SUMMARY

The great cities of the developing countries have been characterized in recent decades by a high population growth accompanied by a disorderly urban expansion. Although it is now commonly believed that the phenomenon of urban population growth has been slowed by a change in the migration (movement of rural - urban to more complex movements) (cf. State of the cities of Latin America and the Caribbean, UN Report-HABITAT, August 2012), there are still unplanned urban expansion, including in many cases there are new settlements outside these administrative boundaries of cities.

Under this premise we face frequently deficient and obsolete public infrastructure (electricity, water, sewerage etc.). The systems of water distribution are no exception and, under this scenario, often do not cover urban water demands.

The most striking result of this phenomenon is represented by the presence of an intermittent supply (not continuous) in the water, which entails, among others, the following main problems:

- Extreme complexity in the daily operations of the distribution network
- Changes in the habits of users due to the installation of home systems in order to mitigate the rationing of liquid
- Increased breaks in pipes by transients induced by intermittent service
- Difficulty in detecting and locating physical losses by acoustic methods for the low pressurization of existing pipelines
- Worsening water quality by the use of tanks and cisterns diffuse home and pathogenic intrusion by high points in the piping breaks
- Difficulty in mathematical modeling of the system according to conventional techniques.

Regarding the latter point, it is important to show that conventional modeling programs were created originally for systems with continuous service (as the program EPANET U.S. environmental agency EPA, one of the best known). When these programs have been used for networks with intermittent service, researchers have faced difficulties due to the lack of models that can accurately represent this kind of situation. This is the case of a study in Havana (Cuba) in 2002 (Ordas JA et al., 2002) whose

aim was to model the consumption points of users as deposits in a pilot area of Havana. The same approach may fit other studies, such as J. A. Cabrera et al. (2009), although in this case the authors have emphasized their study in simulation the initial filling of the pipes (start of service) by SWMM program, another EPA program, which allows to model overland flow in pipes sanitation. In general, the professionals involved in this field need to create "tricks", more or less complicated, to simulate aspects that for conventional programs are considered extraordinary while in intermittent systems appear on a daily basis.

Other studies that have a merely academic approach and focus mainly on the design of water systems where is known, from the beginning, that the water supply cannot meet population demand. In a complementary manner, to address the weaknesses of the softwares with more conventional models, we are seeing a number of researches that focus on the development of models based on pressure driven systems (not demand based). This is the case of work P. B. Cheung (Extension of Epanet for pressure driven demand in water distribution system modeling, P. B. Cheung et al., 2005) and A. Pathirana (Epanet2 desktop application for pressure driven demand models, Pathirana A., 2010).

Although in the case of design of water supply systems with intermittent supply, specific literature, so far, has been prolific, for the analysis and management of such networks doesn't exist many precedents and even less in Latin America. Particularly significant is the exception represented by the contributions of Vairavamoorthy, K. et al., among which stands out the doctoral thesis presented at Imperial College London (Design of Sustainable Water Distribution Systems in Developing Countries, Kalanithy Vairavamoorthy, Ebenezer Akinpelu, Zhuhai Lin, Mohammed Ali) that approaches the problem in the design and control supply networks in developing countries where the intermittent supply is practically inevitable.

In this study we present a scheme of work / methodology in order to help in the proper management of an intermittent water supply in a context of a developing country. After analyzing carefully all phenomena induced by a water service with these features, it will quantify the impact that these phenomena cause in the community, especially in terms of cost. Once it has been made the diagnosis system and it has been evaluated the economic impact that involves this kind of management, it will

propose a set of improvements in a given time horizon. The set of proposed improvements will form the master plan that represents the final product required. The methodology has been considered in a multidisciplinary approach, since an intermittent system requires the service provider works in an environment of uncertainty that must be addressed in an integrated manner, considering all possible aspects that can influence the dynamics of the system. It is essential that the intrinsic characteristics of intermittent systems are defined and considered in the proper perspective, which is responsible for providing useful inputs to make decisions on the framework considered.

It will also present the results of applying the proposed methodology to the system of a Central American capital that is characterized by an extremely intermittent supply service.