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III. Water supply, wastewater and stormwater networks, effective management methods, GIS technologies

INTEGRAL WATER MANAGEMENT, INCLUDING RAINFALL RUNOFF HARVESTING, AND WASTE WATER RECYCLING AND REUSE

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Summary. Integrated water management is uncertain since is based on atmospheric phenomena [illegible] hydrology aspects, such as stage and flow rates at rivers and streams and water demands of people and industry [illegible] order to quenching the thirst and to protect people and habitat from water and pollution it is necessary to [illegible] and to measure / monitor particularities of the so called "hydrology cycle". In modern times global and/or climate change added uncertainty in management, and also possibilities for improvement of water management [illegible] rainfall harvesting and waste water reuse and recycling aiming to mitigation of the global and climate change.

Introduction

Concept of integral water management include major aspects, such as, place-location and demands, time span for a solution and distribution, quantity and quality of water, [illegible] their composition in a vivid time dependent dynamic system. Unfortunately, demands [illegible] water are increasing, water quality is decreasing, and additional respect is put [illegible] climate/global impact.

In this regards, "new" sources of water were found, such as reuse and recycling of [illegible] water, and old tradition of using rainfall water not only in dry areas but also in other worlds.

Major concern that should be paid to is necessary time of implementation [illegible] integrated water resources management concept, particularly in a lesser developed or [illegible] arid and semi - arid areas. In those areas / locations, urban or rural, the implementation process takes quite a time for getting the completion and most of the designed efficiency [illegible] instead the concept become senseless and inapplicable. Worldwide water resources economy and management practice is fulfilled with partially done but never effectively completed systems.

The basic principles and requirements for any of the integrated water management [illegible] either urban or rural environment, as follows:

a) Relevant data on people, such as inhabitants, tourists, etc., including projections [illegible] those.

b) Relevant long term samples of data, concerning climate conditions, such as temperature, precipitation, humidity, as well as geology and geo-mechanics data etc.

c) Accurate and reliable data for a longer period of time for all and any [illegible] resources, either natural or within the constructed systems.

d) Monitoring scheme and contents of the measurements, including precipitation, temperature, flow rates, levels/stages at water courses, ground water levels and reserves, including water quality.

e) Water demands, such as: characteristics and habits of people, numerous industry [illegible] economy requirements, in capacity and quality, seasonality, and along the years.

f) Data and reports on traditional water resources management at the local and general scale, including shortages, malfunction and relation to public health of people and cattle.

g) Political, social, financial and legal systems' evaluation aiming at assessment [illegible] potentials in local, regional and/or international cooperation and support for IWRM.

h) Traditional practice of coordination, planning, design procedures, including standards and norms, revision of those, construction, equipment, supervision, and maintenance and operation of plants, systems structures.

i) Public awareness of water issues: wider audience, academic, professional, and local, regional, state or international.

Principles that should rein the process of integrated water resources management:

a) Priorities in water demands/problems,
b) Decentralized / centralized approach,
c) Demand management based on water availability, economy or equity bases.

Education process parallel to all the other activities should be the bases, not only for professionals but also for young generations, business people, decision makers, should be the major driving force for successful integrated water management.

In this regard, integration of traditional ways of water resources management have to be enriched by modern knowledge and improved technologies, but new projects and new habitat and industry capacities should implement all of the modern experience and solutions.

All together, at the river watershed/basin level or at province /state level, water management should be in order to provide quenching thirst in a hierarchical order and in compliance to economy as the bases

Modern integrated approaches

In general, management of water resources in either urban or rural conditions in an integrated pattern should be organized in hierarchical order accounting for detailed analyses of professional and educational aspects, but also institutional development and legal background for maintaining a complete environment for development and implementation of such concept (Mays, 2005).

The concepts could be established on a different levels and scales, from the river basin, region / province or state level. Also such a concept can be applied at the metropolitan area of large cities, yet all and the each plans aiming at an integrated water management should be in compliance to the plans of a next greater area or basin, which is prepared before; e.g. anywhere at the river Danube basin, each plan for small river or district should be prepared in compliance with the River Danube Management Plan (ICPDR, 2009; Achleitner S., 2004).

It is difficult to develop an integrated water resources management in urbanized conditions in a traditional water projects done in old times, accounting for a numerous historical and less effective phases, particularly accounting for environmental issues. Also known are CSO - combined sewer overflows and also artificial or constructed lagoons, river channelization that impact aspects of environment sustainability (Brombach, 2002).

So, not only design and construction of a waste water treatment plant – WWTP should be the issue within any urban environment, but even more tasks are to be undertaken at a series of water subsystems accounting for sustainable responses to any increasing water demands.

