

# Research on the tensions of the connotation of Sponge City in China

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**Abstract.** Chinese scholars hold different academic views on the connotation of Sponge City, given their diverse professional backgrounds, study perspectives and research philosophies. Their different views even raise conflicts, disagreements and contradictions which are jointly named as tensions in this paper. This paper primarily focuses on the tensions of the Sponge City from two aspects. On one hand, whether Sponge City equals to low impact development (LID) is analyzed; on the other hand, this paper discusses that Sponge City aims to coordinate urbanization with resources and environment or to solve urban water problems. The key to eliminating these tensions is to clarify the dialectical and unified relationship among “Sponge City”, “LID”, “water” and “urbanization”. How the advanced concepts—BMPs, LID, GI/GSI, SUDS, WSUD, LIUDD and NDS—were developed in western countries may give new insights for interpreting this dialectical and unified relationship.

## 1. Introduction

Currently, China is facing numerous water problems, inclusive of the problems in water resources, water ecology, water environment and water security. These water syndromes are problems being systemic and comprehensive, which should be urgently addressed through an all-round water-control mode. “Sponge City” is proposed just considering this background in China [1].

In December 2013, Chinese General Secretary Xi Jinping emphasized, on the Central Urbanization Working Conference, that we should build Sponge City characterized by “natural accumulation, natural infiltration and natural purification”. In February 2014, as “2014 Key work points of the Ministry of Housing and Urban-Rural Development (MOHURD)” explicitly stated, China should speed up the study of policy measures of Sponge City construction. In October 2014, “Technology Guide for the construction of Sponge City—LID Rainwater System Construction” (Trial) was rolled out by MOHURD. In October 2015, the General Office of the State Council promulgated “Guidelines for Promoting Sponge City Construction” to deploy and promote the construction of Sponge City. China, as supported by series of regulations and policies, has fully implemented the pilot project for the construction of Sponge City. In early 2015, 16 pilot cities such as Zhenjiang, Jiaxing, Xiamen, and Jinan were launched. In April 2016, 14 more pilot cities for Sponge City construction were identified. For a time, China has an upsurge in the construction of Sponge City.

As this construction is booming, the cognition of Sponge City construction is constantly increasing and deepening in Chinese engineering and academic circles. However, in the process of continuous deepening, people get different interpretations of the connotation of Sponge City, which even raises



the conflicts, disagreements and contradictions, overall referred to as tensions here. These tensions are primarily concentrated in two aspects: whether Sponge City equals to low-impact development (LID); the Sponge City aims to coordinate urbanization with resources and environment, or to solve urban water problems. These tensions are raised by contradicted focuses and perspectives of how to define Sponge City. Accordingly, it is necessary to analyze these tensions to grasp the integrated content of Sponge City from multiple dimensions.

## **2. Tensions of the connotation of Sponge City in China**

### *2.1. Is “Sponge City” equivalent to LID*

“Technology Guide for building Sponge City—LID Rainwater System Construction” (abbreviated as the “Guide”) compiled by MOHURD though pertaining to the technical layer, gives an authoritative account for the connotation of Sponge City: “Sponge City means that the city just like a sponge to have a good 'elasticity' in adapting to changes in the environment and responding to natural disasters. Sponge City could absorb water, store water, seep water, and purify water when it rains. When water is needed, Sponge City 'releases' and uses the stored water.” [2] It is noteworthy that the definition of Sponge City in the Guide has been widely recognized and accepted by the academic field in the most general sense. Yet throughout the Guide, the content of Sponge City is too focused on “LID”. With the subtitle and design chapters of the Guide, it is easy to understand that Sponge City is namely LID.

Similarly, Qiu Baoxing (2015) in the article “Connotation, Approaches and Prospects of Sponge City (LID)” thinks that there are essential differences between the impacts of Sponge City construction and the traditional urban construction model on the surrounding aquatic ecological environment [3]. On the basis, he suggests that could be called LID. The title of Qiu Baoxing's article also infers that his concept of Sponge City equals to LID. As Zhang Rong (2016) proposes, Sponge City respects nature and can alleviate the contradiction between urban development and natural destruction. She also calls Sponge City as “LID” [4]. Lin Chensong et al. (2016) [5], Xiong Kunyang et al. (2016) [6], Yin Hongjun et al. (2016) [7], too, point out that Sponge City means LID.

