DEMONSTRATION AND ANALYSIS OF TANGIBLE HERITAGE MANAGEMENT STRATEGY USING GEOGRAPHICAL INFORMATION SYSTEMS FOR THE CITY OF AL-AIN, UNITED ARAB EMIRATES

A Thesis

by

AZZA HASAN AL ZAABI

Submitted to the Office of Graduate Studies of
Texas A&M University
in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE

August 2006

Major Subject: Architecture

DEMONSTRATION AND ANALYSIS OF TANGIBLE HERITAGE MANAGEMENT STRATEGY USING GEOGRAPHICAL INFORMATION SYSTEMS FOR THE CITY OF AL-AIN, UNITED ARAB EMIRATES

A Thesis

by

AZZA HASAN AL ZAABI

Submitted to the Office of Graduate Studies of
Texas A&M University
in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE

Approved by:

Chair of Committee,	Valerian Miranda
Committee Members,	Douglas Wunneburger
	Guillermo Vasquez de Velasco
	Tazim Jamal
Head of Department,	Mardelle Shepley

August 2006

Major Subject: Architecture

ABSTRACT

Demonstration and Analysis of Tangible Heritage Management Strategy Using Geographical Information Systems for the City of Al-Ain, United Arab Emirates. (August 2006)

Azza Hasan Al Zaabi, B.S. Arch. Engg., United Arab Emirates University

Chair of Advisory Committee: Dr. Valerian Miranda

The United Arab Emirates (UAE) is focusing on towards two paradoxical directions especially after the oil-boom. The first is the contemporary architectural development, while the second is the conservation of traditional dwellings and historical sites in the country. It is obvious that the management and planning towards the first direction are fully integrated and highly précised to be implemented efficiently, thus, unveiling a new façade of contemporary lifestyle to the world. But the second direction is lacking good strategic efforts for conservation, preservation methods and tourism promotion, especially among different authorities that are in charge of either management or implementation of conservation techniques. Therefore, the country started looking for solutions that initiate the right management strategy to be followed and improve the use and promotion of tangible heritage. In this research, I am taking the case of the city of Al-Ain since it has started taking the path and has established an agreement with UNESCO. Geographical Information Systems is used in this research as

a tool to implement the major objectives and solutions for issues discussed in the agreement.

In this research, the main issues that were discussed in the agreement were segregated and studied separately in terms of geographic extent, then, spatially represented on the map. Furthermore, they were analyzed using the different techniques in the Geographical Information Systems software ArcGIS to demonstrate each issue and problem and study its expected results. It was clear from this research that these issues were clearly presented using the software and will aid in the decision making process, especially for stakeholders and different entities in the city of Al Ain.

DEDICATION

To the soul of my father;

to my mother;

to my siblings Laila, Ahmad and Mona

In appreciation of their considerable love and support

AKNOWLEDGMENTS

I would like to thank my committee chair, Dr. Valerian for his great support and patience and my committee members, Dr. Douglas, Dr. Tazim and Dr. Guillermo, for their encouragement and guidance throughout the course of this research.

I have to thank my friends back in the United Arab Emirates who were supportive of all my academic time at Texas A&M University, as well as, my friends in Texas who never left me alone and have always been there when I needed them.

I would love also to thank my wonderful mother, who sacrificed a lot and has always been there for me thousands miles away, yet I never felt the distance because of her encouragement. My elder sister Laila, younger brother Ahmad and my youngest sister Mona were always around supporting and patient, thank you.

Finally, to the soul of my father who used to pray for us in his lifetime, I am thankful for the great inner support it gave me.

TABLE OF CONTENTS

CHAPTER Page

LIST OF FIGURES

FIGURE Page

LIST OF TABLES

CHAPTER I

INTRODUCTION

Management of indigenous artifacts and the conservation of Tangible Heritage (TH) has become one of the most conspicuous concerns in the modern era. This issue is highly controversial because of rapid growth in urban areas. This growth hinders the cultural values and changes the identity of the buildings in affected countries. In the Arabian Gulf region, particularly in the United Arab Emirates (UAE), heightened awareness of urban heritage has been visible since the late 1980s (Bussaa, 2002). It can be argued that urban heritage and its tangible heritage and culture can only be conserved for future generations if appropriate urban conservation and management strategies are well developed and implemented.

1.1. Tangible Heritage (TH) definition

The International Council on Monuments and Sites (ICOMOS) stated that the Tangible Heritage encompasses a broad concept including all historic places, sites, built environments and assets, as well as landscapes; All of which represents past history and encompasses the identity and culture of the place (Cros and McKercher, 2002). Therefore, the management of such heritage is crucial and has become one of the most important issues to be addressed in the UAE. There are a large number of important historic relics in the region of UAE that need to be managed and conserved; this study is

---

This thesis follows the style of the Journal of *Geographic Information and Decision Analysis (GIDA)*.

concerned with the cultural heritage and historical assets particularly in the city of Al-Ain. They need illustration through studies and pilot projects, showing how conservation projects or tourism promotion and economical development of those assets cannot be separated from an efficient management strategy that needs to be processed in the society in which it takes place.

1.2. Al Ain Tangible Heritage

Al-Ain is considered the largest city in the eastern region of the United Arab Emirates; the city covers an area of 700 sq. km (270.27 sq. miles) while Al-Ain region covers 13,000 sq. km (5019.32 sq. miles) with a total population of 382,625 (Al-Ain Town Planning Department census, October 2001), it is also notable that the city is known as the Garden City of the UAE (Figure 1).

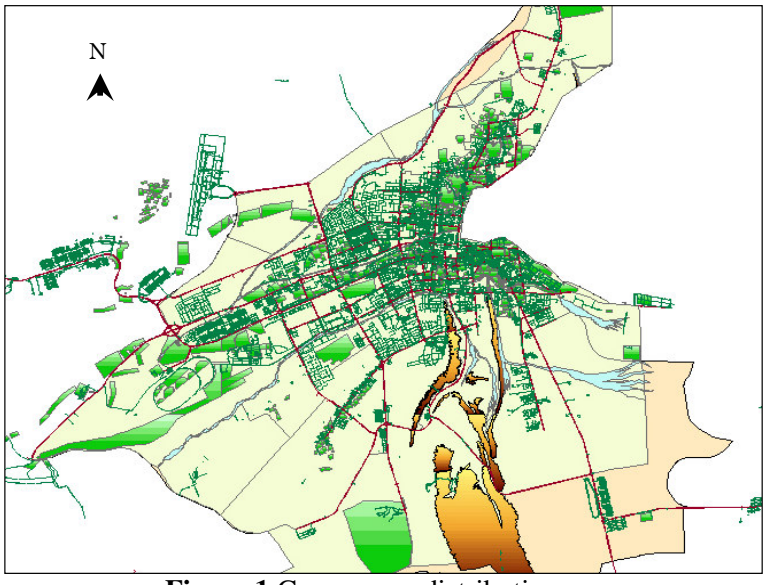


Figure 1 Green areas distribution

Attractions in the Al-Ain region include the Hafeet Mountain region, which draws the border with Oman from the southern edge, as well as archeological sites together with cultural and historical buildings scattered throughout the city. Collectively these make up the region's Tangible Heritage fabric, which will be illustrated in the next few pages.

1.2.1. Hili culture

The first inhabitants in the country existed before Islam namely the: Stone Age 6000-3200 BC, the Bronze Age 3200-2700 BC, the Iron Age 1200-300 BC, the Hellenistic era 300BC- 300AD and the pre-Islamic Period 300-600 AD. According to studies and excavations in archeological sites, Hili relics located in the city of Al-Ain date back to about 10,000-8,000 years ago and culminated around 6,500 years back (refer to Figure 2). These artifacts represent the humanitarian interlock between people who lived in the country and the available resources available at the time to build shelters. The discipline of architecture shows evidence that the main objective of these ancient peoples was to create enclosure in which to survive (Cleuziou, S. 1981).

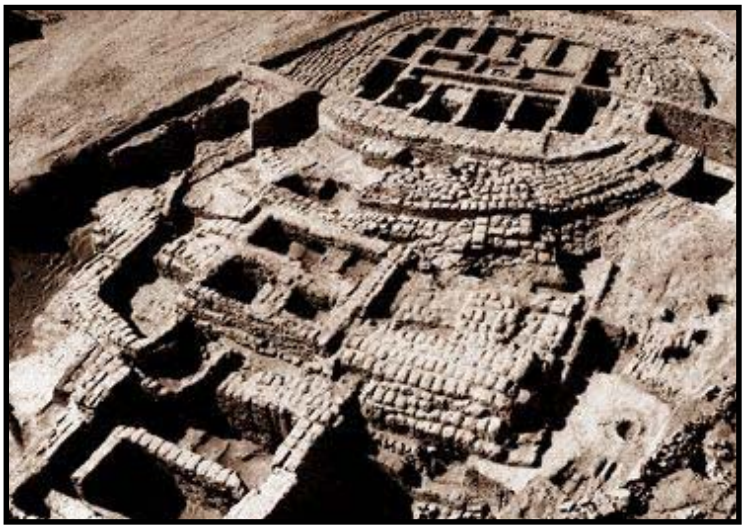


Figure 2 Hili archeological sites 3000 BC
Image credit: http://www.aam.gov.ae/sections/images/arc/hili8.jpg

Because of the availability of the stones and mud bricks used in construction along with the weather conditions, those settlements spanned well over thousands of years of continuous occupation (Figure 3). In 1980-1981, a French archeological crew discovered that these dwellings consisted of two towers, rooms and walls. It was thought that this unique architectural style, as defined by circular tombs and circular homes especially at that time of the Hellenistic era, were designed to increase enclosure space (Cleuziou, S. 1981).

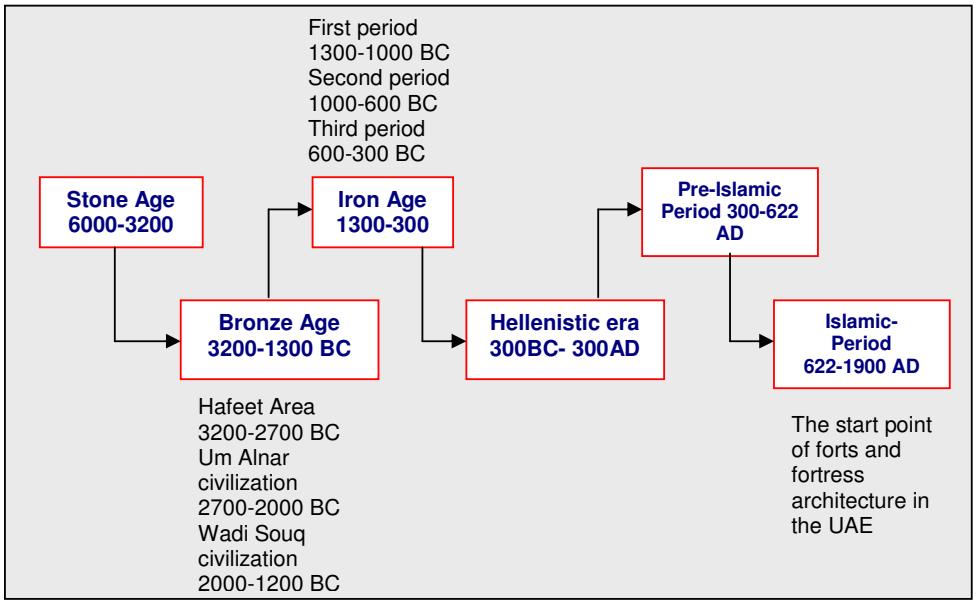


Figure 3 Chronology of periods participated in the architecture transformation in Al Ain. (Yasin, W., 2005)

Researchers and archeologists chasing the results of excavations at the Hili site in Al-Ain have noticed that most of the tombs were of beehive-shaped and constructed of stone. The size of the tomb revealed an interesting status of tribes and people living at that time, as it was suggested to be a building for highly religious administrative importance. In addition to that, the findings of almost 600 pottery vessels with distinctive paintings are good evidence of the living conditions at that time (Zutterman, C. 2004). From the Hili culture to the Bronze Age a noticeable change took place in the buildings, and the later use of camels among nomads or *"bedu"* for traveling reasons, necessitated the adding of an attachment to the houses for animals. Furthermore, the

harsh weather conditions and the materials available for construction of their enclosures resulted in a distinctive architectural style.

1.2.2. Hafeet Mountain

Hafeet Mountain is the highest mountain in the UAE and reaches almost 1350 meters above sea level (http://www.alain.gov.ae/abed3.htm). The mountain is the westernmost outlier of Hajar mountain range, overlooking Al-Ain city and the Buraimi Oasis.

It has many significant features and is rich in natural resources. The burial tombs around the foot of the mountain, which date back to the 4000 BC, represent the only remaining ruins of the peninsular civilization.

Geologically, Hafeet Mountain is of great importance due to the combination of rocks that are free of plants, and the fact that it contains ancient archaeological remains left by man around 5000 years ago. Archaeological surveys proved that there are around 500 burial tombs distributed between two zones. Generally, the burial tombs around the foothill of the mountain and the ancient fossil bearing caves at the summit indicate that the area is of tremendous cultural and archaeological significance. It is also of significant geographic importance as it outlines the borders between Al-Ain city and Oman (Yasin, W. 2005).

1.2.3. Forts and historical buildings

1.2.3.1. Hili Fortress (1500 AD)

Hili Fortress is one of the first constructed forts in the city, and is actually located inside a farm nearby the archeology site. The significant level of deterioration and loss of

some parts indicates the high risk of further loss and the urgent need for preservation (refer to Figure 4).

Figure 4 Hili Fortress (1500 AD)

1.2.3.2. Al Rumeilah Fort (1845 AD)

The Al Rumeilah fort is a small walled structure with interesting architectural features, and is located in a residential area in the northern suburbs, near Rumeilah community. It is also the first known Iron Age settlement excavated on a large scale in the UAE. According to the UAE Interact, "The site consists of a series of mudbrick buildings, some of which are so well preserved that their roofs are still intact" (UAE Interact www.uaeinteract.com/culture/al_ain.asp), it is a two story building surrounded with a huge wall (Figure 5).

Figure 5 Al Rumailah Fort (1845 AD)
Image credit: http://www.alamuae.com/uae/topic/img/alain_002.gif

1.2.3.3. Al Muraijib Fort (1816 AD)

The Al Muraijib Fort consists of a main fort, a smaller fort and a watchtower, surrounded by a formal park and children's playground. Located on Al Jimi St, several kilometers northwest of the city center on the northeastern part of Al-Qattarah district. It is considered one of the oldest citadels of Al Nahyaan tribe or the royal family. The design is of architectural significance as it has a monitoring square tower located on the northwestern edge and another cylindrical tower by the southeastern side of the citadel. The Muraijib citadel is also a two-story building, which was somewhat unique at time. Its sprawling 66 rooms were supplied with wooden ornaments for the windows screening "arabesque" and some wooden logs used to support the ceilings were imported from India (Figure 6).

Figure 6 Al Muraijib Fort (1816 AD)

1.2.3.4. Al Aanqah Fort (1830 AD)

The Al Aanqah Fort is a very old fort of a rectangular shape located in Al Anqah area, which is 55 km away from Al-Ain city towards Abu Dhabi. Its fame derived from the Anqah Battle, which took place between tribes of that region (Figure 7).

Figure 7 Al Aanqah Fort (1830 AD)

1.2.3.5. Mazyad Fort (1846 AD)

Figure 8 represents the restored Mazyad Fort located in the Mazyad rural district. It was built of mud brick walls with battlements and watchtowers surrounding a courtyard, and is a rectangular building with three cylindrical towers and one square two-story tower.

Figure 8 Mazyad Fort (1846 AD)

1.2.3.6. Al Jahili fortress (1898 AD)

The biggest fortresses in the city of Al-Ain is the Al Jahili fortress, with its unique architectural style built by His Highness Sheikh Zayed Bin Khalifah Al Nahyan (Zayed I) in 1898 AD, during his presidency period from 1855-1909 AD (Figure 9).

Figure 9 Al Jahili Fortress (1898 AD)

1.2.3.7. Eastern Fort – Sultan's fort (1907 AD)

Referring to Figure 10 the eastern fort, otherwise known as the Sultan's Fort was built by the presidency period of H.H. Sheikh Sultan Bin Zayed Al Nahyan. It is adjacent to the Eastern Citadel and due to its importance was restored in 1969 before building the Al-Ain Museum beside it.

Figure 10 Eastern Fort – Sultan's Fort (1907 AD)
Image credit: www.uaeheritage.com

1.2.3.8. Eastern Citadel (1910 AD)

The Eastern Citadel was also built by H.H. Sheikh Sultan Bin Zayed Al Nahyan and is located in the center of downtown Al-Ain. As shown in Figure 11, three watchtowers surround this building and the wooden door has huge pointed semi – nails exposed. The battlements on the wall as well as the small openings lined in it were used for defense purposes in battles and wars times. There are also some rooms inside with a courtyard and water well.

Figure 11 Eastern Citadel (1910 AD)
Image credit: http://www.asiatravel.com/uae/gifs/estrn.jpg

1.2.3.9. Al Qattarah Fort (Bin Aaty House) (1925 AD)

Excavations of the Al Qattarah fort or Bin Aaty House located beside Al Darmaky Fort were carried out by an Iraqi team in early 1970s where a tomb was discovered that dates back to the second millennium BC (refer to Figure 12).

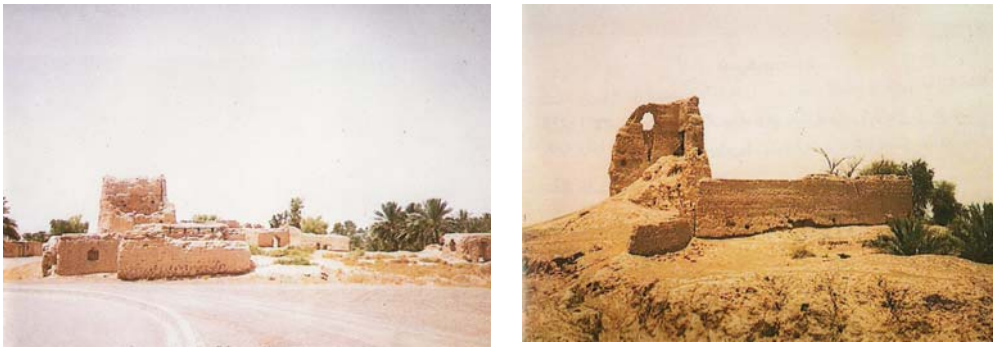


Figure 12 Al Qattarah Fort (Bin Aaty House) 1925 AD

1.2.3.10. Al Darmaky House (1925 AD)

The Al Darmaky house is located on a hilly site, and is supported with two towers one of which is for residential purposes. This residential tower includes some rooms and a water-well centered in the courtyard, which is considered a distinguishing element of that time (Figure 13).

Figure 13 Al Darmaky House (1925 AD)

1.2.3.11. Al Muwaiji Fort/Palace (1946 AD)

The Al Muwaiji Fort/Palace comprises a main fort and a mosque that was recently constructed. The site comprises the main fort and a reconstructed mosque and is surrounded by three watchtowers and walls of 5 meters height. As shown in Figure 14, the fort has three towers and a residential building. The current president of UAE H.H. Sheikh Khalifah Bin Zayed Al Nahyan was born in this palace.

Figure 14 Al Muwaiji Fort / Palace (1946 AD)
Image credit: http://www.uaeheritage.com/4images/details.php?image_id=14

1.2.3.12. Al Murabba Fort (1948 AD)

The Al Murabba Fort was named for its unique shape; in Arabic, Murabba translates to square. This square-shaped fort is located in the center of the Al-Ain business area, and was built by H.H. Sheikh Zayed Bin Sultan Al Nahyan, the first president of UAE. At some period of time it was used as the police headquarters with a prison attachment (refer to Figure 15). (UAE Interact)

Figure 15 Al Murabba Fort (1948 AD)
Image credit: http://www.uaeheritage.com/4images/details.php?image_id=443 (1948 AD)

1.3. The development of the agreement

It is apparent that some of those buildings were well preserved and maintained that they still keep their authentic image and identity in our ancestors' schemata, old images are not differing than the present status of those we pass by frequently; despite the urban growth they face, their management and improvement was to some extent successful like the case of Al Muraba'a Fort that lies in a hyper zone of the city, as well as Al Jahili Fort which has been embraced by a public garden for its attractiveness, location and historical value. However, other assets like Al Rumailah Fort, Al Qattarah Fort, Al Darmaky House and some Hili Archeological remains and the forts are striving to live against the time wheel, weather factors, the sometimes trivial maintenance and the abandonment of the different entities in charge of taking care, managing and improving them, whether from public sector or private.

Although Hili Archeological Site has been represented in a way as to capture tourists and visitors to the site, the issue of representing its culture, history and even different settlements in the city didn't go beyond the conventional methods, such as surrounding it with public gardens and fencing the inside tombs.

When thoughts and needs to create an authority for cultural heritage management and tourism promotion appeared on the horizon, the intention was to manage those buildings before they further deteriorate due to the lack of expertise and the conflicts between the urge to develop the city and to preserve those assets. Dr. Mounir Bouchenaki UNESCO Assistant Director General for Culture proclaimed that there is a good opportunity for the UNESCO to establish a protocol with the Tourism Authority to promote, develop, preserve and enhance the use of the cultural sites.

As a result on May 25th 2003, the Al-Ain Economic Development and Tourism Promotion Authority (AAEDTP) established an agreement with the United Nations Educational, Scientific, and Cultural Organization (UNESCO) (Kazmi, A. 2003). The main goal of this agreement was to create and implement a strategic plan for the documentation, preservation and management of historical and archeological sites in the city. From this agreement, tasks will be designated to different participants in charge of the implementation of this strategy. Because management strategies are better understood and implemented if they were demonstrated with high precision and quality, these tasks will be determined by current studies from different specializations (Nahar, A., 2005).

