The Significance of Low Impact Development on Urban Water Resources

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Abstract. China is a developing country suffering from severe water shortage. Although the total fresh water resources account for 6% of the total national water resources, China's per capita water resources are only 25% of the world's average. As a result, China is now one of the most water-scarce countries in the world. In this context, China's urbanization level is constantly improving, and in the process of urbanization and urbanization, human social practice has an increasingly greater impact on water resources and the environment. At the same time, urban water logging and other disasters have led to a large number of loss of life and property, which has caused a series of water resources and environmental problems, causing widespread social concern. Sponge city construction is achieved through low-impact development technology. In the design, construction and management of the development process, low-impact development seeks to minimize the impact on water resources, especially to maximize the utilization and control of rain-flood resources. In order to achieve "low impact", urban development and planning must follow the principle of respecting water resources. The core meaning of the proposal and use of Low Impact Development technology is to respect nature.

1. Introduction
Water should be respected. The requirement is that the river should not be used as a garbage disposal station and grass and ditch vegetation along the water bank should not be damaged. More importantly, non-point source pollution should be prevented so as to protect the self-purification system of water system and water ecosystem.

From the perspective of hydrological cycle, hydrological characteristics before and after urban development should remain basically unchanged, including total runoff, peak flow and peak occurrence time. Therefore, infiltration, storage, regulation and retention should be adopted to achieve a certain amount of runoff without outflow after urban development. In order to keep the peak flow constant, measures such as infiltration, storage and regulation should be taken to reduce the peak flow and delay the peak flow. For the same rainfall, the proportion of water resources will vary greatly with different characteristics of underlying surface and development intensity. Generally speaking, under natural vegetation conditions, 40% of the total rainfall will enter the atmosphere through transpiration and evaporation, 10% will form surface runoff, and 50% will infiltrate into soil water and groundwater. The construction of cities breaks the pattern of rainwater distribution: transpiration and evaporation exceed 40%, surface runoff may increase from 10% to 50% or more, and infiltration may
decrease from 50% to 10% or less. Once it encounters heavy rainfall, it is easy to cause floods and water logging disasters. At the same time, it is accompanied by severe losses of rain-flood resources, soil erosion, non-point source pollution and damage of self-purification system of water system. Therefore, reducing surface runoff, reducing soil and water loss, reducing non-point source pollution, reducing the loss of rain-flood resources, reducing flood and early disaster hazards, as well as increasing local infiltration of rainwater and replenishing groundwater have become the key technologies of low-impact development.

2. The significance of the application of low impact development
In recent years, with the rapid development of urbanization, the urban construction and development with traditional extensive mode has caused the original river, wetland, lake and other hydro-ecological environment to suffer from varying degrees of damage in the cities. For example, the use of impermeable material on the ground makes the impermeable area on the ground increasingly expand, destroying the hydrological characteristics and natural ecosystems of the cities. The rapid development and construction of cities have allowed a large amount of rainfall that could have infiltrated underground to form a runoff within a short time and to be discharged through gray infrastructure such as conduit, etc. [1] Because the existing drainage system has no enough functions to withstand such huge urban drainage pressure, urban water logging eventually occurs, leading to a large amount of rainfall that can not be stored and effectively recycled. In the traditional treatment mode of rapid rainfall, except for evaporation and a small amount of infiltration, the drainage pressure of conduit reaches nearly 80%, resulting in the massive loss of rainfall resources and the emergence of urban water logging. The application of LID technology can be conductive to the effectively infiltration of rainfall through the use of ecological grass planting ditch, permeable pavement and concave green space, etc, reducing the discharge of runoff to less than 40%, thereby achieving the purpose of saving and utilizing precipitation resources. [2]

2.1. LID is conductive to reduce the load of the grey infrastructure in urban
The municipal rainwater pipe network of the underground is the main way for achieving urban drainage. Roof gutters and pavement along 3% slopes help the rainwater to enter the municipal rainwater pipe network and eventually discharge away city. Before the drastic reform, the situation of urban drainage was as follows: 40% of rainfall was evaporated, and 50% of it infiltrated underground soil to supplement groundwater resources. 10% enter the river. However, the rapid development of urbanization has resulted in changes in soil cover patterns, reducing the amount of rainfall infiltrated into the underground soil to 5%, and more than 55% of the precipitation was fed into municipal rainwater networks and discharged away the cities. As a matter of fact, it's the impermeability of soil in the process of urbanization that caused the loss of rainwater absorption and storage function of underground soil, which eventually brought about urban water logging. Another main reason is that urbanization has neglected and buried the original urban waterways and gully in the process of its development.