Evidently, the above literatures generally hold that Sponge City equals to or is namely LID. About this standpoint, some scholars lodge objections: Sponge City does not equal to LID. Che Wu et al. (2015) regard that Sponge City construction neither relies solely on gray facilities nor pursues the green facility (namely LID) [8]. In the same year, Che Wu et al. add that Sponge City construction is a combination of green and grey systems, and it should not equal to LID on narrow sense [9]. Zhang Jianyun et al. (2016) also believe that the connotation of Sponge City cannot be limited by LID, and the construction approaches of Sponge City are not just about LID [10]. Cui Guangbai et al. (2016) [11] and Yu Kongjian (2016) [12], analogously, stress that LID is only a part of the content of the Sponge City. Li Junqi et al. (2015) clearly point out that Sponge City does not equal to rainwater storage or LID [13].

### *2.2. Does “Sponge City” aim to coordinate urbanization with resources and environment or to solve urban water problems*

Qiu Baoxing finds that Sponge City follows the rules of the nature and adopts the low-impact development model that coexists with the surrounding aquatic ecological environment. Accordingly, Sponge City could systematically address urban water issues. Given this, he concludes that the purpose of Sponge City is to harmonize urbanization with resources and environment [3]. This view has received the support and recognition of many scholars. Huang Jingnan et al. (2016) also state that Sponge City primarily aims to increase the quality of China New-type Urbanization and cope with urban flooding and other issues [14]. Ma Hailiang et al. (2016) also propose that Sponge City seeks to coordinate the economic and social development of human with the protection of ecological environment. Its ultimate goal is to promote harmonious coexistence between mankind and nature [15]. This perspective is also echoed by many other documents [16-19].

Nevertheless, plenty of scholars have also issued different voices: Sponge City aims to address water issues. As Cui Guangbo et al. (2016) mention, Sponge City is the management of water. And river basin refers to the whole of water, and it is also a complete natural water collection unit. Thus, the definition of Sponge City cannot be separated from the basin, otherwise Sponge City will lose the theoretical support [11]. Zhang Jianyun et al. (2016) also suggest that the hydrological rule of the basin is the scientific basis of the Sponge City, so the content of Sponge City should be described from the perspective of the urban hydrological process [10]. Similarly, as Zuo Qiting (2016) [20] and Yan Maosen (2015) [21] propose, the underlying point of Sponge City is “water”. Zhang Wang et al. (2014) also consider Sponge City is an innovation and development of the theory of rainwater utilization, and it is an important part of urban water-control in the new era [22]. Other literatures also highlight that Sponge City aims to solve water issues [23, 24].

In brief, the key to eliminate the foregoing tensions is to clarify the dialectical and unified relationship among “Sponge City”, “LID”, “water” and “urbanization”. To clarify these relationships, we should trace the source of Sponge City. This source actually refers to the development of Sponge City in western developed countries. The reasons are as follows:

(1) Sponge City in western developed countries is carried out relatively early. As a result, these countries have formed relatively advanced concepts, such as BMPs (Best Management Practices), LID (Low Impact Development), GI/GSI (Green Infrastructure/Green Storm water Infrastructure), SUDS (Sustainable Urban Drainage System), WSUD (Water Sensitivity Urban Design), LIUDD (Low Impact Urban Design and Development) and NDS (Natural Drainage System).

(2) These advanced concepts associated with Sponge City (BMPs, LID, GI/GSI, SUDS, WSUD, LIUDD and NDS) have laid the foundation for Sponge City of numerous countries including China.

Therefore, the next step we should do is to give a deeper analysis of the development of Sponge City in western developed countries.

