*SPATIUM*
*No. 38, December 2017, pp. 35-41*

UDC 711.434(497.11)"20"
712.252(497.11)"20"
502.131.1:711.434
Scientific analysis or debate
DOI: https://doi.org/10.2298/SPAT1738035C

# GREEN INFRASTRUCTURE PLANNING FOR CLIMATE SMART AND "GREEN" CITIES

***Tijana Crnčević***[1], Institute of Architecture and Urban & Spatial Planning of Serbia, Belgrade, Serbia
***Ljiljana Tubić***, Public Utility Company "Greenery Belgrade", Belgrade, Serbia
***Olgica Bakić***, Institute of Architecture and Urban & Spatial Planning of Serbia, Belgrade, Serbia

**The aim of the paper is to present green infrastructure planning within the concept of climate-smart cities. In this context the use of Geographic Information Systems (GIS), as part of green infrastructure planning, is stressed in the establishment of climate-smart cities. In addition to presenting international examples of good practice, such as using GIS data, maps and tools for support in the USA, or designing a tool for water management and water infrastructure planning in Chicago, the paper provides an insight into the current status of green infrastructure planning in Serbia. The "Green regulation of Belgrade" project is presented as a representative example.**

**The conclusions emphasise that the main preconditions for achieving climate-smart and green cities include legal and planning frameworks, as well as appropriate strategic and other programs that will further encourage the creation of GIS for green areas and create the conditions for climate-smart green infrastructure planning.**

***Key words:*** **green infrastructure, smart cities, climate change, planning, geographic information system (GIS).**

## INTRODUCTION

The concept of Smart Cities involves the use of digital and communications technologies and, as such, it strives towards high quality resource management and service delivery (CAICT, 2014). It supports the reduction of cost and energy consumption, integrates public service functions and includes co-operation with citizens. Compared to other terms, such as "digital city" and "city of the future", the term "smart city" primarily means "smart" data management, and one of its important features is project implementation from the "bottom up" through the involvement of local communities (Đukić and Antonić, 2016). The concept of smart cities has over 100 definitions, since the urban environment "encompasses a number of requirements in relation to space and all these requirements are coordinated to the things expected from the way of living out of working time, ...basically it can be supposed that every civilization, in other words, society, has its own image of the frame desirable for everyday living" (Tošković, 2016:39). An in-depth analysis of the existing definitions resulted in the following definition: "A smart sustainable city (SSC) is an innovative city that uses information and communication technologies (ICTs) and other means to improve quality of life, efficiency of urban operation and services, and competitiveness, while ensuring that it meets the needs of present and future generations with respect to economic, social and environmental aspects" (ITU-T, Report, 2014).

The key criteria for achieving a smart city are a smart economy, smart citizens, a smart city administration, smart mobility, a smart living environment and a smart way of life (Giffinger *et al.*, 2007). It is necessary that cities become "smarter" to respond to the numerous challenges in the 21$^{st}$ century, which include environmental degradation, limited resources, urban migration and climate change. Thus, in order to support the EU's 20/20/20 climate action goals[2] the European Innovation Partnership (EIP) for Smart Cities and Communities encourages the reduction of high energy consumption and greenhouse gas emissions, including not only energy, but also transport and the ICT sector, with a budget of over € 365 Million (European Innovation Partnership on Smart Cities and Communities, 2013). Also, as one of the basic preconditions for increasing regional competitiveness and attractiveness for investors, the Thessaloniki Agenda for the Balkans from the year

[1] Bulevar kralja Aleksandra 73/II, 11000 Belgrade, Serbia
tijana@iaus.ac.rs

[2] The Europe 2020 strategy, the EU agenda for smart, sustainable and inclusive growth, has set the following targets: 20% cut in greenhouse gas emissions (from 1990 levels), 20% of EU energy from renewables and 20% improvement in energy efficiency (https://ec.europa.eu/info/strategy/european-semester/framework/europe-2020-strategy_en#thestrategysetouttargetsinthe5followingfields).

2003[3] distinguishes investments that are developing modern infrastructure in the field of energy, transport and telecommunications as a priority.

In the urban environment, in the context of climate change, green infrastructure (GI) has an important role in reducing the need for energy, providing ambient cooling effects, reducing floods at the local level, restoring local groundwater reserves, allowing the soil to absorb acidity, and so on. Regarding the smart environment, the GD IP (2014) description includes smart energy, including renewables, ICT enabled energy grids, metering, pollution control and monitoring, the renovation of buildings and amenities, green buildings and green urban planning, as well as the efficient use and reuse of resources and resource substitution to serve the above goals. Therefore, green infrastructure planning, greening of the environment and the use of related ICT contribute towards achieving climate-smart cities, whereby a significant contribution is accomplished by means of adaptation measures and limited, but still important, mitigation measures (Cvejić *et al.*, 2011).

Based on the analysis of the available documentation, the paper presents an overview of the role and current status of green infrastructure planning in the context of climate-smart and green cities worldwide. In this regard, the importance of the application of GIS in the planning and management of GI is especially emphasized. In addition to a review of the current situation within the Republic of Serbia, the "Green Regulation of Belgrade" project is presented as an example of good practice.