CHAPTER II

PROBLEM STATEMENT

The documents of the agreement between the UNESCO and the AAEDTP declared that the first step to accomplish the desired tasks and initiate the objectives and issues of the management strategy required investigation process, which has since been carried out by a crew of experts from fields of cultural heritage. This team consisted of a conservation expert, a museum specialist, a human resources expert, an urban planner, a landscape architect, a cultural legislation expert, a cultural tourism expert, an education expert, a cultural heritage inventory expert, and an expert in the promotion on cultural heritage in the media. They were able to address the following major issues and problems from current observations and latest studies upon the sites:

1. Some of the Tangible Heritage buildings are suffering from deterioration status that is apparently getting worse due to time and neglect; therefore, efforts should be taken to guard and maintain these buildings.

2. Defining the cultural areas would promote the tourism of the city, yet it requires defining the methods to promote and what to promote.

3. Because of lack of collaboration between stakeholders and decision makers regarding the town development and the cultural heritage preservation, the creeping movement of the urban context has infringed upon those heritage masses. Therefore, a strategy needs to outline the bylaws and tasks to be undertaken for the long-term sake of the tangible heritage.

4. There is a general lack of awareness among the civil society and little efforts have been accomplished towards the preservation process. Therefore, an adequate management should take place for the intention of protection and reasonable usage.

5. There is a lack of comprehensive database and record for the cultural built heritage that meets the international standards. Such information would enhance the decision making process.

6. There is a real need for a clear legislative board and management strategy that meets the up-to-date changes in the Cultural Built context.

7. There is a need to record and collect the required information about the different sites for reference and record them in the World Heritage Record

8. There is a need for "local" experts available to identify the entailed problems in their area (The Al-Ain Cultural heritage Management Strategy, February 2005). The above-mentioned problems help clarify the real objectives of the research. Because GIS has been widely used in solving, economical, political, agricultural, historical, architectural and many other disciplinary problems, it was chosen as a helpful tool to lesson the risk of failure in future management and investment projects for the country.

2.1. Using the GIS for strategy implementation

It is critical to demonstrate a management system using GIS tools particularly with the presence of the many culturally built masses in Al-Ain, which adopts buildings dated

back to earlier than 2000 BC, as well as traditional buildings because GIS spatial analysis is a strongly utilized tool, which carries out the modeling process and eases the understanding of the Emirates architecture through the management strategy. Furthermore, it will greatly reduce the amount of time spent in analysis and decision-making. In this project, variables were defined and extracted from the Management Strategic Plan, incorporated with the related attributes in the maps, and processed by means of spatial analysis.

Using the Geographic Information Systems (GIS) as a management tool will create a clear strategy to be followed by governmental, private and non-profit sectors towards the preservation of the treasures in Al-Ain, the city hosting the future Regional and Planning Center (The Al-Ain Cultural heritage Management Strategy, February 2005).

2.2. The hypothesis

If a GIS system is appropriately developed to incorporate all the necessary information, then; it can become the primary tool to demonstrate the heritage management strategy. This in turn will aid different agencies to the full understanding of the current situation and set of data supplied, hereafter; efficient decisions will take place in accordance to the dynamic solutions represented spatially.

In most managerial strategic projects, identifying issues and problems is an important phase in addressing the priorities, tasks to be followed and then projects to be implemented. In this research, defining the different assets within the issues was a

critical first step. These assets were then demonstrated with respect to their locations and categories on the map and analyzed using the GIS software. Research methodology and procedure hierarchy were as follows:

1. The agreement was studied to be able to define the different issues discussed within its articles.
2. The major issues were segregated into categories for investigation such as (historical sites, cultural heritage buildings, the preservation tasks, the tourism routes, the economical impact, zoning specific functions to take place…etc.)
3. The issues were demonstrated with respect to the major objects involved in the GIS software and the outcomes were analyzed.

Accordingly, the research objectives were addressed as follows.

2.3. Research objectives

1. Define the different issues derived from the strategic plan between the UNESCO and Al Ain Tourism Authority.
2. Classification of cultural and historical sites and assets to assign desired projects to different governmental authorities.
3. Demonstration of the management strategy with respect to the defined issues using the Geographical Information Systems, and these issues are:
    - Historic preservation
    - Tourism promotion
    - Public awareness

- Protection of Tangible Heritage

4. Analysis of the outcomes from the demonstrated management strategy.

2.4. Significance

The implementation of GIS on architectural relics by referring to historical data in conjunction with the modeling method and spatial analysis technique will enable different preservation, planning and conservation firms to make good choices. As a result, it will increase the possibilities of building a management network/system that interacts among those firms to avoid double mistakes, conflicts and predict financial income better in respect to tourism or local use of the buildings.

The use of GIS in any interdisciplinary project is beneficial, because it enables the researcher to measure and evaluate the available criteria, implement them on specific problem and then analyze the results. According to the literature and studies among several cases presenting the use of GIS in different ways, it is obvious that its use is open ended. This is an advantage that leads to multi-directional discussions among different firms looking for one unified strategy.

As has been explained in the introduction, the inadequate representation of Al-Ain heritage was the main motive for the establishment. The following are the benefits and outcomes that encourage local authorities to implement the strategy as soon as possible:

1. It would enable the city to reveal its cultural identity through the process of conservation and the development of its resources.

2. It is beneficial in the role it will play in the economical sector for its essence, as Cultural Resources will participate in different ways to achieve such a target.
3. It would enhance understanding of historical assets and their individual circumstances and is an essential need due to its ability to draw a better understanding of the current and future architectural settings. (The Al-Ain Cultural heritage Management Strategy, February 2005)
4. It will bring balance between the preservation of Al-Ain city historical assets and cultural buildings and the rapid development of its urban fabric.

It will identify cultural heritage areas, thus, visitors will be able to better recognize them within the urban context and define and target the newly developed cultural heritage zones.

2.5. Scope and limitations

The application of the management strategy is mainly built upon the aspects defined by the agreement, which in this research was segregated as separate variables and procedures represented on different map layers. There are a certain amount of techniques that served in the implementation of the strategy. However, due to software failure that sometimes occurs, some of the techniques were found difficult to be represented. This will be discussed in certain parts of the research with thorough explanation, although the concepts were carried out to a clear end and analysis for better decision making.

CHAPTER III

REVIEW OF RELATED LITERATURE

Defining the term "Geographic Information Systems" (GIS) has never been satisfactory as it entails different perspectives according to its functionality and importance. "the Label GIS is attached to many things: amongst them, a software product that one can buy from a vendor to carry out certain well-defined functions; digital representations of various aspects of geographic world in the form of datasets, a community of people who use these tools for various purposes; and the activity of using GIS to solve problems or advance science" (David et al., 2001). Therefore, the meaning of the GIS, as represented in Table 1, depends on the context in which it is used.

Table 1 Geographic Information Systems (GIS) definitions

Table 1.3. Definitions of a GIS, and the groups who find them useful

a container of maps in digital form	the general public
a computerized tool for solving geographic problems	decision-makers, community groups, planners
a spatial decision support system	management scientists, operations researchers
a mechanized inventory of geographically distributed features and facilities	utility managers, transportation officials, resource managers
a tool for revealing what is otherwise invisible in geographic information	scientists, investigators
a tool for performing operations on geographic data that are too tedious or expensive or inaccurate if performed by hand	resource managers, planners, cartographers

Yet, more generalized definition of GIS is: relational databases that are combined with spatial interpretation for analysis to be conducted upon, which is represented in the form of a map. *"A more elaborate definition is that of computer programs for capturing,*

storing, checking, integrating, analyzing and displaying data about the earth that is spatially referenced." Driven from its essence, researchers around the world within the realm of GIS Applications have brought out the best of this cross-disciplinary field to serve in business, military science, natural sciences, public health and medicine, education and much more, yet architects, planners and decision-makers consider it an essential tool to develop appropriate approaches for the implementation of management strategies. The conservation, development, preservation and tourism promotion of historical and cultural sites and assets requires a deep understanding and knowledge to allocate technology for them to be accelerated. Article 5 of the Convention of the World Heritage states that parties to the convention must endeavor to *"take appropriate legal, scientific, technical, administrative and financial measures necessary for the identification, protection, conservation, presentation and rehabilitation of this heritage."* (Box, P. 1999). Thus, experts from different fields collaborating in the implementation of a strategic plan will require updates for the input-output ongoing process to make a final decision of their projects. For this reason, GIS is a successful choice for its essence that matches their requirements and stakeholder defined priorities and issues.

3.1. Importance of GIS in management strategy implementation

GIS enables the definition on a map of Real World Features that have geographical attributes and spatial data. It also defines entities that do not have coordinates and dimensions, such as population, age, ownership…etc. and this method of recording the non-spatial data on a spatial location is called "Geo-coding" or "spatial referencing".

This technique was used in completing this research. Although the use of GIS to implement a strategic plan in terms of software requirements, data preparations, staffing commitments…etc. requires large expenses, the benefits of its use are difficult to asses in terms of numbers (Al Hassan and El Kadi, 2002). But the importance of such application justifies the expenses. These unique benefits include the following:

1- Data accessibility and retrieval
2- Up-to-date databases (such as census data upgrading, topographical changes…etc.)
3- Spatial and non-spatial data manipulation and representation
4- Vast analysis techniques that differ in level of difficulty depending on the requirements of the decision makers.
5- It's compatibility with different data formats in terms of input, (satellite images, maps drawings, excel worksheets). (Box, P. 1999)

Furthermore, it will enable decision makers to understand, have clearer vision, and improve specific area under investigation. Assertions were made by experts that geography is a factor in almost everything. (David et al., 2001)

3.2. Data requirements within the GIS environment

The GIS is used to compile numerous types of attributes or data including aerial photos, topographical maps, hydrological maps, census data, natural resources, easements, historic photographs …etc. in this way, it is much easier to gather, store, display and analyze data to get the acquired information. However, the type and amount of data

required depends mainly on the project needs and the owners' demands. Figure 16 illustrates the required datasets to accomplish a GIS project:

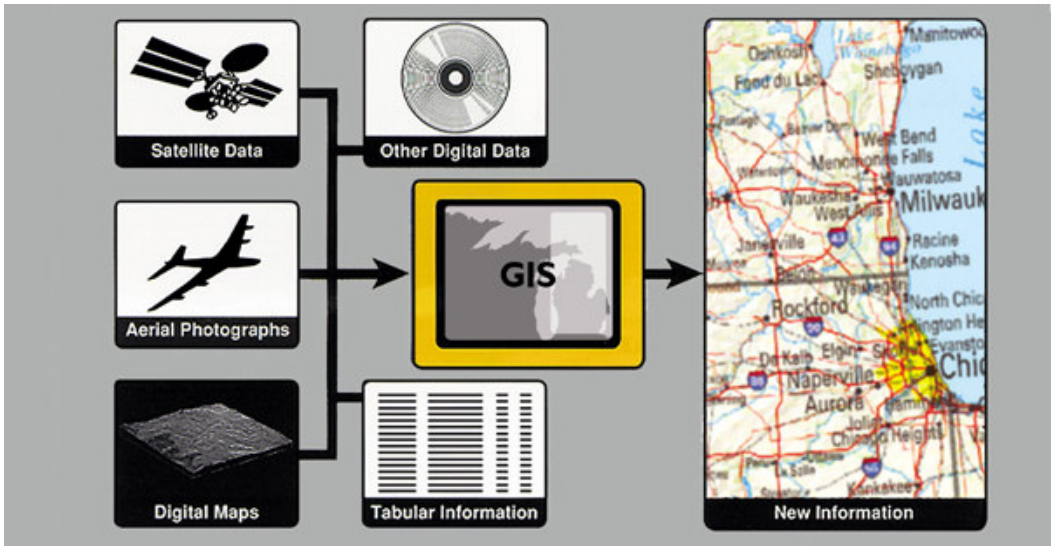


Figure 16 Data types requirements with a GIS system
Image credit: http://erg.usgs.gov/isb/pubs/gis_poster/

The main two types of spatial data required are:

- Base mapping: that includes any features related to the topography of the earth as seen on that specific surface that the study upon which is conducted.
- Application data: essentially refers to the resources inventories that are generated for a specific application and/or project and then illustrated in thematic maps, depending on what is required. *"For a cultural heritage application this data might*

include an inventory of archaeological sites, settlements and land use..." (Box, P., 1999)

An example of how manipulation of different data resources such as: digital maps, tabular information, aerial photographs, satellite photos…etc. within the GIS environment became crucial is shown by the example of the case of Prince Williams Forest Park as explained by Paul.

3.3. GIS applications on tangible heritage management

There are techniques and methods used around the world to accomplish specific targets and implement management strategies. Thus ArcGIS software must collaborates with the logical thinking in strategic planning systems and hierarchy in implementation of such procedure in order to be successful. To generate and succeed with any GIS management project, users depend on different layers of maps placed on the top of each other allowing a greater depth of information to be displayed. This is critical for decision making for historic preservationist and stakeholders. For instance, analysts noticing a specific change in a parcel in a city would be able to track this change periodically such as the crowd of people in specific nodes at specific times of the year, traffic peak hours, or expansion of the built areas along some neighborhoods. This would assist in an economical study of the case. The same aspect is easy to implement in tourism and planning, enabling the decision makers to identify the weaknesses or strengths of some historical and archeological sites for future improvements.

As Buckler, J. (1998) a GIS coordinator in the Department of Anthropology, University of Maryland clarified, the GIS made it easy to apply certain measures and aspects of management upon the district of Annapolis, which has an excess of historical sites dated back to the 17th century. These, along with the conjunction of three different overlapping districts embracing historical sites was a crucial reason the preservationist and planners to chose to use GIS software. It is a system to manage and identify the archeological data for review and analysis purposes. The concept is the integration of past and present settlements, which would lead to realistic and precise decision-making. Figure 17 illustrates the historic district of Annapolis.

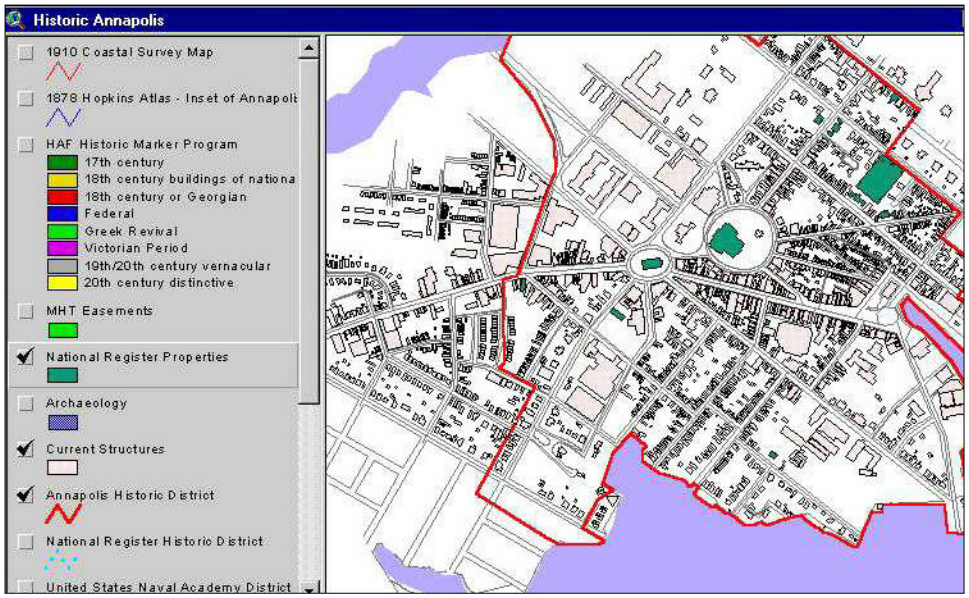
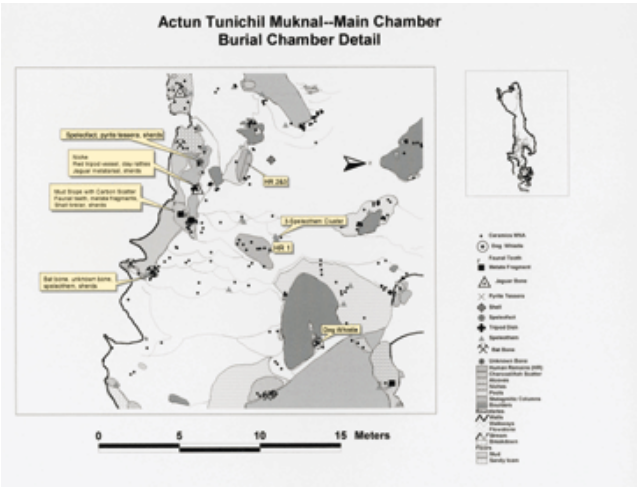


Figure 17 The Historic District of Annapolis
Image credit: http://www.csanet.org/newsletter/winter98/nlw9805f1.html

The value of such a case study in relation to this research shows one way to use this management methodology to assist government, non-profit agencies and the private sector for both business and/or housing. Business entails tourism, historic preservation or investment projects, while housing entails the management of built masses expansion that will either hinder or improve the income of those historical and archeological nodes.

GIS is not only a discipline that is capable of manipulating current facts and available information, it could go way beyond that. For instance, the knowledge about caves is not as broad as the knowledge about other shelters, even though they were the first human beings homes; in some ideological aspects, caves used to be mysterious and scholars deducted that they were used for specific rituals (Jaime J. and Moyes H., 2000). As was the case of the Mayan cave located on a tributary of the Roaring Creek River that lead a crew from the Western Belize Regional Cave Project (WBRCP) to conduct investigations. The main goal was to record and provenience, catalog its attributes and analyze depositions patterns (refer to Figure 18). The study of the nature of the cave astonished the crew by discovering a chamber that had been cemented to the floor by flowstone (calcium carbonate). This information in itself leads to a great economical income resource for future tourism, as it became a natural museum. Such study reveals how GIS tools for mapping and relating literature to locations and scientific evidences are adding a new income resource for the hosting city.



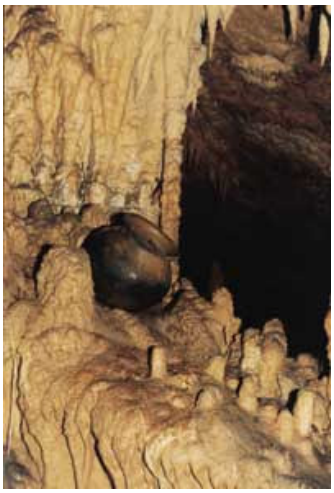


Figure 18 Relationships between the artifacts by buffering.
Image credit: http://www.esri.com/news/arcuser/1000/graphics/map2.gif
Right: Cave photo. Image credit: http://www.esri.com/news/arcuser/1000/graphics/cave1.jpg

Carmen (2003) represented a challenging project to understand the ancient roman city in Tunisia. There were ruins backed to the Roman city that had been exposed to 10 archeological projects between 1995 and 2002. It resulted in the discovery of the ruins and the hydraulic supplying system for the northwest side of the city. For this specific project, GIS and CAD were of great benefit in storing layers and analyzing the gathered data.

The outcome of this project concluded that ancient patterns and block distribution differed from more recently built structures. This difference was in respect to positioning the sloped areas and the contours and topography. This lead to better decisions being made by future administrative and land use zoning. This outcome was

possible due to the ability to identify the irregular wall pattern using the GIS software that is different from current projects (Figure 19).

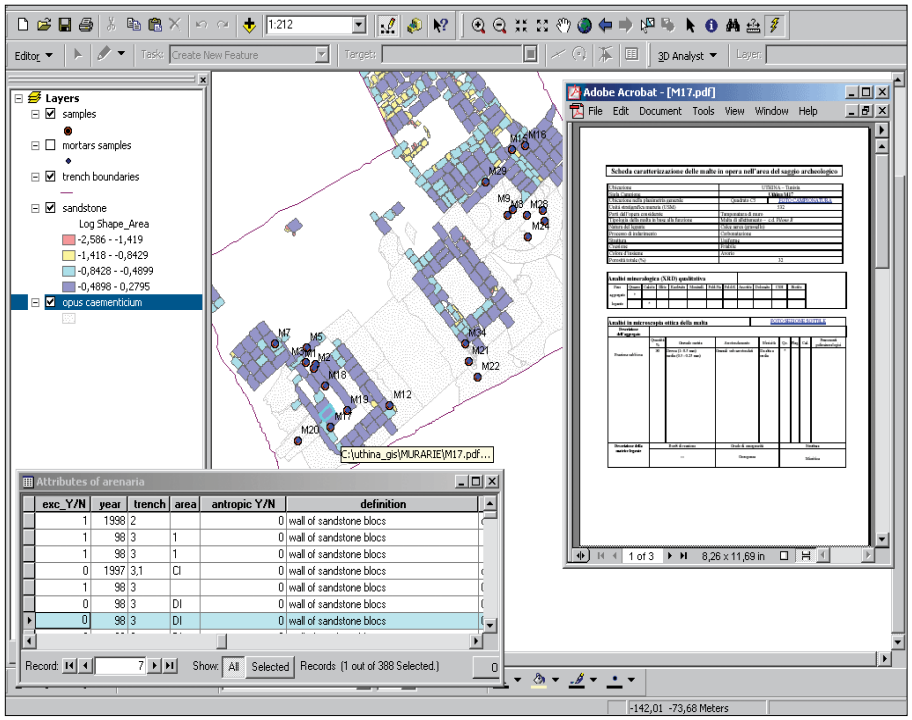


Figure 19 The shape area of blocks
Image credit: http://www.esri.com/news/arcuser/1003/graphics/romanruins_1_lge.gif

Another important value is the ability to share information between different researchers and among different disciplines conducting the same study using the program; it is considered an immediate visualization of data of large stone blocks and structures.