In modern times planning and design of urban or rural water systems have to encompass all of the water aspects, meaning fresh water, ground water, rainfall runoff, waste water, and salt water as well. Recollecting memoires of historical times, rainfall water use to be traditionally consumed for all purposes throughout the world, and nowadays it is known as "rainfall harvesting". There is also reuse and recycling of waste water as a promising new component of hydrology cycle in the both, urban and rural conditions, and will be discusses hereafter (Garcia-Fresca B., 2005).

In Figure 1 is presented a scheme of an urban composed "hydrologic cycle" consisting of a numerous sources and systems. A list of sources and leakages is not completed and could be improved with recycled water and rainfall harvested water as well.

Water recycling and reuse is rather sensitive issue concerning potentials and safety for people and cattle as well. Such concept is very good as a response to shortages of water accounting for distant places, places at the coast and in wilderness and desert. Yet, with good side also are serious tasks for the authorities that would follow up the implementation of such solutions. At first place is establishing a series of water policies concerning safety for environment and people, levels of treatment and areas of applicability of such water. Also numerous documents should be issued concerning economy aspects of water in the region or county for preparing common and sound ground for applicability of treated water for reuse.

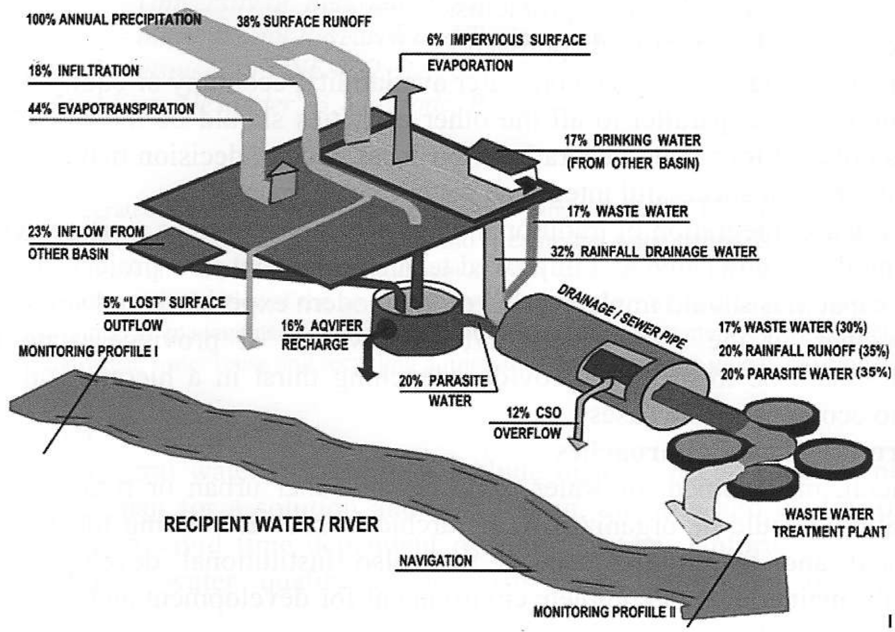

Figure 1. A combined urban hydrologic cycle including sources of water and numerous losses, counting in percentages from 100 % of annual average precipitation and supplied water trough several infrastructure systems toward WWTP and recipient water/river limited for navigation pathway, and monitoring at the two profiles for a comparison of waste water treatment efficiency and the city pollution (based on Brombach, 2000)

Modeling of the infiltration of collected rainfall runoff from the bridge deck and traffic loop Gazelle in Belgrade along the banks of the Sava river was a pioneering project of a certain rainfall runoff harvesting, constructed during years 2010 thru 2012 (Despotovic et al., 2002, 2012, 2013), given in Figures 2 and 3.

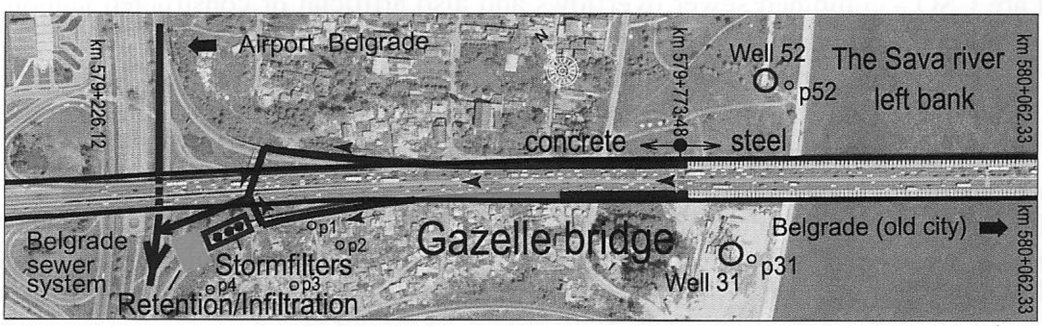

Figure 2. The Gazelle bridge on the Sava river which is in vicinity of the potable water field at the left bank, was completed with a complex storm water drainage system including treatment system for conveying water either into Belgrade sewer system, or the structures of Stormfiltering and Retention/Infiltration and recharge the aquifer for the wells.