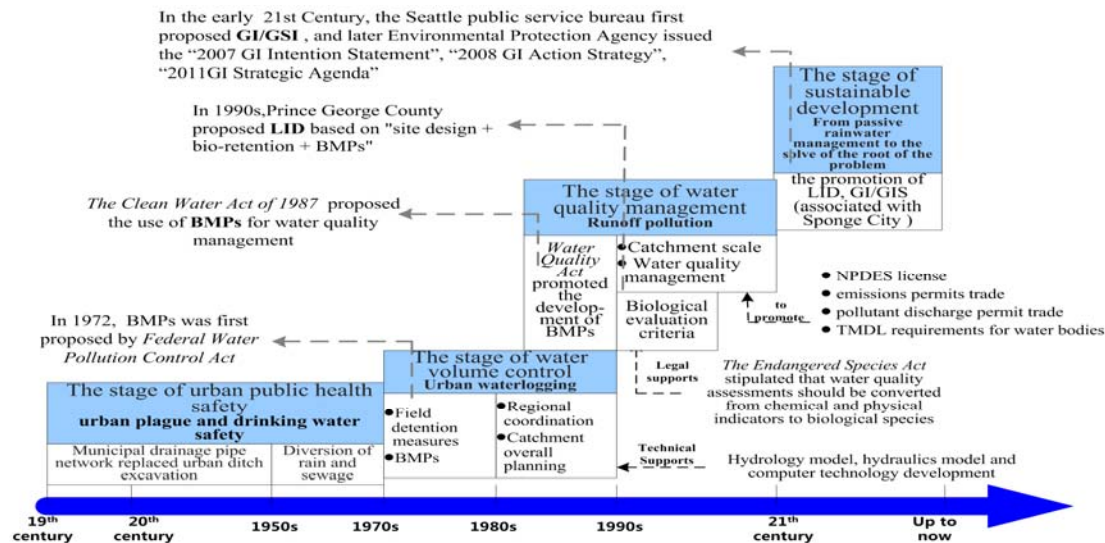
### **3. The development of Sponge City in western developed countries**

#### *3.1. Theoretical basis: urban storm water management*

In fact, there is no common reference to Sponge City in western countries. Instead, it is directly defined as “Urban Storm water Management” [25]. The above concepts, including BMPs, LID, GI/GSI, SUDS, WSUD, LIUDD and NDS, all belong to urban storm water management theory system. In other words, they are the constant innovation and extension of urban storm water management theory in various countries, and their theoretical basis is the theory of urban storm water management.

In the past, given frequent floods, runoff pollution, loss of water resources, deterioration of water ecological environment, and other issues, a series of urban storm water management theories was proposed in western countries. Later on, with the development of science and technology such as ecological technologies and computer technologies, western countries gradually formed Urban storm water management theories associated with Sponge City. The United States formed BMPs, LID and GI/GIS; the United Kingdom proposed SUDS; Australia formed WSUD; New Zealand formed LIUDD; Germany formed NDS.

Western countries not only learn from each other but also integrate their own national conditions in forming the theories of urban storm water management [26]. Also, rainwater control measures, theoretical systems, practical effects of the theories of urban storm water management are similar in these countries. In the following, the United States is used as a representative country to briefly introduce the development of the storm water management in western developed countries, as presented in Figure 1 [27].