## CLIMATE SMART CITIES AND GREEN INFRASTRUCTURE PLANNING

The ITU-T (2014:12) states that "a smart sustainable city is a city that leverages ICT infrastructure in a flexible, reliable, scalable, accessible, secure, safe and resilient way". ICT infrastructure is used in order to improve the quality of life and well-being of the inhabitants, as well as to ensure economic growth, establish an "environmentally responsible and sustainable approach", provide more efficient infrastructure, strengthen the prevention of disasters, mitigate climate change, and also provide regulatory and governance mechanisms (*Ibid.*). In the operationalization of the smart cities concept, one of the key elements is ICT, although it cannot be expected that a globally acceptable set of basic ICT standards for smart cities will be identified in the near future (Petrović *et al.*, 2015). Standards Developing Organizations, scientists and professionals, decision makers in cities and citizens will have a key role in this process (*Ibid.*). The Focus Group on Smart Sustainable Cities (FG-SSC) is an open platform for the exchange of information within ITU-T concerning issues, questions and ICT standards for smart cities from various stakeholders (academic and research institutes, municipalities, non-governmental organizations, ICT organizations, industry forums and consortia). It has, so far, published over 20 reports on its website covering issues related to indicators, standardization, integrated management for smart cities, etc. (Focus Group on Smart Sustainable Cities, 2017).

In the context of climate change, the benefits of the use of green infrastructure (GI) are numerous and positive as the impacts of climate change are becoming increasingly visible – such as the occurrence of drought, floods, waves of warm weather/heat and a rising sea level. Climate change has a negative impact on the population, built environment, infrastructure and natural resources. Regarding the use of GI in urban planning "... the main constraint identified by an international consortium was that the planning of green infrastructures was not integrated into typical urban planning processes and the possibility of optimizing effects towards cost not given" (Scharf, 2017). Marić *et al.* (2015) and Crnčević (2016) highlight the importance of local initiatives (programmes, strategies etc.) in which the existence of guidelines, principles and criteria for GI planning have given specific results. In the context of climate change and the contemporary planning context, GI is becoming an integral part of strategic frameworks, programs and standards within the urban planning process with the aim to promote the use of GI in adaptation strategies, while pointing out the necessity for finding the investments or mechanisms to provide financial support for establishing and managing green areas (GA) (Crnčević, 2016).

In relation to GI, within the process of creating climate-smart cities, the domains of ICT applications and improvements include: public space and utility services management, informing citizens and involving them in decision-making processes, the ability to perform various online activities (overlapping with economic needs) and similar. One of the applications of ICT is in the Geographic Information System (GIS), which can integrate data from various sources, and therefore it can be very helpful while "converting a city into a smart city or into a green city" (Rehmat, 2016). The GIS is a computer-aided system (hardware, software, data and users) for collecting, editing, storing, modelling and analyzing data, as well as for its alphanumerical and graphical presentation (Crnčević and Bakić, 2010; Bakić and Gajić, 2014). Thus, with the help of a GIS, it is possible to complete the parcel inventory of zoning areas, floodplains, industrial parks, land uses, trees and green spaces, and then perform an analysis of the percentage of land used in each category, the density levels according to neighborhoods, threats to residential amenities, and proximity to unwanted land uses, and in that way assist urban planning. Existing GIS packages can produce digital cartographic attachments that display selected phenomena, processes and their properties, and gather information and provide its visual representation, thus facilitating decision making in the planning process (Bakić and Đurđević, 2011). The basic application of GIS for gathering information has expanded into data visualization, which makes it possible to understand what is happening in selected locations, track events and direct the development of both individual space systems and the whole system (Figure 1).

[3] The "Thessaloniki Agenda for the Western Balkans: Moving towards European integration" (Thessaloniki Agenda) adopted in 2003 in Thessaloniki includes a number of instruments and other forms of cooperation between the EU and the countries of stabilization and association (Albania, Bosnia and Herzegovina, Montenegro, Croatia, Macedonia, Serbia and Kosovo under UN Resolution 1244/99) (www.europa.rs/upload/documents/key.../Thessaloniki%20 Declaration%202003.doc,).

