

## **Documenting and Development of Archaeological Sites in Al-Muthanna Governorate in Iraq Using Geographic Information Systems (GIS)**

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### **Abstract**

Employing geographic information systems (GIS) in documenting and developing the archaeological sites of Muthanna Governorate in Iraq, through the ability to analyze spatial and descriptive data and use them as a database that is easily accessible to users with the possibility of modification. In this research, GIS is combined with archeology through the latest Versions of the ArcGIS software, where ArcGIS 10.4 version was used and applied to the archaeological sites of Al-Muthanna Governorate, which allows the possibility of future planning for archaeological sites, as well as adopting this data as a basis for any subsequent software applications to obtain results through which it can contribute to the development and preservation of these archaeological sites, and given what they have been exposed to. Archaeological sites in Iraq in general are affected by many factors during continuous wars and other environmental conditions and demographic overruns, because of that the using of modern technologies, information systems and software with their latest version to document and develop these sites is very important to preserve them and make them available through applications for users in archaeological tourism, and this is due to support on The economic aspect of the city and country as well. And making it available to experts in the archaeological field contributes to its development and draws attention to more archaeological discoveries, especially in countries with ancient civilizations. Also, an accurate analysis of the pattern of environmental and demographic damages and spatial analysis of archaeological sites in

Al-Muthanna governorate help officials to take the necessary measures to protect these important sites.

## **Keywords**

Geographic Information Systems (GIS), Archaeological Sites, Data Base Management System (DBMS).

## **Introduction**

The development of geographic information systems (GIS) and information technology showed the need to enter them in all different fields of science, and because of importance of archaeological tourism in supporting the economy of cities and countries, the integration of modern software and information technology with archeology is economic and scientific importance. Al-Muthanna Governorate is one of the cities of Iraq that owns many archaeological sites that get damaged due to environmental factors and population violations. Therefore, it is important to form an electronic information data base for it and integrate it with spatial maps, where this information and others are provided by choosing the required area and distance and saving it automatically and coordinating, arranging and tabulating it so that it is easy to obtain the required information in an automatic, quick and easy way, as the information cannot be analyzed in a map if this data is not in a digital form that a computer can read. Therefore, several methods are used to convert paper maps into digital maps to create a computer model of the paper map consisting of data that completes the process of collecting its coordinates, and when information or map is needed, obtaining that takes only seconds for the system to search and display the required information or map on the screen, as well as the possibility The system provides information in multiple forms, whether in paper, film, pictorial, or even digital form for use in the same system in the future or in another system if the possibility of conversion is available. The data processing depends on the efficiency of hardware and software. Also, the geographic information systems applied to the archaeological sites of Al-Muthanna Governorate will enable us to obtain the lengths and areas of the lines and shapes shown on the map automatically and to match or project the maps on each other to obtain new information and maps derived from the basic maps, The management of cultural heritage sites is the highest and most demanding stage of using GIS in cultural heritage (Valjavec & Vallone 2014).