3.4. Spatial analysis and advanced techniques using the GIS

Using GIS is an endless world of different utilities, which are getting more advanced as life requires and progressive era needs. More intellectuality embodied in the essence of the application starting from one-click command buttons to the step-by-step spatial analysis techniques, to the algorithm and the complex Visual Basic scripting environment. The nature of the software reveals a hidden problem-solving world beyond the screen interface.

According to McCarthy (2004), *"GIS software represents real-world features in individual map layers according to feature type, such as roads, building footprints, or country boundaries."* It also has tremendous techniques to represent real-world features in maps and to utilize them in different decision making. Take for example the ownership and stewardship issues; the software is able to prioritize land parcels in an essence that aids landowners to pursue them according to their criteria. The higher the criteria the parcel has, the higher its opportunity to be owned and managed for future preservation and further project. Armstrong and Henry (2004) used GIS to evaluate and define points and areas of interest and significance about a village on the banks of Big Sandy Creek in Southeastern Colorado. This site was the location where some Native American tribes were camped but had been massacred by American Troops. (Figure 20) The resulting the map represents the historical resources that are located along the riverbank and have been identified according to the tribes' oral history.

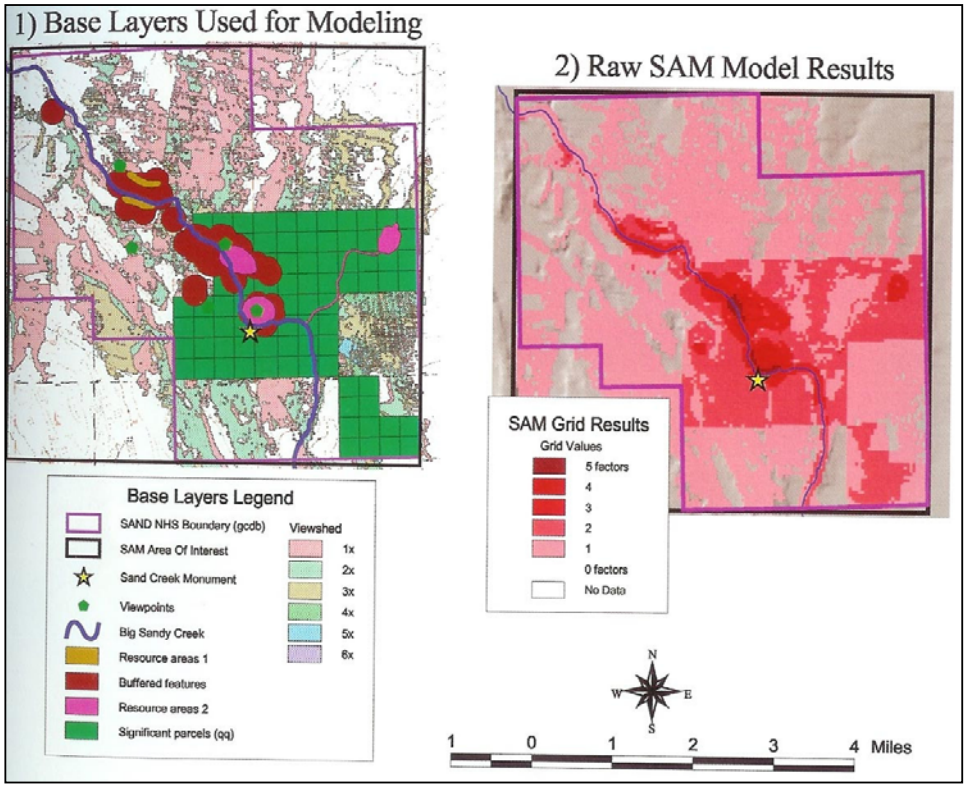


Figure 20 Base layers used for modeling and Raw SAM Model results
Image credit: Armstrong, L. and Henry, M. (2004) Mapping the future of America's National Parks: Stewardship through geographic information systems, Redlands, California, USA, ESRI Press 67.

In another study, the National Parks Service utilized a GIS to demonstrate the values of each parcel according to its sensitivity to the criteria addressed by the National Parks and its parties. GIS software specialists were able to create a map (Figure 21) illustrating the importance hierarchy of parcels. By using this spatial technique they were able to create a grid of all the values, by which the stakeholders were able to define their stewardship accordingly and thus initiate their preservation projects before those sites were open to public.

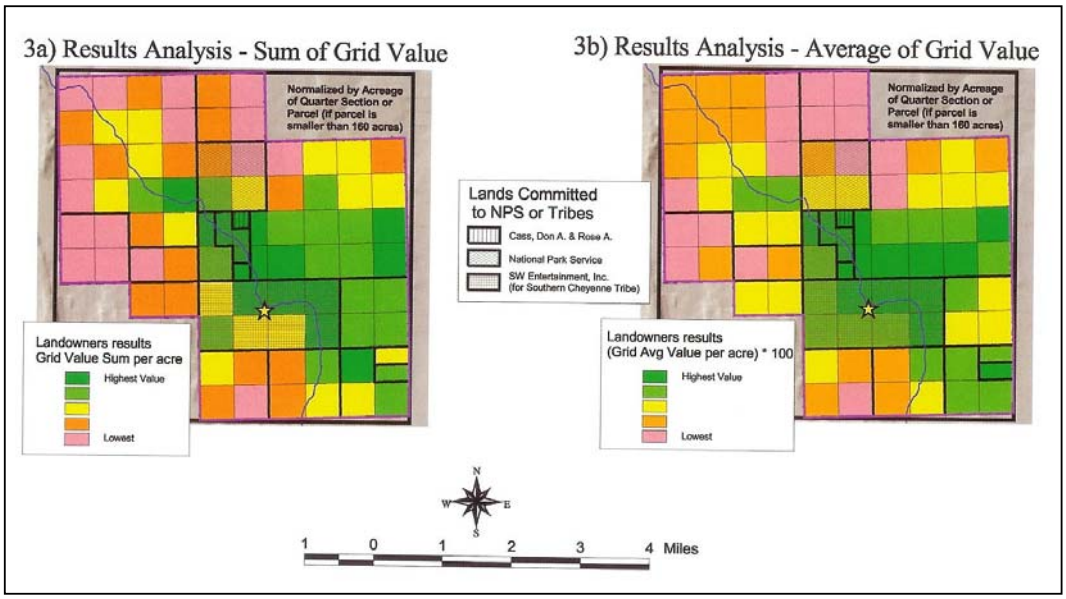


Figure 21 Land parcel prioritizing using the Sensitive Area Model.
Image credit: Armstrong, L. and Henry, M. (2004) Mapping the future of America's National Parks: Stewardship through geographic information systems, Redlands, California, USA, ESRI Press 67.

Information for small areas can be summarized for reporting purposes and analysis. 1- a group of areas sharing similarity in geodemographic clusters using Mean Value of its area. 2- a group of areas having similar locational Proximity, for instance, sets of administrational units by taking the population samples and also by using the Mean Value[1].

In this case, the small areas estimations are used in communication programs targeting individuals and households. The professionals in this project investigated the

[1] This implies the importance of using statistical approach to quantify the relative contribution of each level of data by using specified indicators.

properties of spatial dependence and spatial heterogeneity in a range of applied settings. The procedure followed in this project is:

- Specifying (Target Group) which is constructed by dividing a target population by certain criteria.
- Outputting estimation, which was defined as "incidence of group".
- Making the estimation was made by the use of one or more proxies, those proxies are variables expressed in rate form.

As well as, there are certain ways to apply the distance measure by:

6- Coordinate – base-distance measures

7- Network – base-distance measures

8- Polyline – base-distance measures (De Smith, 2003)

These are considered the basic components for most of spatial analysis, but in this case a question had been raised: what are the assumptions that underlie such measures?
The result is that they create formulas for 2D and 3D distance on a sphere entailing the following:

- Measured distance along shortest physical path
- Completely uniformed space.

The researchers and professionals in this case have created a technique to resolve this problem by "Accumulated Cost Surfaces" ACS, which is applicable with polygons or triangles, as far as the collision avoidance was concerned. Collision Avoidance is represented by the buffer zone of the defined obstacles using measure path, simple illustration in Figure 22.

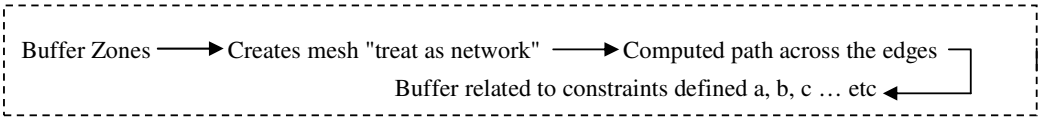


Figure 22 Collision Avoidance

The path length "Cost" = incremental step length x cost or effect of each step This technique applied to 2D simple obstacles representation, but with complex and larger obstacles a 3D methodology would help a lot.

- Path Finding: Paths involving motion incorporate gradient and / or curvature constraints, example; locating path across ridge structure will be implemented by:

1- Defining the step length "D"

2- Selecting random point in the region "X"

3- Extending start straight line "D" from start point to random point "X" (Webber and Longley 2003)

The following (Figure 23) illustration explains the technique:

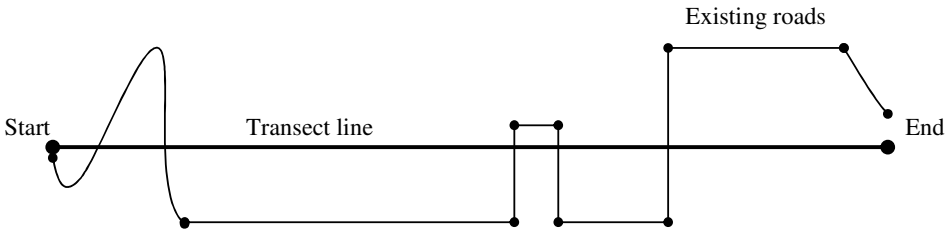


Figure 23 Path finding

CHAPTER IV

RESEARCH METHODOLOGY

The procedure of Tangible Heritage Management requires a specific structure of activities that enables its ongoing inputs-outputs essence, for this reason the management strategy that had been established between the UNESCO and the AAEDTPA addressed its main mission, which is to identify, manage and develop Al Ain Cultural Resources.

The application of GIS in putting any policy in to practice involves four main procedures to be undertaken; those procedures are described and have been taken to guide this research from the GIS and Cultural Resource Management: The manual for heritage managers (Box, P. 1999).

1. Background: this phase entails documentation of the historical background of cultural resources and their physical sites. This stage has been discussed already in the introduction of the research. Because any management project should build upon past, current and future status of the assets, starting the inventory process was an urge to all participants in the project to create map-based documents which are essential tools in the accomplishment of this process. This results in a good decision-making for stakeholders, planners and investors involved in this strategy; henceforth, the map-based documents with their data will contribute to the process of communication and administration in a potential beneficial result. To create such map-based documents, the first step was the inventory, which was carried out by Maunsell Consultants and Al-Ain planning Department. The result was the creation

of attribute tables and their linked shape files and layers to create a whole set of metadata for the city. This metadata was used to extract the data that would serve the research needs (refer to Table 2 and Figure 24).

Table 2 Attributes of the assets

OBJECTID	COMENG	DISTENG	SHAPE_AREA	Name	Date
1113	Galaat Al Muwai	Al Muwaiji	4381.53958	Al-Muwaiji Fort	1946
1912	Galaat Al Muwai	Al Muwaiji	51974.41406	Al-Muwaiji Palace	1946
7842	Al Shuabah	Al Qattara	8094.98768	Al-Qattarah Fort (Bin Aaty house)	1925
20069	Shareat Al Qatt	Al Qattara	165.46566	Al-Darmaky House	1925
20070	Shareat Al Qatt	Al Qattara	154.47919	AlShuabah Fort	1915
62128			10655.95350	NA	-
62129			608608.30112	NA	-
62130			3595.89954	NA	-
62131			40473.58852	NA	-
22902	Al Misbah	Al Hili	17109.47695	Hili Fortress	1500
23556	Athar Hili	Al Hili	1966371.30484	Hili Archeology	-3000
26581	Shareat Hili	Al Hili	1800.78662	Shareat Hili archeology	1500
27242	Al Rumailah	Al Hili	6979.67538	Al-Rumailah Palace	1845
27775	Hai Al Murabbaa	Central Dis.	7650.99534	Al-Murabba'a Fort	1948
61096	Al Graifah	Al Hili	5034.41696	Al Graifah	1820
61655			1806480.62456	Hafeet Remains	-2000
29111	Hai Al Hisn	Central Dis.	13067.14970	Sultan Fort	1907
29111	Hai Al Hisn	Central Dis.	13067.14970	Estern Fortress	1910
62018	Hai Al Qalaa	Al Jahili	61211.86407	Al-Jahili Fortress	1898

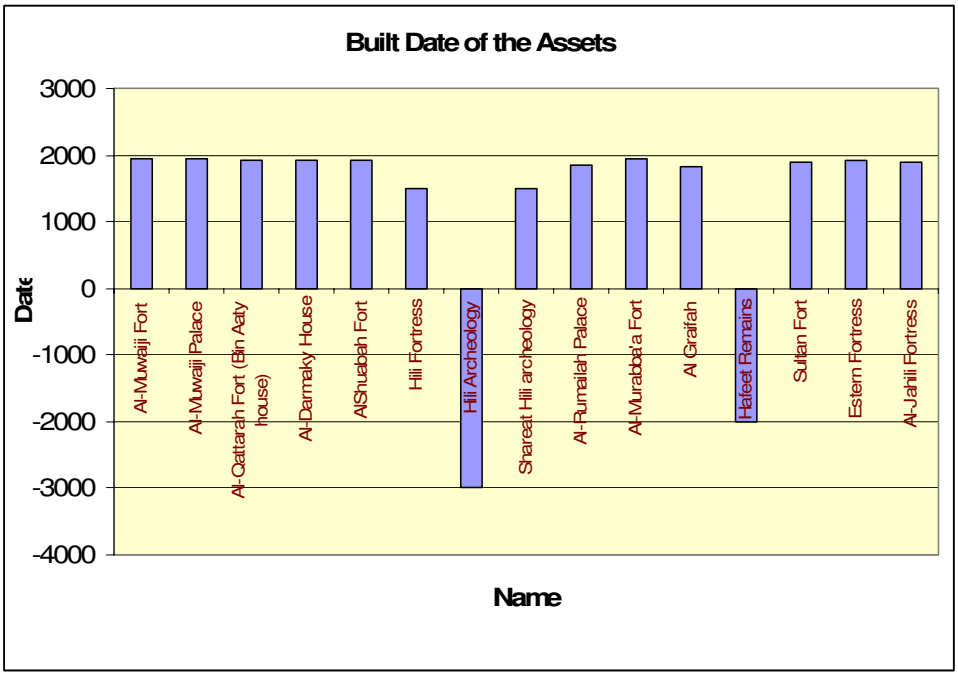


Figure 24 Assets and their date of origin

2. Analysis: studying and analyzing the physical condition of the assets under investigation, as well as the cultural, social, and in some cases, religious significance of the context.

3. Response: defining the issues under which the strategy will be stated for this specific research, the response will initiate projects directed to *historic preservation, tourism promotion, public awareness and protection of the assets* and their *management towards heritage activity*.

3.1 The *historic preservation* process requires ongoing inputs claiming the buildings' conditions and/or their influential surroundings and circumstances

(Cros and McKercher, 2002). Carrying on the conservation task entails a precedent knowledge of the quality, significance, regional and local context of the assets. But unlike most countries relying on international codes and bylaws, most of which are under the guidance for any historical assist listed in the World Heritage list, Al-Ain city has begun to create their own legislation and board.

3.2 Although not the only criterion of a mature planning strategy implementation, *Tourism Promotion* is a vital key that reveals through its representation how the cultural heritage was planned and managed. The situation in a country is considered critical when tourism occurs before suitable cultural management legislation is enacted (Cros and McKercher, 2002). Thus, tourism assets need to be segregated with respect to management legislation. For this specific research, each activity was implemented with guidance and awareness instead of vulnerable techniques and projects. One of the tourism issues is defining which path tourists should follow while visiting the city. Also assets that are of a higher significance than others should be more widely promoted. Such questions took place to find out a reasonable solution using the GIS system.

3.3 *Public Awareness and Protection of the assets* would not have a suitable response if there were no clear specifications, those sites and assets need regular inspection conducted by representatives and specialists from assigned firms or entities. With respect to artifacts, certain protection zones need to be identified which accordingly will affirm their importance and highlight their presence in the districts where they are located. The matter of population in each district should

be considered because it is proportional with the protection and awareness raising issue. Consequently, the representation of heritage will stand on a solid base and respond to the articles mentioned in the UNESCO and AAEDTP establishment.

4. Implementation: This is the stage at which GIS application is a critical tool to monitor, evaluate, illustrate and analyze the policies on the process. As most of the tasks are accomplished by separated entities each of specific interest and specialty, the GIS create linkage between different procedures and bodies. This allows the GIS to illustrate the different possibilities to achieve a certain task and/or represent the data taken from one firm with a conjunction to another set of data collected by another one. As a result, demonstration of the past, current and future situation will be significantly easier compared to paper work and laborious analysis procedure done by individuals. Figure 25 represents the implementation methodology using the GIS in its basic form.

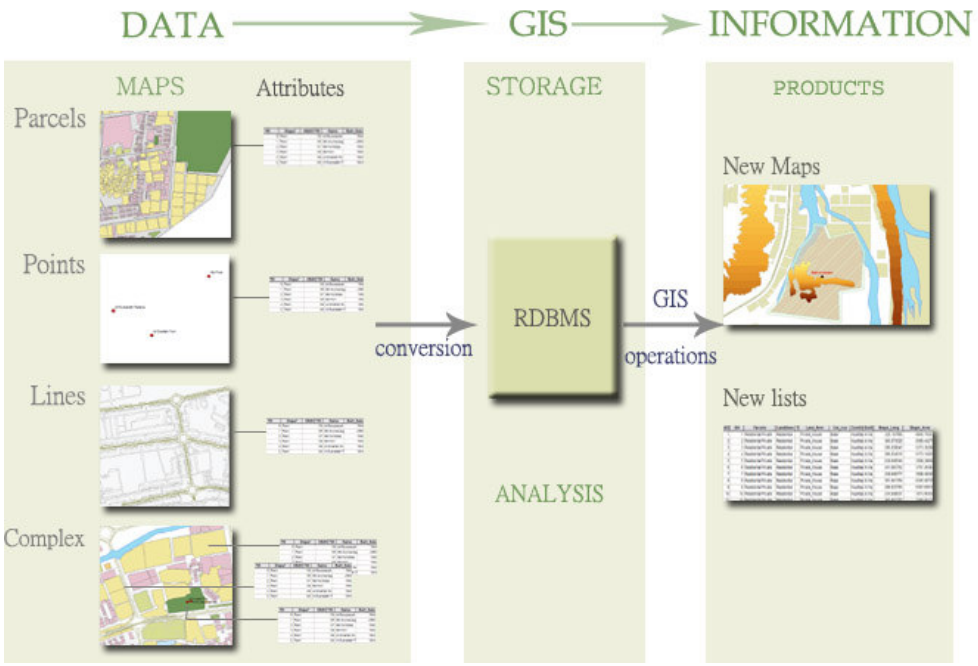


Figure 25 Implementation methodology using the ArcGIS software

CHAPTER V

DEMONSTRATION AND ANALYSIS

The major objectives of the research were to protect, preserve, promote, conserve and improve the Tangible Heritage by implementing a management strategy. The efficiency of an implemented management strategy depends mainly on the study of the factors affecting the assets and areas of cultural and historical value with respect to their importance, location, population of the district…etc. The procedure in this study was to carry out the demonstration of all the mentioned factors on which the preservation, tourism, protection, and improvement dependant (refer to Figure 26).

5.1. Prioritizing assets preservation projects: "Preservation issue"

The buildings and sites that are enriched with the heritage of the city need to be well preserved and maintained periodically. However, a certain planned process should be followed in order to demonstrate the procedure of preserving and conserving those assets. Because some buildings are of a higher priority than others, the projects of preservation should take place first on those assets. The criterion in this case was the historical value and the date of origin of the asset. The older the asset, the more valuable it was considered thus striking an alerting risk of destruction or vanishing.