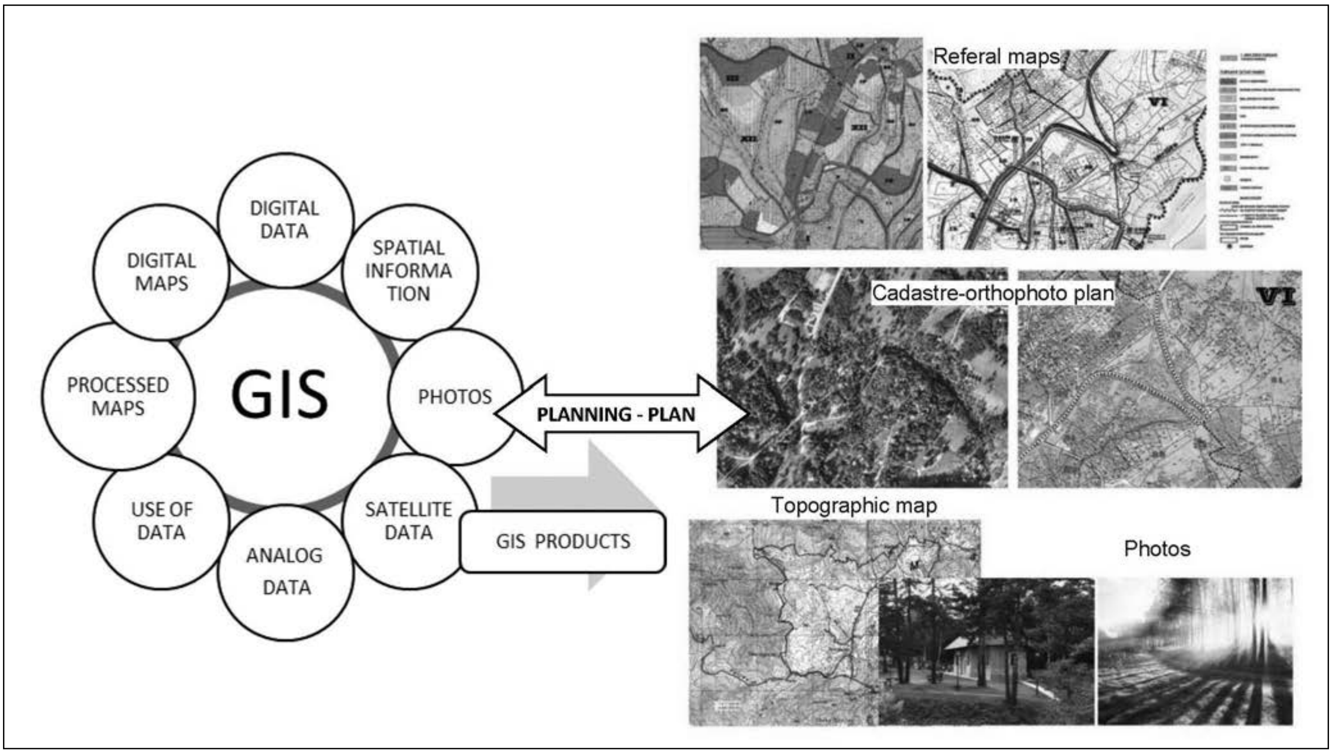


*Figure 1. Integration of spatial information in GIS*
*(Source: authors)*

Therefore, in answer to the universal question of how to set development policies that support everyone (Esri,GI, 2017) with the help of GIS, it is possible to identify locally valuable areas and to prioritize them for protection as well as to visualize their connection with the space beyond the boundaries of the plan. Esri, a GIS consultancy in the USA, provides data, maps and tools for GI planning, (*Ibid.*). Using Esri's tools, the GI plan was produced for South Carolina after it was hit by hurricane Joaquin, a two-day storm that resulted in flooding, the destruction of infrastructure, and the loss of life and up to 160,000 homes. Considering that "most disaster recovery and development strategies focus on rebuilding and extending existing man-made infrastructure" (*Ibid.)* and dismiss green infrastructure, a new plan was formulated in which, this time, GI was included in the main plan. The plan was the result of partnership between the planning and conservation departments in Richland County, South Carolina (USA) whereby the green infrastructure plan was developed using Esri's GIS tools for creating asset maps and maps of intact habitats, conducting landscape analyses, assessing fragmentation and risks, developing a core quality index, and prioritizing opportunities (*Ibid.*).

Taking into account that every city on the globe has its own priorities, many of them are developing frameworks which promote the concept of smart cities. A significant incentive is an international smart city competition (Smart City Forum, 2017), which involves a combination of urban density (high and medium) with a high quality of life. The most common projects representing the concept of smart cities, apart from technological centers, are smart electricity grids, the introduction of electric buses, schemes for the common use of bicycles, and green urban areas (CAICT, 2014). One such project related to climate-smart and green cities, the "City Digital's Smart Green Infrastructure Project" (SGIM) is presented here. The main aim of the SGIM project is to create a tool for water management and water infrastructure planning in Chicago (USA), i.e. to monitor the quantity of water, how it flows, and whether it is flowing (Smart Cities Connect, 2017). By incorporating sensors within green infrastructure for five selected sites in Chicago, it is possible to collect data covering storm water runoff, the amount of precipitation, humidity levels, soil moisture, air pressure levels and chemical absorption rates (*Ibid.*). As the project progresses, these data will be communicated via a cellular network into an analytics platform where the performance of selected green infrastructure installations will be monitored in real time, enabling historical analysis of the data. The expected results, which will be available to the public on a public portal, will show which green elements work best and where, which could be of interest for other cities in the area of GI planning (*Ibid.*).

