GIS-BASED CONCEPT FOR CONSERVATION OF THE ARCHAEOLOGICAL SITE OF PLISKA

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ABSTRACT

The significance of the non-destructive methods in archaeology has grown up in the recent years and the application of remote sensing and GIS technologies has become more important. Preservation and conservation of the archaeological sites has always been one of the main goals in the archaeology due to the fact that the sites are exposed to many destructive factors, natural and anthropogenic, but they have always been dependent of the development of technologies. In this paper a GIS-based concept for conservation of the archaeological site of Pliska using remote sensing data and GIS technologies is presented.

The medieval town of Pliska existed from the end of 7th century till the mid of 11th century. From the beginning of its existence until the end of 9th century it was the first capital of Bulgaria. The archaeological exploration of Pliska started in 1899 and with some interruptions it continues today. The medieval town was divided into two parts. The Outer Town is a region of approximately 23 sq. km surrounded by an earthen rampart and a ditch and the Inner Town is a stone fortress occupying an area of 48 hectares.

The proposed GIS-based concept is a useful method for conservation of the archaeological site of Pliska. The basic idea of this concept is the relationship between modern land cover and ancient structures and the dependence of the archaeological sites by the surrounding land cover conditions. The GIS based concept is build upon several methods, which combination is successfully applied in research of the archaeological site of Pliska and very good results are achieved. Satellite images of very high resolution and aerial photography, topographic maps, and old maps of archaeological sites, made by field observation are used.

Keywords: *GIS-based concept, archaeology, remote sensing, GIS, Pliska, field observation*

INTRODUCTION

The application of remote sensing and GIS technologies has become more popular and important in the recent years, as the significance of the non-destructive methods in archaeology has grown up [1], [2], [3], [4], [5]. Preservation and conservation of the archaeological sites has always been one of the main goals in the archaeology due to the fact that the sites are exposed to many destructive factors, natural and anthropogenic. There are many case studies of application of GIS and remote sensing technologies for conservation of cultural heritage. [6], [7], [8], [9]. The preservation of material structures and artifacts is closely connected with their documenting, because the information for the object is an image of the object itself, and this information can be stored, processed and preserved, even after the real object is damaged or destroyed, and can help for its restoration. The GIS technologies are very important for collecting and analyzing of spatial information for the archaeological objects and sites and subsequent planning of their research and conservation. Using this technologies we can preserve the archaeological sites in two main ways – by taking active measures for conservation of the sites and by careful planning of the research which preserve them as long as possible.

PURPOSE

The purpose of this paper is to present a GIS-based concept for conservation of the archaeological site of Pliska using remote sensing data and GIS technologies.

