the spring chamber, located in a workshop area accessible from the central court, is the well (Fig. 74). This two-meter deep circular well, approached by a small set of stairs, was also filled by spring water. A wooden hoist, found preserved in the water from some point during its history, was clearly used to draw water from the well. Numerous finds from the well itself included cups, dishes and bowls containing offerings such as grape seeds and pumice as well as burned animal bones (see Table 16). Fragments of a plaster three-legged offering table were also found within the fill of the well's enclosure.
3.1.2 Politics, ritual, and water management at Kato Zakros

All Minoan palaces have several features in common. These features include a central court, a west court with theatrical area, a triangular causeway, a west wing, storage and industrial areas, pier-and-door partitioned halls and numerous rooms dedicated to ritual activity such as pillar crypts and ‘lustral basins’ (Hitchcock, 2012: 192-195; McEnroe, 2010: 45-60). In addition, many palaces had a complicated or labyrinthine ground plan, with numerous entrances, and used fine ashlar masonry to construct imposing façades. The palace at Kato Zakros diverges from these in several important ways: it lacks the complex, labyrinthine ground plan of the other palaces, has no west court, theatrical area or raised causeway, nor does it have any pillar crypt (Reid, 2007: 21). However, one of the most important ways in which the palace at Kato Zakros diverges from the norm is the monumental and unique Hall of the Cistern.

The Hall of the Cistern is without doubt the most spectacular of the water installations at Kato Zakros, and contributes significantly to the monumentality and ostentation of the palace as a whole. With its broad and finely cut steps, hydraulic plaster lining, and potential portico, the cistern itself would certainly have been an impressive focal point for the hall, but also perhaps for the ‘royal’ wing of the palace, at the centre of which it sits. The conjectural portico and second floor, suggested by both column bases and a stairway leading upwards out of the hall, further suggest that the Hall of the Cistern’s monumental impressiveness was central to the cistern’s function. As discussed in Chapter 4 (section 3.4.1), monumentality combines permanence, centrality, visibility and uniqueness to communicate the power and importance of those to whom such structures belong, and contributes directly to the visual articulation of the identity of specific groups. The cistern at Kato Zakros certainly fulfils these criteria: it occupies the centre of its hall, which itself commands a prominent position within the important east wing of the palace; the Hall of the Cistern could be made visible, or closed off, accessible or inaccessible, through the opening and closing of the pier-and-door partitions in the Minoan Hall which separated the hall from the central court, as well as potentially from above; and finally, the Hall of the Cistern is unique to Kato Zakros. Not only did the cistern at Kato Zakros demonstrate technological expertise, through their construction and maintenance of a large indoor cistern complete with hydraulic plaster to maintain the cistern’s integrity, and wealth, it also conveys a sense of dramatic grandeur (with its large circular structure dominating an impressive hall complete with columned portico and pier-and-door partitions) appropriate to elite architecture.
This monumentality represents a localised and distinctive form of the material culture found at other Minoan palaces. In line with a broader Minoan practice of incorporating local elements into monumental architecture, in order to assert a connection with the local community and landscape (see Chapter 4, section 3.4.1), the cistern makes a monumental structure out of the area’s distinguishing characteristic: its spring water. A grandiose display of mastery over this resource is being used here to symbolise the palace’s authority over the settlement and region. In this way, the monumentality of the cistern is fused with another elite strategy, namely conspicuous consumption. As discussed in Chapter 4 (section 6.2), the lavish and luxurious consumption of fresh water – especially if that water held added cultural or religious significance – may well have had the same ideological status as the consumption and possession of exotic materials and prestige items. The possession of fresh water in such abundance as was made possible by the cistern at Kato Zakros, and its private use (suggested by the highly restricted access to the hall), is indicative of a form of consumption that was about communicating status, as much as washing or drinking.

Understood in this way, the cistern’s likely use can be firmly connected to its function as monumental architecture. In Chapter 5 (sections 4.2 and 4.3.2), I argued that, in contrast to the customarily secular interpretations offered by Platon and others (such as a swimming pool or fish tank), the cistern could have enabled the performance of certain ritual acts, such as the inducement of altered states of consciousness through sensory deprivation, or ritual washing. The architectural context of the cistern becomes clearer in this light: the adjacent Minoan Hall, with its pier-and-door partitions allowing for controlled visual access to the cistern from the central court, and the conjectural portico allowing visibility from the upper floor, are more befitting of an installation involving performance, rather than consumption for its own sake.

The significance of the cistern in this regard is that various forms of access to it appear to have been carefully restricted. In order to effectively function along the lines of monumentality, conspicuous consumption, or certain types of ritual performance, such structures must be visible; it is the presence of an audience that gives them their communicative power. This allows us to infer the ideological or social function of the cistern from the likely intended audience. The primary audiences would have witnessed activity in and around the cistern from either the central court, the adjoining Minoan Hall, or from the second floor above the hall (Fig. 75). Unlike monumental façades or grand entrances, the cistern could only be viewed by those belonging to, or invited into the palace.
confines. This makes it highly likely that the communicative or ideological elements of the cistern functioned within the social group that used the palace, much like the frescoes at other palaces.

As argued throughout Chapter 4, what emerges here is the articulation of identity. Whether it is a stratum within the elite, asserting their privilege and status over other palace users (the layout of the palace at Kato Zakros suggests separate areas for workshops, kitchens, and administrative and religious activities, all with access to the central court), or a way for a broader palatial elite to reinforce their social bonds through display: what is important here is the use of the cistern to articulate and sustain an ideological construction of the users’ social difference from the rest of the community. In this way, the audience for the ideological function of the Hall of the Cistern would have been the elite themselves, in a not dissimilar way to the private pools and expensive artworks in modern mansions. It is worth noting here that, even though the general population of Kato Zakros might never directly see the cistern, it is possible that they may know about it, perhaps in fabled or rumoured terms: we might envisage the local community knowing about a sacred source of water contained in its own glorious hall within the palace. If this were the case, the restricted access to, and knowledge of, the cistern would heighten its ideological power.

This ‘inward-facing’ ideological practice, fusing monumentality and conspicuous consumption, was not the only water management system through which such ideas about social difference and elite identity could be expressed. The spring chamber, opening out to the exterior of the palace and possibly in a southeast court, is strongly suggestive of a more public display of the connection between the palace and the spring. Constructed from fine ashlar masonry and Poros stone, with a long flight of stairs descending from ground level into the subterranean basin, the spring chamber is no less monumental than the nearby Hall of the Cistern. Unlike the latter, however, it is more readily associated with ritual activity: an abundance of offerings, including food, conical cups, and a stepped pyramid, were found in the spring chamber, and horns of consecration were found outside it. Platon suggests that, as the ledge could not be used as a structural support or a platform to stand on, the ledge surrounding the basin probably functioned to hold ritual symbols and idols (1971: 194-195).

There is some doubt over the nature of the area from which the stairs of the spring chamber were accessed (see Fig. 75). Platon concludes that it may be a court in itself, or merely an ‘open area’ (1971: 195) accessible from outside the palace. At present, there is insufficient evidence to conclude whether or not the area around the spring chamber was
open to the wider community, and therefore whether it would have been a usable source of water for people outside the palace. However, the monumental and ritual aspects of the spring chamber suggest that the public provision of water was not its primary intended function. The relationship between the spring chamber and the surrounding buildings provides some clue as to the purpose of this water management system. First of all, unlike the cistern and the well, the spring chamber exhibits an approach to access that is less focused on the central court and the identifiable ‘inside’ of the palace complex. The source of its water springs up and collects into an antechamber inside the palace confines, which is then intentionally channelled via a small conduit into the spring chamber’s basin. If this monumental installation was intended for use by the palatial elite, it is difficult to understand the effort to channel water outside the central palace buildings. Even harder to explain is that the spring chamber was only accessible from ‘inside’ the palace via a circuitous route from the central court, leading through a narrow corridor.

The more convincing interpretation is that the spring chamber provided a venue for the ritualised interaction of palatial elites and other groups, perhaps the inhabitants of the harbour town and local area. The monumentality of the spring chamber would have been, in this interpretation, the venue for ceremonial activities involving the spring water, performed in front of, and perhaps including, a wider non-palatial audience. While we cannot say what the ritual itself meant, its central message is clear: the construction and reinforcing of a cognitive association between the spring water, and whatever cultural value it possessed, and the palace. In this way, a symbolic link can be seen between the way that the spring water is fed to the chamber from inside the palace, and the way that the palatial participants in such ceremonies emerged from the corridor adjacent to it. It is possible, given the evidence for a second floor above the hall of the cistern, that the ceremonial activities focused on the spring chamber could have been viewed, or perhaps presided over, from a balcony or window overlooking the southeast court or area. In contrast to the cistern, whose communicative aspects were ‘inward-facing’, the spring chamber appears to have been oriented towards a non-palatial audience. The spring chamber would have made it possible for the elite to participate in ritual or ceremonial action as part of the wider community, asserting the unity of the palace (and the political hierarchy it represented) with the settlement as a whole, while at the same time imprinting their superiority and authority over proceedings. Appearing to control – and indeed produce – the spring water would likely have been the central component of this message, not only displaying the elite’s
mastery over natural forces but also asserting that their domination was itself ordained by nature.

The conceptual nexus of nature, ritual activity, water and palatial control is further demonstrated by the most humble of the palace’s three water management systems. The ‘Unit of the Built Well’ is generally understood as having a practical function, being located in an area of the palace identified as ‘workshops’, although it may have also supplied water to activities in the central court from which it is accessed (see Fig. 75). Lacking the same attention to monumentality and conspicuous consumption, this is a relatively simple spring-fed well, within a rectangular enclosure, in which water was drawn via a bucket and hoist. The significance of this ostensibly more practical water management system lies in the fact that it contained a number of finds not normally associated with an ‘industrial’ installation, but rather more ritual contexts. When Platon excavated the well, he found within it a large number of vessel fragments, as well as bowls, burnt animal bones, small branches from aromatic shrubs, pieces of pumice in handleless cups, an animal figurine, and fragments of an offering table. This diversity of finds at first raises the suspicion that the well may have served as a rubbish dump for a variety of different activities; however, Platon argues that the evidence suggests “special offerings to the deity were made within this well” (1971: 196). Compelling evidence for this interpretation comes from the fact that a large number of olives were found, some still in their ‘offering cup’, with their flesh still intact, having been preserved underwater.\(^ {67}\) The whole olives offer solid ground for an interpretation of the well as a site of ritual deposition rather than rubbish dumping – an interpretation that can reasonably extended to other finds commonly associated with ritual activity, such as the pumice, aromatic shrubs and offering table. Discounting the explanation that the diversity of finds in the well was merely the result of it being a rubbish dump, two linked interpretations present themselves: either the well was of mixed use, being the site of both secular and ritual activity, or it was treated as sacred or special by those using it for mundane purposes. Perhaps the ritual offerings were intended to preserve or placate the sacred source of the water, and therefore imbue the productive activities that required it with some portion of its power.