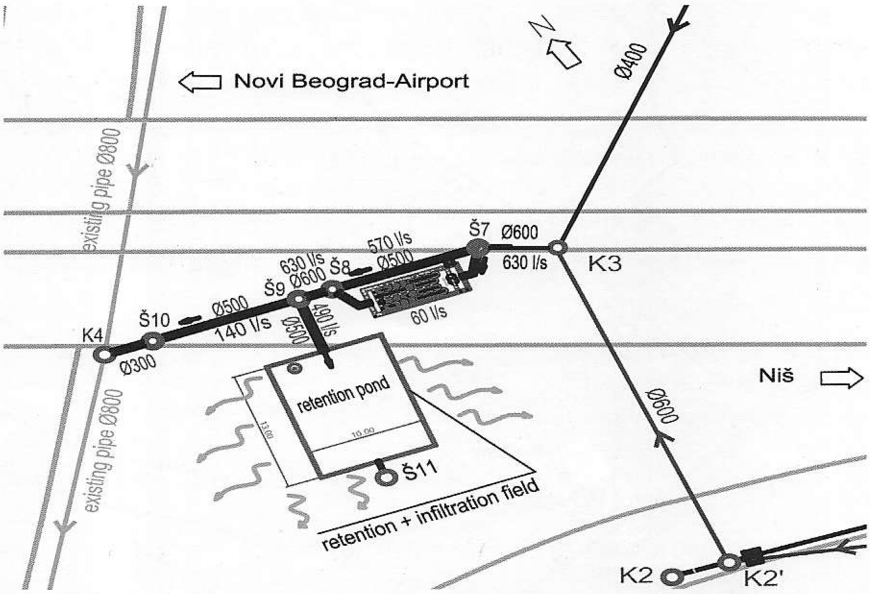

Figure 3. The structures for partial Stormfiltering of storm drainage water from the bridge including discharge into Belgrade sewer system, or into the Retention/Infiltration and recharge the aquifer for the wells (Despotovic et al., 2012, 2013)

Wider audience and professionals should promote ideas of recycling and reuse much before such projects would be in the game, and if not on time the projects would not be implemented properly or timely (Lerner, 2002).

In Figure 4 is given a case study of complex of two systems, agricultural irrigation and bridge and highway drainage system along the potable water source area Makis field, downstream of the bridges Ostruznica. In order to increase capacity of s series of wells at the left bank, treated rainfall runoff will be tested for irrigation and recharge at the left bank. Strongly is needed monitoring in order to test and balance flow rates, capacity of irrigation water and levels of pollution including existing irrigation channel network and designed infiltration and irrigation channels along the series of wells – W.

In rural conditions on the other hand even more data and maps have to be analyzed before any concept of integrated water resources management is established, as follows:

a. People habits, i.e. shepherds /cattle breeders, farmers or nomad living conditions etc.

b. Settlements, either stable or temporarily, number of people is increasing or decreasing, traditional habits in general and those related to water, health aspects,

c. Landscapes characteristics, including slopes, erosion capacity, pasture capacity, flood exposure fields,

d. Soil characteristics, such as: karstic, rocky, alluvium, arid and semi – arid etc.

e. Forests, natural or seeded, erosion prone or deposition lands, fire prone areas close to villages.

f. Climate characteristics, including precipitation seasonality, rain/dry seasons, wind etc.

g. Hydrographic network , including underground streams

h. Ground water presence and characteristics, availability, water quality.

i. Irrigation systems, maintenance, management.