STUDY AREA

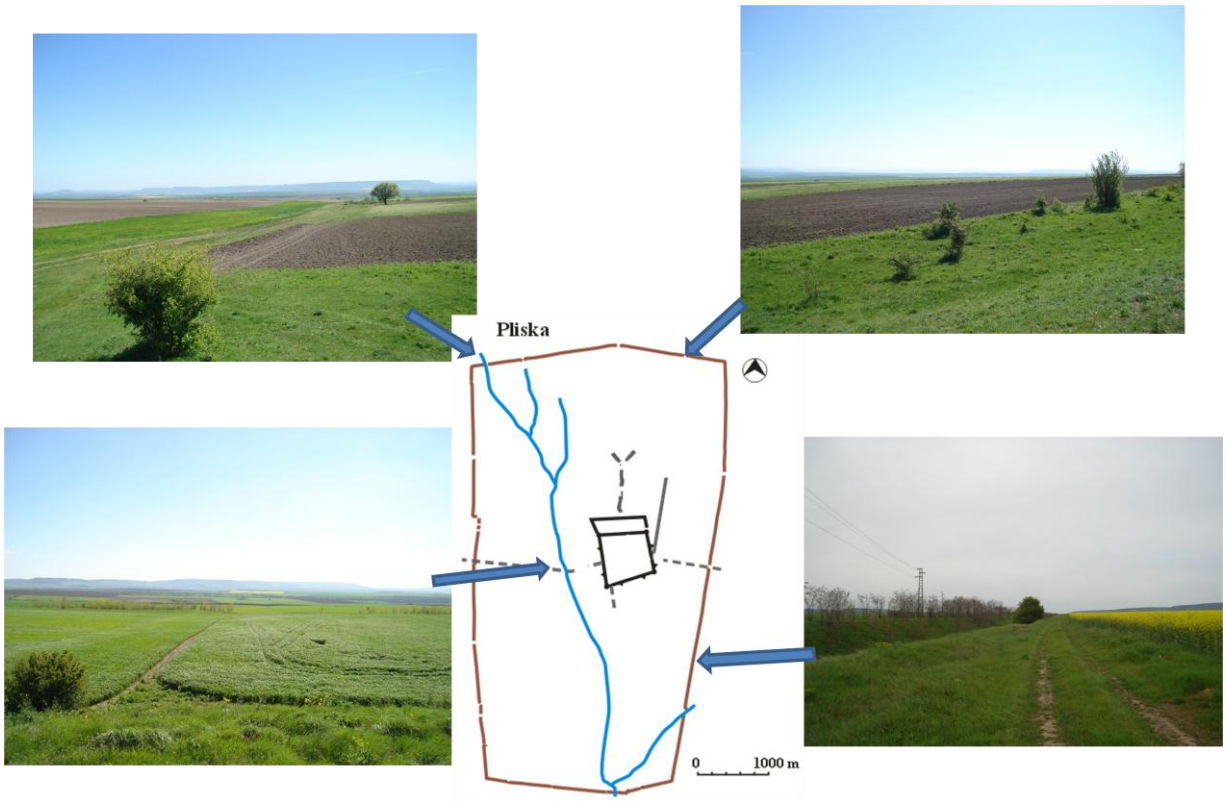
Fig. 1. *Location of the study area*

Overview of the medieval town of Pliska

The medieval town of Pliska existed from the end of 7th century till the mid of 11th century. From the beginning of its existence until the end of 9th century it was the first capital of Bulgaria. We find the name Pliska last mentioned in Bulgarian Apocryphal Chronicle from 11 century. It appears again in 1688 on a geographical map printed in Amsterdam and in 1767 the name is mentioned by the German traveler Karsten Nibur. In 1878 the Hungarian scientist Felix Kanic visited the ruins of Pliska, where he read the name Burdizo on a stone column and decided that this should be the name of the town. In 1884, the Czech historian Constantine Irechek corrected this vision, thus becoming the first scholar who connected the ruins with the town Pliskova /Pliska/, mentioned in Byzantine chroniclers from 10–11 century.

The archaeological exploration of Pliska started in 1899 and with some interruptions it continues today. The medieval town was divided into two parts. The Outer Town is a region of approximately 23 sq. km surrounded by an earthen rampart and a ditch and the Inner Town is a stone fortress occupying an area of 48 hectares. Because of its smaller size and the importance of its structures, the Inner Town tends to be much better explored as a result of which we know its history in more detail. The Outer Town which is spread on a vast territory and comprises many sites and structures has been relatively less excavated and studied. A village called Aboba has existed in the southern part of the Outer Town since 17th century, which was renamed into Pliska in the first half of the XX century. Today, the territory of the Outer Town is also used for agriculture. All of these put forward the necessity of a creating a spatial model of this archaeologically important area for the purpose of conservation.

Fig. 2 http://www.kroraina.com/pliska/pl_3_1.html



USED METHODS AND DATA

The GIS based concept is build upon several methods, which combination is successfully applied in research of the archaeological site of Pliska and very good results are achieved. Satellite images of very high resolution and aerial photography, topographic maps, and old maps of archaeological sites, made by field observation are used. A geodatabase of all the available spatial data for the area is created, which can be used for future analyzes and planning of research and conservation of the archaeological site.