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\(^ {67}\) Platon recounts: “When the olives first came out of the water they looked as if they had just been picked from the tree, a fact recorded in the excavation photographs. Unfortunately, after a few minutes, the skins wrinkled rapidly, and, despite many attempts to preserve them, the olives never regained their original appearance” (Platon, 1971: 196).
At first glance, then, the three water management systems appear to be structured according to some division of labour: the cistern has commonly been interpreted as for the private, leisurely consumption of water, the well as a source of water for industrial activity, and the spring chamber as a religious installation or shrine. The evidence, however, disrupts this division, as ritual elements, political articulation, and practical usage, appear to be intertwined. It is clear that in the case of the palace at Kato Zakros, the spring water is never merely a resource. Rather, the socio-economic, religious, and political meaning of water plays an important role in constructing the social relationships that the palace embodies. The palace of Kato Zakros does not seek to directly control access to fresh water, but instead uses water management and the meanings inherent in water to further its ideological control.

3.2 The Caravanserai, Knossos

Facing the southern façade of the palace of Knossos across the Vlychia gorge is the Caravanserai of Knossos (MM III- LM IIIB) (Fig.76). Excavated by Sir Arthur Evans, it is a large, two-storey building with a courtyard to its north side, which faced the presumed course of a main Minoan road towards the palace. Located just to the north-west of the Caravanserai is a section of what Evans terms the Minoan ‘viaduct’ (1928a: 96-100) (see Figs. 76 and 77).

The function of the Caravanserai is obscured by uncertainty over the social status of the complex itself. Its uniqueness contributes heavily to this problem, and has meant that this exceptional building has been under-researched and under-examined, generally receiving only passing references in the archaeological literature (Schofield, 1996: 27). Though strongly palatial in construction and character, and clearly connected to the nearby palace of Knossos, it is impossible to definitively state whether this building was restricted to the palatial elite, or open to all as a sort of civic building, or indeed, as Evans hypothesised, was intended for travellers and visitors to the area, where they could eat, drink and bathe as well as stabling and watering their mules (1928a: 117).

The Caravanserai has two water management systems – a spring chamber and a sunken bath – as well as numerous water conduits which supplied various parts of the building, and evidence for the use of ‘bath tubs’, with the provision for heated water, in one part of the complex (Fig. 78). The eastern half of the building contains a number of different rooms and a series of basements with cobbled floors. A covered conduit runs south to north through this basement complex, which channelled fresh spring water from
the Vlychia spring above the Caravanserai. Fragments of a fine cement pavement were found within the basement rooms, which are thought to have fallen from the floor above. This ‘tarazza’ pavement is waterproof. Immediately to the west of the basements is the Stepped Pavilion which could be entered from both the front and inner court of the complex (Fig. 79). The room was decorated with painted representations of pillars and running across the top of the room is the well known Partridge Frieze (see Fig. 46) (Chapter 3, section 4.2). In contrast to the palace at Kato Zakros, where spring water is incorporated in to a complex with multiple other uses and functions, the Caravanserai appears to have a much more singular, though mysterious, purpose, incorporating the use of water.

3.2.1 The Caravanserai’s main water management systems

Adjoining the pavilion and also accessible from inner and outer courtyards is the stone sunken bath/basin: a rectangular basin flanked on three sides by slabs which project towards the basin (see Fig. 23). It could be entered by three descending steps, while from the south (from an interior court) the basin could be accessed by a flight of five steps. Additionally, there is a stone trough on the northern edge of the bath. The basin is fed by spring water (the same source as the basement conduits) which is channelled into it from underneath the southern steps via a complex system of pipes and conduits. The basin also contained a stone plug. Directly to the west of the sunken basin is a room which contained terracotta ‘bath tubs’. No water conduits were found in this room suggesting that water must have been carried into the room from another source (Schofield, 1996: 29).

The westernmost structure of the Caravanserai is the spring chamber (see Figs. 19 and 80). This is a separate small building which is not joined to the rest of the complex. This quadrangular chamber made of gypsum encloses a sunken gypsum basin with overlapping slabs on all sides, which is accessible via three stone steps from the front court of the Caravanserai. Access to the water could be controlled by a small wooden door at the entrance to the chamber. The basin is filled by spring water which rises up through its pebble floor. On the back wall of the spring chamber is an almost square niche with two ledges. In later periods (LM IIIC and SM), the chamber contained a great deal of material including a hut-urn containing a goddess with upraised hands and many other ritual items, as well as cups, bowls and vases. As with the well at Kato Zakros, these finds could plausibly be explained away as the result of rubbish dumping. Again, however, the weight of evidence makes a cultic or ritual interpretation for the depositions in the spring chamber.
more reasonable: the practice of votive offerings at the chamber is generally understood to continue well into post-Minoan periods (Hood and Smyth, 1981: 14), and is supported by the central niche in the chamber’s back wall, which “resembles, and may deliberately imitate, the façade of a Tripartite Shrine” (Schofield, 1996: 29).

3.2.2 Politics, ritual, and water management at the Caravanserai

The political function of the Caravanserai is as enigmatic as the structure itself. Clearly, as discussed in Chapter 4, it displays a strong sense of monumentality – *permanence, centrality, visibility and uniqueness* (Moore, 1996: 139-140). The Caravanserai especially fits Trigger’s definition of monumental architecture, in that it is exceeding in scale and elaboration the requirements of any practical function (1990: 119). Complete with its painted columns and friezes, its variegated and polished floors, and elegant portico, the Caravanserai would have been visually impressive, both from within the buildings and from the Minoan road, and intentionally so. Interestingly, the Caravanserai was a prominent part of the ‘fine view’ towards the Vlychia gorge from the palace of Knossos, and likewise visitors to the structure would have been treated to an admirable view back across the gorge to the palace from the second storey or flat-roof terrace (Schofield, 1996: 29, 33 n6).

Such emphasis on visual impression strongly lends itself to a politics of elite display and architectural statements of dominance and status. The political message of incorporating the landscape – and especially a key source of spring water – into such a grandiose complex is also relatively clear: the Caravanserai expresses not merely mastery over the landscape and spring, but also by incorporating local springs into the building – linking the man-made with the natural – the power of those who built and used the complex is consolidated and confirmed as being as timeless and incontrovertible as the slopes of the Gypsadhes.

The uncertainty surrounding the exact function of the Caravanserai, in particular the social status of the complex, has affects the way in which we interpret the water management systems of the site. The sunken bath in particular is affected by this public versus private dilemma, as it is accessible from both outside and inside the complex with little evidence for doors or screens to restrict access. If this is for elite use, as I argue in Chapters 4 and 5, the restriction of access to the general public would have to be enforced by guards or social conventions.

Aside from the paucity of evidence supporting Evans’ interpretation of the Caravanserai as being more public (not to mention Evans’ anachronistic association of the complex and a nearby inn (Schofield, 1996: 27)), there are more theoretical reasons for
thinking of the Caravanserai as an elite and exclusive structure. The grandeur and monumentality of the buildings resonate with another cultural practice, discussed at length in Chapter 4 (section 6.2), namely conspicuous consumption. The way in which water was collected, transported, and consumed at the Caravanserai is suggestive of the use of water as a prestige commodity: technically sophisticated conduit systems, finely constructed basins, and probably terracotta baths with heated water, would have all contributed to a complex where water was not just used but enjoyed, in a not dissimilar way to that at the Hall of the Cistern in Kato Zakros. In this respect, as the impact of conspicuous consumption is oriented as much to an audience as to the consumer, the openness of the Caravanserai begins to make more sense. Observers from the road or front courtyard would have an ample view of users entering the sunken bath, and sitting in the open pavilion, surrounded by the partridge fresco, adjacent to the sunken bath. Along these lines, Schofield challenges Evans’ interpretation, suggesting instead that the complex was an exclusive prestige symbol focusing on bathing and washing (1996: 32).

The ‘conspicuous consumption’ element of the Caravanserai need not have been entirely public-facing, however, as the water-related activity in more closed areas (such as the spring chamber, upper floor, and bath tub area) can be interpreted as being for a more restricted audience. Communal washing or other ritualised forms of interaction with water could well have formed a part of ceremonies or activities amongst, and visible only to, the initiated. This more inward-focused conspicuousness is related especially to the articulation and performance of a group identity that was the focus of Chapter 4. Considered as a vehicle for the expression of elite identity, the Caravanserai’s peculiarities in terms of access become clearer. Rather than it being a question of the whole building being either public or private, civic or exclusive, we can understand the Caravanserai through the political lenses of conspicuous consumption as being for private use, but where that use demands to be seen in order to have the desired impact. For our present purposes, what is important here is the role played by water. The sunken bath, a striking threshold granting access to the complex from the front courtyard and Minoan road, would have provided a highly visible opportunity for those entering the Caravanserai to wash before withdrawing from public view into the complex. This symbolic act of preparation would have affirmed the participant’s difference and separation from those remaining outside. Once inside, the focus of activity would then have shifted to consolidating the identity and bond of those with access to the interior of the complex. The deployment of a water management system to mediate between the inside and outside of the structure, and the political and social
statuses conferred by that binary, suggests a thematic connection with the Spring Chamber at Kato Zakros, which uses a similar device of having a public-facing but nonetheless elite structure.

The themes that emerge from thinking politically about the Caravanserai, through the theoretical concepts of monumentality and conspicuous consumption, correspond in some interesting ways to the links between water and Minoan ritual action, as discussed Chapter 5. The ritual significance of bathing adds a sacred dimension to the Caravanserai’s incorporation of water. If the water-related activities within the complex served, as I have suggested, to consolidate the social bond and identity of its (elite) users, it is easy to see how the repetition of washing activities could quickly become ritualised and even ceremonial, sanctifying the identity and coherence of the group.

As I argue in Chapter 5 (section 4.1), the theme of water acting as a metaphorical and physical boundary, common to many cultures, takes on a specific sense in Minoan religion. Here, water is used as much to link spaces as delineate them, and plays a central role in identifying specific spaces (especially built environments) with heterogeneous places, whether natural, imaginary or a hybrid of the two. In this context, the function of the sunken bath at the Caravanserai may be considered to be religiously significant, as it provides a physical and metaphorical transition from outside to inside, perhaps helping to determine the character of the internal space and the activities within. The architectural surrounding of the sunken bath already suggests the logic of metaphorically constructing heterogeneous spaces within the complex: the painted columns around the bath function to invoke an environment rather than constructing it physically (in this case, most likely the palaces). More significantly, the adjacent pavilion is dominated by the Partridges and Hoopoes fresco, which clearly invokes a natural, damp environment, probably a cave or marsh (see Chapter 3, section 4.2). In addition, then, to its literal function as a threshold, we may interpret the sunken bath as helping to construct the Caravanserai as a complex charged with meaning, in which the distinctions between the built spaces and other natural and imaginary places are blurred, especially through the metaphorical functions of water. In this way, the Caravanserai becomes an ‘architectonicised landscape’ in both the literal sense of incorporating the Vlychia spring into its structure, and in the ideological sense of constructing meaningful spaces out of visual references to natural elements.