The application of LID facilities aims at perfecting the ecological rainstorm and flood management system by means of scientific methods, realizing the absorption and slow drainage of rainwater confluence and discharging, so as to reduce the drainage load of the grey infrastructure in urban. [3] To use the LID and comprehensive make use of a series of facilities that are coupled with the grey infrastructure of the urban to realize the comprehensive management and control of rainwater from the source of rainwater collection on the site. While meeting the requirements of urban ground-surface hardness, the load of grey infrastructure has also been reduced, alleviating urban water logging to a great extent.

2.2. LID is conductive to supplement groundwater resources to cities
The important sources of groundwater replenishment include atmospheric rainfall and infiltration of surface water and atmospheric rainfall is the most important replenishment of groundwater
resources. It's showed based on the results that the infiltration of rainfall is caused by the common effects of molecular force, capillary force and gravity and other factors, and the infiltration rate of atmospheric rainfall is also affected by soil conditions. As mentioned earlier, the change of current urban land cover has destroyed the original hydrological cycle model, eventually leading to the loss of rainwater resources and the shortage of groundwater resources.[4] Experts pointed out that groundwater infiltration decreases by 250,000 cubic metres per square kilometre of impermeable area in recharge area of groundwater, at the same time, surface runoff increased by 457,300 cubic metres.

LID is an important means in the construction and planning of ecological city. The pavement of impermeable pavement takes the place of the highway construction with hardened surface. Such kind of ecological transformation mode will be beneficial to urban groundwater to recover step by step, conserve the original functions of storing water, reduce the loss of rainwater resources, rebuild the process of "sponge effect" of soil, and directly help urban groundwater to be effectively recharged, and reduce ecological problems such as urban drought and flood, etc. Therefore, it's the important ways to supplement the groundwater resources of urban by strengthening the construction of LID facilities, constructing the rainwater management system of urban, slowing down the speed of surface runoff, increasing the duration of runoff, and enhancing the function of absorption of permeable ground and storage of rainwater.

2.3. LID is beneficial to the sustainable utilization of rainwater resources.

The change of surface cover forms of urban leads to the rapid loss of rainwater resources. The main contradiction in water resource has become the contradiction between the water resources utilization that urban inhabitant has a great number of demand increasingly and the loss of water resources in cities. The suggestion of sustainable utilization of rainwater resources will inevitably become an important measure to solve the contradiction of water resources, and will also become the development trend of ecological civilization construction planning in China.

LID constructs ecosystem used by urban rainwater by means of planting grass ditches and artificial wetland, etc. Effective rainwater recycling can be used for non-potable water in residential life, public places or factories, such as toilet flushing, green planting irrigation and water for landscape, to maximize the utilization of rainwater resources.[5] LID comprehensively takes into account the rainwater runoff path, effectively controlling rainwater discharge starting from the sources, and realizing rainwater's recycling through a series of measures such as filtration, precipitation, purification and storage, etc, and then used for living, production and landscape, thus realizing the rainwater recycling. It can be seen that LID is an important way to realize the sustainable utilization and management of rainwater resources.

After the ecological environment of a city is destroyed, a series of problems will occur, such as water logging, loss of water resources, deterioration of water ecological environment and pollution of water environment, etc. As a result, the measures for sustainable development of water conservation and ecological environment are imperative, the original form of development and construction concept must be changed. LID is the main means in the construction of sponge city, is also the main way to improve the current situation of urban water ecological environment, more importantly, it's also an important measure for sustainable development of ecological civilization cities.[6] The application of LID takes the construction of ecological civilization as a guide, which is conductive to the rational layout of green space in cities and countrysides, to the improvement of infrastructure and the improvement of living environment. At the same time, it is more beneficial to coordinating the interaction between economic, social, ecological environment, ecological security and the progress among urbanization. It is of great theoretical and practical significance to establish a sustainable development of ecological civilization society.

2.4. LID is beneficial to the effective control of non-point source pollution

Non-point source pollution refers to the pollution sources that discharge pollutants into the water environment in the form of "surface flow". During the scouring process of precipitation and surface
runoff, nitrogen, phosphorus and other pollutants existing in the atmosphere and the surface enter the water environment in the form of "surface flow", thus causing different degrees of pollution in the water environment.