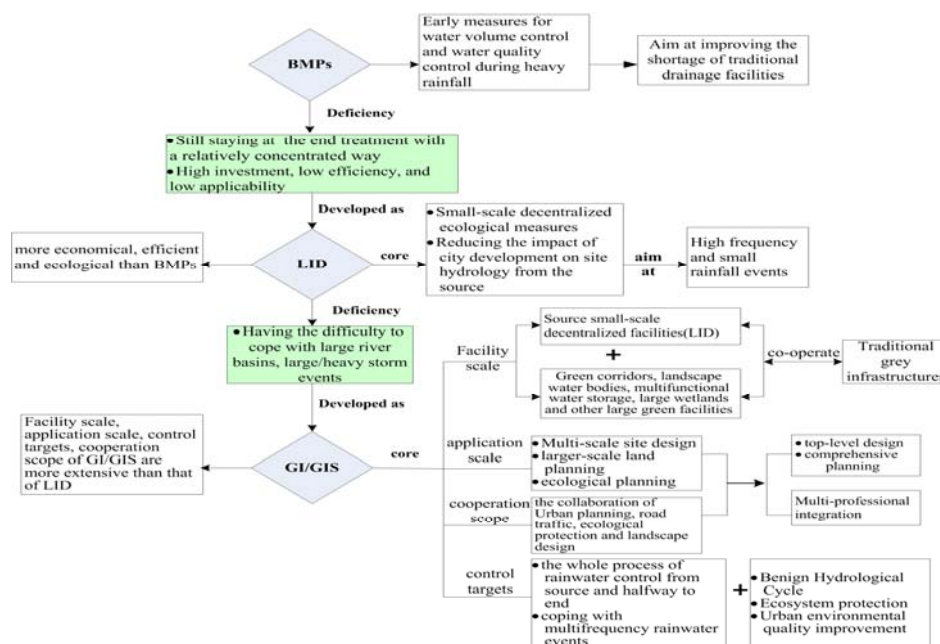


**Figure 1.** The development of U.S. storm water management theory.

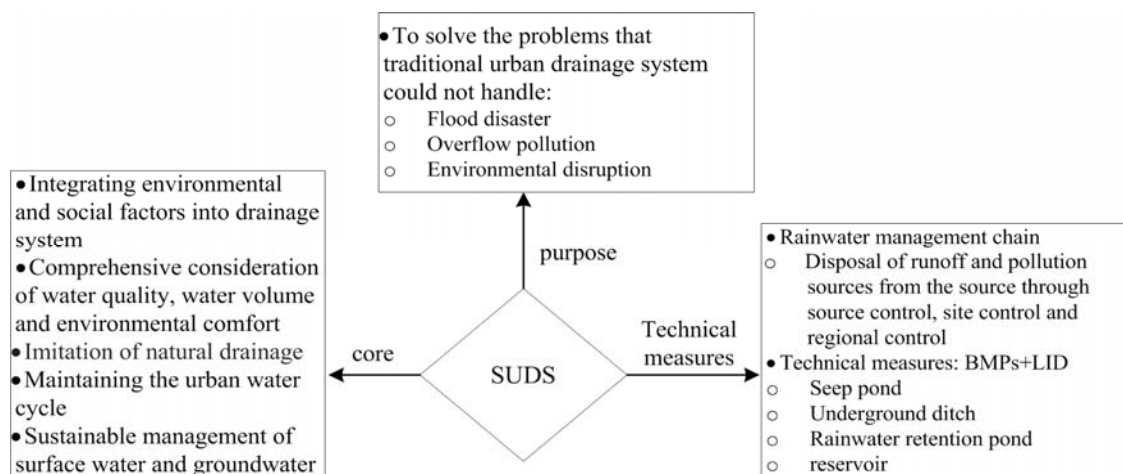
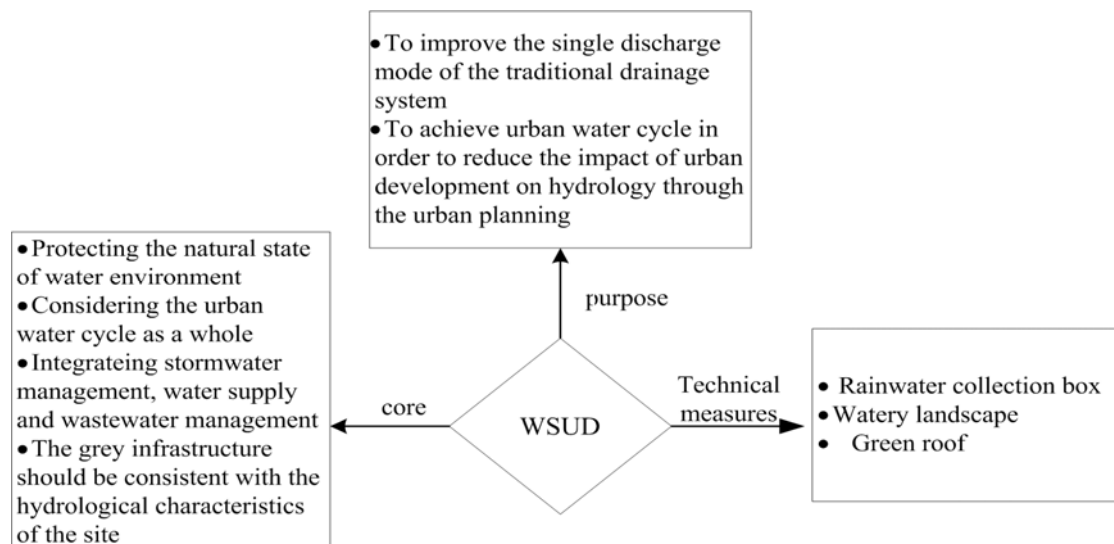
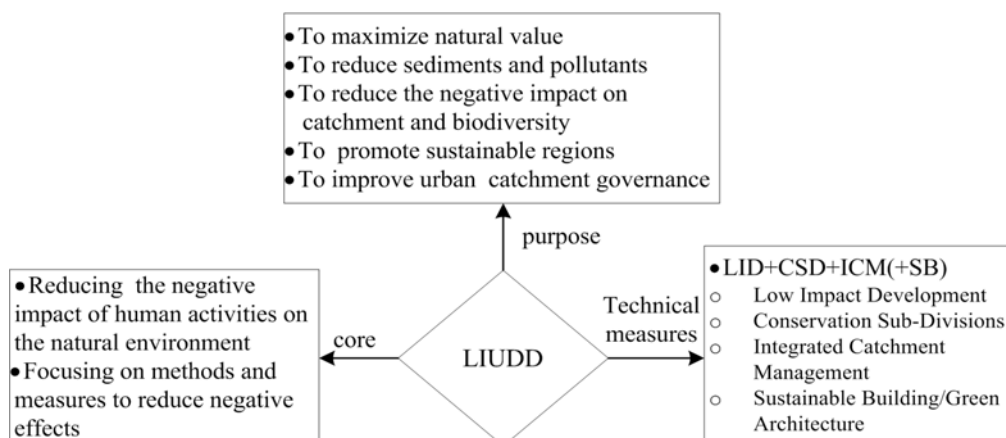
As suggested above, the U.S. urban storm water management theory has gone through four stages with the advancement of Science & Technology, and the introduction of relevant laws and regulations. The four stages are from the single drainage, water quantity and water quality management, to modern sustainable storm water management (namely BMPs, LID, and GI/GIS).