The relationship between the Caravanserai and ritual action is not a new consideration. Evans reported that the spring chamber, which sits at an odd angle to the rest of the complex, was full of ritual offerings and paraphernalia. Though many of these
finds date to the LM IIIC to SM periods, the presence of a carved niche in the back wall suggested to Evans that the chamber acted as a site for ritual activity throughout its entire life, perhaps as a shrine (1928a: 343). The sacredness of the spring, which is in keeping with a Minoan reverence of spring water evidenced at numerous sites (see Chapter 5, section 4.3.3), may have been integral to the meaning of the activities undertaken with the Caravanserai complex. Certainly, consuming water construed as ‘special’, perhaps identifiably special through differences in taste or appearance, could have formed part of the strategy of conspicuous consumption. Moreover, by distributing water from the Vlychia spring, via pipes, conduits and vessels, through the complex, the sacredness of the water may have thus been distributed around the Caravanserai, infusing the building and the activities therein with the sacred character of the water. In this way, there is much to support Schofield’s interpretation of the Caravanserai as involving “some sort of purificatory ritual” and prestige activities (1996: 32).

However, the evidential association between the spring chamber and ritual artefacts and offerings can lead us to overemphasise the ritual importance of the spring chamber, at the cost of understanding the Caravanserai as a whole as a space for ritual and culturally meaningful action. If we view the Caravanserai through modern lenses, in which water appears as either practical or sacred, it is easy to follow Evans in asserting a division of labour between the religious spring chamber and the secular Caravanserai proper. Indeed, after challenging Evans’ assumptions, Schofield goes on to assert that “the complex as a whole cannot be considered a sanctuary” and that instead the function of the Caravanserai may have been “some form of hydrotherapy” (1996: 32). This takes us no closer than did Evans in unravelling the function of this enigmatic complex. Instead if, as this thesis has argued, water is a repository and channel for a host of meanings and beliefs, about identity, religion, place, and social order, the Caravanserai takes on a very different hue. Rather than being a building with a defined but unknowable use, the Caravanserai can be revealed as a unique space whose function was as much to do with performances – ritual action, conspicuous consumption, and the articulation of elite identity – as to do with the material needs of individuals. The built environment created by its walls and water management systems represents more than just a venue for this or that type of activity. On the contrary, the complex as a whole constructed a specific space – perhaps a number of different spaces – which expressed and articulated a number of meaningful ideas and associations. Through imitating, representing, and incorporating natural elements – particularly water – the Caravanserai expressed the elite’s connection with and mastery over nature itself. Far from
being a mere adjunct to the nearby palace of Knossos, a sort of resort or leisurely retreat, the Caravanserai can be understood as manifesting the same elite strategy as the Minoan palaces: it is a fusion of inferred political power through prestige, religious belief, public and private performance, and a complex, ideological negotiation with nature.

4. Key Findings

I have chosen to present these two case studies here as they highlight two different but deeply interconnected claims. The water management systems at the palace of Kato Zakros reveal above all else the close connection between political power, the economic control of certain resources, and ritual or religious beliefs, and the role of water – as a conduit for the construction of meaning – in articulating this connection. The different uses of the three water management systems at the palace, including industry, display, consumption and ceremony, highlight the utility and versatility of water in the Minoan imagination. By securing the abundance of water, through technological knowledge and architectural design, this versatility was brought into the service of the social group that occupied the palace, and their diverse strategies for reinforcing and articulating their status.

These elements are, I argue, equally present at the Caravanserai; however its separation from the palace and the uncertainties about its ‘clientele’ obscure and blur the relationship with power that is more clearly visible at the palace of Kato Zakros. The importance of the Caravanserai for my overall argument, aside from the concentration of water-related archaeology at the complex, emerges from its enigmatic and atypical nature. A key argument of this thesis is that, if we restrict our understanding of water in the archaeological record to functional, biological and technical concerns\textsuperscript{68}, buildings such as the Caravanserai become indecipherable, and all the more susceptible to anachronistic speculation such as Evans’ ‘Travellers’ Rest’. Remaining sensitive to the water’s metaphoric power, with the help of recent theoretical and comparative work on the meaning of water, enables us to illuminate not only the probable function of the Caravanserai, but also its relationship to the political, social, and religious strategies of the Knossian elites.

More broadly, I have sought to establish that a close attention to the potential of water to articulate and construct meaning, alongside detailed archaeological study, can yield

\textsuperscript{68} Clearly, many of the water management systems discussed in this chapter have a prosaic function and were used as a supply of water for practical and economic uses. However, this chapter, and the thesis as a whole, has sought to highlight the many ways in which water and water management can be thought of as something more.
significant results beyond merely demonstrating that water was important to the Minoans in more ways than just as a resource. A key finding of this thesis is that the Minoans had an identifiable approach to water, emphasising and valuing certain aspects of it above others, and repeating specific repertoires of meaning construction in a number of different contexts. There is a clear reverence of spring water throughout the evidence, with many of the most elaborate water management systems being focused around spring water, and a close association between natural springs and sites of ritual action, such as peak sanctuaries. A likely related Minoan preference appears to have been for flowing water. Many of the most notable examples of Minoan hydrological expertise concern the movement of water, such as hyperbolic curves and pressurised pipes. There are numerous examples, most notably Knossos, where conduits, spouts and channels have been incorporated into the built environment of the palaces in a highly noticeable way, suggesting a visual emphasis which is also strongly reflected in fresco art, where water is almost always depicted in movement. This apparent interest in the movement of water opens up the tantalising prospect that part of the Minoans’ ritual interaction with water took the form of pouring rituals. The well-known ceramic evidence from Minoan Crete includes a number of pottery forms dedicated to pouring rather than storing or transporting liquids. As discussed, it is not possible to conclusively show that water was the main liquid, or even one of the liquids poured, however the weight of evidence for a Minoan cultural inclination towards moving water – with all the potent sensory stimulation that involves – makes this a significant possibility.

Throughout Chapters 3, 4 and 5, I investigated the ways in which the Minoans used water to construct a network of ideas, concepts and associations through their representation and built incorporation of water. One of the most striking outcomes of this investigation is the recurrence and interconnection of a handful of strategies of the construction of meaning through water, which together constitute a broad repertoire, spanning art, architecture, and ritual action. This repertoire is composed of two main themes: water as a linking element, and the incorporation and mastery of nature.

4.1 Water as a Linking Element

As discussed in Chapter 3, water is used in Minoan fresco art to link together often different landscapes: the horizontal flow of water across fresco compositions serves to both draw the eye across the scene, but also to compositionally link together different elements or even different scenes (Morgan, 1988: 150). Water also links frescoes
metaphorically through the use of dedicated motifs to signify the presence of water (or more broadly, ‘wetness’), such as the ‘bifid motif’, but also through water metonyms such as specific birds, plants and insects. This use of metonymy can also be seen in Minoan ritual action, where, for example, water-worn pebbles are used to recall specific water sources, places or even the power of water.

Water’s ability to act as a linking element can also be detected in what I have termed ‘spatial referencing’ (Chapter 4, section 4.1.3). Here, water or water-elements (such as water-worn pebbles) are used to recreate or construct specific natural environments within a built setting in order to transmit the meaning and power of those other places – such as the spring-laden peak sanctuaries or even an imaginary location – to the new site. This act of linking or referencing has clear religious implications but also political ones: being able to access and associate themselves with actual or even imaginary places of great importance, imbues upon the elite a portion of that same importance, but also in being able to ‘inhabit the other’, elites are able to further construct their ideology of difference (Chapter 4, section 4.1.4).

4.2 Incorporating and Mastering Nature

The incorporation of water elements within palaces and other important buildings is consistent with Minoan preference for displaying their affinity with, but also mastery over, nature and natural elements. This control has both symbolic and political significance. Not only does it demonstrate that the elites could control and master a difficult and often unpredictable element, and thus, have more control over their environment and seasonality, but it also demonstrates their control over the ideological and symbolic meanings water held. Water, far from being just something horded, is used to construct and give meaning to their built environment through the architectonicising of nature. Water is understood and incorporated, I argue, as an active participant in the construction and articulation of meanings. Water has considerable power and manifold meanings, which, through its integration into palatial architecture and ritual action, can be harnessed and utilised by the elite. It demonstrates the concordance of natural order and the power of the elite, thus legitimising their power and authority.

5. Original Contribution

I have comprehensively catalogued fresh water management systems on Crete. This builds on, but also dramatically expands upon, work done by water engineers interested in
historical approaches to the management of fresh water (Angelakis, Dialynas, et al., 2012; Angelakis, Mays, et al., 2012; Gorokhovich et al., forthcoming; Mays et al., 2007). I believe that one of my key contributions is that I have brought together two very different literatures: a water-technology engineering literature, which looks at water but from a technical perspective but that deals little with archaeological issues and social context, and the archaeological literature, which has so far generally neglected fresh water and water management.

The key contribution, however, is that my research has highlighted that there is far more to the Minoan relationship with fresh water than previously assumed. Looked at individually, practices and material culture to do with fresh water do show up in the archaeological record, as would be expected based on the fact that water is vital for any society. However, by looking more holistically at the set of water management practices and other activities involving fresh water, this thesis has illuminated a consistent and significant involvement of water in almost every major arena of Minoan life: political, economic, social and religious.

6. Limits to this study and areas for further research

As with any project, my research omits certain topics or areas of investigation in order to fit within the parameters of a thesis. One such consideration is the level of detail or comprehensiveness the thesis addresses. The nature of water management archaeology is such that there are vast discrepancies in the quality and availability of the data. In this respect, some systems are presented in more detail than others. However, what my database of water management systems does is provide a substantial starting point from which individual systems can be investigated in more depth and detail, and compared with each other at that level. In addition, although Chapter 4 deals with regional variations in the water management evidence, there is insufficient space to launch into a thorough examination of these variations in the context of other types of evidence, for example to see if water management variation is greater or less pronounced than, for instance, pottery types or architectural features. This is a potential area for further research.