## GREEN INFRASTRUCTURE PLANNING IN SERBIA FOR CLIMATE-SMART AND "GREEN" CITES

The application of ICT technologies in the Republic of Serbia is "in the initial phase of development at all levels of governance, which places Serbia in an unfavourable position in relation to developed countries" (Lalović *et al.*, 2016: 474). On the other hand, the results of ICT research in the Republic of Serbia[4] indicate a positive trend in terms of providing

[4] The survey was conducted in April 2015. The type of research was a telephone interview that covered 1361 companies. The response rate was 92.7% (1261 enterprises, with 10 more employees in the fields of the manufacturing industry, electricity supply, waste water management, construction, wholesale and retail trade, transport, storage and communications, accommodation and food services, information and communication, real estate business and others).

technical infrastructure (Kovačević *et al.*, 2015). Thus, 100% of companies use computers in their business and 99.1% of them have internet connections. As many as 94.5% of companies use electronic public administration services, mostly for obtaining information (93.5%), filling in forms (91.7%), and for returning completed forms (88.2%). An increase in the number of household appliances (TV, cable, mobile phone) in relation to the previous years was noticed: 7.4% more than in 2013. The results reveal that 65.8% of the population use computers, 91.4% use a mobile telephone and 65.3% use the internet. The respondents said that they use the internet, to a large extent, for seeking information on goods and services (67.7%) and for reading online newspapers and magazines (62.3%) as well as for participation in social networks such as Facebook and Twitter (75.6%). The survey also showed that 38.9% of respondents that used the internet in relation to public services used it to obtain information from the public institution's website. However, although a significant shift has been made regarding the use of ICT in planning, the view still dominates that the quality of public information does not provide an adequate contribution to sustainable planning and development management. Although there are a wide range of applications based on GIS planning and management technology, the "implementation of these solutions in Serbia's planning practice practically is completely absent" (Lalović *et al.*, 2016:472).

The use of GI in planning is, in practice, a complex process which can be facilitated by using GIS tools. The GIS of green areas (GA) is the information system for these areas that maintains units within them. It is a model that is used to consider specified system requirements, hardware, software, data collection methods, organizational charts and a method for maintaining the system (Crnčević and Bakić, 2010, 2012). It is a modern tool for better, more efficient and more economical maintenance of existing green areas, for planning and developing new green areas and for protecting urban green spaces (*Ibid.*). Efficient maintenance is made possible by collecting and providing accurate information on green areas and their content, which can facilitate planning, implementation and record keeping. Developing the GIS GA basic system allows more efficient planning and control of funds. By comparing the expense data, one can more objectively answer the question of whether the expenditure is justified. As the GIS GA connects environmental and statistical data, it is an important basis within the GI planning process for planning green infrastructure both as a system and as individual green areas. The GIS GA data show the disparities in supplying green areas and their ecological features. They also provide information on the need for renewal and enable the simulation of new or more economical solutions. The following stages are included in the process of establishing a GIS GA: (1) analyzing the existing state of the data; (2) reviewing the available cartographic material; (3) elaborating methods to survey and digitize data; (4) developing a catalogue of units involved; (5) digitizing maintenance units; (6) controlling the mapping quality and data entry; and (6) entering the data in the GIS.

Regarding GI planning in the Republic of Serbia, the main limitation for climate-smart and GI planning is the inadequate legislative support and information base. The Law on Planning and Construction of the Republic of Serbia (Official Gazette RS, No. 72/09, 81/09-correction, 64/10-UC, 24/11, 121/12, 42/13-UC, 50/13-UC, 98/13-UC, 132/14 and 145/14) does not provide direct support for GI because it does not refer to green areas or green surfaces. Therefore, the GI planning framework follows the requirements related to infrastructure. The Law on Environmental Protection (Official Gazette RS, No. 135/04, 36/09 and 72/09-43/11-US) establishes the conditions for formulating a special law that would address the issues of planning and management related to GIs. However, the Draft of the "Decision on the protection and improvement of green areas of Belgrade" (in accordance with the Project "Green regulation of Belgrade") has been in the procedure for adoption for over a decade, which points to the lack of adequate procedural support for its adoption (Marić *et al.*, 2015; Crnčević and Sekulić, 2012).

However, despite the inadequate legislative and planning context, a review of the existing practice in Serbia has shown that there are examples of good practice in GI planning, such as the GI plan for Vrnjačka Spa where, within GIS, a topographic key for visualizing GI for all spa areas was created (Crnčević and Bakić, 2010) and others, among which the city of Belgrade stands out (Crnčević and Bakić, 2010; Manić *et al.*, 2012, etc.).

**Example of Belgrade**

In the review of the implementation of the General Plan 2021 for Belgrade, analysis of the current state of data and prospects for the development of Belgrade's green areas has shown that Belgrade did not have a clearly defined strategy for the development of GI as a system, or any adequate legislation to this regard (JUP Urbanistički Zavod Beograda, 2017). On the initiative of the Secretariat for the Environmental Protection of Belgrade, the Executive Committee of the City Assembly decided in December 2002 to initiate the project "Green Regulation of Belgrade"[5] aiming to regulate the management of Belgrade's green space system, i.e. its planning, development, arrangement, maintenance and protection (Cvejić *et al.*, 2004). The project's design had four phases: (I) Analysis of the situation and preparation of the document "Decisions on the Protection and Improvement of the Green Areas of Belgrade"; (II) "Preparation of the Content and Program for the Development of a GIS of Belgrade's Green Areas", "Preparing the Content and Defining the Procedure for Mapping Belgrade's Biotope"; (III) "Mapping and Evaluation of Belgrade's Biotope" and (IV) "Plan for the General Regulation of Green Areas in Belgrade".