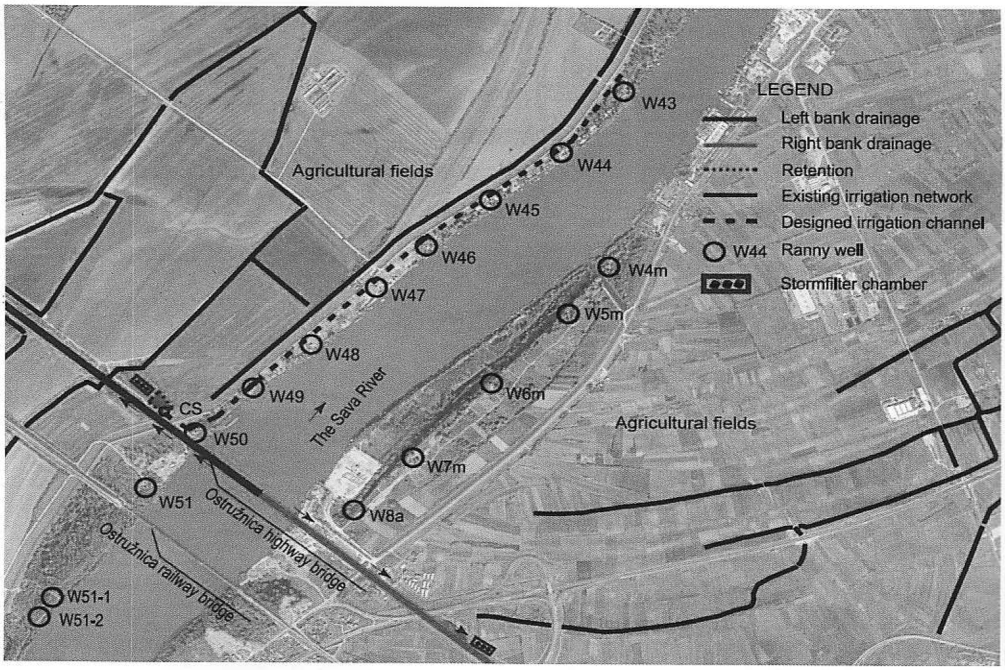

Figure 4. Potable water source area Makis field, downstream of the bridges Ostruznica, including existing irrigation channel network and designed infiltration and irrigation channels along the se of wells

In Figure 5. is presented a landscape chosen for experimental upgrading of an ar prone to erosion (right) , consisting of high slopes, with added vegetation (left photo), a also close to the highway. There are lots of steps that should be undertaken in orde accomplish a concept of integrated water resources management at the site, such as analy of the following: precipitation, wind and temperature regime, area survey aiming at collec data on soil type, surface cover characteristics, infiltration capacity, in addition also highw area and pathways of runoff from it, vicinity of human settlements, potential activitie people in the close area, etc. (Steenbergen, F. Van, 2011).

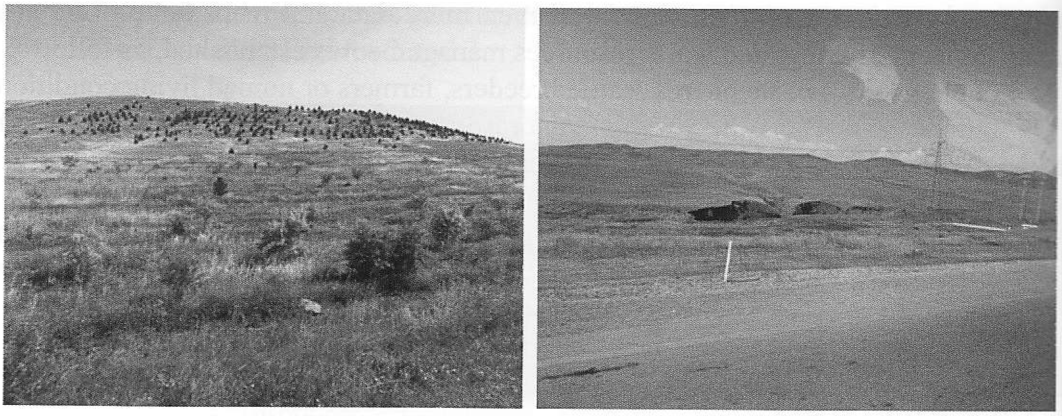

Figure 5. A natural hill slope area devastated by erosion of surface runoff and wind erosion (right), pure pastured land (left) next to a highway as promising rainfall water harvest area

Requirements and conditions for IWRM

In a series of documents issued in Europe and everywhere, such as EU Wa Framework Directive and other ones a lots of efforts were put in order to encompass a called "river basin management planning", while the contents of it are rather a menu list of called "Visions and Measures", although it is very difficult to put in balance all of components of any hydrological cycle. And instead of copying international experience all along the so called trans-boundary basins, either surface and also ground water data from the field, that are listed above, should be the basis for implementation of integrated water resource concept of management(Achleitner S., 2004).