The finding of this thesis, that water management in intimately connected to power and social order at an ideological rather than a resource-control level, opens the door to sustained discussion regarding Minoan political economy. While I endeavour to address the main issues raised by this finding, the constraints of this thesis did not permit a thorough discussion or reconstruction of ongoing and unresolved debates about the structure of
Minoan political economy to provide more background for the politics of water management. Clearly, this is a highly significant area of study, and one that, with further research, could shed more light on the complex question of whether strategies of water management different greatly between elite and non-elite settings.

In addition to these areas of further or more in-depth research, there are a number of additional topics I would like to address in the future should I have the opportunity. I believe a more detailed study of Minoan drainage systems would be a fruitful area of research, as they offer a wealth of archaeological evidence, which I chose not to address in as much detail in order to focus on fresh water, rather than ‘grey’ water. Their diversity, complexity and number (drainage systems are far more widespread across the whole of Crete than other water management systems) would provide ample data and could perhaps further illuminate Minoan approaches to both practical problem solving, but also how a relatively ‘functional’ aspect of Minoan life can be significantly embedded in socio-politics. I would also like to explore the relationship between the Minoan conceptualities of fresh water and sea water. There is a considerable literature on the depiction of, and interaction with, the sea and marine life in Minoan archaeology (see for example Berg, 2011; Betancourt, 1977; Bicknell, 2000; Morgan, 1988; Mountjoy, 1984; Saunders, 2008) which, to my knowledge, has not been explored in terms the dichotomy between these two powerful aspects of the Cretan environment. I think such a research topic would help to further our understanding of how the Minoan culture reacted to the problems caused by the eruption on Thera, how this affected their relationship to both fresh water (which has been touched on in this thesis) and sea water. Such research would develop ideas presented in this thesis in terms of the meaning of fresh water by a comparison with the meaning of sea water.

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69 Recent work by Maja Aufschnaiter (2007, 2011, 2012) has begun to shed more light on the social and political role of Minoan drainage systems.
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Sc = Spring Chamber
Sb = Sunken Basin
Aq = Aquaduct
D = Dam
Dr = Drainage system
+ = multiple numbers of that system
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Appendix: Database of Minoan Water Management Systems

Cisterns

C1. Anegyros
Location on Site: Immediately adjacent to the house
Date: LM IA
Construction Materials: Stone blocks
Shape: Unknown
Dimensions: Unknown
Capacity: Unknown
Architecture: Unknown
Plaster Lined: Unknown
Water Source: Unknown
Drainage: Unknown
Associated finds: Unknown
References: Driessen and Macdonald 1997: 208

C2. Archanes
Location on Site: North of the main palace building
Date: LM IA; rebuilt in LM IB (collapsed with final destruction of Palace in LM IB)
Construction Materials: Large Poros blocks; small stones; pebbles
Shape: Circular
Dimensions: 5.25m diameter; 2.2m deep (approx) (1m deep from level of overflow drain)
Capacity: 47,642 litres (approx) (21,574 litres up to overflow drain)
Architecture: Cistern constructed from large Poros blocks; faced with small stones; base lined with pebbles; spring water rises up from below the pebble floor; 5 stone steps (each approximately 1.5m in width) lead down to water level; one stone drain (18cm high x12cm wide)
Plaster Lined: N/A
Water Source: Spring (cistern encloses a spring)
Drainage: One stone drain to the North-West of the cistern made of thick Poros blocks; depression and channel feeds water into the drain; drain runs north-west, then turns west

Associated finds: Unknown

References: Evans, 1928a: 64-66; fig. 29-30; Sakellarakis and Sapounda-Sakellaraki, 1997: 112-115

C3. Chamaizi (Fig. 6)

Location on Site: Within the small court at the very centre of the site

Date: MM IA - MM II

Construction Materials: Limestone blocks; bedrock

Shape: Circular

Dimensions: 2m diameter; 2.2m deep (approx)

Capacity: 6,914 litres (approx)

Architecture: Cistern cut into bedrock; limestone blocks used for the upper part; overflow drain

Plaster Lined: Evidence for some plaster on internal surfaces

Water Source: Rainwater

Drainage: Overflow drain covered by stone slabs runs from the cistern’s north-west side towards the main entrance (south)

Associated finds: Unknown

References: Davaras 1972a, 1992; Lenuzza 2011

C4. Kato Zakros (Figs. 8, 70, 71, 75)

Location on Site: South-east corner of the palace; cistern is inside the palace building; directly north-east of the spring chamber installation

Date: LM IA – LM IB

Construction Materials: Large stone blocks; stone ‘slabs’

Shape: Circular

Dimensions: 5m diameter; 1.42 m deep (approx)

Capacity: 27,892 litres (approx)

Architecture: Cistern constructed from large stone blocks (1m wide); base paved with porous stone slabs laid in radiating arrangement; 8 steps down to the base of the cistern

Plaster Lined: Lined with hydraulic plaster

Water Source: Spring
Drainage: Stone conduit found in fill may have channelled away surplus water

Associated finds: Two column bases from fill (could suggest area above cistern was surrounded by a portico); pottery (date/type not identified by Platon) found in fill; small concave vessel of amethyst coloured crystal only find of note

References: Platon 1971: 185-191; Platon 1992

C5. Myrtos-Pyrgos (1) (Fig. 7)

Location on Site: 5m below the highest point of the settlement; in a paved courtyard to the south of the ‘country house’

Date: MM/MM IIIA – LM I

Construction Materials: Stone blocks; small river pebbles

Shape: Circular

Dimensions: 3.42m diameter; 2.48m deep

Capacity: 22,791 litres

Architecture: Cistern constructed from roughly hewn stone blocks; vertical walls with a concave base; base lined with small river pebbles

Plaster Lined: Walls and base coated with white lime plaster (approx 1-2cm thick)

Water Source: Rainwater

Drainage: A later (LM I) ‘soak-away’ drain (rectangular with painted clay tile lids) may have been used to channel water towards the disused cistern

Associated finds: When the cistern falls out of use (LM I) it was filled to the brim with river pebbles (hard grey limestone sideropetres with white veins); potentially used as a ‘soak-away’ for storm water


C6. Myrtos-Pyrgos (2) (Fig. 7)

Location on Site: 12m below the highest point of the settlement; below the terrace walls on the north side of the slope; to the south-west, at the end of the main terrace wall is a ‘tower-bastion’

Date: MM/MM IIIA – LM I

Construction Materials: Stone blocks; small river pebbles

Shape: Circular (irregular)

Dimensions: 5.3m diameter; 3m deep

Capacity: 66,212 litres
Architecture: Cistern is partially built into the slope of the hill; has a pronounced bulge to the west; constructed from roughly hewn stone blocks; vertical walls with a concave base; base lined with small river pebbles

Plaster Lined: Walls and base coated with white lime plaster (approx 1-2cm thick)

Water Source: Rainwater

Drainage: U shaped open drains, gutters and spouts found near the cistern could have channelled water from roof drains/courts to the cistern

Associated finds: LM I pottery fragments including some Marine Style


C7. Nerokourou

Location on Site: In the south-west corner of the light-well to the south of the building

Date: LM IB

Construction Materials: Unknown

Shape: Circular

Dimensions: Unknown

Capacity: Unknown

Architecture: Unknown

Plaster Lined: Unknown

Water Source: Possibly rainwater

Drainage: Unknown

Associated finds: Unknown

References: Driessen and Macdonald 1997: 125

C8. Tylissos

Location on Site: North-eastern corner of the settlement; built against the northern wall of an earlier LM I House Γ (variously House C)

Date: LM IIIA – LM IIIIB/C

Construction Materials: Stone blocks; rough stones

Shape: Circular

Dimensions: 5.4m diameter; 3m deep (approx)

Capacity: 68,734 litres
Architecture: Cistern constructed from large stone blocks (0.65m thick); base is lined with rough stones; 9-10 steps built into the north side of the cistern lead down to the base

Plaster Lined: No, however, base and walls lined with a cement of lime and sand

Water Source: Probably spring water; cistern is fed by a series of pipes/conduits which channel water from a source south-east of the cistern; the water is passed through a rectangular basin (1.49m x 1.82m), which acted as a filtration system, before being piped 11.43m into the cistern itself

Drainage: Cistern has a small overflow drain

Associated finds: LM IIIB/C clay male head and two clay female torsos; LM IIIB kylix sherd; LM IIIB plain kylix; LM IIIB/C animal figurines; LM III C schematized bull’s head pendant


Wells

W1. Amnisos (Fig. 14)

Location on Site: North of the ‘Villa of the Lilies’; within Area B; close to entrance of small cave.

Date: LM I – LM III

Construction Materials: Limestone Blocks, smaller stones, reused stone blocks

Shape: Rectangular/trapezoidal shaft, plus a bulge incorporating some of the hill slope (possible location of a conjectural staircase).

Dimensions: Width at surface: 2.94m approx (narrowing lower down); length 3.85m approx (excluding ledge, narrowing considerably due to large stone block); depth: 4.75m (minimum).

Capacity: 5376 litres approx.

Architecture: Three constructed sides, built into hill slope, with the rock of the hill slope serving as the southern wall. North, East, and West walls constructed of large recycled stone blocks, uncut stones, held together with wedge-shaped fragments. At the northern edge, there is a large ledge or “overhang” (measuring 2.18m x 0.80m) probably constructed in a later phase during which the height of the well was extended by 0.7m. The later additions use slightly different construction techniques. The well is
fed by a spring which enters through the rock of its southern wall, between 3.39m and 2.53m below the top of the shaft. The south-western corner of the trapezoid opens out to a sharp slope possibly containing a staircase. The well is contained within a roughly triangular area, with an external wall of large cut stones, and filled with coarse stone material. The southern face of this triangular area is given by the hill slope. Approximately 12m above the shaft opening is a small cave.

**Plaster Lined:** None

**Water Source:** Spring

**Drainage:** None

**Associated finds:** LM I ‘floral style’ pottery sherd and handle of stirrup jar; LM II and LM III sherds.


### W2. Chania, Splantzia quarter

**Location on Site:** Within the Papadopoulos plot off Daskaloianni Street; immediately in front of the façade of a building

**Date:** LM IB

**Construction Materials:** Unknown

**Shape:** Circular

**Dimensions:** Unknown

**Capacity:** Unknown

**Architecture:** Unknown

**Plaster Lined:** Unknown

**Water Source:** Groundwater

**Drainage:** Unknown

**Associated finds:** Unknown

**References:** Driessen and Macdonald 1997: 124

### W3. Kato Zakros (Fig. 70, 74, 75)

**Location on Site:** Built into a room at the south-east corner of the central court; accessible only from the central court; adjacent to workshop area south of the central court; east of Spring Chamber installation. ‘Unit of the Built Well’.