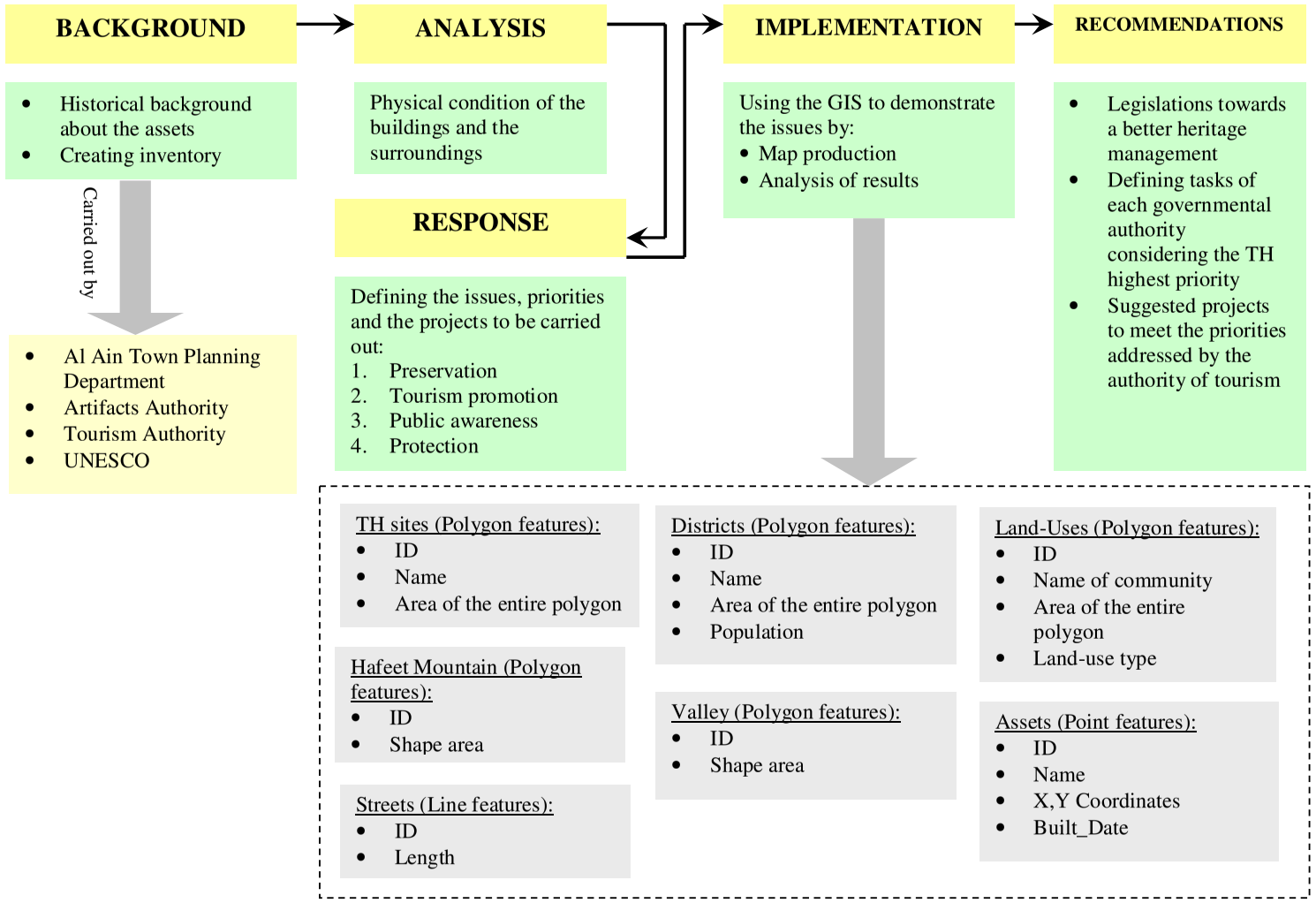


Figure 26 Methodology flowchart

5.1.1. Geographic extent

This study was conducted on 12 sites as listed: Hili Archeology, Hafeet Remains, Hili Fort, Hili Fortress, Al Graifah Fort, Al Rumailah Palace, Al Shuabah Fort, Al Muwaiji Fortress, Al Muwaiji Fort, Al Qattarah Fort, Al Darmaky House, Al Muraba'ah Fort.

Geographic data source:

Projected Coordinate System:

Nahrwan_1967_UTM_Zone_39N

Projection: Transverse_Mercator

Ellipsoide: Clarke 1880 RGS

False_Easting: 500000.00000000

False_Northing: 0.00000000

Central_Meridian: 51.00000000

Scale_Factor: 0.99960000

Latitude_Of_Origin: 0.00000000

Linear Unit: Meter (1.000000)

Geographic Coordinate System:

GCS_Nahrwan_1967

Datum: D_Nahrwan_1967

Prime Meridian: 0

Semi-major Axis: 6378249.145000

Denominator of Flattening Ratio: 293.465000

Longitude 54 degrees, 5 seconds and 56 east, and between latitude 23 degrees 45 seconds, and 24 degrees 40 seconds north. (Planning and Survey Sector, AATPD)

The themes associated with the data sets include Cultural Areas, Road Network, and districts of the city, Communities, Land uses, and Topographical Features. The following figure represents the Geodatabase supplied from the Al-Ain Planning Department. To complete this study, the following attributes were added to this database: population, and matching and renaming cultural sites after reviewing the literature of buildings (Figure 27).

Figure 27 Geodatabase comprised of the available attribute tables and shape files of polygons and lines representing the areas and streets on the linked map

5.1.2. Defining the TH assets in the city and the preservation priority "classification"

Data analysis carried out through defining the points of interest and weighting them, to illustrate graphically the classes upon which the preservation task was carried out.

In this procedure to the first step was to calculate the centroids for the assets zones represented in polygons (Figure 28). Thereafter, the XY coordinates were used to represent point features of the buildings. The next step was categorizing those assets with respect to the historical Built Date value, or date of origin. The categories were represented on the map to illustrate where preservation should start (from oldest to the most recently built). In this way the preservation task schedule addressed one variable, which was the Built Date. There were other criteria to help the judgment of the highest class or lowest depending on the location of the asset (either in urban or rural districts), the level of deterioration, the approachability of the building…etc. Within this study, the procedure was carried out with respect to historical values after editing the data (Figure 29).

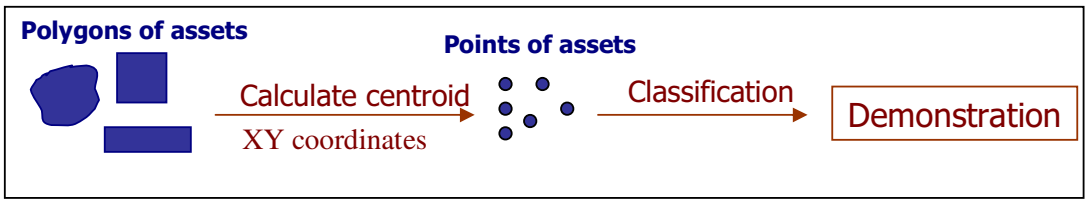


Figure 28 Defining assets and classification process

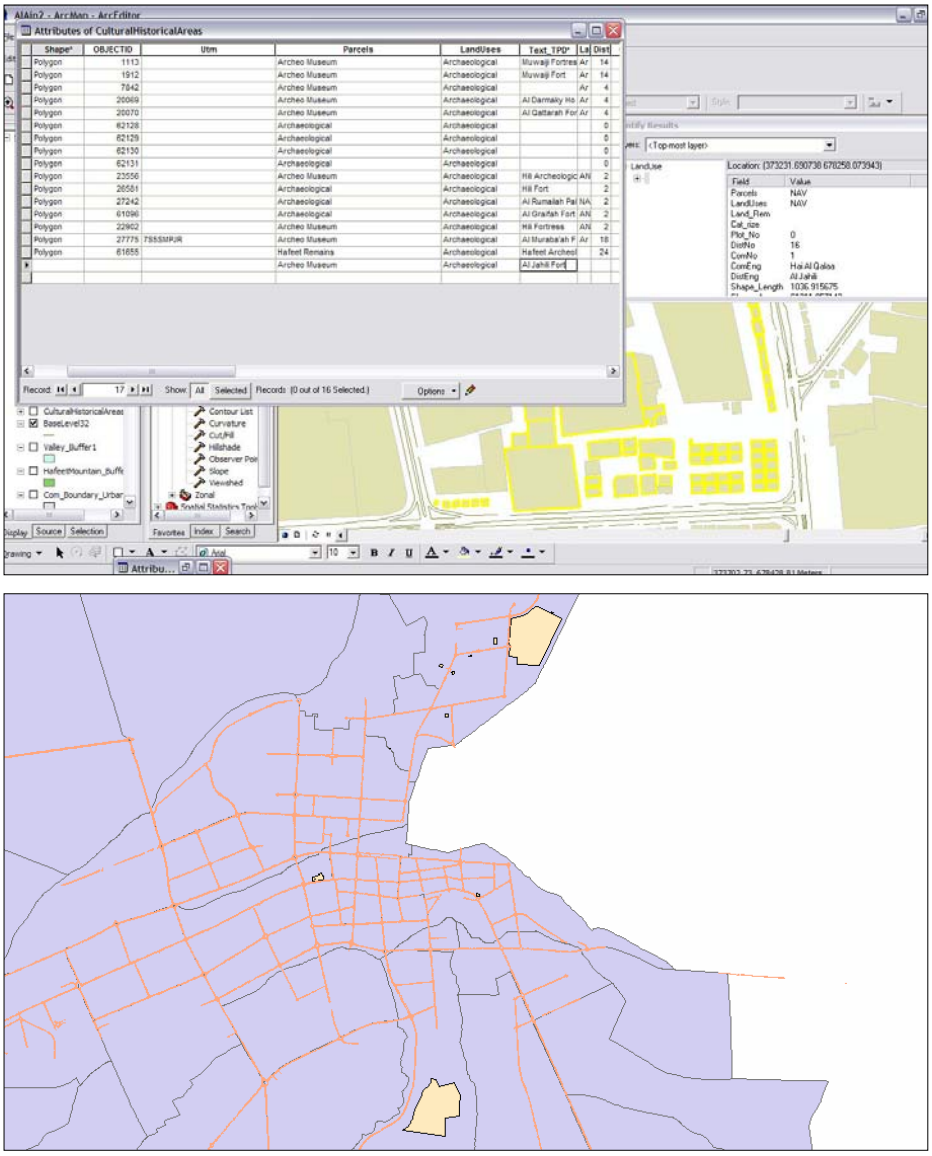


Figure 29 Assets zones represented in polygons after editing and adding some missing assets data to the map

5.1.3. Centroid calculations

After adding the X,Y coordinates of the centroid of a polygon layer to a new field; the centroid calculation was carried out by clicking Editor on the Editor Toolbar and then Start Editing. This allows editing to be completed without the risk of permanent changes to the file as would be the case if changes were made outside of an editing session. The next step was to right-click the layer in question and click Open Attribute Table. The next step was to right-click the field heading for the X field and click Calculate Values. If there were no field for X values, a new field for X could have been added by clicking the Options button and selecting Add Field. However, adding a new field requires exiting the editing session. Once to this point, the Advanced button should be checked. The following VBA statement was then added to the first text box:

```
Dim dblX As Double
Dim pArea As IArea
Set pArea = [Shape]
dblX = pArea.Centroid.X
```

In the text box directly under the X field name, the variable dblX was typed and the "OK" button was clicked (refer to figures 30-32 and Table 3).

The next step was to right-click the field heading for the Y field and click Calculate Values. If there were no field for Y values, a new field for Y could have been added by clicking the Options button and selecting Add Field. However, again adding a

new field would have required exiting the editing session. The values were then calculated by clicking Calculate Values. Again, the Advanced button was checked and the following VBA statement added:

Dim dblY As Double

Dim pArea As IArea

Set pArea = [Shape]

dblY = pArea.Centroid.Y

In the text box directly under the Y field name, he variable dblY was typed and the "OK" button was clicked.

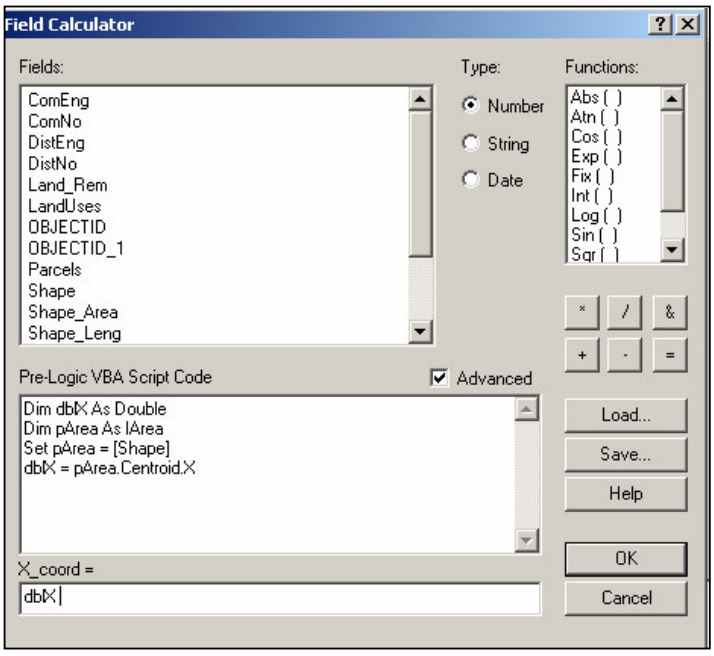


Figure 30 Centroid calculation in a new field added

Table 3 Points coordinates that are used to calculate the centroids

Attributes of CulturalHistoricalAreas

OBJECTID_1	Shape*	LandUses	Text_TPD*	Land_Rem	DistEng	Shape_Length	Shape_Area	X_coord	Y_coord
1	Polygon	Archaeologic	Muwaiji Fortr	Archeological	Al Muwaiji	264.625454	4381.541851	370615.427051	679318.788476
2	Polygon	Archaeologic	Muwaiji Fort	Archeological	Al Muwaiji	1132.191627	51974.420070	370585.519372	679310.862422
3	Polygon	Archaeologic		Archeological	Al Qattara	360.014748	8094.993624	374510.837025	684298.846007
4	Polygon	Archaeologic	Al Darmaky H	Archeological	Al Qattara	78.107213	165.465567	372789.112286	683276.318499
5	Polygon	Archaeologic	Al Qattarah F	Archeological	Al Qattara	76.813309	154.477071	372789.810001	683284.703481
6	Polygon	Archaeologic				412.911616	10655.953500	364100.000026	721845.999873
7	Polygon	Archaeologic				3229.192195	608608.301119	361971.090968	721008.999936
8	Polygon	Archaeologic				239.864064	3595.907202	363715.000090	721665.000128
9	Polygon	Archaeologic				804.723713	40473.588524	361091.000087	721281.999744
10	Polygon	Archaeologic	Hili Fortress	ANTIQUITY	Al Hili	555.738100	17109.471494	376014.261341	686571.833728
11	Polygon	Archaeologic	Hili Archeolog	ANTIQUITY	Al Hili	5758.623704	1966371.368547	377143.933393	686733.610808
12	Polygon	Archaeologic	Hili Fort		Al Hili	258.922276	1800.785068	375256.637359	686126.601791
13	Polygon	Archaeologic	Al Rumailah P	NAV	Al Hili	322.550198	6979.675378	374348.894441	685811.623561
14	Polygon	Archaeologic	Al Muraba'ah	Archeological	Central District	355.191758	7650.993031	375485.840563	678786.594579
15	Polygon	Archaeologic	Al Graifah Fo	ANTIQUITY	Al Hili	290.331072	5034.415193	374715.777560	685590.638954
16	Polygon	Archaeologic				6090.655406	1806480.678727	374174.364337	672224.803340

Record: 1 Show: All Selected Records (0 out of 16 Selected.) Options

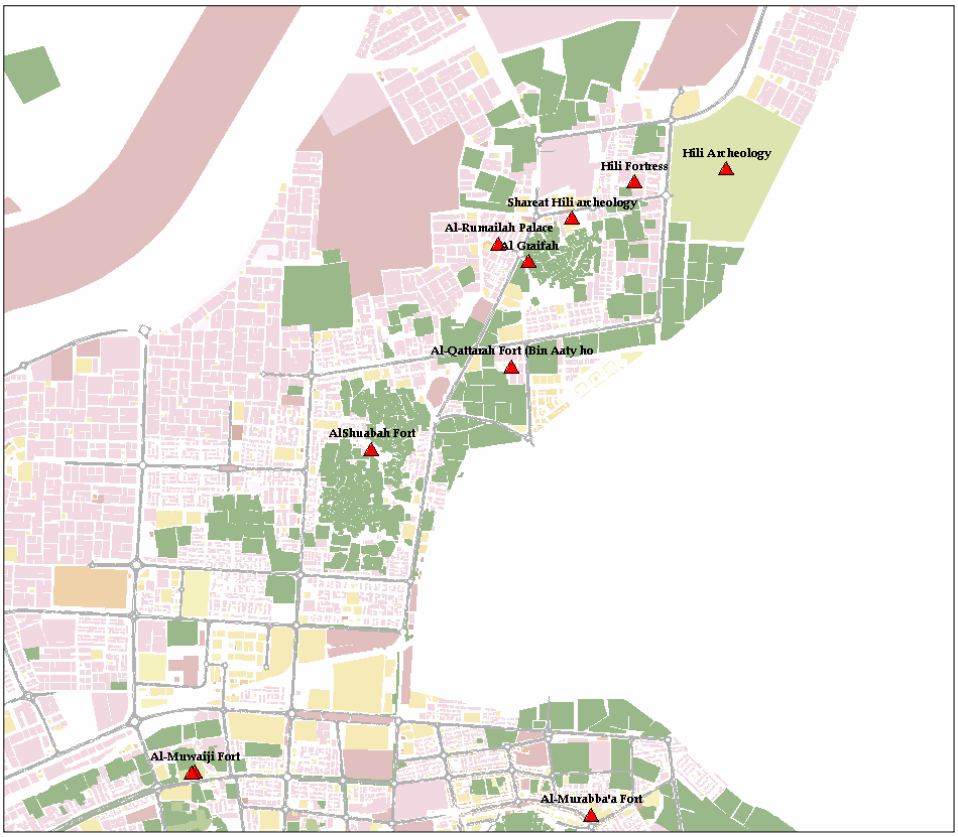


Figure 31 Assets represented as points of centroids of the cultural sites

Figure 32 Assets represented as points of centroids of the cultural sites

5.1.4. Categorizing the assets

Because the historical value is what was considered as a criterion upon which decisions were made to initiate preservation projects upon the assets, the older assets were considered the more important ones to consider (Table 4).

The following shows the categorization of the assets:

Dates < 1000 “A”

Dates > 1000 and < 1850 "B"

Dates > 1850 “C”

Table 4 Classification according to date of origin

Attributes of Assets

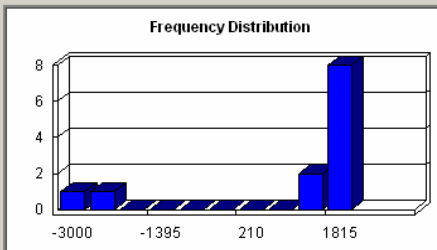
SHAPE*	Name	Built_Date	District	POINT_X	POINT_Y	Class
Point	Al Muraba'ah	1948	Central Distric	375484.7269	678784.4369	C
Point	Hili Archeolog	-3000	Al Hili	377143.9333	686733.6108	A
Point	Hili Fortress	1500	Al Hili	376014.2612	686571.8336	B
Point	Hili Fort	1500	Al Hili	375256.6373	686126.6018	B
Point	Al Graifah Fo	1820	Al Hili	374715.7775	685590.6389	B
Point	Al Rumailah P	1845	Al Hili	374348.8944	685811.6235	B
Point	Al Shuabah F	1915	Al Qattarah	374510.8370	684298.8460	C
Point	Al Muwaiji Fo	1946	Al Muwaiji	370615.4271	679318.7884	C
Point	Al Muwaiji Fo	1946	Al Muwaiji	370585.5193	679310.8624	C
Point	Hafeet remain	-2000	Sanaiya	374174.3643	672224.8032	A
Point	Al Qattarah F	1925	Al Qattarah	372789.8099	683284.7034	C

Record: 11 Show: All Selected Records (0 out of 12 Selected.) Options

Field: Built_Date

Statistics:

Count:	12
Minimum:	-3000.000000
Maximum:	1948.000000
Sum:	13270.000000
Mean:	1105.833333
Standard Deviation:	1632.713173



Although a high frequency lies in the period assigned for class B, according to the representation of classes in the next map, the authority of antiquities and the planning department should consider Hili Archeological sites and Hafeet Remains first for the preservation projects, because they are dated back to thousands of years earlier than the other Tangible Heritage sites. But if the deterioration status has been taken as a criterion at this stage, then some buildings that were categorized in class B such as Al Rumailah and Al Graifah forts would be in an alerting condition and would require an urgent response to be preserved and maintained (Figure 33).