## **Methods**

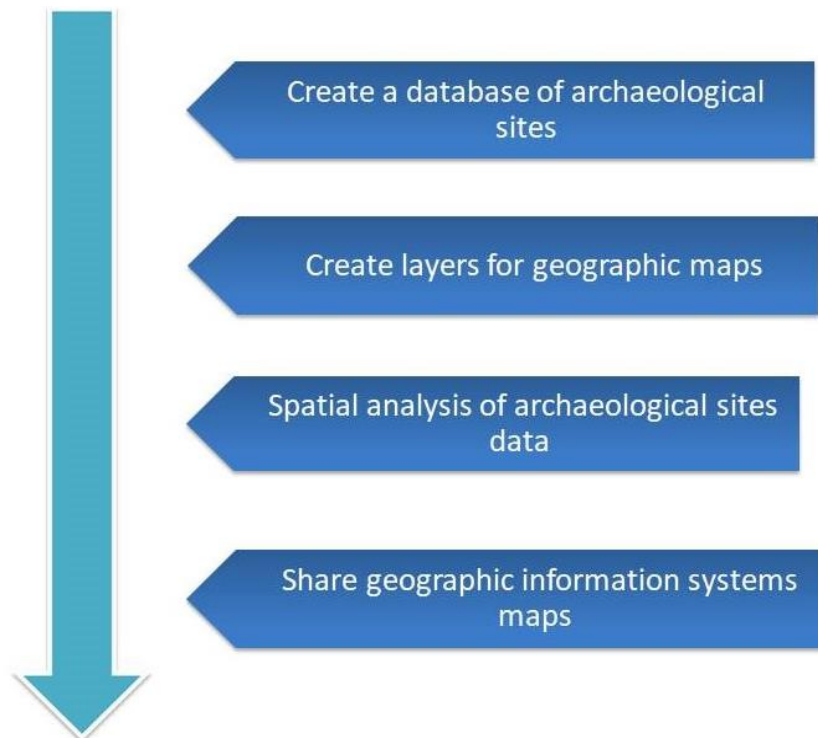
Geo- information science is the scientific field that attempts to integrate different disciplines studying the methods and techniques of handling spatial information (Huisman&Rolf 2009). The benefit of information technology and software in documenting Analyzing the data on the archaeological sites in Al-Muthanna Governorate to use it later in inventorying this site and not losing it and giving a vision for its management as well as showing the importance of using GIS and integrating them with archeology and in the rest of the industrial, agricultural, educational and health fields due to the limited use of geographic information systems at the present time in Iraq. The study answers the following questions:

1. How to locating geographical coordinates of archaeological sites.
2. What are the best methods for create a database for the archaeological site using ArcGIS 10.4 software and drawing maps through it?
3. What are the best ways to share maps with users (tourists or archaeologists?).

The process of creating electronic maps for archaeological sites in Al-Muthanna Governorate, and the roads leading to them, and building a database for each site is within the stages of identifying the necessary hardware and software equipment, so that the data is clear and accurate.

1. Defining devices for locating the coordinates of archaeological sites.
2. Defining the devices for measuring the areas of the archaeological sites and the ways leading to them.
3. Defining the computers with appropriate specifications to deal with data reception and management and dealing with software for GIS systems.
4. Choose the appropriate operating system that is compatible with the geographic information systems software.
5. Choosing the appropriate GIS software that allows dealing with data on archaeological sites and outputting them in an appropriate manner for users.

Figure No (1) shows the sequence of designing and integrating GIS with archeology (Esri global company2020).



**Figure 1**

### **Geographical Information Systems and Archeology**

Use geographic information systems to highlight issues driven by geography. This map reveals population overruns to the geographic patterns of archaeological sites that emerge when the data is well mapped.

Monitoring the change in archaeological sites, as the map reveals starkly the impact of environmental factors on these sites and real-time awareness of the situation

A GIS helps in setting priorities based on spatial analysis. By analyzing the patterns of damage to the antiquities, the surrounding environment and the roads leading to it, public safety officials can identify the target areas and set protection measures for them and improve the roads and the surrounding environment.

Apply GIS technology and integrate it with archeology with tools for understanding and collaboration. It helps people reach a common goal and gain actionable intelligence from all kinds of data. The GIS integrates different types of data layers for the archaeological sites of Muthanna Governorate using spatial location. Most of the data has a geographic component. GIS data includes images, features, and base maps associated with spreadsheets, In addition to the geographic data that define the location are the attribute data that describe the various qualities of the sites (Jonathan. & Shin 2011).

ArcGIS 10.4 software provides a focused ability to get work done and to bring GIS to life as GIS applications work almost everywhere: on mobile phones, tablets, web browsers, and desktops (Deutsches Archäologisches Institut, 2005).