**Date:** LM IA – LM IB

**Construction Materials:** Stone; paving slabs; smaller stones
Shape: Circular
Dimensions: 1.4m diameter (approx); 2m deep (from drawing platform)
Capacity: 3,080 litres

Architecture: Well contained within a rectangular enclosure flanked by a drawing platform accessible via two flights of stairs (six north-south, two east-west); well lined with small stones; floor of well is paved with slabs; small depression on platform to hold round-bottomed water pitchers; hoist secured on pier of the balustrade and the south wall of the room (north-south directly over the well).

Plaster Lined: None

Water Source: Spring

Drainage: Conduit in east wall of the well enclosure takes away excess water (heading east to ‘interior court’)

Associated finds: ‘Ordinary’ Cups and dishes; food offerings including olives, grape seeds; small branches, likely from aromatic shrubs; pieces of pumice in handleless cups; burned animals bones; fragments of three-legged offering tables – plastered and painted; one animal figurine; preserved wooden hoist

References: Platon 1971: 196-199

W4. Knossos (1) (Fig. 9)

Location on Site: East of the central court; within the portico of the ‘Hall of the Double Axes’ in the south-west corner

Date: MM IIIB – LM IIIB

Construction Materials: Unknown

Shape: Circular

Dimensions: 0.90m diameter; 13.4m deep

Capacity: 8, 528 litres (approx)

Architecture: Unknown

Plaster Lined: None

Water Source: Unknown – likely to be groundwater

Drainage: Unknown

Associated finds: Bulk of small finds belonged to the LM I, some represent MM III; LM IIIB sherds also occurred among the rubble which finally filled the well

References: Evans 1930: 255, 326; Hood and Taylor 1981: 22, no. 234
W5. Knossos (2) (Fig. 9)

Location on Site: ‘Upper East Well’ – in the area of the North-East portico; eastern wing of palace in the area to the west of the Court of the Stone Spout (N.B. exact location is not shown in any published plans)

Date: EM III/MM IA

Construction Materials: Unknown

Shape: Circular

Dimensions: 1.5m diameter; 19.4m deep

Capacity: 34,296 litres (approx)

Architecture: Unknown

Plaster Lined: None

Water Source: Unknown - likely to be groundwater

Drainage: Unknown

Associated finds: 44 pieces of fine, well fired pottery (EM III/MM IA), with the most common form being footed and footless goblets; other forms include one-handled cups, shallow bowls, beaked jugs and bridge-spouted/side-spouted jars.


W6. Knossos (3) (Fig. 9)

Location on Site: House A (earlier settlement level); directly below Kouloura II in the West Court

Date: MM IA

Construction Materials: Unknown

Shape: Circular

Dimensions: 0.90cm diameter (approx); 2m deep (approx - well only excavated to this depth)

Capacity: 1, 272 litres (approx)

Architecture: Unknown

Plaster Lined: None

Water Source: Unknown - likely to be groundwater

Drainage: Open clay water conduit, running east-west, found approximately 3m north of the well beyond a wall. No direct connection between well and conduit.

Associated finds: Less than 50 MM IA sherds.

W7. Knossos (4) (Fig. 9)
Location on Site: ‘The palace well’; north-east quarter of the palace
Date: EM I
Construction Materials: None
Shape: Circular (oval at lower depths)
Dimensions: 1.5m diameter (at the surface), 0.57m X 0.59m (at its narrowest); 17.2m deep
Capacity: 30, 407 litres (approx)
Architecture: Well cut directly into the bedrock
Plaster Lined: None
Water Source: Groundwater
Drainage: None
Associated finds:
Deposit 3: Good deal of Neolithic material; some LM IA, IB and LM III pottery
Deposit 2: 80 fragments of Neolithic material (FN IA) including rippled ware and other LN – FN IB sherds; stones and layers of mud and wood ash; fire-hardened pieces of clay storage bins; some body fragments of jugs
Deposit 1: Some pithos fragments; jug fragments; one small complete jug; several almost complete large jugs
Other small finds include a Neolithic spindlewhorl, ‘scrap’ of wall plaster; fragments of bone tools; small fragment of a saddle quern; two or three pounders; two pot boilers; 48 fragments of obsidian (including 35 prismatic blades); some animal teeth and bones; two small olive stones

W8. Knossos (5) (Fig. 9, 12)
Location on Site: Within the ‘Court of the Stone Spout’; east of the central court
Date: MM III
Construction Materials: Unknown
Shape: Circular
Dimensions: 1m diameter (approx); depth unknown
Capacity: Unknown
Architecture: Well built ‘flush’ against north wall of the court of the stone spout; likely to have been fed directly by rainwater but also from water provided by the stone conduit and stone spout on the wall directly above and behind it

Plaster Lined: None

Water Source: Rainwater

Drainage: None, although Evans hypothesises that there must have been an overflow channel to take over-flow water away

Associated finds: Mainly MM III sherds; some LM I sherds

References: Evans 1921: 380, 381 (fig. 276); Hood and Taylor 1981: 21 no.194

W9. Knossos (6) (Fig. 9)

Location on Site: The South-West House; north of the north stepped facade

Date: LM IB

Construction Materials: Unknown

Shape: Circular

Dimensions: Unknown

Capacity: Unknown

Architecture: Unknown

Plaster Lined: Unknown

Water Source: Unknown

Drainage: Possible associated drain?

Associated finds: LM II destruction debris; LM II pottery; few LM IIIA1 sherds; five LM IB Marine Style sherds; virtually complete LM II handless reed cup

References: Driessen and Macdonald 1997: 148; Popham 1977: 186, pl. 26e

W10. Knossos (7) (Fig. 10)

Location on Site: South-south-west of the Caravanserai; north of ‘Hogarth’s Houses’ on the northern slope of Gypsades hill

Date: MM III – LM IA

Construction Materials: Unknown

Shape: Unknown

Dimensions: Unknown

Capacity: Unknown

Architecture: Unknown

Plaster Lined: Unknown
**Water Source:** Unknown – likely groundwater

**Drainage:** Unknown

**Associated finds:** Some MM III pottery including ‘lily jars’, fragments of polychrome cups and bowls; some LM IA pottery including some whole vases


**W11. Knossos (8) (Fig. 10)**

**Location on Site:** South-west of main Knossos site; on the southern side of the Kairatos river

**Date:** Possibly MM II

**Construction Materials:** None

**Shape:** Circular

**Dimensions:** diameter unknown; 13.5 m deep

**Capacity:** Unknown

**Architecture:** Shaft cut directly into bedrock; foot-holes also cut into the well shaft

**Plaster Lined:** None

**Water Source:** Groundwater

**Drainage:** None

**Associated finds:** Hogarth notes that the well is filled with ‘Kamares stuff’; Evans notes these include a fluted ‘fruit’ bowl (MM IIA) and a polychrome jug with lily sprays (MM IIB)

**References:** Evans 1921: 264, fig. 196, 1925: 121, fig. 196; Hogarth 1900: 80; Hood and Smyth 1981: 56, no. 289

**W12. Knossos (9) (Fig. 10)**

**Location on Site:** On the Gypsades hill south of the palace; close to well W11 above.

**Date:** Possibly MM IB

**Construction Materials:** None

**Shape:** Unknown

**Dimensions:** Unknown

**Capacity:** Unknown

**Architecture:** Unknown. Described by Hood as a ‘well-like’ pit

**Plaster Lined:** None
**Water Source:** Unknown – likely to be groundwater

**Drainage:** Unknown

**Associated finds:** Filled with MM pottery

**References:** Hood 1958: 21; Hood and Smyth 1981: 56, no. 290

**W13. Knossos (10) (Fig. 10)**

**Location on Site:** In the grounds of Evans’ ‘Villa Ariadne’, North-West of the ‘Little Palace’

**Date:** MM IA

**Construction Materials:** Unknown

**Shape:** Circular

**Dimensions:** 1m diameter; 12.5m deep (approx)

**Capacity:** 9,821 litres (approx)

**Architecture:** Unknown

**Plaster Lined:** Unknown

**Water Source:** Groundwater

**Drainage:** Unknown

**Associated finds:** Two intact MM IA two-handled pitchers from within well fill

**References:** Evans 1928b: 546-547, 1930: 254; Hood and Smyth 1981: 44, no. 133

**W14. Knossos (11) (Figs. 10, 15, 16)**

**Location on Site:** Within the basement of ‘House A’, adjacent to the ‘House of the Frescoes’, west of the main palace

**Date:** MM III

**Construction Materials:** Terracotta ‘drums’; rubble masonry

**Shape:** Circular

**Dimensions:** 1.5m diameter; 10.4m deep

**Capacity:** 18,385 litres (approx)

**Architecture:** Upper part of well constructed of rubble masonry (potentially Roman re-building), below this, well lined with a series of 17 terracotta ‘drums’ (each drum approx 60cm high and constructed in three sections); each drum had a triangular hole cut into it; incised linear lines/makers marks on each drum

**Plaster Lined:** None

**Water Source:** Groundwater

**Drainage:** Unknown
Associated finds: None. (Evans notes that the well was cleaned out and reused during the Roman period, which may attest to the lack of finds in the well)
References: Evans 1930: 255-259, figs. 175, 176

W15. Nirou Chani
Location on Site: One kilometre to the west of the mansion, on the promontory at Ag. Theodoroi
Date: LM I?
Construction Materials: Unknown
Shape: Unknown
Dimensions: Unknown
Capacity: Unknown
Architecture: Unknown
Plaster Lined: Unknown
Water Source: Unknown
Drainage: Unknown
Associated finds: LM IB pottery?
References: Driessen and Macdonald 1997: 179

W16. Palaikastro (1) (Fig. 11)
Location on Site: Well 576; North of the town; Area 6; built near dismantled 'building 6'
Date: LM IB – LM IIIA
Construction Materials: Irregular stone blocks; natural bedrock
Shape: Oval
Dimensions: 2.05m (widest), 1.60m (narrowest) diameter; 9.25m deep (approx)
Capacity: 18, 605 (approx. minimum)
Architecture: Well cut into bed of natural conglomerate rock; first 2-3 meters of well-shaft lined with irregular stone blocks
Plaster Lined: None
Water Source: Groundwater
Drainage: None
Associated finds:
Deposit 1: 76 pieces of mainly LM IB pottery representing over 50 vessels mainly used for water collection; quern stone and two stone pestles
Deposit 2: large pieces of broken slab; small number of LM IB pottery
Deposit 3: small number of LM IB – LM II pottery
Deposit 4: LM IB architectural debris; fragmentary pottery from LM IB – LM IIIA
Deposit 5: 11 pieces of LM IIIA pottery mainly used for water collection; great quantity of animal bone, incl. numerous dog skeletons deposited whole
Deposits 6-12: fragments of burned slab; pottery fragments; bone fragments

References: MacGillivray and Sackett 2007

W17. Palaikastro (2) (Fig. 11)

Location on Site: Well 605; North of the town; Area 6; built near dismantled 'building 6'

Date: LM IB

Construction Materials: Fine, flat rectangular stone slabs

Shape: Circular

Dimensions: 1.20m diameter; 8m deep

Capacity: 9,051 litres

Architecture: Well cuts down through earlier occupation layers (MM II – LM IA) and into bedrock; well head re-built using larger flat boulders; pebble surface preserved around the well head.