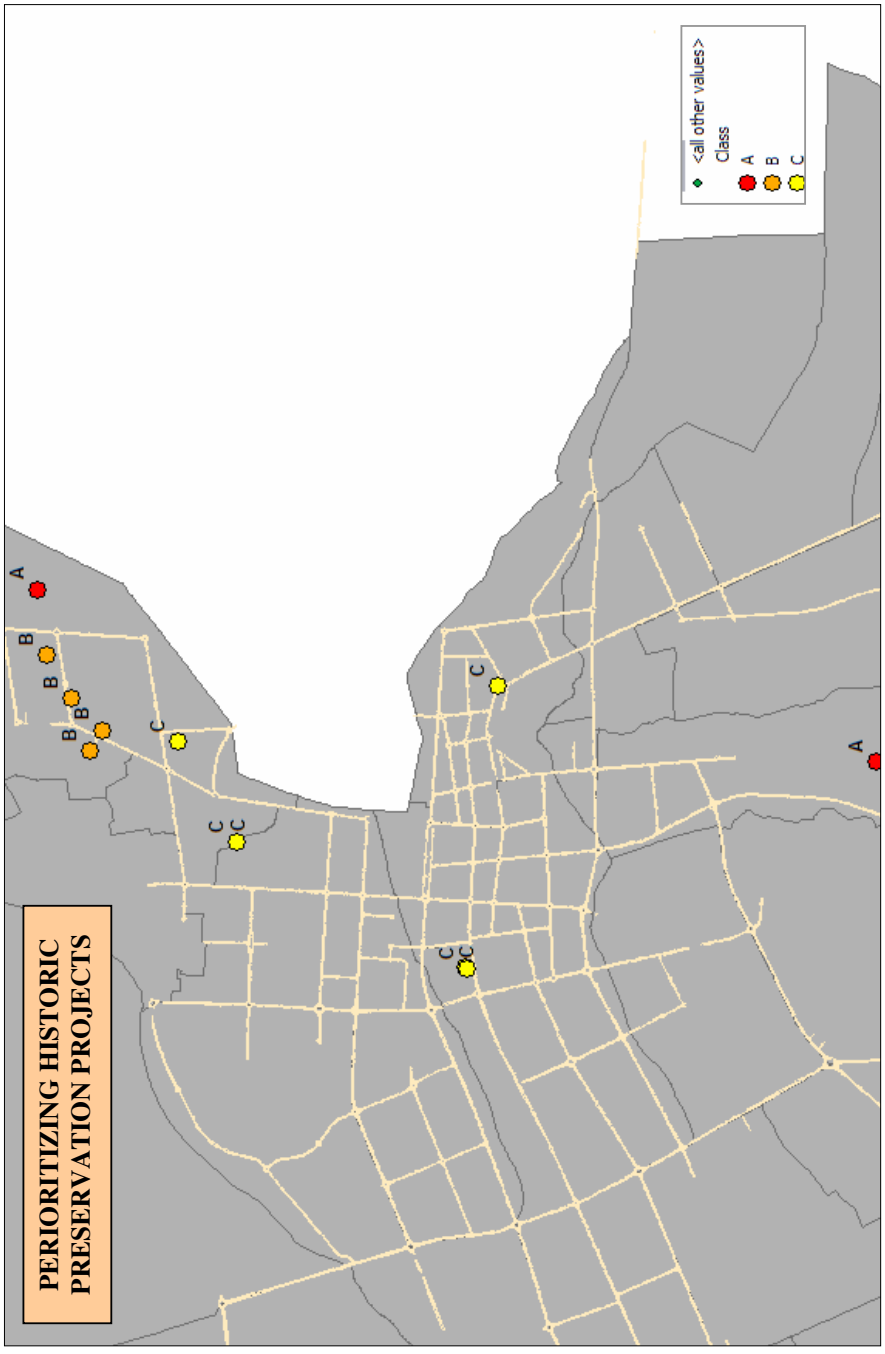


Figure 33 Categorizing according to historical value

5.2. Tourism promotion for the cultural sites: "Tourism issue"

Network Analysis is a linear referencing tool used to create a route between designated points. This technique would have been helpful to define which route should be followed for tourism purposes, first by locating the features along the route, second by calculating distances from the points of interest (assets) to the main roads (refer to figures 34-36 and Table 5). The representation of such path wasn't completed due to the unavailability of the tool within ArcGIS 9.0, which didn't enable the completion of the analysis.

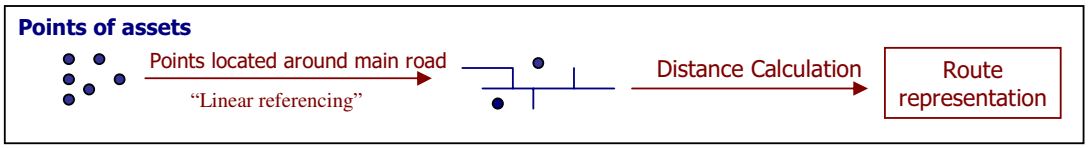


Figure 34 Defining tourism route

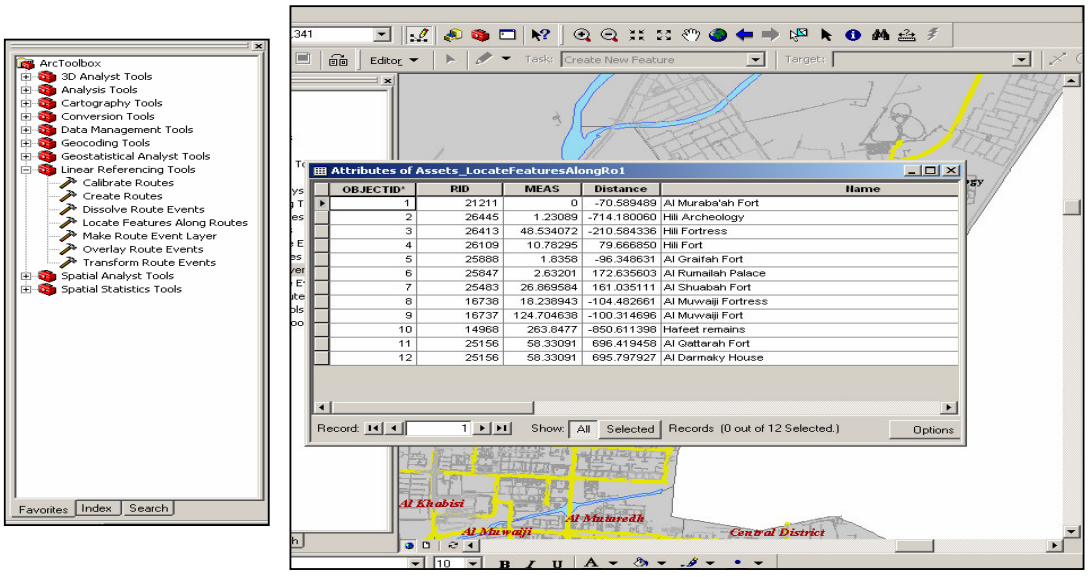


Figure 35 Locating point features along route

Table 5 Distance calculations from the assets to the main roads

Attributes of Assets_LocateFeaturesAlongRo1

OBJE	RID	MEAS	Distance	Name	Built_Date	District	POINT_X	POINT_Y	NEAR_FID
1	21211	0	-70.589489	Al Muraba'ah Fort	1948	Central Distric	375484.726949	678784.436952	2209
2	26445	1.23089	-714.180060	Hili Archeology	-3000	Al Hili	377143.933350	686733.610848	-
3	26413	48.534072	-210.584336	Hili Fortress	1500	Al Hili	376014.261285	686571.833696	2776
4	26109	10.78295	79.666850	Hili Fort	1500	Al Hili	375256.637348	686126.601823	2746
5	25888	1.8358	-96.348631	Al Graifah Fort	1820	Al Hili	374715.777572	685590.638943	2714
6	25847	2.63201	172.635603	Al Rumailah Palac	1845	Al Hili	374348.894499	685811.623519	2710
7	25483	26.869584	161.035111	Al Shuabah Fort	1915	Al Qattarah	374510.837028	684298.846046	2674
8	16738	18.238943	-104.482661	Al Muwaiji Fortres	1946	Al Muwaiji	370615.427104	679318.788441	1781
9	16737	124.704638	-100.314696	Al Muwaiji Fort	1946	Al Muwaiji	370585.519392	679310.862425	1781
10	14968	263.8477	-850.611398	Hafeet remains	-2000	Sanaiya	374174.364323	672224.803282	-
11	25156	58.33091	696.419458	Al Qattarah Fort	1925	Al Qattarah	372789.809954	683284.703453	-
12	25156	58.33091	695.797927	Al Darmaky House	1925	Al Qattarah	372789.112226	683276.318557	-

Record: Show: All Selected Records (0 out of 12 Selected.) Options

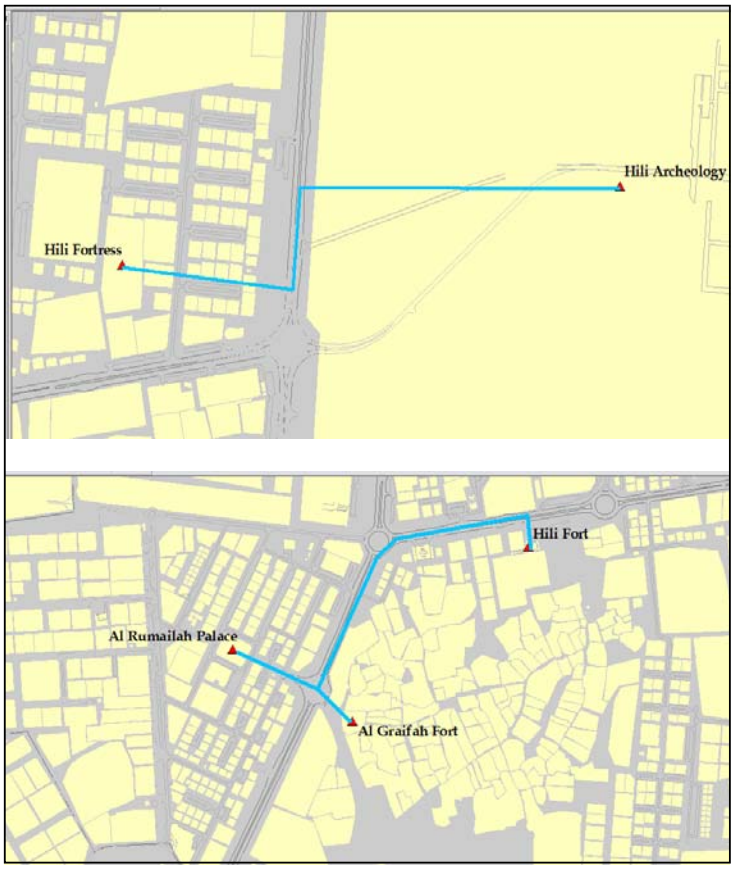


Figure 36 The definition of the tourism route

5.2.1 Circumstances and influential factors surrounding the assets

There are certain interventions or integration features that either obstacle or improve the development of these assets, such as the location of a cultural site in-between the mountains or the adjacency to a valley or its location on a high way. To determine whether these features are affecting the assets negatively, the study needed to allocate them with relationship to the sites themselves. A buffer was created around these features such as the Hafeet Mountain, and the Valley to find out if these buffers intersected with the historical and cultural areas. These intersections were then unified to identify the zones to consider; the following model was used to generate the desired technique (Figures 37-38b).

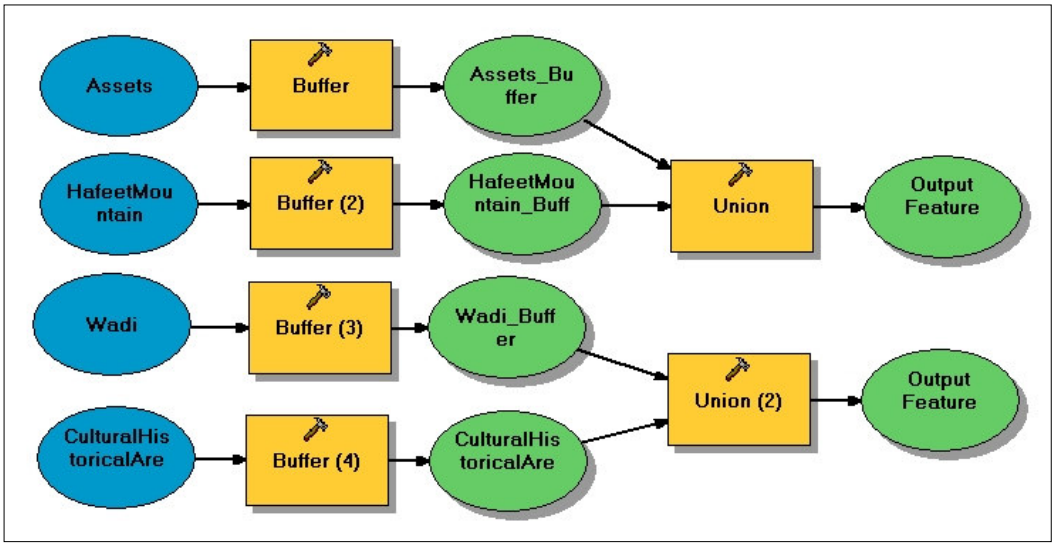


Figure 37 Model to determine the influential factors around TH

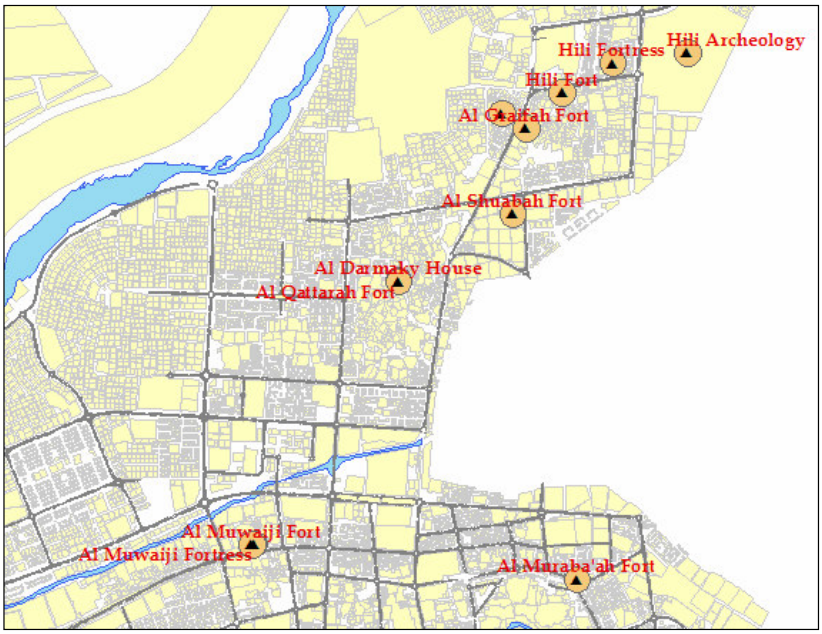


Figure 38a Buffer of 100 meters from the center of the cultural sites center

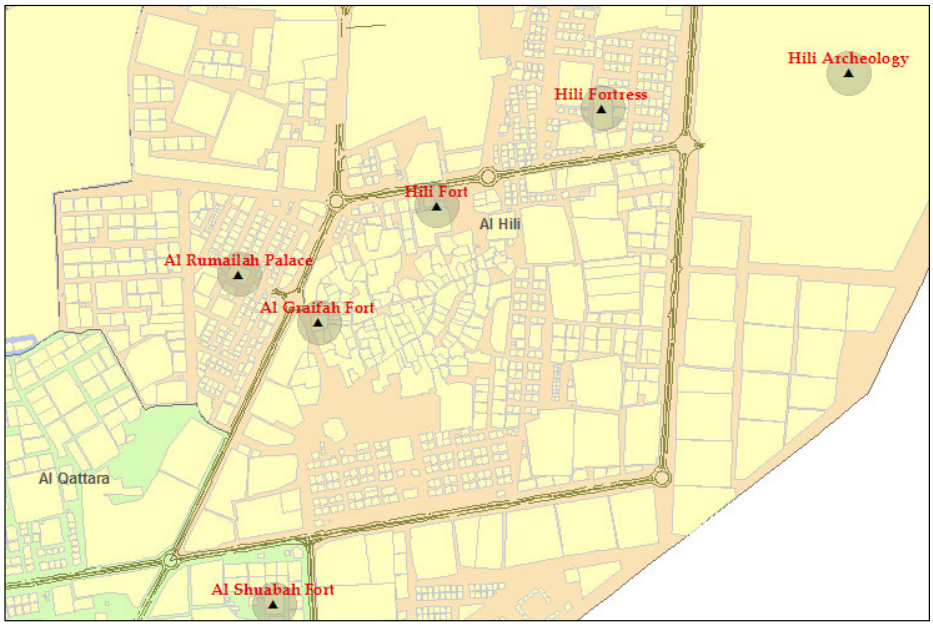


Figure 38b Assets center point buffer representation

Figure 39 shows the valley that was buffered by a 50-meter distance offset. This was done because there were already some seating areas on the entire edge and it is well used as a promenade. It is evident that there are some edges that are intersecting with the mountain region and the historic cultural zone is trapped in the middle.

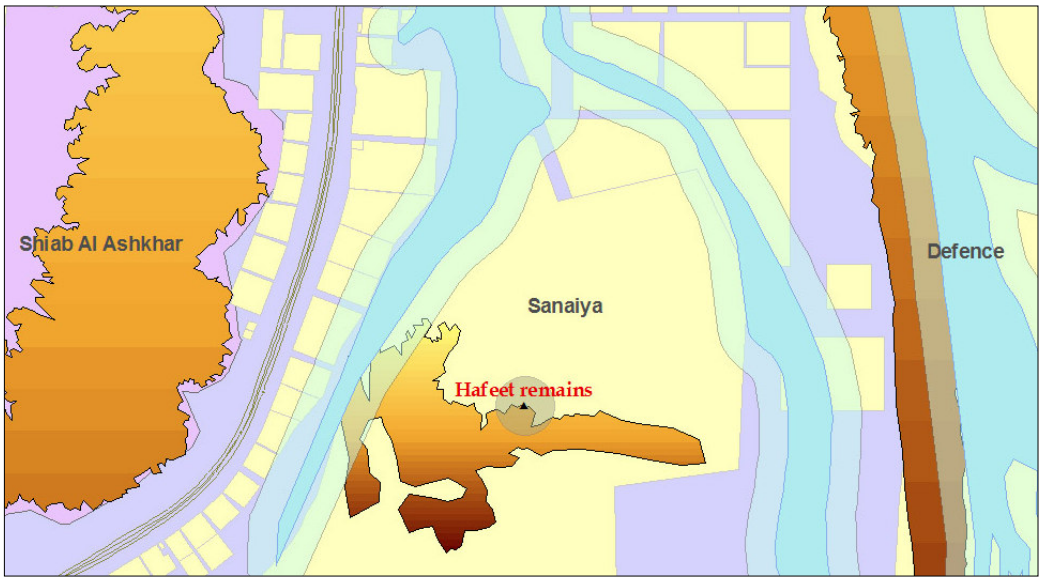


Figure 39 Buffer of the valley

The buffer around the mountain was defined as 400 meters because of the tourism projects already taking place around them, as well as taking into consideration the position of the hot springs and some picnic green areas by the versant sides "Al Mubazzarah" and hiking activities. The hatched area is a cultural-historical zone as

defined by the Tourism Authority and the planning department and the city legislation entities.

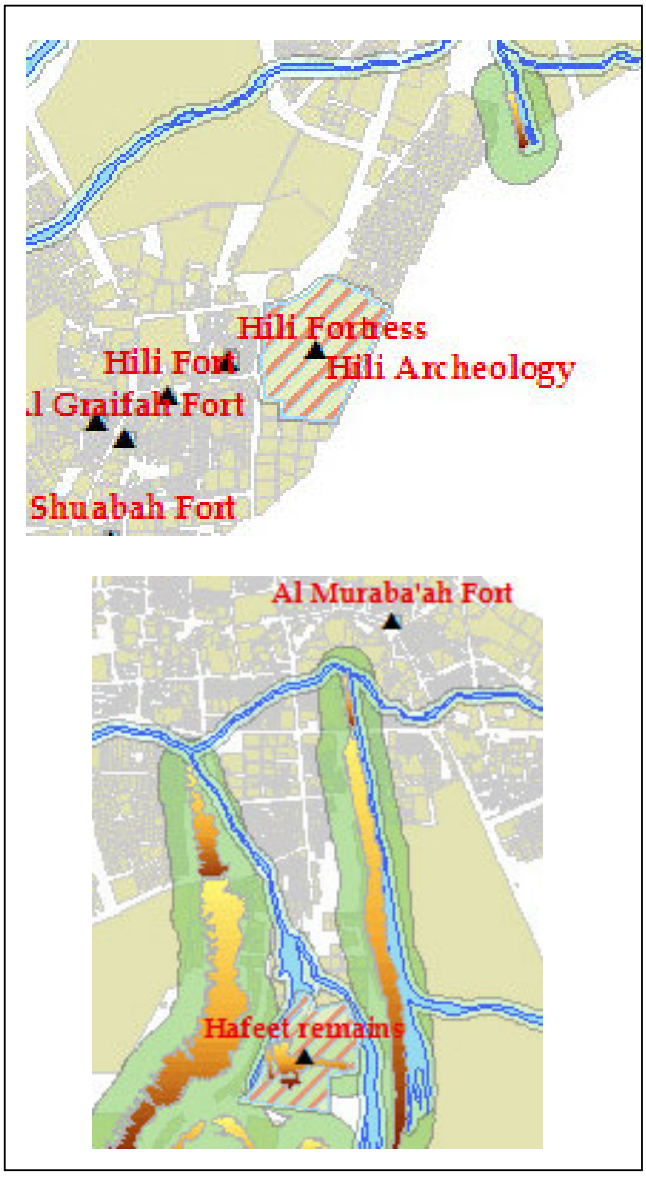


Figure 40 Buffers of valley, mountain, assets and cultural-historical areas

Figure 40 shows that in the Hili district, the intersection of these layers was far away from the historical site of Hili Archeology and the other nearby assets, while the Hafeet Remains were right in the middle of the mountain and valley intersection zone.

5.3. Population and tangible heritage: "Public Awareness issue"

The process under which the reclassification of the Districts-Population distribution showing the high and low densities took place to identify areas of relevant high/low impact on the TH in it. The census data, which was supplied by the planning department (Table 6), had been joined to the attribute table. Exporting it as a database .dbf file, then specifying the joining field from both datasets accomplished this. The joining field, which should be the same in both, was OBJECTID, as represented in Figure 41 and Table 7.