### 3.2. Purpose: solving urban water problems

The theory of urban storm water management, as the name suggests, is the theory formed in line with urban water problems. In other words, the evolution of urban water issues promotes the development and innovation of urban storm water management theory. This point can be illustrated by briefing introducing the purpose, core ideas, and specific technical measures of BMPs, LIDs, GI/GIS, SUDS, WSUD, LIUDD, and NDS (as presented from Figure 2~ Figure 6).



**Figure 2.** BMPs, LIDs and GI/GIS of the US.

**Figure 3.** SUDS of the UK.**Figure 4.** WSUD of Australia [28].**Figure 5.** L IUDD of New Zealand [29].



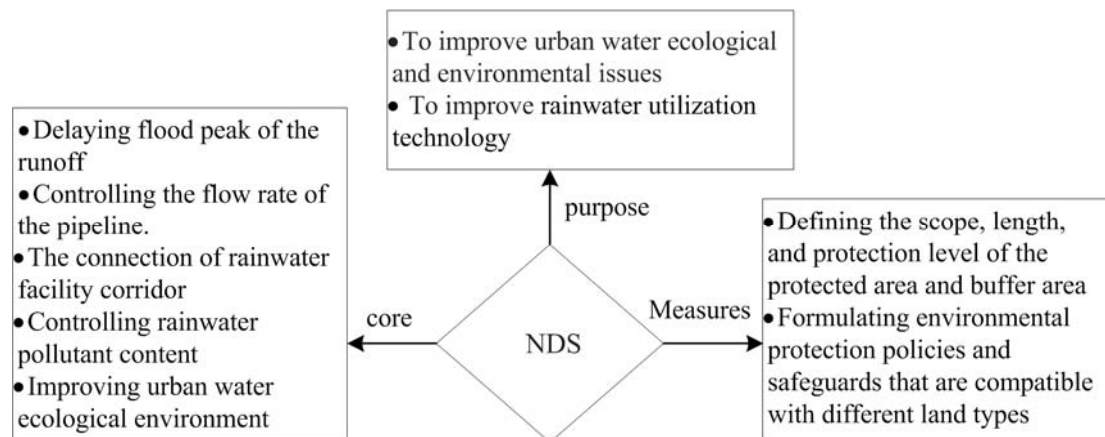


Figure 6. NDS of Germany.