Plaster Lined: None

Water Source: Groundwater/rainwater

Drainage: None

Associated finds:
Deposit 1: base of well produced whole LM IB artefacts, mainly jugs, jars and cups exclusively; 2 stone grinders/pounders
Deposit 2: small pebble wash and large stone block; 4 LM IB jug fragments
Deposit 3-4b: discarded building debris; numerous LM IIIA pottery fragments; numerous stone vessels
Deposit 5a: some pottery sherds, including some whole LM IIIA conical cups; imported wares including a LH IIIA piriform jar; stone lamp stem; clay drain gutter/channel; stone quern; conch/triton shell
Deposit 5b: layer of packed stones; some pottery including a LM IIIA imported Cretan fine plain cup
Deposit 5c: final abandonment; numerous LM IIIA pottery sherds, mud brick fragments.
References: MacGillivray and Sackett 2007

W18. Palaikastro (3) (Figs. 11, 17)

Location on Site: Within Building 5, in the south-west corner of room 11
Date: LM I A - early LM I B
Construction Materials: Stone blocks
Shape: Roughly circular
Dimensions: 0.70m diameter; 6.2m deep
Capacity: 2,386 litres
Architecture: Constructed of ‘loosely set irregular rubble’; possibly set inside rectangular area demarcated by pier-and-door partitions, perhaps open air
Plaster Lined: None
Water Source: Groundwater
Drainage: None
Associated finds: Well top jammed with large building stones, which may have been put there intentionally/part of the LM IB destruction of the building
References: MacGillivray et al. 1991: 126; MacGillivray et al. 1998: 229

W19. Palaikastro (4) (Fig. 11, 18)

Location on Site: House B, within ‘room 4’ – accessible only from courtyard to the south-east, or from an upper floor
Date: MM IIIB - LM IA
Construction Materials: Unknown
Shape: Circular
Dimensions: 0.90m diameter; 4.5m deep
Capacity: 2,863 litres
Architecture: Unknown
Plaster Lined: None
Water Source: Groundwater
Drainage: None
Associated finds: Pottery ranging from MM IIIB to LM IA
References: Bosanquet 1902: 310-311; Bosanquet and Dawkins 1923: 21

W20. Palaikastro (5) (Fig. 11)

Location on Site: 8m north-east of House A
Date: LM I

Construction Materials: Limestone blocks

Shape: Circular

Dimensions: 2 m diameter; 3.7 m deep

Capacity: 11,628 litres

Architecture: Unknown

Plaster Lined: None

Water Source: Groundwater

Drainage: None

Associated finds: Some Kamares fragments

References: Bosanquet 1902: 308 (N.B. Bosanquet refers to this structure as a cistern, whereas later authors including Sackett et al. (2007) refer to the structure as being a well.)

W21. Vasiliki

Location on Site: ‘Space 39’

Date: EM I - EM III

Construction Materials: Unknown

Shape: Circular; ‘funnel shaped’

Dimensions: 1 m diameter (at well head); 8 m deep

Capacity: 25,142 litres (approx.)

Architecture: Well is ‘funnel shaped’ – 1 m wide at the mouth of the well, tapering to 0.75 m, and opening back up to 1 m at about 2 m deep; small notches cut into the sides of the well to give access

Plaster Lined: None

Water Source: Groundwater

Drainage: None

Associated finds: EM II B Vasiliki ware; well filled in with pottery during EM III

References: Hood and Cadogan 2011: 21

Spring Chambers

SC1. Caravanserai, Knossos (Figs. 19, 63, 76, 78, 80)

Location on Site: Westernmost structure at the front of the ‘caravanserai’; forms an annex to the main building at an obtuse angle
**Date:** LM I – LM IIIB

**Construction Materials:** Gypsum slabs; pebbles; stone

**Shape:** Rectangular

**Dimensions:**
- Basin: 1.20 m x 0.70 m; 0.45 m deep (approx)
- ‘Quadrangular’ chamber: 1.9 m x 1.70m (approx)
- Niche: 0.30 m x 0.30 m (approx)

**Capacity:** 378 litres (if basin were full)

**Architecture:** ‘Quadrangular’ chamber, made of gypsum, enclosing a sunken gypsum basin which is accessed via three stone steps from the front court of the Caravanserai; overlapping slabs on all sides of the basin; floor of basin lined with pebbles from which spring water rose into the basin; at the bottom of the steps on the right is a round socket for a door-post; at the rear of the chamber (western wall) an almost square niche is cut in the stone; the niche is flanked by two ledges; ‘square-cut double cornice’ above the niche’s lintel

**Plaster Lined:** None

**Water Source:** Groundwater/spring

**Drainage:** Over-flow duct on eastern edge of the basin takes water away underneath the slabs due North to the front court where it meets another drain (from the ‘sunken bath’); the course of the drain appears to head North towards the Minoan roadway

**Associated finds:** Fragment of the grooved rim of a finely cut marble vessel, possibly a two-spouted lamp was found in the basin; stone lamps found heaped outside the entrance to the chamber; fractured fine-veined limestone fluted ‘candlestick’ stand and several LM IA sherds found a little NW of the chamber; chamber chocked with later (LM IIIC and SM) material including a hut-urn containing a goddess with upraised hands, clay figurines, incense burners, kalathoi, two fenestrated stands, later pottery including a stirrup jar, cups, a jug, a bird vase, skyphoi and some carbonised matter


**SC2. Kato Zakros (Figs. 20, 70, 72, 73, 75)**

**Location on Site:** South-west of the cistern; in the south-east corner of the palace

**Date:** LM IA – LM IB

**Construction Materials:** Ashlar masonry; Poros stone slabs

**Shape:** Rectangular
Dimensions:
Basin: 3.1m (max) 2.0m (min) x 1.9m wide; 1.6m deep (approx)
Chamber: 5.7m (including stairs) x 3.1m (approx)
Capacity: 7,752 litres (approx)
Architecture: Rectangular chamber; upper walls carefully constructed in ashlar masonry of Poros stone project slightly inwards, limiting the amount of space within the chamber and creating ledges on all four sides of the chamber; lower part of the chamber is paved with irregular slabs; water basin accessed by 15 stone steps approaching from the south which are flanked by two walls of ashlar masonry. Access to the chamber was via a direct route from the central court via a corridor to the north-west of the spring chamber; the spring chamber itself is situated in an open court, with the top step being level with the court floor
Plaster Lined: None
Water Source: Spring water is channelled into the water basin via a small conduit (0.55 m by 0.35 m) in an opening at the base of the north wall; the conduit itself comes from an ancillary chamber adjoining the spring chamber to the north. This rectangular chamber is a basement room under a conjectural stairwell and was apparently inaccessible; the chamber was constructed out of neatly laid ashlar masonry; spring water bubbled up from the floor of the chamber and is then carried off to the spring chamber. There is a smaller conduit at the base of the east wall, which Platon suggests may have also had a similar function; however the course of this conduit is unknown
Drainage: None
Associated finds: Clay and stone vessels; loom weights; conical cups; pieces of pumice; three-stepped pyramidal base of a double axe; horns of consecration (found outside the chamber); fragments of a stone conduit; food offerings including olives (N.B. the exact location of these finds e.g. as to whether they are from the chamber itself, from the ancillary chamber, or from the surrounding area, is unclear)
References: Gessell 1985: 140; Platon 1971: 192-199; Schofield 1996: 30

Sunken Baths/Basins

SB1. Caravanserai, Knossos (Fig. 23, 78)
Location on Site: Basin (‘Sunken Bath’/‘foot bath’) contained within a narrow, open-ended hall adjoining the western edge of the ‘stepped pavilion’ of the Caravanserai
Date: MM III/ LM IA

Construction Materials: Ashlar masonry, gypsum slabs

Shape: Rectangular

Dimensions: 1.52 m x 1.38 m wide; 0.45 m deep

Capacity: 943.92 litres

Architecture: Rectangular basin flanked on three sides by slabs (approx. 0.60m wide) projecting inwards (by approx. 0.20 m) towards the basin; basin accessible from both the north and south of the building – from the north, the basin could be entered by 3 descending steps (approx. 0.50m wide), while from the south (from an interior court), the basin could be accessed by a flight of 5 steps; basin’s side are constructed from ashlar masonry; floor is paved with gypsum slabs; a stone trough on the northern edge of the basin is almost adjoined to the basin; the eastern wall of the corridor in which the basin has a slight recess for the reception of painted plaster – there are some traces of white stucco, and part of a painted pillar (similar to the ‘Partridge Frieze’ found on the walls of the stepped pavilion next door)

Plaster Lined: None

Water Source: Spring water; complex system of stone ducts and terracotta pipes carried water to the basin; stone ducts in the area of the southern stair channelled water into a terracotta pipe which then fed the basin from a small opening underneath the projecting slabs of the southern wall of the basin; a small groove cut in the blocks below the slabs conducted water along the western edge of the basin to an outlet just to the right of the northern entrance – this may have served to fill the adjoining trough with water

Drainage: In the north-west corner of the basin, an overflow channel cut into the masonry directs overflow water away, potentially into a drain running in a north-west direction towards the Minoan road (intersecting with the drain running from the nearby spring chamber); in addition, a round hole cut (leading to an underground drain) into the north-east corner of the basin may have been used to empty the basin for cleaning purposes (presumably, the hole must have been plugged in some way when the basin was in use)

Associated finds: Unknown

References: Evans 1928 (II: I): 116-120; Schofield 1996: 29
SB2. Mochlos (Fig. 22)

Location on Site: Basin located to the north side of room 2.2 in building B2 in the north-west corner of the site

Date: LM I

Construction Materials: Unknown

Shape: Rectangular

Dimensions: 2m long; 1.25m wide; 0.05-0.4m deep

Capacity: 125 litres (minimum) 1000 litres (maximum)

Architecture: Basin is sunk into the north side of the floor of room 2.2; next to the basin (southern edge) are two stone column bases on either side of a triangular slab of purple schist which is marked with circular hollows (kernos)

Plaster Lined: Yes

Water Source: Hand fed – potential to be rain fed

Drainage: Drain in south-east corner of basin which leads under the east wall of the room and through the eastern facade of the building, emptying out into the street below

Associated finds: None from basin; several LM IB cups (conical and one-handle) found in drain; pieces of incense burner found on floor near basin

References: Soles and Davaras 1996: 188-189; plates 50e; 51b

SB3. Palaikastro (1) (Fig. 21)