Table 6 Population spreadsheet. (Census 2001, AATPD)

Dist_	Dist_Name_En	Citizens	GCC	Other_Arabs	Indo_asians	Europeans	Total Pop	Density
	Central District	3083	307	10951	21062	353	35756	30.0
04 T	Al Qattara	1456	106	1101	2100	4	4767	10.9
05 T	Al Jimi	5611	736	10540	4393	430	21710	18.6
15 T	Al Mutaredh	1869	214	3665	4689	185	10622	17.5
16 T	Al Jahli	676	95	2354	3383	85	6593	35.3
17 T	Al Mutawa'a	558	35	795	1308	48	2744	23.2
19 T	Al Sarooj	4826	187	1266	3238	76	9593	12.4
		14996	1373	19721	19111	828	56029	17.0
02 T	Al Hili	6107	438	1263	3673	5	11486	4.2
03 T	Al Masoudi	2226	151	182	920	0	3479	2.2
06 T	Al Towayya	4535	400	640	1399	48	7022	3.4
07 T	Al Khabisi	6654	916	3975	6207	220	17972	21.4
08 T	Al Markhaniya	1359	41	145	895	31	2471	2.2
09 T	Al Dahmaa	0	0	9	49	0	58	0.0
10 T	Al Bateen	271	19	12	144	0	446	0.3
11 T	Ghrebah	0	0	21	28	0	49	0.0
12 T	Al Maqam	8808	411	1251	2493	159	13122	7.3
13 T	Asharej	9836	441	529	758	270	11834	13.8
14 T	Al Muwaiji	5836	287	4767	4167	269	15326	11.0
20 T	Al Shuwaimah	7	30	74	568	17	696	0.6
21 T	Aflaj District	15	87	0	109	0	211	0.2
22 T	Al Khrair	0	0	0	0	0	0	#DIV/0!
23 T	Defence	181	12	59	378	0	630	0.2
24 T	Sanaiya	0	5	1441	33470	14	34930	15.6
25 T	Falaj Hazzaa	3609	83	252	1495	68	5507	4.6
26 T	Shiab Al Ashkhar	0	4	91	1619	3	1717	1.1
27 T	Jebel Hafeet	0	0	52	545	0	597	0.1
28 T	Ain Al Fayda	2	0	46	364	0	412	0.1
29 T	Zakhir	9776	138	299	3077	17	13307	2.8
30 T	Al Agabiyaa	1713	20	56	730	8	2527	2.3
31 T	Al Shuaibah	930	12	61	286	0	1289	1.2
32 T	Al Qisais	0	0	3	52	0	55	0.0
		62718	3598	15394	64094	1129	146933	2.8
		80797	5278	46066	104267	2310	238718	4.2

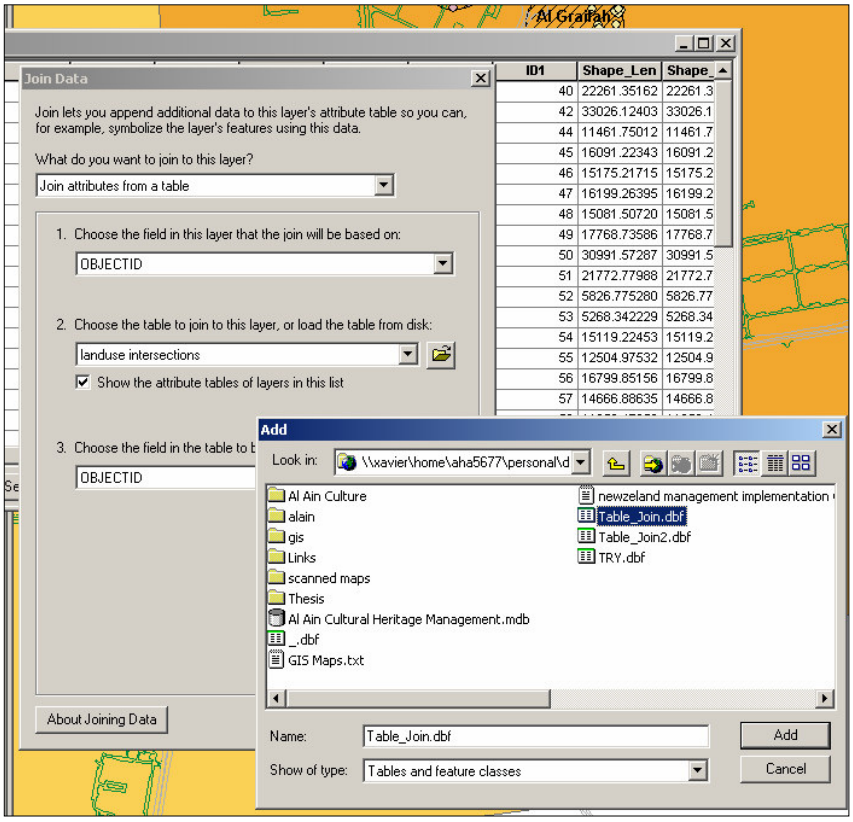


Figure 41 Joining tables from excel spreadsheet to geodatabase

Table 7 Attribute table with population field joined from excel spreadsheet

Attributes of Dist_Boundary_Urban_03

ID4	ID3	ID2	District_N	District_1	Area_Hecta	ID1	Shape_Len	Shape_Len	Shape_Area	POP_2001
9	35	35	Al Ain Int'l Air	40	5,042.8	50	30991.57287	30991.57289	50428050.84	<Null>
10	36	36	Central Distric	18	1,197.1	51	21772.77988	21772.77989	11970694.95	35756.00000
11	37	37	Al Jahili	16	187.8	52	5826.775280	5826.775268	1878297.384	6593.000000
12	38	38	Al Mutawa'a	17	123.7	53	5268.342229	5268.342211	1236628.846	2744.000000
13	39	39	Al Sarooj	19	790.8	54	15119.22453	15119.22450	7907678.791	9593.000000
14	40	40	Al Mutaredh	15	600.4	55	12504.97532	12504.97529	6003849.124	10622.00000
15	41	41	Al Muwaiji	14	1,400.3	56	16799.85156	16799.85151	14002583.70	15326.00000
16	42	42	Falaj Hazza	25	1,210.3	57	14666.88635	14666.88637	12102833.44	5507.000000
17	43	43	Asharej	13	863.7	58	11950.47253	11950.47255	8636651.016	11834.00000
18	44	44	Al Agabiyaa	30	1,158.7	59	14788.46328	14788.46330	11586911.06	2527.000000
19	45	45	Al Maqam	12	1,802.0	60	18247.80110	18247.80110	18019936.70	13122.00000
20	46	46	Al Shuaibah	31	1,182.5	61	15074.52608	15074.52612	11824759.12	1289.000000
21	47	47	Ghrebah	11	4,997.0	62	34887.95647	34887.95649	49969816.20	49.000000
22	48	48	Al Qisais	32	1,935.1	63	17188.40991	17188.40988	19351059.54	55.000000
23	49	49	Zakhir	29	5,207.9	64	34341.60618	34341.60621	52079169.38	13307.00000
24	50	50	Defence	23	3,867.7	68	29260.09154	29260.09156	38677333.96	630.000000
25	51	51	Sanaiya	24	2,217.1	69	29372.58429	29372.58430	22171078.54	34930.00000
26	52	52	Al Khrair	22	3,130.9	71	26786.39280	26786.39275	31311330.34	7009.000000

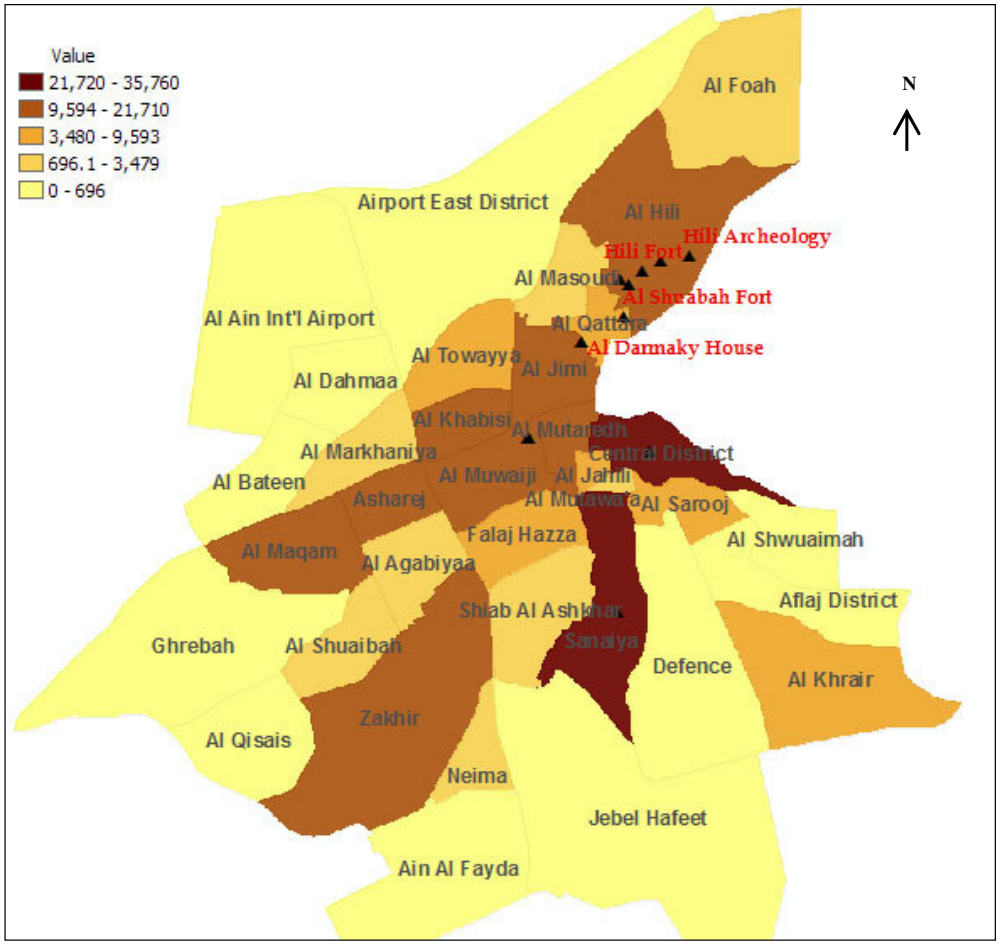


Figure 42 Population distribution in the city of Al Ain

Relating to Figure 42, it is clear that there are two major regions of noticeable high density. These are: the Central District and the Hafeet Region. Comprising the industrial zone, these sites are of a significant contrast to each other in terms of inhabitants and land uses. The Central District is full of major downtown elements such as the Al-Ain Mall, the different shopping centers, the museum, Al-Ain oasis, recent

residential gated communities, buildings of maximum five stories[2], and vibrant main roads like Sh. Khalifa Street. People living in this area are aware of the changes happening within the last decade either from the construction domain or infrastructure and grand openings. Because of such activities, the cultural assets in this area like Muraba'a Fort or the Eastern Citadel, and their different adjacent or onsite activities, should consider the people high density first before beginning their respective preservation projects. The development of tangible heritage and its contribution to the public awareness regarding the historical and cultural values should in fact study the segment of inhabitants.

In this district, the improvements could be possible and easily carried out, and less precautions regarding any expected obstacles from the people living in this area could be taken. However, in the Hafeet Region, specially the industrial zone, which accommodates mainly low income labors, vast number of body shops, carpenters' workshops, garages and some corrugated sheets buildings for storage, the public awareness issues are more critical and of a higher priority. People in this area have expanded their stores and condensed their presence around the site thereby threatening its aesthetic and historical value.

[2] The city municipal and planning regulations forbade building higher buildings to preserve its garden-city style and oasis environment. This ensures that it will not be intervened with skyscrapers, which were thought to lessen this attitude.

5.4. Defining protection areas around the assets: "Protection and urban context issue"

The protection zone around the assets doesn't necessarily imply that they should be destructed or retreated in an adequate manner to enhance the architectural identity of the TH sites. This would prove to be difficult to accomplish in today's society. But this protection zone would be the first place to define the different land-uses around the assets. Also certain legislations regarding the offsets, setbacks, recommendations and elaborated discussions could be initiated by the stakeholders to generate this protection methodology with respect to the urban context.

At this stage, a buffer zone of 50 meters was created around the perimeters of the TH sites. This buffer layer was then intersected with the buffer of the Land-use Layer to find out where they intersected and which types of buildings were creating such intersections (Figures 43 and 44).

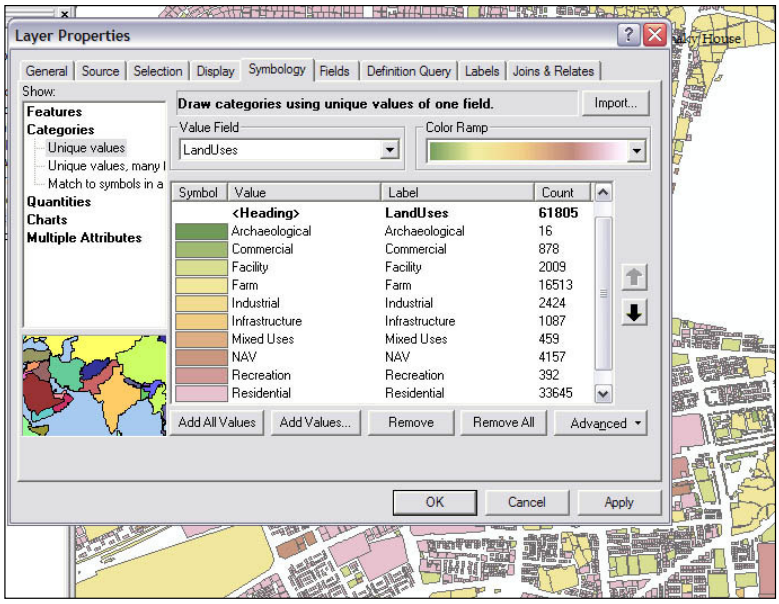


Figure 43 Land-use layer

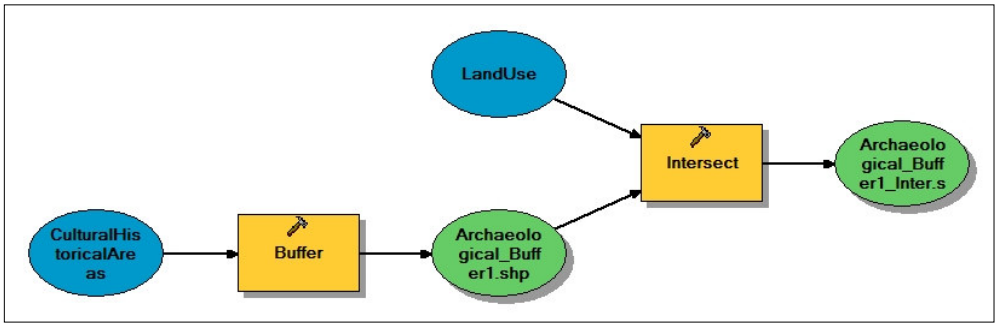


Figure 44 GIS model to define intersections with TH sites

A buffer zone of 50 meters was created around the perimeter of the TH sites. This distance was chosen because it had previously been used in different cases of

historical sites that are defined as world heritage sites and managed and operated by the UNESCO.

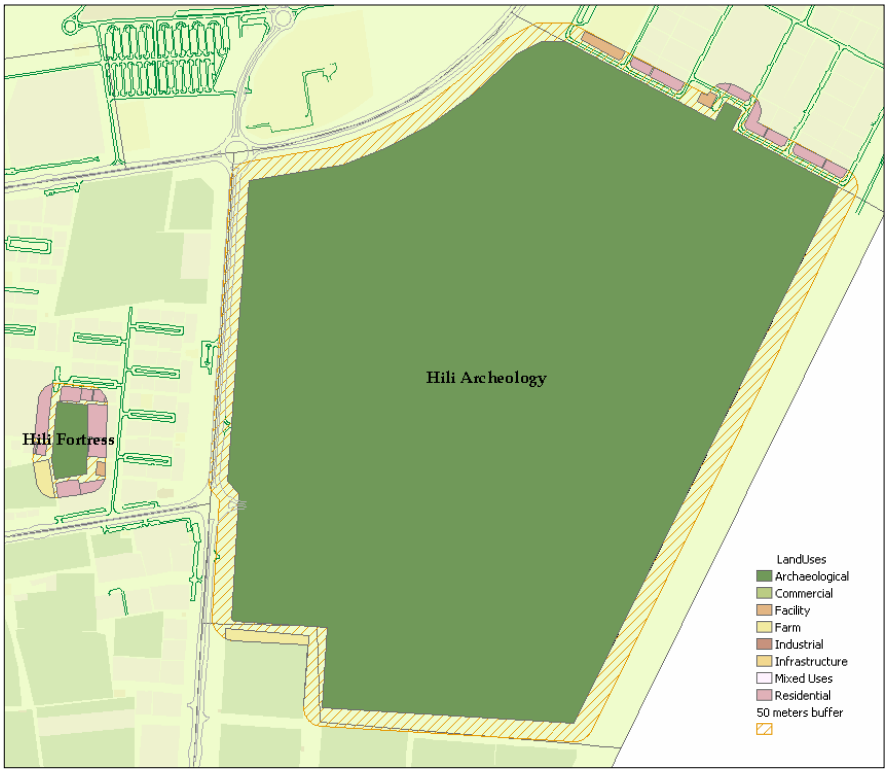


Figure 45 Hili archeology and fortress protection zone

An area like the archeological Hili site, which today is a park, wouldn't be highly affected by the surroundings whether they were residential, or facilities as it appears in Figure 45, because it is already outlined and defined as an entertainment zone enclosed with its own boundaries. However, the case is not the same with the other historical forts

and palaces like in Figure 46 where Al Graifah fort intersects with a farm zone. This indicates a specific treatment should be considered by stakeholders depending on their decisions. Either the surrounding farms and green areas could act as attraction elements, or an integrating zone with the asset either to keep, remove or reuse them in a way that doesn't harm the priority of protecting the building (refer to figures 47-49).