Remote sensing methods include mainly computer aided visual interpretation, as most relevant with the specifics of the archaeological structures [10], an unsupervised classification was applied to much lesser extent and a map of shape patterns of probable archaeological sites is created. A map of land cover, land use for the area is also created by computer aided visual interpretation of satellite images and aerial photography [11]. The results are combined with the data from topographic maps and old maps of the archaeological sites for verification and the newly discovered sites are added to the existing maps. All remote sensing data are verified through field check during field observation accomplished by special field observation method for archaeological sites and modified specially for the site of Pliska [12], [13]. Satellite images with very high resolution of WorldView-1 and IKONOS satellites and aerial photos with very high resolution are used and also topographic maps in scale 1:5000. Ground-based data are presented by documented and localized by GPS measurements archaeological structures and artifacts on the terrain. The GIS technology has a crucial role, as it integrates all the data in one geodatabase. As a result an integrated GIS-based concept and methodology for research and conservation of the archaeological site of Pliska is created.

RESULTS

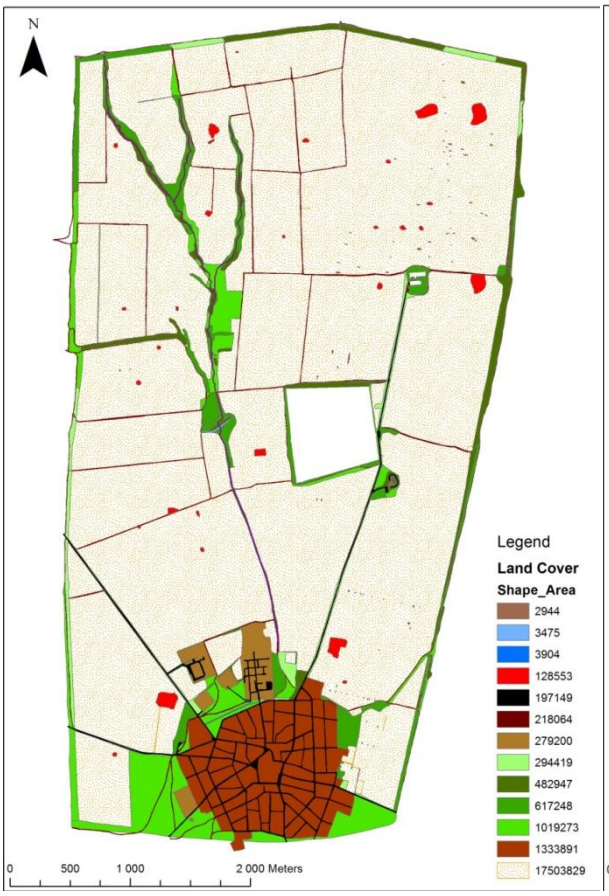


Fig 4. *Map of the Land cover Shape Areas*

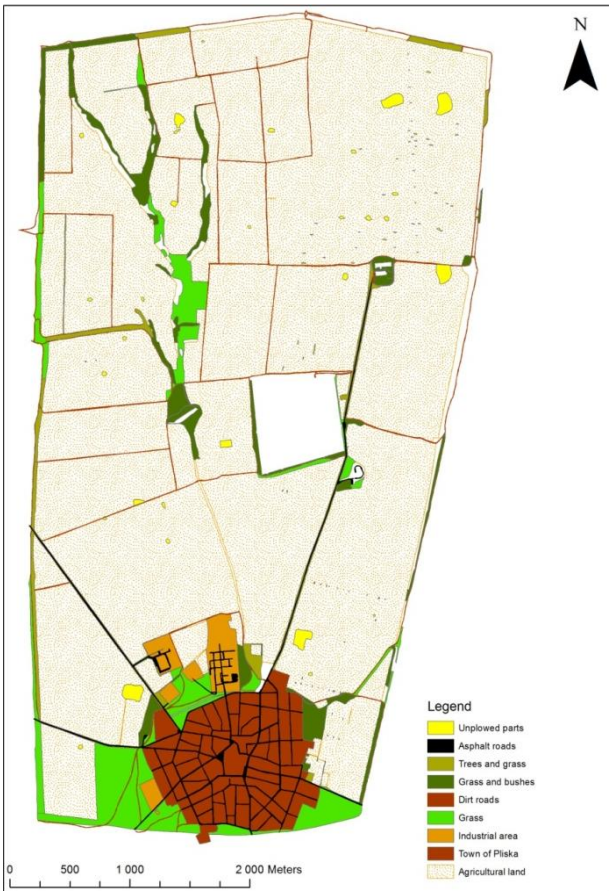


Fig 5. *Map of the Landcover Classes*

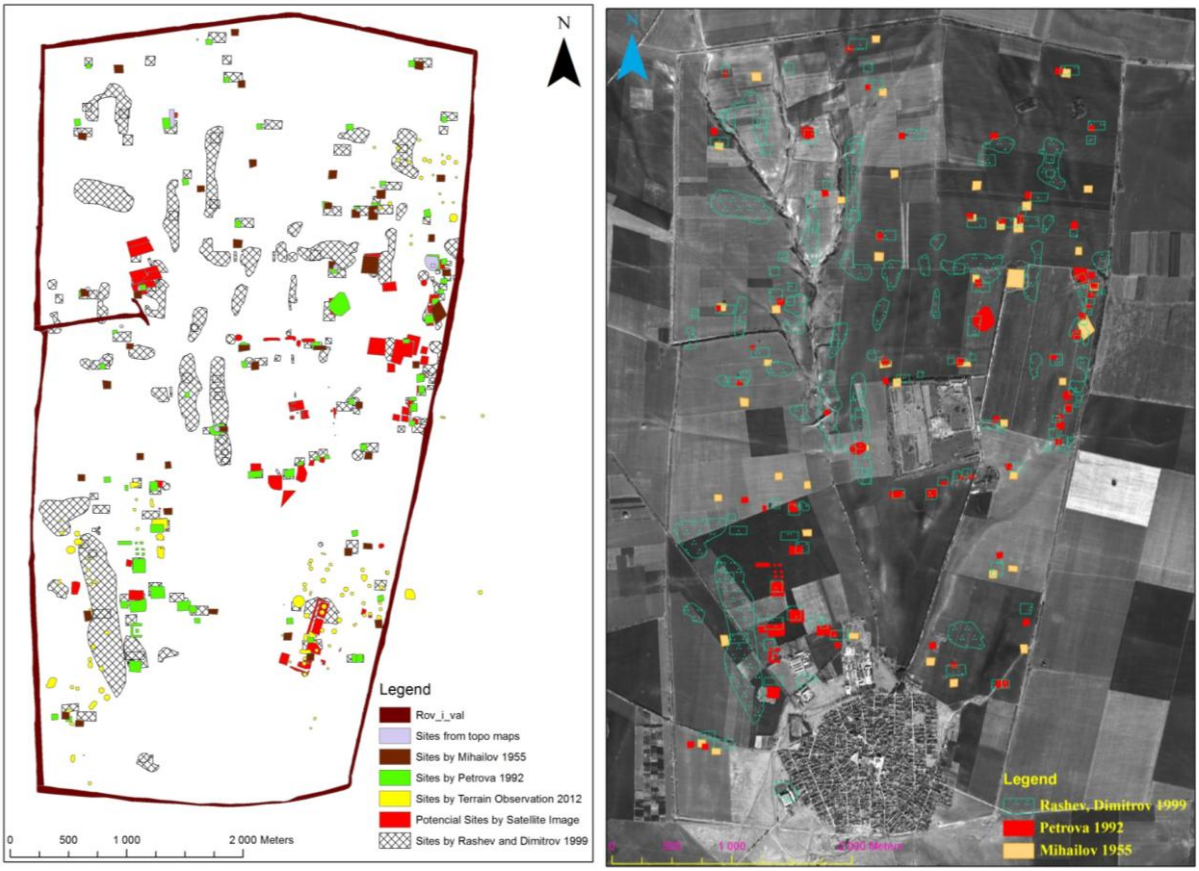


Fig. 6. *Maps of the archaeological sites registered in the Outer Town of Pliska*