Location on Site: Room 7 of ‘House B’, Block B, in the south-east of the site

Date: LM IA

Construction Materials: Stone slabs

Shape: Square

Dimensions: 1.7m²; depth unknown

Capacity: Unknown

Architecture: Sunken square basin within a larger, central L-shaped room; the floor directly surrounding the basin is paved with a border of square slabs; at each corner of the square is a column base (the four bases varying from 0.32m to 0.36m in diameter)

Plaster Lined: Yes, lined with white cement

Water Source: Rain

Drainage: None

Associated finds: Unknown
SB4. Palaikastro (2)

Location on Site: Room 19 of Block Δ in the north-west of the site
Date: LM I
Construction Materials: Unknown
Shape: Square
Dimensions: Approximately 1.7m²; depth unknown
Capacity: Unknown
Architecture: Sunken square basin within a larger, central room; the floor surrounding the basin is paved; at each corner of the square is a column base (diameter of bases unknown); the basin itself is not paved or lined
Plaster Lined: None
Water Source: Rain
Drainage: None
Associated finds: Unknown
References: Bosanquet 1903: 279; Driessen 1999: 230

SB5. Palaikastro (3)

Location on Site: Room 23 of Block Δ in the north-west of the site
Date: LM I
Construction Materials: Stone slabs
Shape: Square
Dimensions: 3.5m²; depth unknown
Capacity: Unknown
Architecture: Sunken, square basin within a larger ‘central’ room; the floor directly surrounding the basin is paved; at each corner of the square is a column base
Plaster Lined: None
Water Source: Rain
Drainage: Yes; a drain runs from the north-east corner of the basin along the west side of room 21 and empties into a gutter in the street
Associated finds: Unknown
References: Bosanquet 1903: 293; Driessen 1999: 230
SB6. Pseira

**Location on Site:** Basin located to the rear of ‘The House of the Pillar Partitions’ (House BC) adjacent to the north wall; House BC is to the North-West of the site

**Date:** LM I – LM IB

**Construction Materials:** Phyllite slabs; limestone block

**Shape:** Rectangular

**Dimensions:** 1.35m long; 1m wide (approx.); 0.12m deep (basin’s interior dimensions are irregular in places)

**Capacity:** 162 litres

**Architecture:** Basin is sunk into the floor of the house with phyllite slabs lining three of its sides (northern, eastern and southern); a stone drain allows liquid to seep into the lower stratum of the floor; two low stone benches flank the bath on its northern and eastern sides

**Plaster Lined:** None

**Water Source:** Hand fed

**Drainage:** Stone drain (made by piercing a limestone block) in the western corner of the basin; the opening of the drain measures 0.16m, tapering to 0.11m (approx.) at the base, forming an irregular hole

**Associated finds:** Unknown

**References:** Betancourt 1988: 211-213

SB7. Zou

**Location on Site:** Room Ma (Room 11)

**Date:** MM IIIB-LM IA

**Construction Materials:** Unknown

**Shape:** Oval

**Dimensions:** Unknown

**Capacity:** Unknown

**Architecture:** Oval basin with upright slabs and a slightly dipped bottom; connected with a small covered drain, which took the liquid in the basin away

**Plaster Lined:** None

**Water Source:** Hand fed

**Drainage:** Small slate-covered drain leads from the basin across the paved floor of the room across the western edge of the room
Associated finds: Part of a clay table and rhyton
References: Platon 1955, 1956

Aqueducts

A1. Gournia
Location: Faneromeni, Asari
Date: Unknown
Construction: Unknown
Potential Length: approx. 7000m
Water Source: Unknown
Associated finds: Unknown

A2. Karphi
Location: Karphi, Lassithi
Date: Unknown
Construction: Unknown
Potential Length: Unknown
Water Source: Unknown
Associated finds: Unknown

A3. Knossos
Location: Approximately 400m south-west of Knossos, running along the western edge of the Vlikhia ravine approximately 150m above sea level
Date: MM
Construction: Rectangular enclosed stone conduit comprised of vertical carved slabs and horizontal slabs with a small channel carved down the centre; internally, the conduit was approximately 0.35m wide and 0.70m deep
Potential Length: Approx. 700m
Water Source: Mavrokolybos spring
Associated finds: Unknown
References: Angelakis et al. 2007: 97-98, fig. 3; Angelakis, Koutsouyiannis, et al. 2012: 233; Evans 1928b: 462-463, fig. 273
A4. Malia

Location: Profitis Ilias, Malia (conjectural)
Date: Unknown
Construction: Unknown
Potential Length: Approx. 2,400m
Water Source: Spring of Profitis Ilias
Associated finds: Unknown
References: Angelakis et al. 2007: 99, fig. 7; Angelakis, Koutsouyiannis, et al. 2012: 233, 236

A5. Mochlos

Location: Unknown
Date: Unknown
Construction: Unknown
Potential Length: Unknown
Water Source: Unknown
Associated finds: Unknown

A6. Tylissos (Fig. 25)

Location: Tylissos
Date: Unknown
Construction: Closed pipes; curved channels; stone conduits
Potential Length: Approx. 1,400m
Water Source: Spring at Saint Mamas, north-west of Tylissos
Associated finds: Terracotta filtration pipes found near the Saint Mama spring; the filter was of a conical shape (height 0.80m, bottom diameter 0.62 m, upper diameter 0.22 cm) and would have been filled with charcoal; aqueduct pipes/conduits are thought to be associated with the filtration basin and cistern at Tylissos and are potentially the source of the cisterns’ water
References: Angelakis et al. 2007: 98-99, figs. 4 -5; Angelakis, Koutsouyiannis, et al. 2012: 233; Sklivaniotis and Angelakis 2006: 660, fig. 1
Dams

D1. Chalinomouri (Fig. 26)

Location: Adjacent to the LM I B farmhouse within a steep-sided ravine

Construction Date: Unknown, possibly LM I B

Construction Method and Materials: ‘Earth dam’ constructed across the ravine creating a reservoir

Dimensions: Unknown

Drainage channels/basins: Unknown

Associated Structures: Located near to the LM I B farmhouse

Associated Finds: Unknown

References: Soles and Davaras 1994: 427; Soles 2003: 104

D2. Choiromandres Valley, Zakros (1) (Fig. 26, 27)

Location: South-east part of the valley of Choiromandres within a rocky ravine with a steep east-to-west gradient

Construction Date: Neo-palatial 1750 – 1430 BC (evidence of Old Palace Period MM I – MM III (1900 – 1700 BC) walls at the upper end of the ravine) MM III-LM II

Construction Method and Materials: Constructed from ‘stout’ megalithic masonry; bridges the gap between the protruding rocks that form the sides of the ravine; water coming down the ravine is ‘caught’ behind the dam; to the east of the dam, a channel formed by the rock funnels excess rainwater back into the ravine beyond the dam

Dimensions: 27m long; 3.1m high; width unknown

Drainage channels/basins: None

Associated Structures:
Inside the ravine, short walls were set up parallel or perpendicular to the streambed, channelling the rainwater and slowing its flow;

Enclosure wall: large megalithic enclosure wall over 540 meters long and 1.20 meters wide, marking out an area of about 35,000 m²; area inside enclosure also includes terraced agricultural land along with the ravine;

Guardhouse: a ‘guard house’ is constructed on a rocky ridge to the southern side of the valley in an area formally occupied by an Old Palace Period open-air sanctuary. This building collapses during the early New Palace Period and is later re-built at the same time as the palace at Zakros;
A further megalithic enclosure wall and small ‘tower-like’ building are constructed on a plateau south-west of the guardhouse during the New Palace Period

**Associated Finds:** A foundation deposit beneath the megalithic enclosure that defined the terraced area on its uphill side (exact location of the deposit is unknown). Deposit consisted of a small storage vase placed in a hollow in the soft bedrock. The vase contained volcanic ash, thought to be Theran.

**References:** Chryssoulaki 2011

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**D3. Choiromandres Valley, Zakros (2) (Fig. 26, 27)**

**Location:** South-east part of the valley of Choiromandres within a rocky ravine with a steep east-to-west gradient

**Construction Date:** Neo-palatial 1750 – 1430 BC (evidence of Old Palace Period MM I-MM III (1900 – 1700 BC) walls at the upper end of the ravine) MM III-LM II

**Construction Method and Materials:** Two megalithic masonry retaining walls which converge, and join, crossing the bed of the ravine to form a dam

**Dimensions:** Unknown length (dam wall formed from length of 540m long enclosure wall); approx. 3m high; 1.2m wide

**Drainage channels/basins:** None

**Associated Structures:**

Inside the ravine, short walls were set up parallel or perpendicular to the streambed, channelling the rainwater and slowing its flow;

Enclosure wall: large megalithic enclosure wall over 540 meters long and 1.20 meters wide, marking out an area of about 35,000 m² (part of this enclosure wall forms the dam); area inside enclosure also includes terraced agricultural land along with the ravine;

Guardhouse: a ‘guard house’ is constructed on a rocky ridge to the southern side of the valley in an area formally occupied by an Old Palace Period open-air sanctuary. This building collapses during the early New Palace Period and is later re-built at the same time as the palace at Zakros;

A further megalithic enclosure wall and small ‘tower-like’ building are constructed on a plateau south-west of the guardhouse during the New Palace Period

**Associated Finds:** A foundation deposit beneath the megalithic enclosure that defined the terraced area on its uphill side (exact location of the deposit is unknown). Deposit consisted of a small storage vase placed in a hollow in the soft bedrock. The vase contained volcanic ash, thought to be Theran.
References: Chryssoulaki 2011

D4. Gournia (1) (Fig. 26)

Location: 90m West of the ‘Shore House’ within a riverbed, approx. 500m north of Gournia

Construction Date: LM I

Construction Method and Materials: Two outer walls of ‘Cyclopean’ boulders packed with sherds, pebbles and stones; on the west bank of the ravine 120m from the present shoreline

Dimensions: Unknown length; 4m wide; 1.4 high (preserved)

Drainage channels/basins: None

Associated Structures: Two series of Minoan (Protopalatial and Neopalatial) stepped terraces to the east of the ravine and perpendicular to it; MM II - LM III ‘Shore House’, coastal fortification walls and ‘tower’ (Protopalatial to Neopalatial) located nearby on the coast to the north-east

Associated Finds: Pottery sherds found within wall fill

References: Watrous 2012: 530

D5. Gournia (2) (Fig. 26)

Location: 90m West of the ‘Shore House’ within a riverbed on the west bank of the ravine 20m south of dam 1; approx. 500m north of Gournia

Construction Date: LM I

Construction Method and Materials: Two outer walls of ‘Cyclopean’ boulders packed with MM III – LM I worn sherds, pebbles and stones