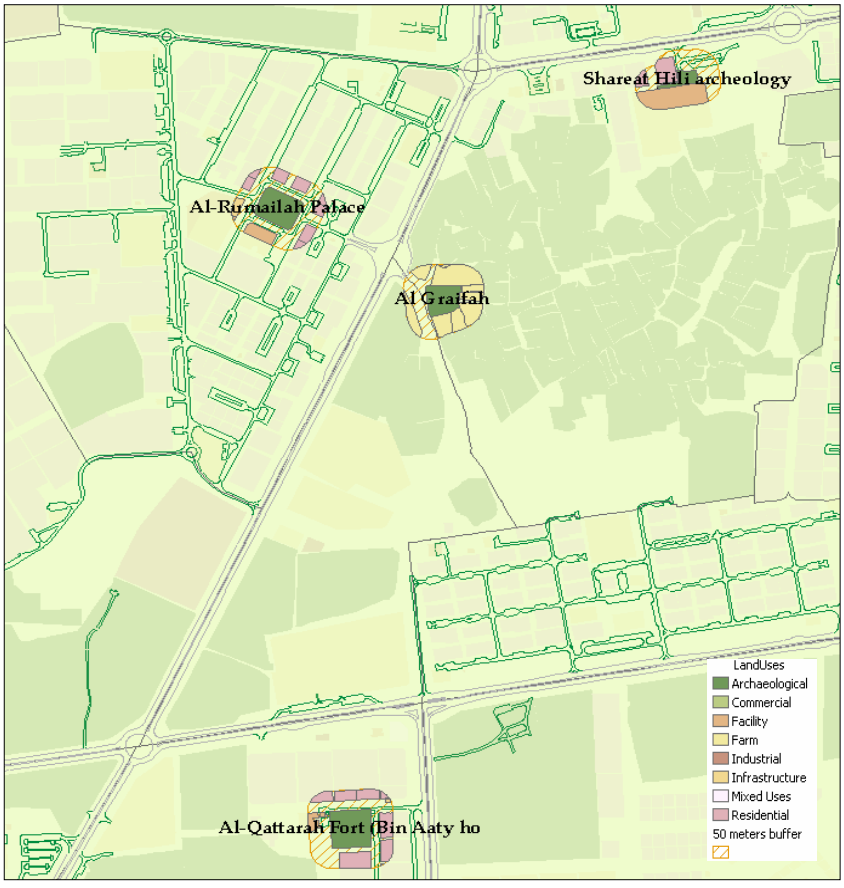


Figure 46 Intersections of land uses and protection buffer zone

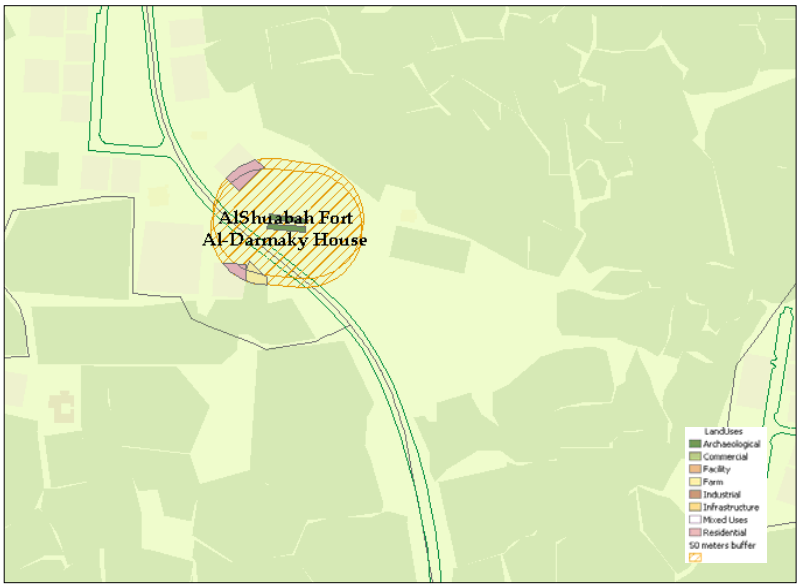


Figure 47 Al Darmaky House protection zone within 50 meters

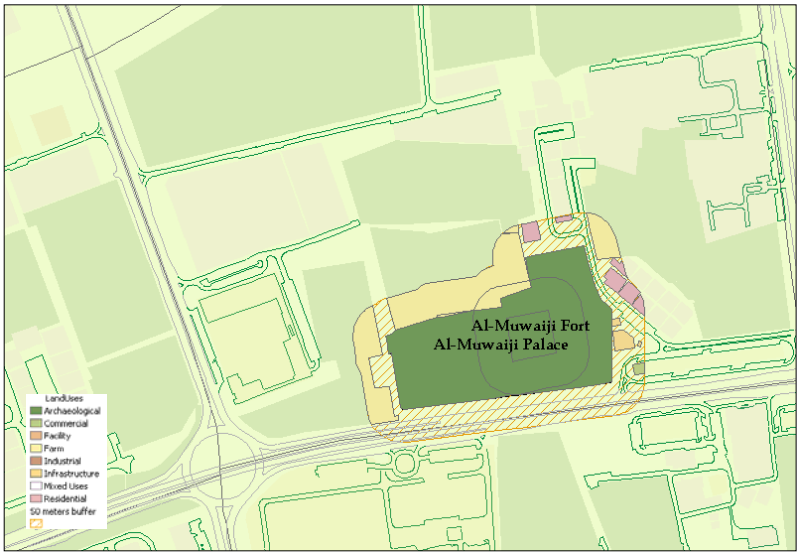


Figure 48 Al Muwaiji Fort / Palace with different land-uses intersections

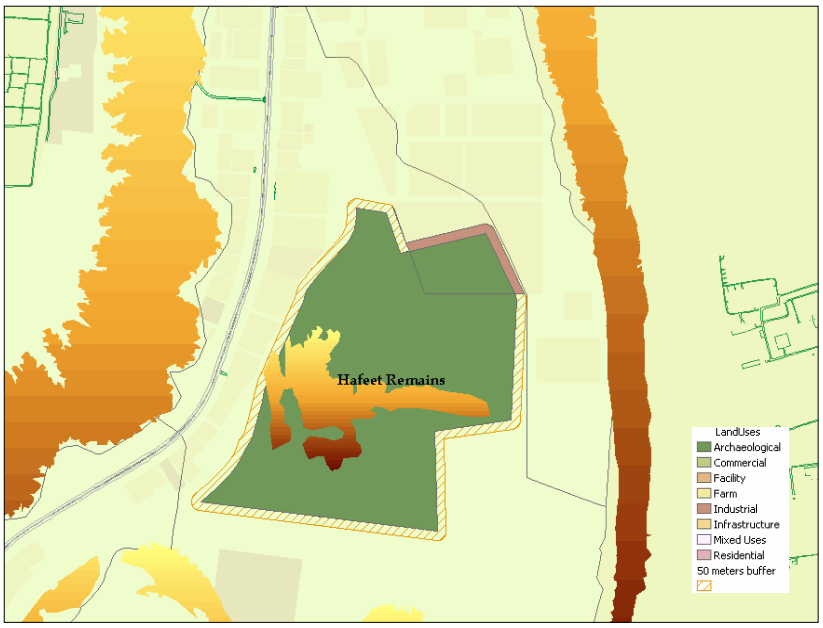


Figure 49 Hafeet region protection zone intersections with the surroundings

The intersections of different Land-Use parcels with the defined TH sites represent a total of 62 intersections (Table 7). In this case, compensation of such buildings and areas to the owners is not the right solution to preserve and develop all of these areas because it would be too costly. However, some intersections that might be considered as high risk to the TH sites should be dealt with either by compensation or transferring ownership to either the planning department, tourism authority or artifacts authority to implement adequate management over it. Depending on each community's intersections that might threaten the assets or even improve their presence, stakeholders might make their own decisions with regards to how to handle them. As shown in Table

8, the Galaat Al Muwaji community has 25 intersections with the assets that it encloses, while in Shareat Hili community there are only 4 intersections. Therefore, the number of intersections in each represents the amount of work and in-depth studies that should be conducted by stakeholders upon each intersection and which solution to accelerate over it. This case also has time constrains if the UNESCO establishment is to be implemented within five or six years.

On the other hand, if the measure were taken with respect to the number of intersections with each asset; not all of them of a high risk. Again, a detailed study would need to be conducted upon each intersection and how it would influence the development of each asset either negatively or positively (refer to Tables 9 and 10). In this case Al Muwaiji Palace would be the highest priority as it has 21 intersections,

Table 8 Total land-use intersections with assets (buffer 50 meters)

OID	LandUses_1	Count_LandUses_1
0	Archaeological	26
1	Facility	4
2	Farm	15
3	Industrial	2
4	Infrastructure	4
5	Residential	11

Table 9 Intersections per community

OBJECTID_1*	Culturalassetsfinal	Count_C
1		8
2	Al Graifah	18
3	Al Misbah	14
4	Al Rumailah	12
5	Al Shuabah	13
6	Athar Hili	12
7	Galaat Al Muwai	25
8	Hai Al Murabbaa	6
9	Shareat Al Qatt	13
10	Shareat Hili	4

Table 10 Intersections per asset

OBJECTID_1*	Culturalassetsfinal_NAME	Count
1		4
2	Al Graifah	18
3	Al-Darmaky House	7
4	Al-Murabba'a Fort	6
5	Al-Muwaiji Fort	4
6	Al-Muwaiji Palace	21
7	Al-Qattarah Fort (Bin Aaty ho	13
8	Al-Rumailah Palace	12
9	AlShuabah Fort	6
10	Hafeet Remains	4
11	Hili Archeology	12
12	Hili Fortress	14
13	Shareat Hili archeology	4

The buffer distance is a sensitive criterion upon which the number of intersections would dramatically change, if a buffer of 100 meters were created around the assets. If this were changed, double the amount of intersections would appear and higher considerations would be initiated for the safeguarding of these sites (Figures 50a-

53). The summary of the number of assets intersecting with areas of different land uses is as follows in Table 11:

Table 11 Assets intersections with land-uses (100 meters)

OID	Culturalassetsfinal_NAME	Count_Culturalassetsfinal_NAME
0		4
1	Al Graifah	34
2	Al-Darmaky House	19
3	Al-Murabba'a Fort	21
4	Al-Muwaiji Fort	9
5	Al-Muwaiji Palace	38
6	Al-Qattarah Fort (Bin Aaty ho	19
7	Al-Rumailah Palace	36
8	AlShuabah Fort	16
9	Hafeet Remains	12
10	Hili Archeology	26
11	Hili Fortress	22
12	Shareat Hili archeology	7

The type of landuse intersections are represented graphically by calculating the centroid of each intersection, then exporting the attribute table and displaying the XY of each intersection by symbolizing it. This makes the maps more readable by stakeholders enabling them to define which areas to consider first and upon which to build their own analysis (Figures 54-58).

Table 12 represents the number of intersections in a buffered distance of 100 meters around the assets:

Table 12 Land-uses intersections (100 meters)

OBJECTID*	LandUses	Count_LandUses
1	Archaeological	28
2	Commercial	3
3	Facility	22
4	Farm	68
5	Industrial	7
6	Infrastructure	17
7	Mixed Uses	12
8	Residential	106

A summary for the different demonstration projects is represented in Table 13.

Table 13 Summary for the demonstration project

ISSUES	GIS DEMONSTRATION	RESULTS
Historic Preservation Classification according to historical value (criterion could be changed according to stakeholders priorities)	Assets classification Preservation projects prioritized according to the historical value of the assets	2 sites identified as of a high priority and should be considered firstly to implement preservation projects upon
Tourism Promotion Defining tourism route and entertainment surroundings, accordingly, tourism activities should be prioritized	Tourism route map to be followed by tourists The route defines tourism priority among the assets if distance is considered	Considering tourism direction from north to south, 5 sites to start with and a suggestion of architectural panorama and history project to be located first i.e. Hili Site
Population and Public Awareness	Population thematic map representing the density of population in each district	2 major districts of high density, Central District and Hafeet Region
Urban Context and TH Protection	Land-uses were intersected with TH sites using the buffer technique. Comparison between two buffers took place for alternative decision making	Al Muwaiji Palace and Al Graifah Fort facing risk of creeping urbanism around While in terms of districts Hili and Al Muaiji share the high number of intersections

CHAPTER VI

CONCLUSIONS AND RECOMMENDATIONS

Conducting this research revealed how the use of GIS aid in the process of decision making, and enables different authorities to understand each other's priorities and allow them to measure the outcomes of each priority. It also initiates a vision that could be adopted by the different entities in attempting to work together to advance Tangible Heritage development, tourism promotion and preservation solutions. The easy-to-use ArcGIS software was especially helpful in demonstrating and analyzing a Tangible Heritage Management Strategy. It was recognized from the results that the GIS has demonstrated its usefulness and ability to represent the issues that were discussed earlier.

6.1. Accomplishment and validation of objectives

6.1.1. Definition of issues

Defining the problems of the current situation regarding the Tangible Heritage in the city of Al-Ain was the first objective of the research. It revealed the extent to which the different authorities should intervene, and clearly defined those authorities namely the Al-Ain Tourism Authority, Al-Ain Town Planning Department, Abu Dhabi Artifacts Authority, and Al-Ain Municipality. Each is in charge of carrying out different aspects of the solution to safeguard the assets from the previously defined issues. The use of GIS will aid those authorities in defining their different priorities and regulations and plan for the future.

6.1.2. Classification of assets

The different authorities in charge of classifying the assets either by use, location, or historical value, or any other criterion they define, can use the GIS to define these assets depending mainly on their architectural essence: forts, palaces, citadels and residences. The classification is the first step to understand the TH values from different perspectives because this step reveals the historical depth of each asset. It will also help in making decisions about future projects. All the assets were defined in the attributes table and represented on the map. This enables decision makers to segregate projects based on their attributes.

6.1.3. Demonstration of the issues

- The issue of historic preservation projects needing to be carried out on the assets was demonstrated using the ArcGIS software by classifying the TH sites and buildings. This was accomplished by taking their date of origins as a criterion to measure their historical values; the older the TH site, the more valuable and thus the first to be preserved. This study revealed that forts and archeological sites in Hili, along with Hafeet remains, are of the highest priorities to initiate the preservation projects. However, if decision-makers and authorities classified those assets depending on any other criteria, for instance the deterioration of the buildings or their cultural significance, then the classification would be different. In these two cases, the preservation projects would be ordered differently depending on which one had the worst deterioration or which one had the highest cultural significance, respectively. GIS enables the different

authorities to classify the assets depending on their priorities and conditions, therefore the preservation projects would take place according to plans.

- The issue of tourism promotion is influenced by the nature of the projects represented to the tourists who are visiting the city. Hence the visitors are in some cases coming from north to south, i.e. from Dubai and north Emirates towards Al-Ain. Therefore, decision makers and governmental authorities should take into consideration the type of tourism projects to be applied especially on the assets that are located in the north part of Al-Ain. This will attract tourists and encourage them to visit the farther assets located in the southern part. ArcGIS software was used to define the route that should be followed by tourists according to the shortest distance to the main road, but decision makers could define it using the same technique taking the type of projects they want to implement on those assets (i.e. museums, galleries, libraries, restaurants) as a criterion.

- The public awareness issue was demonstrated in terms of the population of each district that contains the assets. It was notable that two districts, Central District and Hafeet Region (including the industrial zone) were of the highest densities. This implies that public awareness in these areas should be a critical issue, because it would affect the use of the cultural and historical sites along with their prospective projects. It would also affect the idea of establishing the cultural educational center in the city that was proposed in the agreement (The Al-Ain Cultural Heritage Management Strategy,

February 2005). This could either be reacted to negatively or positively depending on how many people are aware of these assets. Because the GIS enabled the representation of the assets with respect to the population density, governmental authorities can estimate how delicate situations of some assets are according to the population distribution. This will facilitate participation in the allocation process for the public awareness center.

- Protection zones were demonstrated using the ArcGIS software by buffering around the boundaries of the TH sites. The buffered distance was 50 meters off the borders. It was clear that in some cases there were high number of intersections in the protection zone of the asset, which entails that the use around these defined areas was not well studied or managed. This stage is a critical one because of the depth it revealed; that cultural and historical sites are not taken into consideration with respect to land ownerships, the type of projects and their distribution. , Decision makers and governmental authorities could utilize this technique using GIS to define protection zones and then regulate those zones according to the current situation and the available solutions.

6.1.4. Analysis of outcomes

As an interdisciplinary tool, the GIS was used in this research to demonstrate the management strategy issues. Although not the only goal, this lead to a deeper vision and a better understanding of how a qualitative study can result in a solid decision making

approach. This was brought up by discussing each issue that was demonstrated and representing its own results in statistical forms to define the spectrum of each issue and objective.

The research was able to validate the hypothesis, which was: If a GIS system is appropriately developed to incorporate all the necessary information, then it can become the primary tool to demonstrate a heritage management strategy. This in turn will aid different agencies in the full understanding of the current situations and set of data supplied. This would allow for efficient decisions to take place in accordance with the dynamic solutions represented spatially.

Validating the hypothesis was achieved by segregating the different issues addressed by the Al-Ain Tourism Authority in the agreement, then representing each issue on the map and analyzing the demonstrated results. Developing an appropriate GIS system had been easily achieved by using the different spatial analysis techniques available in the software, which were represented on the maps for analysis purposes later.

The software had the capability to incorporate all the available information by joining the different data and spreadsheets to the attribute tables and project them on the layers of the maps. Because of the GIS ability to update databases; these data are manipulated easily and accepting the up-to-date information supplied by the governmental authorities, which will enable decision makers to share, provide and require certain information to accelerate their individual projects. Thus, the GIS was able

to connect them all through the representation of different layers of issues and aspects for which they each seek.

6.2. Recommendations

After demonstrating the different issues and problems using the GIS, it is recommended that:

- Classifying the TH sites with regard to the conservation priority is mandatory because it entails a sufficient provision of financial coverage and specified budget to each asset by the government.
- Comparing the cultural and historical sites for the purpose of preservation with the purpose of a protection zone around their boundaries, or for the purpose of tourism promotion are significantly different. This is evident because certain sites fall under the highest-class category in the preservation projects while they don't necessarily for the protection zones. This explains the conflict between stakeholders and decision makers in assigning the adequate projects upon the assets. In such case, the GIS allows many possibilities to process hierarchy between the parties to be displayed and measured, which will reduce the gap between them.
- The process of inventory and geo-coding of the assets was, in some cases, not precise in that some landmarks and TH sites were misrepresented. For instance Al Jahili Fort, which is considered the center mark of the tangible heritage in the city as a significant element for the fortified architecture and aesthetic representation, was represented on the map as a park but not an historical or cultural resource. Also, as the

Eastern Citadel was represented as a museum but not an historical asset. These differences would entail a completely different perspective for the management of these sites.

- The land ownership and land-uses legislations should consider the historical and cultural resources before initiating any adjacent project, despite the UNESCO auspices and guidelines. The city government, with the new administration integrity with Abu Dhabi Tourism Authority, should define the type of activities and projects surrounding the assets that should not intrude upon them.

The Recruitment of local experts is not just a nation's need, but it also ensures that the locals are aware of inner problems and collaboration between different entities to safeguard the assets, as well as to accelerate the procedure of registering historical sites in the World Heritage List.

REFERENCES

Al-Ain Maps, The Mounsell Consultancy, Al Ain Town Planning Department, United Arab Emirates, (2005)

The Al-Ain Cultural Heritage Management Strategy, (2005), Al Ain Economic Development and Tourism Promotion Authority, Al Ain, UAE.

Al Ain Town Planning Department census (2001). URL:http://www.alainplanning.gov.ae/en/aboutalainpopulation.asp?id=aboutalain&subid=population

Al Hassan, R., El Kadi, H. (2002) *Information System Applications for Conservation Strategies*. URL:http://www.cultnat.org/download/PdfConf/New%20Folder/information_system.pdf

Armstrong, L., Henry, M. (2004) *Mapping the Future of America's National Parks: Stewardship Through Geographic Information Systems*, pp. 66-67, Redlands, California: ESRI Press.

Buckler J. (winter 1998) GIS and Historic District Management: Annapolis. *CSA Newsletter*. 10 (3). URL:http://www.csanet.org/newsletter/winter98/nlw9805.html

Bussaa D. (2002) *Towards an Inter-Emirate Urban Conservation Strategy in the United Arab Emirates*. URL: http://www.rics.org/NR/rdonlyres/D945BB6F-0058-408F-9D0C9DB8FB1F8E61/0/towards_interemirate_urban_conservation_strategy_20020410.pdf

Box, P. (1999). *GIS and Cultural Resource Management: A Manual for Heritage Managers,* UNESCO, pp. 4, 9, 31*,* Bngkok, Thailand, UNESCO Principal Office for Asia and the Pacific.

Carmen, L. (October-December 2003). Understanding an Ancient Roman City in Tunisia. *ArcUser Online*. URL: http://www.esri.com/news/arcuser/1003romanruins.html

Centroid Calculations, URL:http://webhelp.esri.com/arcgisdesktop/9.1/index.cfm?id=340&pid=326&topicname=Making%20field%20calculations, Accessed: July, 2005.

Cleuziou, S. (1981). *The Hili Excavations 1980-1981*. Bulletin of the Emirates Natural History Group 14: 6-8.

Cros, H., McKercher, B. (2002). *Cultural Tourism, The Partnership Between Tourism and Cultural Heritage Management*. pp. 7, New York, USA: The Haworth Hospitality Press.

David J., David W., Paul A., Michael F. (2001). *Geographical Information Systems and Science*. West Sussex, England: John Wiley & Sons, Ltd.

Jaime J., Moyes H. (October 2000). *Spatial Analysis of an Ancient Cave Site. ArcUser*. URL: http://www.esri.com/news/arcuser/1000/cave.html

Kazmi A. (May 2003) Al Ain, UNESCO in Deal on Preserving Heritage, *Gulf News*. URL: http://www.gulfnews.com/Articles/news.asp?ArticleID=88 560

McCarthy, D. (2004) Innovative Methods for Documenting Cultural Resources: Integrating GIS and GPS Technologies, *CRM Journal Summer*. 86, 3.

Micheal J. (2003, chap 15) Spatial modeling, In: Batty, M., Longley, P. (2003) *Advanced Spatial Analysis*. pp. 309-326. Redlands, California: ESRI Press.

Nahar, A. (2005) Abu Dhabi Hosts Regional Meeting of World Heritage in Arab States, Unveils Strategy to Better Protect It, *Middle East Online*. URL: http:// www.middle-east-online.com/English/?id=15152

Petersen, P. *Suitability Modeling at Prince Williams Forest Park*, URL: http://www.nps .gov/gis/applications/how.html, accessed: January, 2006.

Terminology on Disaster Risk Reduction (2003), *International Strategy for Disaster Reduction*, URL: http://www.adrc.or.jp/publications/ terminology/top.htm

Webber, R., Longley, P. (2003, chap 12) Location in physical and socio-economic space, In: Batty, M., Longley, P. (2003) *Advanced Spatial Analysis*. pp. 233-266 Redlands, California ESRI Press.

Yasin, W. (2005) Department of Antiquities and Tourism. URL: http://www.aam.gov.ae /sections/hafit_cairns.htm Department of Antiquities and Tourism

Zutterman, C. (2004) The Softstone Vessels from Qarn Bint Sa'ud, Abu Dhabi (U.A.E.), *Arabian Archeology and Epigraphy*, 15 (105).

Supplemental resources

Cultural Center, *United Arab Emirates Museums and Heritage Villages*, URL: http://www.uaeinteract.com/ culture/al_ain.asp, Accessed on: January, 2005.

History and Traditions- Heritage, URL: http://www.uaeinteract.com/news/ default.asp?ID=58, accessed on: January 2005

Important places in Al Ain, URL: http://www.theuae.com/tourism/Tourism.html, Accessed on: July, 2004.

Planning and Survey Sector, location, URL :http://www.alainplanning.gov.ae/en/ aboutalainlocation.asp?id=aboutalain&subid=location, Accessed on August, 2005.