Maps are the geographic container for data and analysis layers that include the exact sites of antiquities and the routes leading to them. Offering GIS maps to be easily shared and embed in apps, they can be accessed by almost everyone everywhere. Ultimately, spatial analysis of archaeological sites allows assessment of relevance and capacity, assessment, prediction, interpretation, understanding, and much more, bringing new perspectives to decision-making.

## Data

Primary data was collected using the GPS device in archaeological sites in Al- muthana government, at the highest point of each site, and the communication with the satellite began. Two readings were recorded for each archaeological site, representing the map type, number, longitude and latitude, and keeping the site's name and image in the database.

Table 1 Represents the data that were recorded from visiting ten (10) archaeological sites in Al-Muthanna Governorate

**Table 1**

No	Site name	Importance	Condition	MGRS Coordinate	Side	Governorate
1	uruk	XXXXX	GOOD	NV 60580 MGRS 65501	AL-WARKA	AL- Muthana
2	ANANA	XXXXX	GOOD	NV 60908 MGRS 65749	AL-WARKA	AL- Muthana
3	ANU	XXXXX	GOOD	NV 60446 MGRS 65608	AL-WARKA	AL- Muthana
4	AL-NUFAJI	XXXXX	GOOD	NV 60935 MGRS 68962	AL-WARKA	AL- Muthana
5	AL-NUFAJI 2	XXX	destruction	NV 61586 MGRS 67748	AL-KIDER	AL- Muthana
6	REDO	XXX	destruction	NV 52479 MGRS 65989	AL-KIDER	AL- Muthana
7	GARUSE TEMPLE	XXXXX	GOOD	NV 61042 MGRS 64880	AL-WARKA	AL- Muthana
8	AMAM MIZHIR	XXXX	destruction	NV 37447 MGRS 85316	AL-WARKA	AL- Muthana
9	jawi	XXX	destruction	NV 65987 MGRS 37828	AL-KIDER	AL- Muthana
10	AL- HAMMAM	XXX	destruction	NV 94736 MGRS 78512	AL-KIDER	AL- Muthana

The database was built according to basic information for each archaeological site that included:

1. The name and number of the land district of the archaeological site, the disposal of it (owned by the state, persons or endowment)
2. Indication of the names of the closest points to the site, such as villages, and public places with the distance from it.
3. The type of transportation that can be used to access to sites in different seasons.
4. Details about the residents nearby the site.

Along with databases, the fundamental element to exploit them is database management systems (DBMS). These systems are an intermediary element between the data and the software that uses them. Software such as a desktop GIS does not access the database directly, but through a DBMS. (Olaya 2018) (van, 2019).

### **ArcGIS 10.4 Software and Maps of Al-Muthanna Archaeological Sites**

Work with eligible objects for storage in ArcGIS 10.4 as different types of geographic information. To make it possible to examine the most common and accessed elements: layers and maps.

**Layers:** are logical groups of geographic data. The designed map contained layers (streets and sites) that were designed according to their importance and their surroundings. Layers show how geographic data is organized and combined to create maps and scenes; layers are also the basis of geographic analysis.

Geographical features are represented as (points, lines, polygons, or pictures)

**Maps:** This is the primary interface through which you work with ArcGIS 10.4. Each GIS map contains a base map (canvas), as well as a set of data layers that have been worked on.

### **The Base Map**

Figure No (2 and 3) base map showing the administrative boundaries of the governorates and road networks, with the archaeological sites of Al-Muthanna governorate installed, with the database for each site and its layers.