### 3.3. Urbanization and urban storm water management

As suggested by recalling the development of the storm water management in western developed Countries, urban storm water management theories in different countries overall aim at urban water problems. These water issues are caused by the destruction of the original natural ecosystem and hydrological characteristics. The main damage factor is urbanization [30].

In response to urban water problems caused by the continuous development of urbanization, western countries have progressively formed the above-mentioned urban storm water management theories. It can be said that the urbanization promotes the development of urban storm water management theories in western countries. In the following, the United States serves as an example to illustrate the relationship between urbanization and the development of urban storm water theories in western countries, as shown in Figure 7.

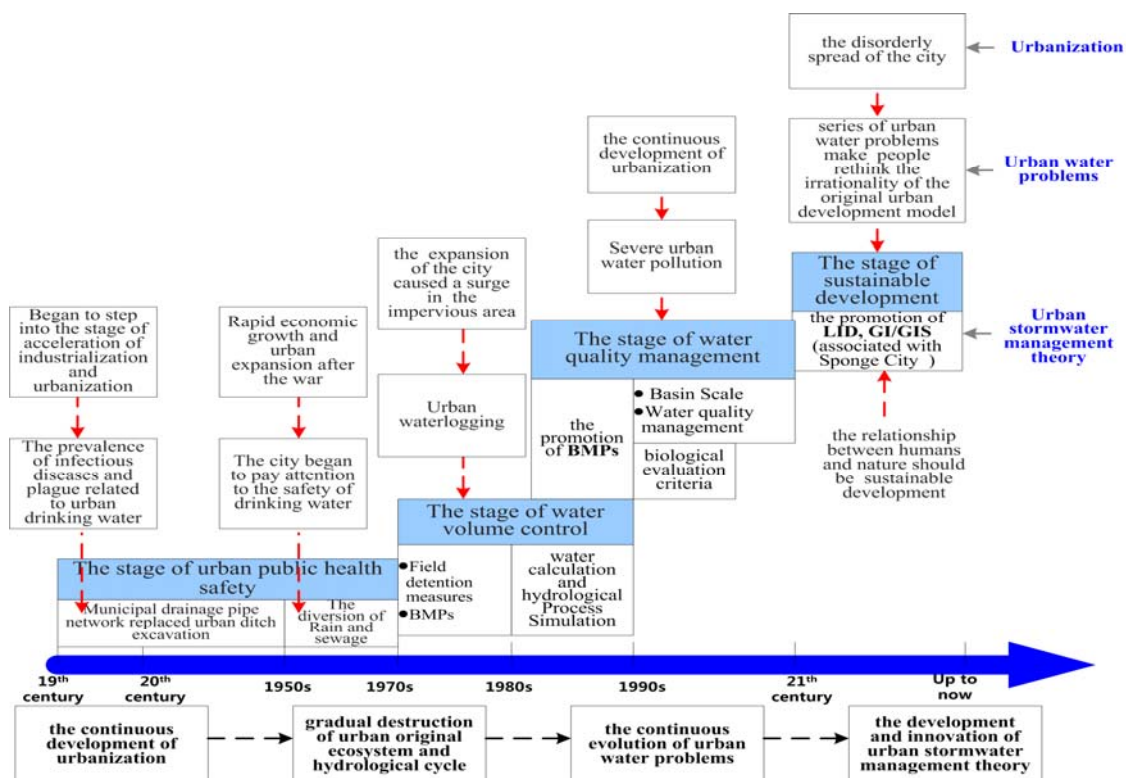


Figure 7. Urbanization and U.S. storm water management theory.

#### 4. Conclusion

Through the analysis of the development of concepts associated with Sponge City in western developed countries, there are major findings as follows:

- (1) Theoretical basis of these advanced concepts (namely BMPs, LIDs, GI/GIS, SUDS, WSUD, LIUDD, and NDS) is urban storm water management theory.
- (2) Urban storm water management is always aiming at solving urban water problems.
- (3) The urbanization development has a lasting and profound impact on the development of urban storm water management theory.

Above findings may provide some new ideas for us to eliminate the tensions of the connotation of China's Sponge City. We should trace the development of China's storm water management theory, and then do a deeper analysis of the roots of China's Sponge City. The relationship among "Sponge City", "LID", "Water", and "Urbanization" may be determined under national conditions of China. In this way, we may eliminate the tensions of the connotation of China's Sponge City.

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