URL: http://www.alain.gov.ae/abed3.htm

APPENDIX

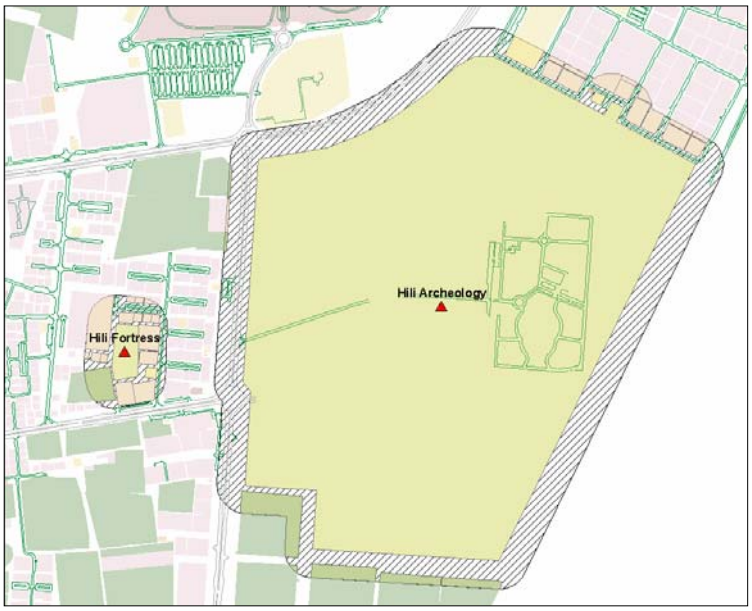


Figure 50a Hili archeology intersections (100 M)

Figure 50b Hili District intersections (100 M)

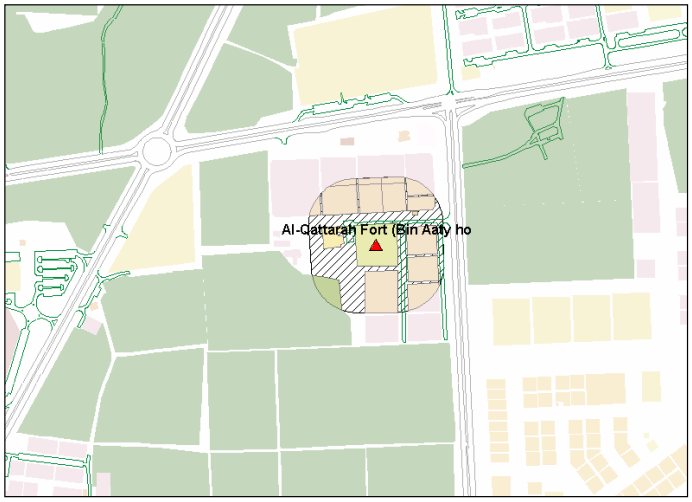


Figure 51 Al Qattarah District land-use intersections (100 M)

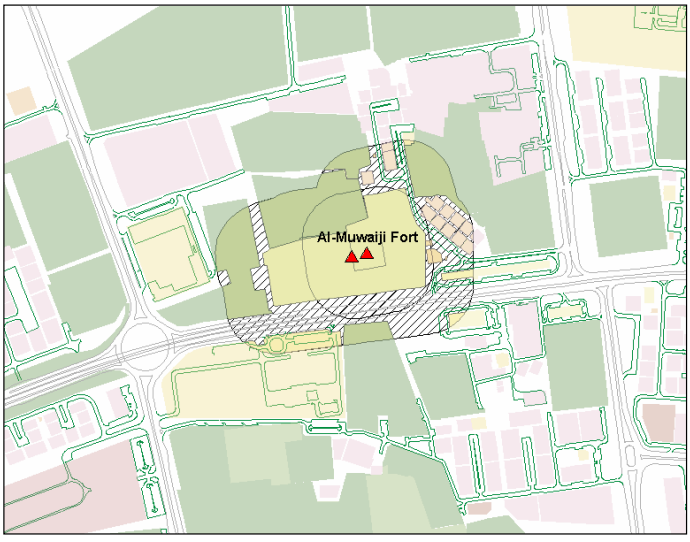


Figure 52 Al Muwaiji Fort/Palace (100 M)

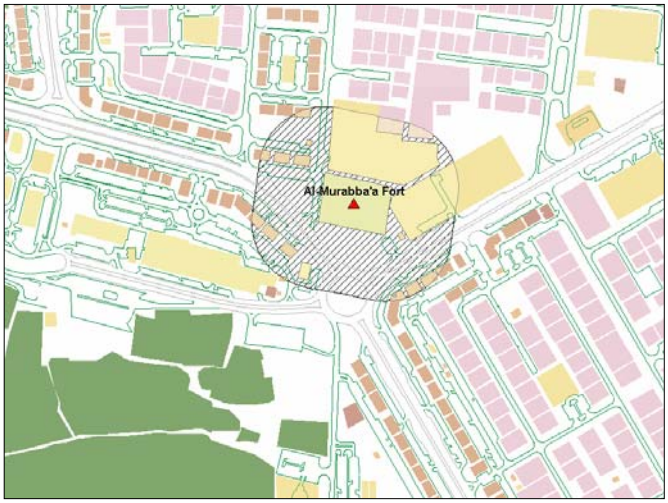


Figure 53 Central District (100 M)

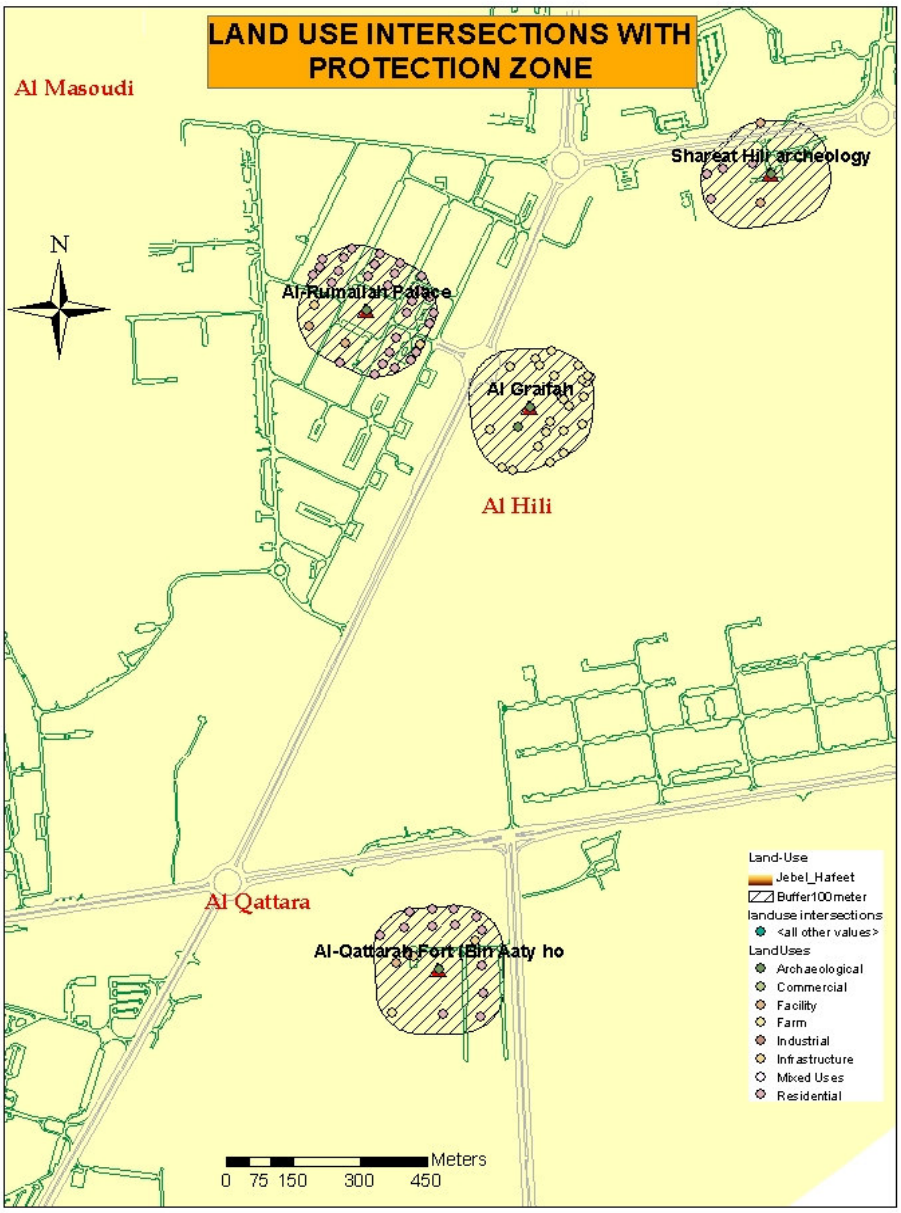


Figure 54 Hili and Qattarah Districts map showing points of intersections within a buffer distance of 100 meters

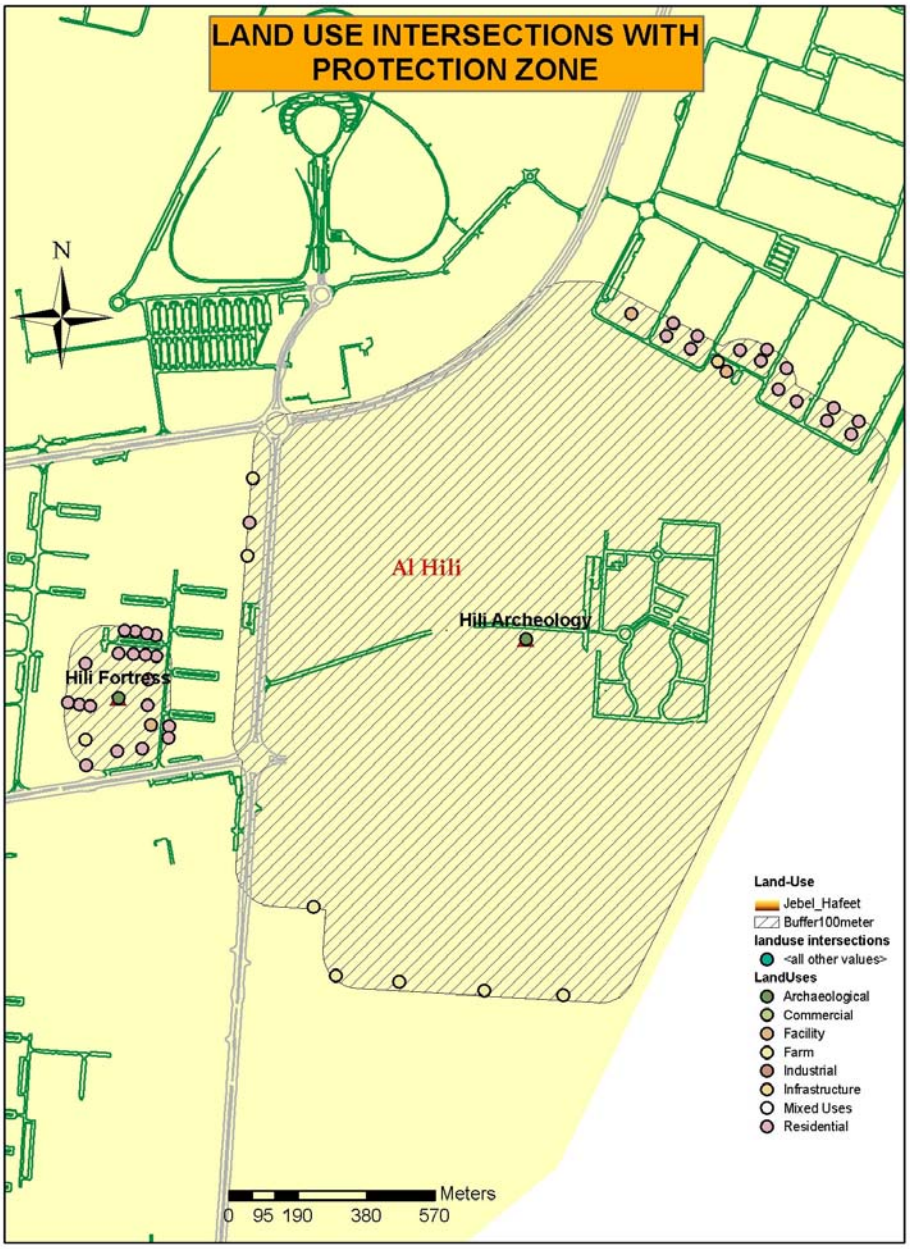


Figure 55 Hili archeological park map showing points of intersections within a buffer distance of 100 meters

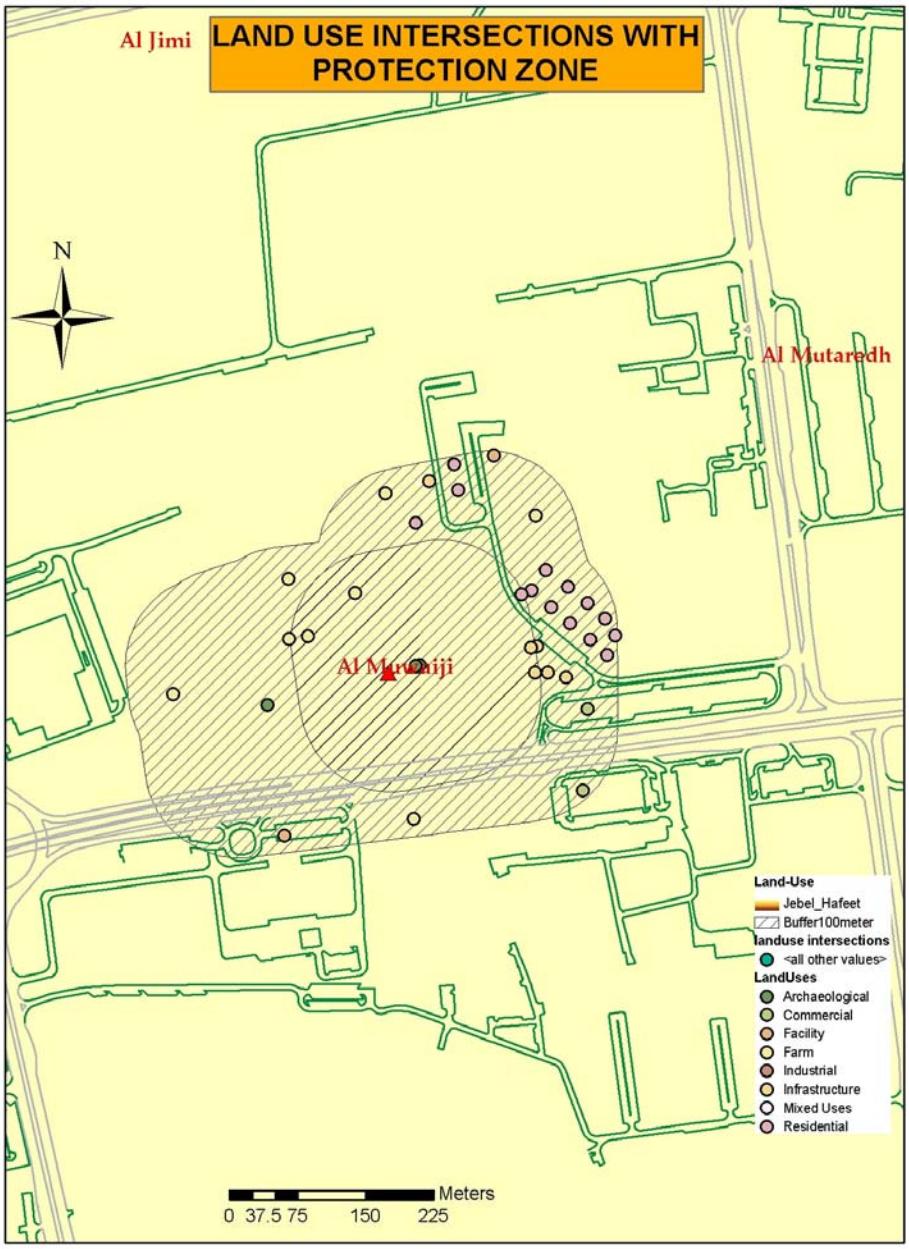


Figure 56 Al Muwaiji Fort/ Palace map showing points of intersections within a buffer distance of 100 meters

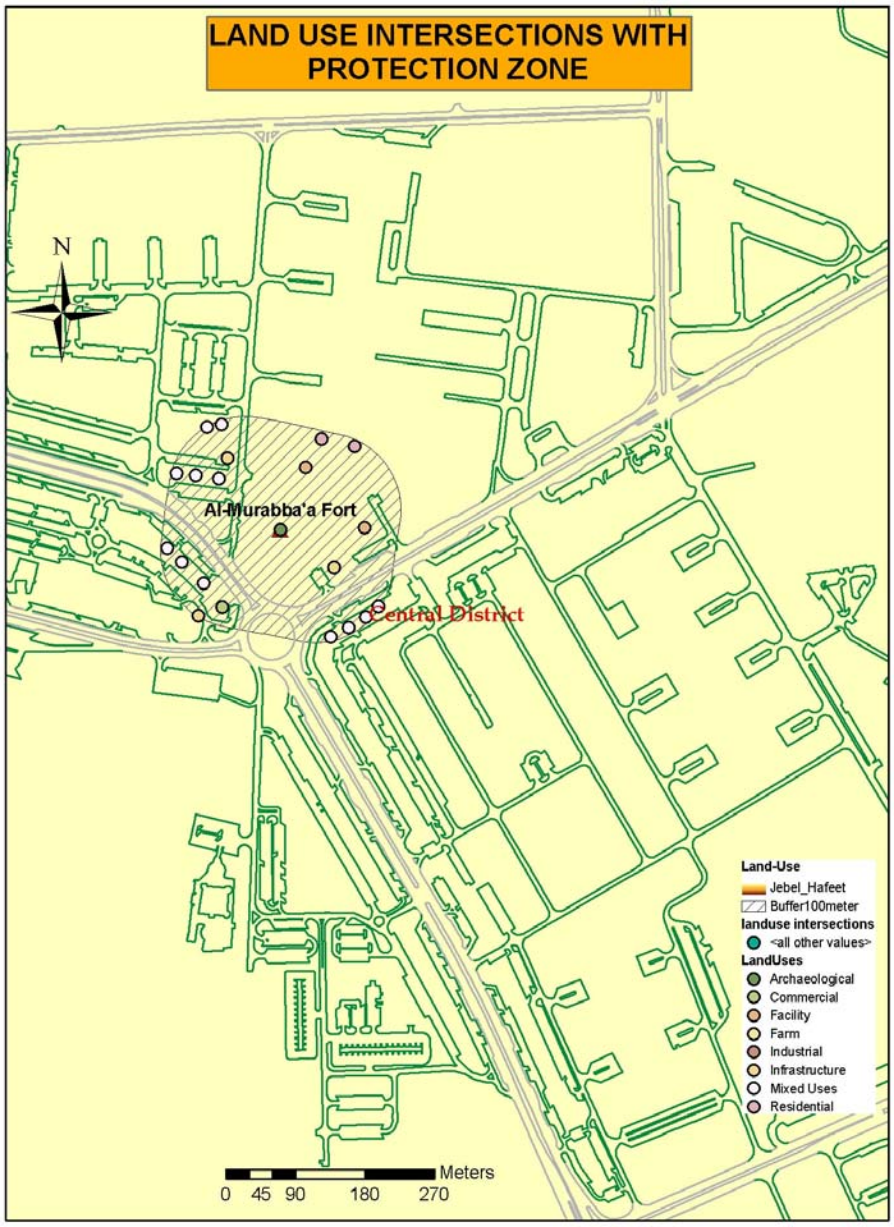


Figure 57 Central District map showing points of intersections within a buffer distance of 100 meters

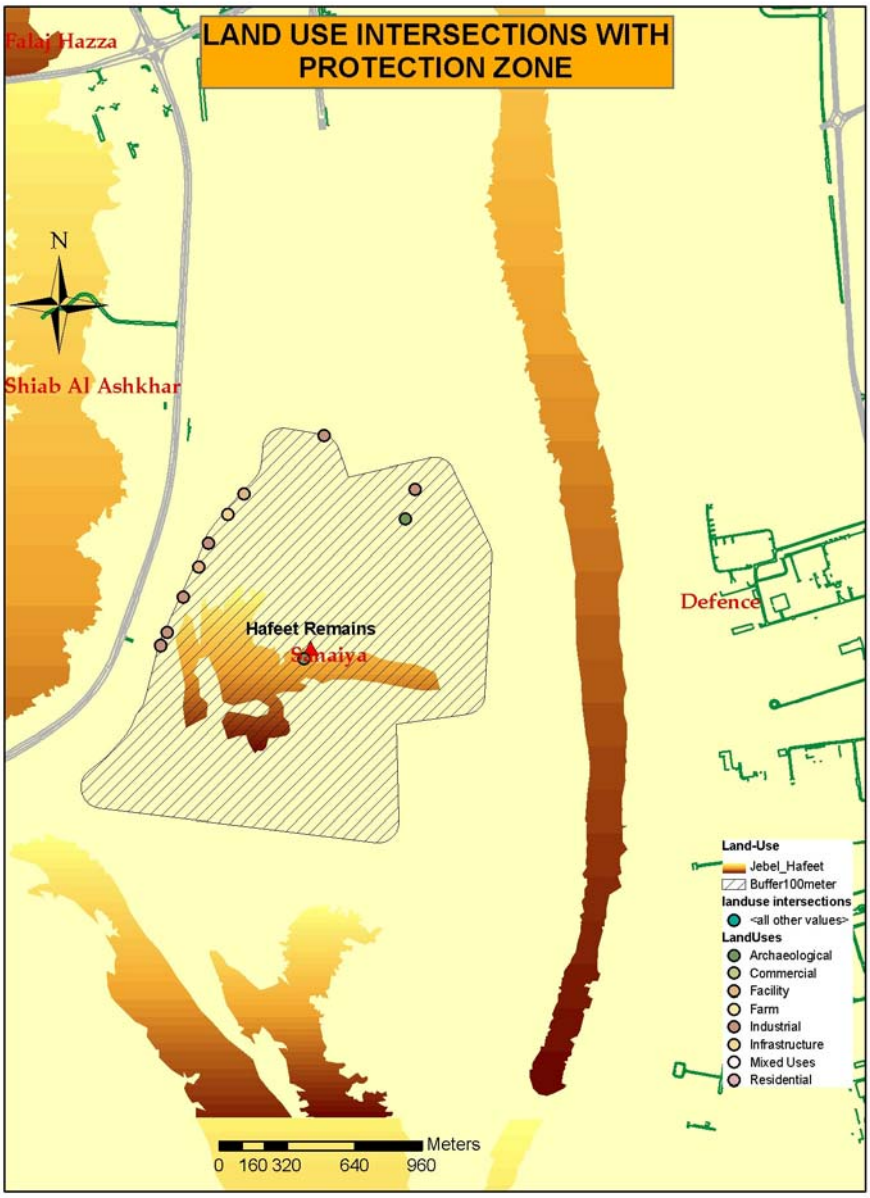


Figure 58 Hafeet region map showing points of intersections within a buffer distance of 100 meters

VITA

Personal Information

Name: Azza Hasan Al Zaabi

Nationality: UAE

Place of Birth: Egypt

Education

M.S. Arch., Texas A&M University

B.S. Arch. Engg., United Arab Emirates University

Permanent Mailing Address

Department of Architectural Engineering

United Arab Emirates University

P.O. Box 17551

Al-Ain, United Arab Emirates