The first phase included assessment of the current state of Belgrade's GA and identified the problems related to its planning, development, maintenance and protection. A significant result of this phase was the document "*Decision on the protection and improvement of the green areas of Belgrade*" which defines the subject of regulation, conditions, procedure and method of planning, design, maintenance, protection and use of green areas as a unique system. The second phase of the project included preparation of the content and program for developing a GIS of GA for Belgrade, together with a proposal for the

[5] Hereafter referred to as Project.

process of creating and later maintaining the system with hardware and software requirements, methods of data collection and an organizational scheme. The main project for the GIS of Belgrade's GA, completed in 2008, provided more detailed software, hardware and telecommunication specifications, project organization and project design. This phase also included defining the main procedures for mapping Belgrade's biotope, which was an important input for the next phase – "Mapping and evaluation of biotopes of Belgrade", carried out for a territory of 77,460 ha. The methodology applied to the Biotope Mapping of Belgrade is mainly based on the experience of German cities and the instructions made by the "Working Team for Biotope Mapping in Built Areas" in Stuttgart, Germany (Ermer *et al.*, 1996). The biotope map outlined the conditions for sustainable urban planning through: the application of domestic and international regulations based on sustainability principles; the introduction of ecological principles into the planning process; the introduction of mapping and evaluation of biotope as an information basis in the planning process; the requirement to provide a realistic picture of the state of the environment necessary for developing a Strategic Impact Assessment (SEA); the impact of development on the formation of strategic commitments in terms of sustainable planning and monitoring the information base of biotopes of Belgrade. Within the fourth phase, the "Plan of General Regulation of the Green Areas of Belgrade", a Draft Plan was prepared and its adoption is in progress. The Plan defines the spatial coverage, typology of green areas, public and other purposes, conditions for and types of their use, and measures for their protection, improvement and development.

### *Belgrade GIS for GA*

The content scope of the Belgrade GIS GA consists of the different types of green areas defined within the General Regulation Plan for the built-up areas of the local self-government unit – the City of Belgrade (Official Gazette RS No. 20/16.). The Public Utility Company (PUC) "Belgrade Greenery" maintains the following green areas: (1) parks; (2) squares; (3) street corridors (including greenery along the road network and street line trees); (4) arranged parts of urban and suburban forests and forests on river islands (derived from the basic type of green areas: city forest, forest and suburban forest and forest on a river island); (5) green areas of residential housing of an open type (derived from their basic purpose – housing, type – open block) (Cvejić *et al.* 2004) . These green areas are the subject of the GIS of GA on the level of the surface and maintenance unit, and they are the primary content of the system. Types of green areas such as city forests, suburban forests, protective forests and forests on river islands make up the content of spatial coverage of the GIS GA of Belgrade only on the level of the surface. The cadaster for these areas is managed by the public companies, PC "Srbijašume" (Serbia Forests) - FE "Belgrade" and PWC "Srbijavode" (Serbia Water), which are responsible for maintaining these areas. Other types of green areas such as special green complexes, nurseries, forests and green areas, unregulated land and wetlands are not subject to the Belgrade GIS GA.

In terms of content the goal of the project was to clearly define the scope of the GIS GA, including the objects of the system and the participants and their roles in it.Furthermore, the project objectives were to create a model of basic system processes, specify the system's requirements, and propose the initial creation and subsequent system maintenance processes. This needed to include hardware and software settings, methods of data collection, an organizational scheme and the basic cost of works. This project was mostly based on the use of element-oriented methods of system modelling and the application of ISO TC 211 and Open Geospatial standards, as relevant global standards in the field of geo-informatics (Senate Department for ETCP, 2017).

The GIS of Belgrade GA, covering about 3,000 hectares of public green areas of different types, is in its final phase of implementation. It will be a significant information base for the development of the strategy for climate change adaptation and in the creation of a climate-smart and green city of Belgrade. Overlapping the green area maps of the GIS GA with temperature maps and maps of the catchment areas of the city will enable the proper distribution of green