Institutional aspects and capacity building in the country as well as in the region, and particularly local authorities' responsibilities should be established and prepared for strong supporting information, participation and education at all levels, in connection to research, development and implementation of the philosophy of integrated water resources concepts. At the project of such so called "stakeholders" have to be in coordinated in a hierarchical order encompassing all of the environmental and water levels and issues.

Last but not the least, Institutional strengthening, policies, guidelines, pilot projects, monitoring, comprehensive design and above all EDUCATION at all levels for everyone (Despotovic, et. al. 2013).

Conclusions

Strategy of water sector on the river basin scale, also at the state and country level is the major document that should be prepared in compliance to the integrated water resources management principles, widely approved practice. Having that target above others it is not that tedious and tiresome work to establish a series of documents for as guidance for implementation based on relevant data on people, settlements, economy, agriculture, housing, tourism, and development, but limited or rather controlled by limits of water resources and demands management.

Partial, slow and long term implementation of designed integral water resources management principles at a river basin or a metropolitan area are prone to miss the point or target, since the synergy and optimal solutions could be replaced by expensive, ineffective and "never ending" process of implementation.

Pilot projects are always important, even when they are partial, when they are based upon accurate and reliable monitoring of the least known components of the hydrological cycle at the chosen site. So they are recommended strongly, even for a short period of time, e.g. for a year or two. Planning of such a pilot projects, either in cities or in rural conditions are major step, before equipping, establishing local procedures and gaining information, results and knowledge upon experience at that area.

Education and research should be very well planned in details, multidisciplinary, well composed, coordinated and harvested to a highest possible degree, because sudden events occur rarely, without any announcement and their measurements and knowledge is precious and important, e.g. rainfall and runoff, and so erosion, mud slides and similar events.

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List of literature

1. Achleitner S., De Toffol S., Engelhard C., Schulz K., Rauch W. 2004 National Implementation Process of the EU WFD – Status and effects to urban water management. Proc. Novatech 2004 – Sustainable Techniques and Strategies in Urban Water Management, M. Desbordes and B. Chocat (eds.), pp. 639-646.

2. Brombach, H. 2002. Urban storm water practice in Germany. Keynote lecture, 9th ICUSD, pp. 659-668. Portland.

3. Despotovic J., Petrovic J. and Jacimovic N. 2002, Measurements, calibration of rainfall-runoff models and assessment of the return period of flooding events at urban catchment Kumodraz in Belgrade. *Water Science and Technology*, **45**(2), 127-133.

4. Despotovic J., Stefanovic N., Pavlovic D. and Plavsic J., 2005, Inefficiency of urban storm inlets as a source of urban floods. *Water Science and Technology*, **51**(2), 139-145.

5. Despotovic J., Plavsic J., Zivanovic V., Velovic N., Jakovljevic N., Ivancevic N. and Dui P., 2012, Design and construction of the storm water drainage and treatment system for the Gazela Bridge in Belgrade. Proc. Ninth International Conference on Urban Drainage Modelling – UDM, Book of extended abstracts, D. Prodanovic and J. Plavsic (eds.), pp. 241-242.

6. Despotovic J., Plavsic J., Zivanovic V., Jakovljevic N., 2013 The storm water drainage and treatment systems at the "Gazela" bridge in Belgrade, Serbia – A case study. Proc. Novatech 2013, GRAIE, Lyon, pp. 115.

7. Garcia-Fresca B., Urban-enhanced groundwater recharge: review and case study of Austin, Texas, USA, The John A. and Katherine G. Jackson School of Geosciences – The University of Texas at Austin, 2005.

7. ICPDR. 2009. The Danube River Basin Management Plan 2009-2015, Wienna.

8. J. Despotovic, M. Ivetic, Lj. Jankovic. 2013. Networking for sustainable education aiming at integrated water resources management, Caspian International Aqua Technologies / CATE Conference, pp.75-82, ISBN 978-9952-28 110-1.

9. Lerner N. D., Identifying and quantifying urban recharge: a review, Hydrogeology Journal 10: 143-152, 2002.

10. Mays, W. L. (Ed.) 2009. Integrated urban water management: arid and semiarid (asa) regions. (Urban Water Series: ISSN 1794-0790, v.3). ISBN UNESCO, paperback 978-92-3-104061-0, Paris.

11. Pokrajac, D. and Howard, K. 2010. Urban groundwater system modelling. (Urban Water Series: ISSN 1794-0790, v.7). ISBN UNESCO, paperback 978-92-3-104173-0, Paris.

12. Steenbergen, F. van,Tuinhof, A.,and L. Knoop, 2011. Transformig lives Transforming landscapes. The Business of Sustainable Buffer Management. Wageningen, The Nederlands, ISBN 978-90-79658-00-8.