Fig 7. *Map of the crop fields in the Outer Town*

Fig.8. *Map of urban, industrial and uncultivated lands*

The GIS-based concept and methodology produce various thematic maps with the results of spatial analyzes of the available data. In this paper some basic maps, describing the spatial distribution of the land cover and archaeological site of Pliska will be demonstrated. Two main layer types of spatial data are used. One consists of the layers of the modern land cover and land use classes and second type are the layers of the archaeological sites discovered in the past. There is one particular layer of probable archaeological sites discovered by computer aided visual interpretation of satellite images and aerial photography. The spatial relationships between the archaeological sites and the areas of modern land cover classes represent one of the most important factors for planning the conservation of the archaeological sites.

The maps on figure 4 and 5 show two aspects of the modern land cover of the Outer Town of Pliska. On map 4 are shown the areas of the land cover classes and on the map 5 are shown the classes of the land cover. The two aspects, serve as base layer for planning the conservation and research of the archaeological sites. It is obvious that if we want to plan conservation work the size and specifics of land cover classes are essential. The maps at the figure 6 show the distribution of the archaeological sites, as they are localized by different sources – old archaeological maps, field observation, interpretation of satellite images and aerial photography. This distribution set the problem of the accuracy of archaeological sites location. The archaeological investigation of the medieval town of Pliska had started in 1899 and still continues. Over this long period several archaeological maps of it had been created and published. First of it was published in 1905, and others in 1955, 1992 and 1999[14], [15], [16]. The map shown here at figure 6 /right/ consists of three layers based on archaeological maps made in 1955, 1992 and 1999. These maps were made by the field observation method and partially by using aerial photography not very accurate, and because of this the location of one archaeological site may be different in the different maps. The application of the remote sensing and GPS technologies and methods significantly increased the accuracy of the positioning of the archaeological sites. They were applied at the latest research at the Outer Town of Pliska during the period 2010 – 2012 / [10], [13]. On the left map at figure 6, layers of archaeological sites discovered by these methods are included. Some archaeological sites were on the old archaeological maps too, but now they are more accurately positioned.

The land cover classes that, has direct relationship with archaeological site are shown at the map of figure 7 and 8. At figure 7 the map of the crop fields on the territory of the Outer Town shows, that over 80% of the area is occupied by arable lands. The regular plowing of the land increases the risk of damaging undiscovered archaeological structures, but also helps for their discovering by removing the surface vegetation.

Urban, industrial and uncultivated lands shown at the map of figure 8, take about 10% of the territory of the Outer Town. It is known that urban and industrial areas create great risk for destruction of the cultural heritage sites. For this reason conducting rescue excavation before starting construction works is obligatory. This imposes collecting preliminary information about the area by field survey and non-destructive methods. We have almost the same situation in areas of uncultivated land areas, if they have to change their status.
At the map of figure 9 is shown the spatial relationship and position between the modern land cover and the archaeological site from all the sources. Unlike the previous land cover maps here the road network is included. Roads do not occupy large territories, but play important role in structuring the area. Also the dirt roads are usually well stamped and show no signs of archaeological sites on their surface. Rescue excavations are required before building asphalt roads. This map describes in which class of land cover an archaeological site is located and give the possibility of presume what kind of measures are necessary for its conservation.