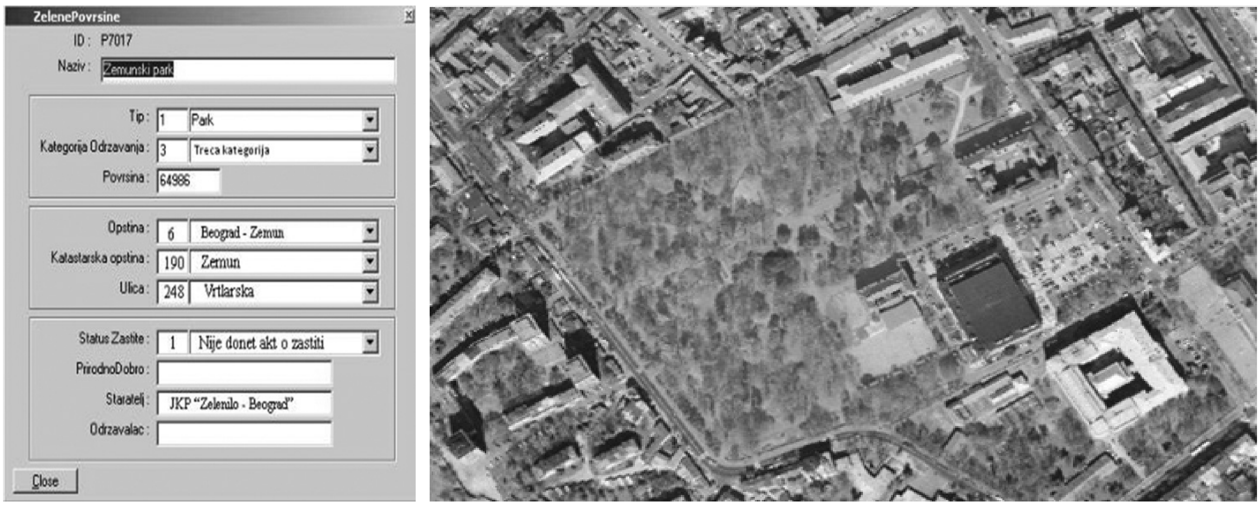


Figure 2. Defining boundaries and attribute values of green areas
*(Source: Cvejić et al., 2004):*

areas and contribute to regulating temperatures at the micro location level and the further management of surface waters.

**CONCLUSION**

Within contemporary planning practice there is a challenge to achieve climate-smart and green cities because the position of GI within urban planning is unsatisfactory. The climate change issues have made a distinct impact on the promotion of GI in the planning process within the framework of strategic planning because GI is used in planning climate adaptation measures and has further encouraged the application of other ICT tools in their planning.

Having adequate support within GIS such as data, maps and tools, as designed by Esri in the USA, or creating a tool for water management and water infrastructure planning within urban areas as seen in Chicago, are examples that should be aspired to. In Serbia, Belgrade is an example of the way forward, with proper support from local authorities and an applicable program base to establish the necessary frameworks for smart planning and management of the city's GI, despite an inadequate legislative and planning framework. The creation of the GIS GA for Belgrade provides the basis for more efficient and economical maintenance, planning and development of green areas. By becoming a part of the business system of public enterprises and institutions dealing with the public GA of the city, GIS GA will contribute toward achieving a climate-smart and green city. Therefore, the expected benefits from the use of GIS GA are numerous, such as determining the condition of GA, managing the maintenance costs, having better communication within the administration and public enterprises, comprehensive transparency, formation of an information basis for decision making and measures in the planning of green and open areas, etc. The example of Belgrade is representative because the resulting experiences can be applied to other cities in Serbia. Certainly, in order to achieve climate-smart and green cities, appropriate legislative and planning frameworks are needed, as well as appropriate strategic and other program bases such as guidelines and standards that will encourage the creation of GIS GA and create conditions for climate-smart GI planning.

***Acknowledgements***

This paper is a result of research conducted within the research projects "Spatial, Environmental, Energy and Social Aspects of Developing Settlements and Climate Change – Mutual Impacts", No. TR 36035 and "Sustainable spatial development of Danube area in Serbia", No. TR 36036, financed by the Ministry of Education, Science and Technological Development of the Republic of Serbia.

**REFERENCES**

Bakić, O., Gajić, A. (2014) Koncept GIS-a kao podrška upravljanju održivim prostornim razvojem Podunavlja, in Maksin, M. *et al.* (eds.) *Održivi prostorni razvoj Podunavlja u Srbiji – knjiga 2*, *Posebna izdanja 73.*Beograd: IAUS, pp. 369-386. [Bakić, O., Gajić, A. (2014) The concept of GIS as a support in managing sustainable spatial development in the Danube area, in Maksin, M. *et al.* (eds.) *Sustainable spatial development of Danube area in Serbia, Book No. 2, Special editions 73*. Belgrade: IAUS, pp. 369-386.]

Bakić, O., Đurđević, J. (2011) Vizuelizacija prostornih planova u GIS okruženju, *Arhitektura i urbanizam,* No. 33, pp. 22-30. [Bakić, O., Đurđević, J. (2011) Visualization of spatial plans in GIS environment, *Arhitektura i urbanizam*, No. 33, pp. 22-30.]

China Academy of Information and Communications Technology (CAICT) and EU-China Policy Dialogues Support Facility II (2014) *Comparative Study of Smart Cities in Europe and China*, Heidelberg:Springer.

Crnčević, T. (2016) Planiranje zelene infrastructure u kontekstu prilagođavanja urbanih sredina na klimatske promene. in Pucar, M., Nenković-Riznić, M. (eds.) *Prostorni, ekološki, energetski i društveni aspekti razvoja naselja i klimatske promene*, Posebna izdanja No.78, Belgrade: IAUS, pp. 215-234. [Crnčević, T. (2016) Green infrastructure planning in the conext of adaptation of urban environment to climate change in Pucar, M., Nenković-Riznić, M. (eds.) *Spatial, ecological, energetic and social aspects of settlement developing and climate change,* Special editions 78. Belgrade: IAUS, pp. 215-234.]

Crnčević, T., Sekulić, M. (2012) Zeleni krovovi u kontekstu klimatskih promena – pregled novijih iskustava, *Arhitektura i urbanizam*, No. 36, pp. 56-57. [Crnčević, T., Sekulić, M. (2012) Green Walls of Urban Spaces in the Context of Climate Change – An Overview of the Actual Planning Frameworks and Experiences, *Arhitektura i urbanizam*, No. 36, pp. 56-57.]