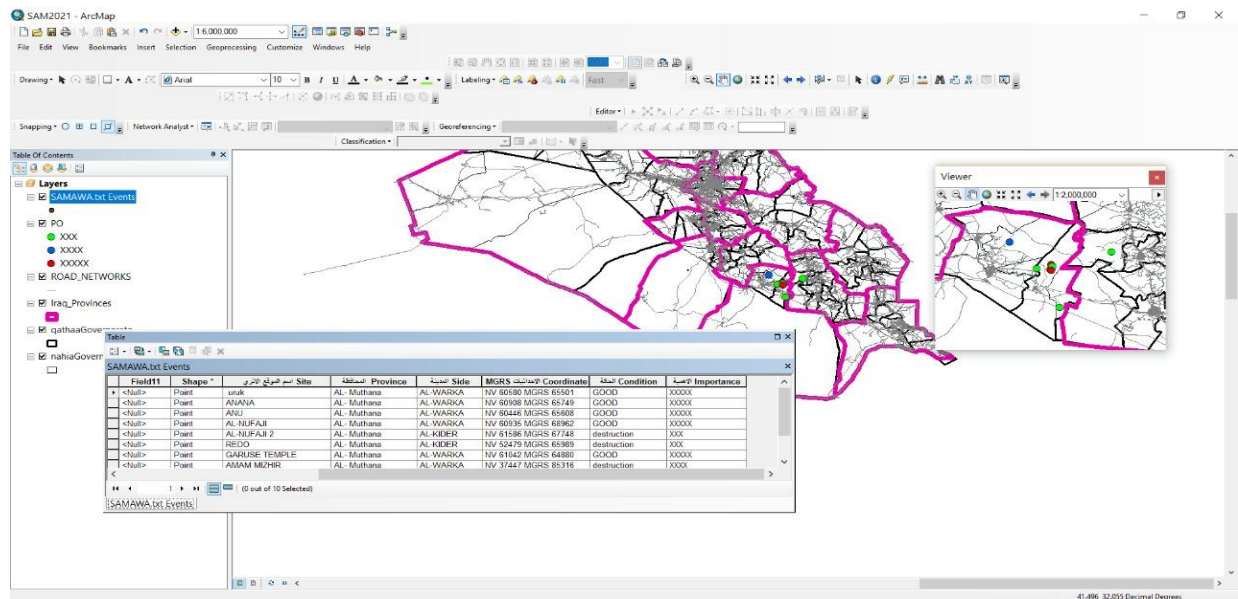


Figure 2

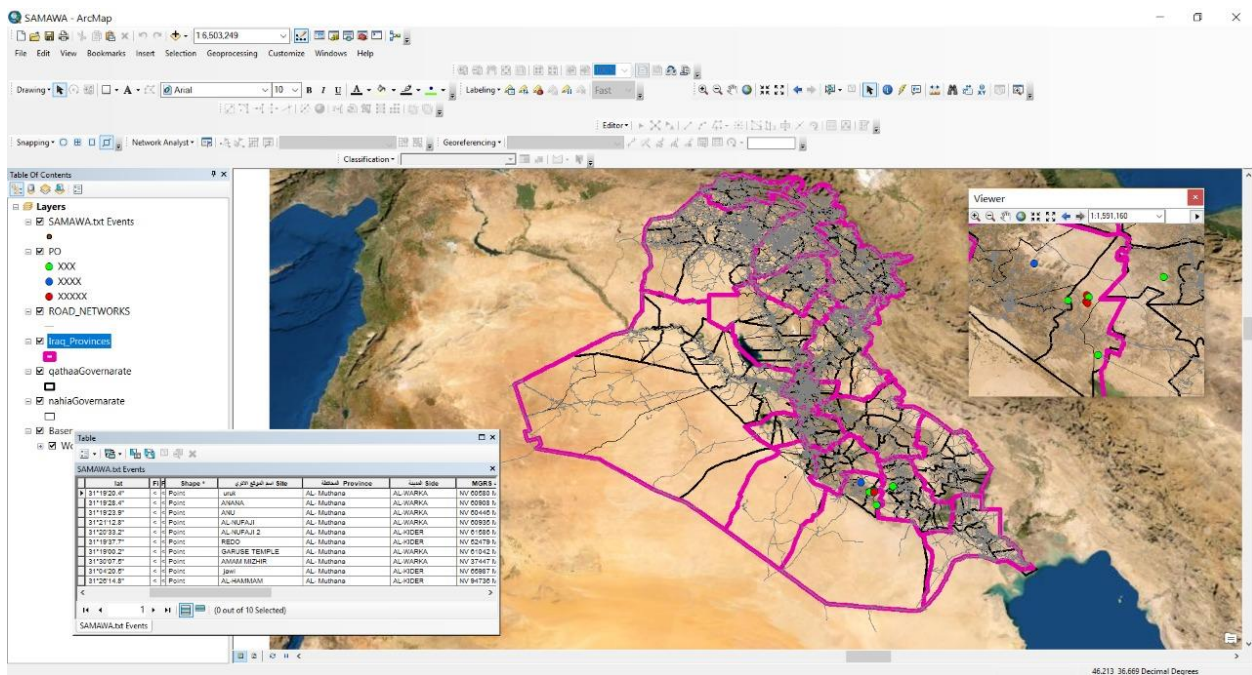


Figure 3

In figure No (4) we show some tools of ArcMap that allow you to search for one of the archaeological sites of Al-Muthanna locations using an address or place-name, to find features that match particular attribute values, and to find locations using linear referencing. Also, by using find tools, you can add a graphic marker or callout label at the place, create a spatial bookmark, or add it to a list of your favorite places.