Dimensions: 9.4m long (preserved); 1.9m wide; 1m high (preserved)

Drainage channels/basins: None

Associated Structures: Two series of Minoan (Protopalatial and Neopalatial) stepped terraces to the east of the ravine and perpendicular to it; MM II - LM III ‘Shore House’, coastal fortification walls and ‘tower’ (Protopalatial to Neopalatial) located nearby on the coast to the north-east

Associated Finds: Pottery sherds found within wall fill

References: Watrous 2012: 530
D6. Pseira (‘M9’) (Fig. 26)

Location: ‘Dune Creek’ ravine, in the South-East of the island

Construction Date: LM I

Construction Method and Materials: Stone and soil dam; extending north-south across the ravine; built upon solid outcrop of bedrock at both sides of the ravine; the large stones were bonded together with mud mortar; smaller stones, rubble and wet soil used to hold wall together; crest of dam is slightly curved and finished with flat stones; retaining wall upriver on the north side prevented soil eroding into the catchment basin

Dimensions: 15.5m long; 3.62m high; 2.5m-2.8m wide; approx. 0.5-0.6 million litres reservoir capacity

Drainage channels/basins: No irrigation system; small pool cut into the bedrock of the ravine downhill from the dam

Associated Structures: Seven short walls which cross the ravine would have functioned as small ‘check-dams’ – their lengths vary from 2.25m to 11.02m; a large LM I terrace wall is located approx. 70m south-west of the dam

Associated Finds: Some LM I sherds found inside lower construction of the dam; some amphora fragments (LM III) found uphill of the dam (similar in shape and fabric to sherds found in Building DA at Pseira)

References: Betancourt 2012: 24-51

D7. Pseira (‘M29’) (Fig. 26, 28)

Location: ‘Middle Creek’ ravine, in the South-East of the island; approx. 450m north of ‘Dune Creek’

Construction Date: LM I

Construction Method and Materials: Stone and soil dam; extending north-south across the ravine; built upon solid outcrop of bedrock at both sides of the ravine; the large stones were bonded together with mud mortar; smaller stones, rubble and wet soil used to hold wall together; crest of dam is slightly curved and finished with flat stones; retaining wall (8-10m long) on the eastern side of the catchment basin

Dimensions: 11.85m long; 2.7m high (preserved) 3.6m (restored); 2.9m-3.1m wide; approx. 0.3-0.4 million litres reservoir capacity

Drainage channels/basins: No irrigation system
**Associated Structures:** Four short walls which cross the ravine (three upstream of the dam, one downstream) would have functioned as small check-dams – their lengths vary from 3.76m to 9.46m; a large LM I A terrace wall (G2) is located uphill of the dam is an extension of an earlier MM terrace wall

**Associated Finds:** 59 pottery fragments (LM I) from inside of wall fill

**References:** Betancourt 2012: 24-51

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**Large Scale Drainage Systems**

**DS1. Aghia Triadha**

**Locations on Site:** Within the main villa and also present within the town

**Brief Description:** Substantial system throughout the majority of the site; use of main drains and tributary systems to carry away rainwater from open areas; some vertical drains used to remove sewerage from ‘toilets’ into larger sewerage drains

**Date range:** MM IIIB – LM IB

**Types of Drainage System in use:** Open and closed stone conduits; terracotta conduits; vertical drainage shafts

**Materials used:** Stone; terracotta

**Filtration Systems and/or sedimentation tanks:** Yes; sedimentation tank (1.5 x 2 m²)

**Hydraulic Cement:** Unknown

**References:** Angelakis et al. 2005; Chatzakis et al. 2006: 758; Shaw 1973: 131

**DS2. Gournia**

**Locations on Site:** Within the palace; channels at street level; many drainage channels directly associated with houses

**Brief Description:** Use of drainage channels (covered and uncovered) in streets and within the palace and workshops; use of main drain and tributary systems; suggestion that drainage channels and spouts were associated with roof drainage; supply of straight terracotta drains left stacked against the wall of a storeroom within the palace

**Date range:** LM I

**Types of Drainage System in use:** U-shaped drainage channels; drainage spouts; ‘splayed drains’

**Materials used:** Terracotta; stone

**Filtration System and/or sedimentation tanks:** None
**Hydraulic Cement:** Unknown

**References:** Shaw 2004: 182; Soles 1991; Lenuzza 2013: 85

**DS3. Kato Zakros (Fig. 32)**

**Locations on Site:** Throughout the majority of palace including the East wing, West wing and South wing

**Brief Description:** Extensive system throughout the majority of the site; use of main drains and tributary systems; drains carrying rainwater away from open areas, such as light-wells and roof tops; some drains used to remove sewerage from ‘bathrooms’ into septic pits outside the walls of apartments; some drainage in workshop areas supplying water to the area; drainage runs both under flooring and at surface level; potential use of pressurised piping system using tapered terracotta pipes

**Date range:** LM IA – LM IB

**Types of Drainage System in use:** U-shaped clay conduits (open and closed); small open stone channels; stone trough shaped drains; terracotta pipes; vertical drains; zoomorphic drain heads

**Materials used:** Dressed stone; limestone blocks and slabs; terracotta

**Filtration System and/or sedimentation tanks:** None

**Hydraulic Cement:** None

**References:** Shaw 1973, Shaw 2004; Platon 1971: 222-225

**DS4. Knossos (Fig. 29)**

**Locations on Site:** Throughout the site; substantial system in Domestic Quarter and adjoining Halls; system present at the Caravanserai and in several Houses surrounding the palace.

**Brief Description:** Substantial drainage system throughout the site, but particularly complex systems in the domestic quarter of the palace. Use of a main drain and tributary systems; drains carrying rainwater away from stone courts and open areas and roof tops; use of parabolic curves and sedimentation tanks; some drains used to remove sewerage from ‘bathrooms’ and workshop areas; drainage runs both under flooring and at surface level; potential use of pressurised piping system using tapered terracotta pipes; possible use of conduits and channels to bring fresh water into the site via aqueduct; kouloura in West court likely used as blind wells, absorbing excess water from courts before the drainage system was fully established.

**Date range:**
Phase 1: MM IIA
Phase 2a: MM IIIA
Phase 2b: MM IIIB
Phase 3: Post LM I

**Types of Drainage System in use:** Stone U-shaped channels (covered and uncovered); runnels; terracotta pipes; vertical stone ducts

**Materials used:** Stone slabs; ashlar masonry; gypsum slabs; limestone slabs; terracotta

**Filtration System and/or sedimentation tanks:** Yes; ‘sedimentation tank’ present at the bottom of a runnel which flows down a staircase

**Hydraulic Cement:** Yes; evidence of its use throughout the system


**DS5. Malia**

**Locations on Site:** Within the Palace - Central Court, East Wing, Magazines

**Brief Description:** Open and closed drainage channels within the palace; some evidence of roof drainage

**Date range:** MM I – LM III

**Types of Drainage System in use:** U-shaped drainage channels; flat ended drains; elbow shaped clay pipes; terracotta pipes; plaster drains

**Materials used:** ‘Plaster drains’ (unique to Malia); terracotta; stone

**Filtration System and/or sedimentation tanks:** None

**Hydraulic Cement:** Unknown

**References:** Lenuzza 2013: 85

**DS6. Myrtos-Pyrgos**

**Locations on Site:** Around the entrance to the site as well as on the north slope near Cistern 2 (C6).

**Brief Description:** Several sections of U-shaped drainage channels, some of which are associated with both cisterns on the site; rectangular channels with removable tile-lids; some drains are painted with LM I motifs; evidence for roof drainage and roof spouts

**Date range:** MM II-III – LM I

**Types of Drainage System in use:** Open U-shaped channels and conduits; roof spouts; painted drains and drain-lids

**Materials used:** Stone
Filtration System and/or sedimentation tanks: None
Hydraulic Cement: Unknown
References: Cadogan 1978b: 83; Lenuzza 2013: 87

DS7. Palaikastro
Locations on Site: Sections found around the site, in open areas and between buildings; also found around the Harbour Road
Brief Description: Sections of drainage found throughout the site including open conduits and channels, stone water spouts and vertical drainage channels linked with draining roofs. There are a number of unique elements including ‘bell-shaped’ joining elements.
Date range: LM I – LM III
Types of Drainage System in use: U-shaped open channels and conduits; flat ended drains; unique ‘bell-shaped’ element joining horizontal and vertical drainage channels; stone water spouts; clay pipes
Materials used: Stone; terracotta; clay
Filtration System and/or sedimentation tanks: None
Hydraulic Cement: Unknown
References: Lenuzza 2013: 85; Shaw 2004: 186

DS8. Petras
Locations on Site: Central court of palace
Brief Description: A substantial drainage system thought to have aided the removal of rainwater from the rooftops surrounding the central court:
MM IIA system: one branch runs north at the base of the western wall underneath the surface of the court and drains to a U-shaped stone drain at the monumental staircase; a second branch, a slab-covered drain under the plastered court, runs eastwards culminating at a retaining wall into a large terracotta spout
LM IB system: shallow channels in the plaster of the floor of the court – one heading north, descending below the surface of the court and into the old U-shaped stone drain, the other runs eastwards
Date range: MM IIA – LM IB
Types of Drainage System in use: Rock cut channels; terracotta pipes; U-shaped stone spouts and drains; channels
Materials used: Stone, terracotta
Filtration System and/or sedimentation tanks: None
Hydraulic Cement: Unknown
References: Tsipopoulou 2003: 44-51; Tsipopoulou 2007: 51-54

DS9. Phaistos

Locations on Site: Within the palace
Brief Description: Drainage systems found in places throughout the palace, both open and closed conduits; also evidence for drainage from rooftops using water spouts and vertical drainage channels
Date range: MM IB- MM III
Types of Drainage System in use: U-shaped terracotta drains; vertical and horizontal drainage channels; splayed-end clay drain; terracotta pipes
Materials used: Stone; clay; terracotta
Filtration System and/or sedimentation tanks: None
Hydraulic Cement: Unknown
References: Lenuzza 2013: 85

DS10. Tylissos (Figs. 25, 31)

Locations on Site: North-eastern corner of the settlement around House B and C
Brief Description: Closed conduits and pipes found around the area of the cistern; sophisticated filtration system linked with the transportation of water via conduits from a remote water source (see C8 above); some clay pipes (leaving a shallow pit) found near House B
Date range: LM IIIA – LM IIIB/C
Types of Drainage System in use: Closed conduits; terracotta pipes; conical pipes
Materials used: Stone; terracotta
Filtration System and/or sedimentation tanks: Filtration tank located next to cistern: water passed through a rectangular basin (1.49m x 1.82m) before being piped 11.43m into the cistern itself
Hydraulic Cement: Unknown
References: Hazzidakis et al. 1934: 57, 62-64
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