Crnčević, T., Bakić, O. (2010) Zelene površine banjskih naselja - prilog uspostavljanju i razvoju informacione osnove u GIS okruženju, in Pucar, M., Josimović, B. (eds.) *Održivi razvoj banjskih i turističkih naselja u Srbiji*, Posebna izdanja No. 64, Belgrade: IAUS, pp. 59-74. [Crnčević, T., Bakić, O. (2010) Green areas of spa resorts / contributing to the establishment and development of information base in GIS environment, in Pucar, M., Josimović, B. (eds.) *Sustainable development of spa and tourist settlements in Serbia,* Special editions 64. Belgrade: IAUS, pp. 59-74.]

Crnčević, T., Bakić, O. (2012) GIS u funkciji planiranja predela na primeru donjeg Podunavlja, in Milijić, S., Josimović, B., Crnčević, T. (eds.) *Održivi prostorni razvoj Podunavlja u Srbiji,* Knjiga 1, Posebna izdanja No. 71, Belgrade: IAUS, pp.179-194. [Crnčević, T., Bakić, O. (2012) GIS in the function of landscape planning refering to the exampleof the Lower Danube, in Milijić, S., Josimović, B., Crnčević, T. (eds.) Sustainable spatial development of Danube area in Serbia, Book No. 1, Special editions No.71, Belgrade: IAUS, pp.179-194. ]

Cvejić, J., Bobić, A., Tutundžić, A., Radulović, S. (2011) Adaptacija gradova na klimatske pormene – uloga zelene infratsrukture, in Zlatanović-Tomašević, V., Gajić, R., Kaić, F. (eds.) *Budućnost razvoja naselja u svetlu klimatskih promen*a, Belgrade: Društvo urbanista Beograda, pp. 27-44. [Cvejić, J., Bobić, A., Tutundžić, A., Radulović, S. (2011) Cities adaptation to climate change – the role of Green Infrastructure, in: Zlatanović-Tomašević, V., Gajić, R., Kaić, F. (eds.) The future development of the settlement in the light of climate change, Belgrade: Društvo urbanista Beograda, pp. 27-44.]

Cvejić, J., Mihajlović, D., Mitrović, M., Teofilović, A. (2004) Priprema sadržaja i programa za izradu geografskog informacionog sistema zelenih površina Beograda, Projekat *"Zelena regulativa Beograda"*, II faza projekta, Urbanistički zavod Beograda, Sveska 1. [Cvejić, J., Mihajlović, D., Mitrović, M., Teofilović, A. (2004) Preparation of contents and programs for the development of the GIS of green areas for Belgrade, Project "Green regulation of Belgrade", Phase II of the project, Urban Planning Institute of Belgrade, Volume 1]

Đukić, A., Antonić, B. (2016) Koncept pametnog grada kao odgovor na klimatske promene, in Pucar, M., Nenković-Riznić, M. (eds.) *Prostorni, ekološki, energetski i društveni aspekti razvoja naselja i klimatske promene*, Posebna izdanja, No.78, Belgrade: IAUS, pp.15-32. [Đukić, A., Antonić, B. (2016) Smart city concept as a response to climate change, in: Pucar, M., Nenković-Riznić, M. (eds.) *Spatial, ecological, energetic and social aspects of settlement developing and climate change,* Special editions 78. Belgrade: IAUS, pp. 15-32.]

Ermer, K., Hoff, R., Mohrmann, R. (1996) *Landschaftsplanung in der Stadt*, Ulmer, Stuttgart, Deutchland.

Esri,G,I case study (2017) http://www.esri.com/about-esri/greeninfrastructure/richland-casestudy, accessed 1st June 2017.

Esri GI, 2017. http://www.esri.com/about-esri/greeninfrastructure), accessed 3rd June 2017.

European Innovation Partnership on Smart Cities and Communities (2013) Strategic Implementation Plan. http://ec.europa.eu/eip/smartcities/files/sip_final_en.pdf, accessed 15th Aug 2017.

European Commission, Europe 2020 strategy (https://ec.europa.eu/info/strategy/european-semester/framework/europe-2020-strategy_en#thestrategysetouttargetsinthe5followingfields, accessed 25th Aug 2017.

Focus Group on Smart Sustainable Cities (2017) (http://www.itu.int/en/ITU-T/focusgroups/ssc/Pages/default.aspx), accessed 1st July 2017.

Giffinger, R., Kramar, H., Kalasek, R., Pichler-Milanović, N. Meijers, E. (2007) Smart cities Ranking of European medium-sized cities, Centre of Regional Science, Vienna UT. http://www.smart-cities.eu/download/smart_cities_final_report.pdf, accessed 15th Aug 2017

GD IP Directorate-General for Internal Policies (2014) Mapping Smart Cities in the EU, http://www.europarl.europa.eu/RegData/etudes/etudes/join/2014/507480/IPOL-ITRE_ET(2014)507480_EN.pdf, accessed 5th Aug 2017.

ITU-T Report (2014) "Smart sustainable cities: An analysis of definitions", https://www.itu.int/en/ITU-T/focusgroups/ssc/Documents/.../TR-Definitions.docx, accessed 10th July 2017.