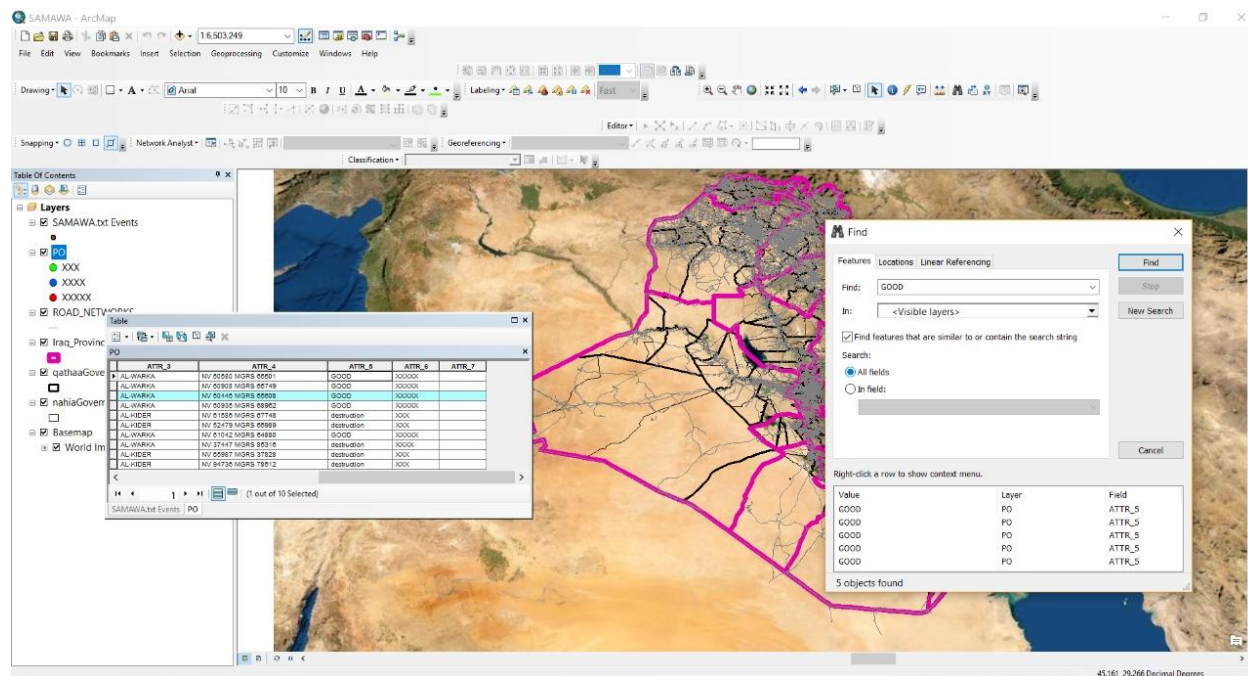


Figure 4

## Hyperlinks Tools

In figure No (5 and 6) we show the using of Hyperlinks tools for two archaeological sites of Al-Muthanna (ANANA and GARUSE TEMPLE) which allow you access documents or web pages related to features. These hyperlinks can be accessed for each feature using the Hyperlink tool Hyperlink on the Tools toolbar, to set and use hyperlink properties for a map layer.