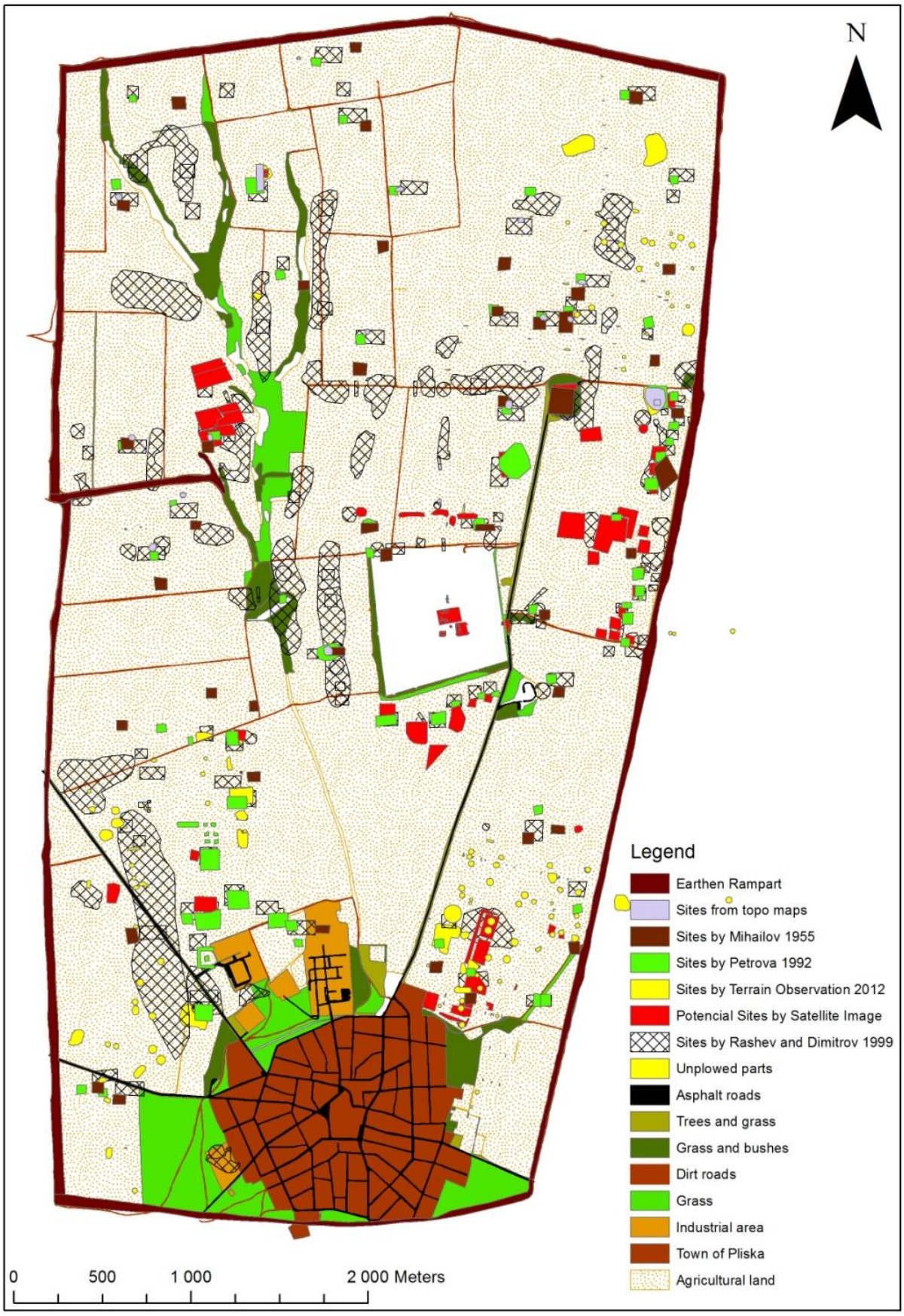


Fig. 9. *This map is showing the spatial relationships between the land cover types, and the archaeological sites.*

CONCLUSION

The proposed GIS-based concept is a useful method for conservation of the archaeological site of Pliska, but it does not have only local application. It can be applied at other sites too. The basic idea of this concept is the relationship between modern land cover and ancient structures and the dependence of the archaeological sites by the surrounding land cover conditions. The changes in the land cover can bring risk for the archaeological sites and this concept aims to prevent or minimize such risk and preserve the site.

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