JUP Urbanistički Zavod Beograda (2017) III Phase of Project "Belgrade Green Regulation" MAPPING AND EVALUATING OF BELGRADE BIOTOPES. http://www.urbel.com/documents/info20-tema.pdf, accessed 1st May 2017.

Kovačević, M., Pavlović, K., Šutić, V. (2015) *Upotreba informaciono-komunikacionih tehnologija u Republici Srbiji*, domaćinstva/pojedinci preduzeća. Republika Srbija, Republički Zavod za statistiku. [Kovačević, M., Pavlović, K., Šutić, V. (2015) Use of information and communication technologies in the Republic of Serbia, households / individuals of the company. Republic of Serbia, Institute of Statistics]

Lalović, K., Radosavljević, U., Rodić, D. (2016) Metode i tehnike generisanja znanja za planiranje klimatski odgovornog lokalnog prostornog razvoja Srbije, in: Pucar, M., Nenković-Riznić, M. (eds.) *Prostorni, ekološki, energetski i društveni aspekti razvoja naselja i klimatske promene*, Posebna izdanja No.78, Belgrade: IAUS, pp.461-482. [Lalović, K., Radosavljević, U., Rodić, D. (2016) Methods and techniques for knowledge base generating for climate responsible local spatial planning in Serbia, in: Pucar, M., Nenković-Riznić, M. (eds.) *Spatial, ecological, energetic and social aspects of settlement developing and climate change,* Special editions 78. Belgrade: IAUS, pp. 461-482.]

Law on environmental protection, ("Official Gazette RS", No. 135/04, 36/09 and 72/09-43/11-US / Zakon zaštiti životne sredine, ("Službeni glasnik RS", br. 135/04, 36/09 i 72/09-43/11-US)

Manić, B., Crnčević, T., Niković, A. (2012) Uloga zelenih površina u prostornoj i funkcionalnoj koncepciji Bloka 23 u Beloj Crkvi, *Arhitektura i urbanizam*, No.33, pp. 67-74. [Manić, B., Crnčević, T, Niković, A. (2012) The role of green spaces in the spatial and functional conception of Block 23 in Bela Crkva, *Arhitektura i urbanizam*, No.33, pp. 67-74.]

Marić, I., Crnčević, T., Cvejić, J. (2015) Green infrastructure planning for cooling urban communities: overview of the contemporary approaches with special references to Serbian experiences, *SPATIUM,* No.33, pp. 55-61.

Petrović, M., Bojković, N., Parezanović, T. (2015) Izazovi standardizacije informaciono-komunikacionih tehnologija u okviru koncepta pametnih gradova, in: *XXXIII* Simpozijum o novim tehnologijama u poštanskom i telekomunikacionom saobraćaju – PosTel 2015, Beograd, 1. i 2. Decembar 2015. [Petrović, M., Bojković, N., Parezanović, T. (2015) The challenges of standardization of information and communication technologies within the concept of smart cities, in: XXXIII Symposium on new technologies in postal and telecommunication traffic ] http://postel.sf.bg.ac.rs/simpozijumi/POSTEL2015/RADOVI%20PDF/Menadzment%20procesa%20u%20postanskom%20i%20telekomunikacionom%20saobracaju/9.%20Petrovic-Bojkovic-Parezanovic.pdf, accessed 1st July 2017

*Planning and Construction Law (*"Official Gazette RS", No. 72/09, 81/09-correction, 64/10-UC, 24/11, 121/12, 42/13-UC, 50/13-UC, 98/13-UC, 132/14 and 145/14) */ Zakon o planiranju i izgradnji*, ("Službeni glasnik RS", br. 72/09, 81/09-ispravka, 64/10-UC, 24/11, 121/12, 42/13-UC, 50/13-UC, 98/13-UC, 132/14 i 145/14)

Rehmat, A. (2016) Review paper on GIS for smart cities, *Global Journal of Engineering and Scientific Researc*h, Vol. 3, Iss. 3, pp.6-9. http://gjesr.org/Document/Vol.3.03/global%20journal%2057.pdf, accessed 1stJuly 2017.

Scharf, B. (2017) Planning Green Infratrsucture Solutions for Smart Cities, World Green Infratrsucture Congres, Berlin. http://www.wgic2017berlin.com/media/files/Scharf_Bernhard_VortragsInfo-en.pdf, accessed 1st May 2017.

Smart City Forum, 2017, http://en.smartcityforum.pl/smart-city-awards, accessed 1st May 2017.

Smart Cities Connect, 2017, https://smartcitiesconnect.org/chicago-launches-storm-water-manageme, accessed 1st Apr 2017.

Senate Department for ETCP (2017) http://www.berlin.de/senuvk/umwelt/stadtgruen/gris/, accessed 1st May 2017.

Thessaloniki Agenda for Western Balkan: Moving towards European integration, http://europa.eu/rapid/press-release_PRES-03-163_en.htm, accessed 15th July 2017.

Tošković, D. (2016) *Urban and rural environment and urbanization developing countries*, Special editions 79. Belgrade: IAUS.

Received October 2017; accepted in revised form December 2017.