In these two archaeological sites we used the hyperlink with the images. When you click on the archaeological site on the map, its data appears with a picture of this archaeological site (van, 2019).



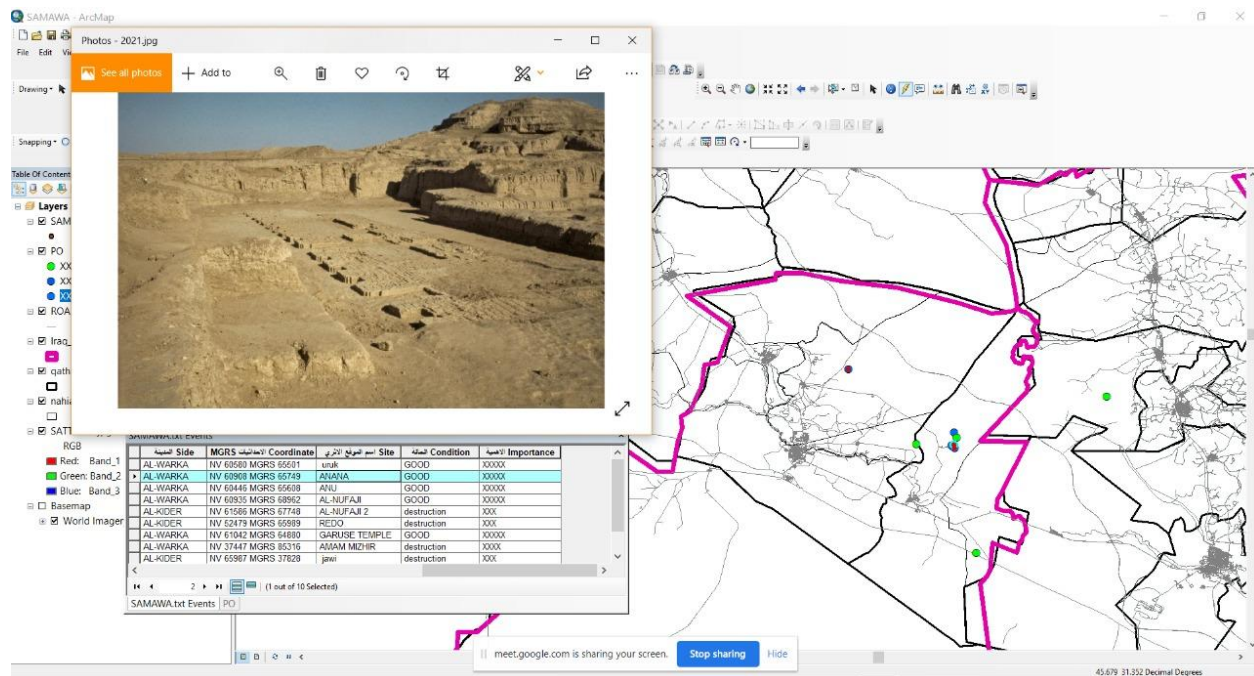


Figure 5

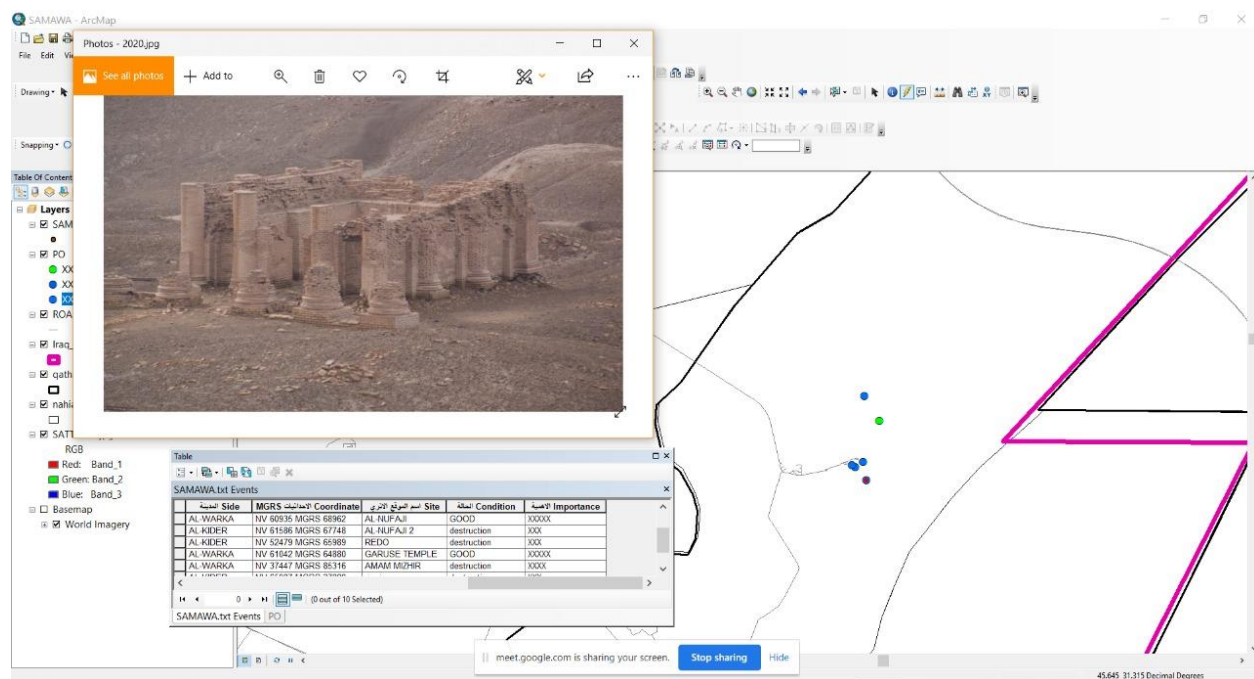


Figure 6

## Conclusions

The use of geographic information systems (GIS) in Iraq is very limited, and the expansion of the use of these technologies contributes to preserving archaeological sites and building a database for them, that will be of assistance to scientists in archaeological

field and directs future attention for government facilities concerned to the development of these sites, The data collected also allows project managers to make informed decisions (Ahmed, 2021).

The research also shows the real need for maps with accurate coordinates that are directly linked to the data on archaeological sites, which facilitates decision-making by the competent authorities responsible for these sites and thus the transition from the current system for antiquities management to a comprehensive electronic system with the possibility of continuous updating on this data and the possibility of integrating it with applications Other software in the future and the establishment of an internal network to manage this digital content, and recommend the following:

1. Creating a database for all archaeological sites throughout Iraq and all its cities.
2. Accurately determining the coordinates of archaeological sites using GPS devices.
3. Using the latest versions of the ARC Maps and ARCGIS Pro, which it is specializes in geographic information systems (GIS) because of the additional features it contains that contribute to accurate documentation.
4. Using remote sensing and integrating it with geographic information systems for archaeological sites to give options for disaster management in different environmental conditions.
5. Creating a network with a local server for all archaeological sites in Iraq to using for a map sharing service
6. The dataset and the GIS analysis have shown to be useful for archaeological sites in Iraq. This methodology can be of the interest to the archaeological sector since it introduces the use of available database to do extensive comparative analyses of the population component of archaeological sites areas in Al-Muthanna government. The study has an aggregate perspective, but this database presents many other possibilities of analysis to perform in a case-by-case basis.

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