Using low impact development technology, the construction of ecological infrastructure, increase the urban green space area, build subsided green space, with is non-point source pollutants in urban surface runoff into the falling of green space, effectively reduce the urban surface runoff, reduce non-point source pollution, and can be surface runoff pollutants such as nitrogen and phosphorus into green space in the "fertilizer" needed for the plant. Therefore, sunken green space has become an effective measure for the control of urban non-point source pollution. The main control method not only blocks the source, but also purifies the process and realizes the rational utilization and resource transformation of non-point source pollutants.

The application of low-impact development is a way to take effective measures to intercept and treat pollutants at all sources of non-point source pollution, so as to prevent pollutants from entering the water system with rainwater runoff and polluting the water environment. The main purpose of these measures is to reduce the non-point source pollution load of surface runoff into water body by reducing water flow velocity and prolonging water flow time. In the urban green space, urban roads and other different sources of intercepting technology can be used sunken green space, permeable pavement, vegetation buffer zone, ecological planting grass ditch and other low-impact development technology.

Another way is to use process blocking to control non-point source pollution. The construction requirement of sponge city is to cut off suspended substances, oxygen-consuming substances, nutritive substances and other pollutants in urban rainwater through the construction of grassland, grass ditch, sponge park, sunken green land, and all kinds of low-impact development measures such as rainwater treatment tank, rainwater sedimentation tank and vegetation pollution treatment belt. Among them, there are nitrogen, phosphorus and other nutrients required by plant growth, which can become fertilizer required by urban green space. In addition, some lipids and toxic substances can be treated in sewage treatment plants along with the underground pipes of the city.

3. The path fully making use of the low impact development in urban planning
LID is a rainstorm and flood management and control method constructed from the perspective of water resources and water ecological environment protection, which belongs to the micro category, and is gradually recognized by the society and is compatible with the urban construction and planning. However, based on the current development situation, the combination between LID and traditional urban planning and construction methods has not been fully launched. I hold that several efforts can be made in the following aspects:

3.1. To effectively integrate LID applications and traditional ecological-oriented urban planning concepts
At present, LID mainly analyzes the water resources cycle, which is of great significance to the analysis of the dynamic process of landscape design and land development in regional construction. Moreover, the hydrological process of the site is the core element in the ecological process of the site. However, not only hydrological factor should be considered, but also other economic factors such as nature and society should be taken into account in regional development. Therefore, LID should be promoted in the overall planning to effectively integrate the overall planning cities in the process of traditional ecological-oriented development, so that LID can be more fully applied to the natural ecological process and socioeconomic process of the regional development.

3.2. To effectively integrate the objective of LID and traditional Eco-oriented urban goal planning
At present, the construction goal of LID mainly focuses on the hydrological and hydro-ecological objectives of the construction area, including the total amount of rainfall, surface runoff volume, surface runoff frequency, water quality, pollution status of the area, etc., while less attention is paid to
the comprehensive ecological, social and economic sustainable development objectives of the construction area. Therefore, it is necessary to promote LID to be compatible with traditional eco-oriented urban planning in the target system, so that LID can have a wider range of comprehensive social, economic and ecological goals.

3.3. To effectively integrate the planning of LID and traditional eco-oriented urban total planning

At present, the construction and planning of LID plays more emphasis on the determination of the development scope of the construction area and the layout of the practical facilities of the comprehensive management of LID. The comprehensive consideration of the land use scheme, the layout plan, the composition of the traffic hub, the planning and layout of the ecological infrastructure system in the construction area is relatively less. Therefore, the content system of LID and traditional eco-oriented regional planning should be effectively integrated in the content system, so that LID can be more widely used in actual construction.

4. Conclusion

In the process of China's new-type urbanization construction, the application of low-impact development is conducive to the realization of ecological civilization strategy and ecological city strategy. Its design concept focuses more on the ecological treatment technology and design of water quality and water pollution, which should run through the construction of urban ecological infrastructure.

In the process of urban construction, low-impact development technologies are adopted to achieve the coupling of low-impact development facilities such as "infiltration, stagnation, storage, purification, use and discharge" of rainwater. Infiltration--reduces surface runoff from the source by reducing hardened surface areas such as roofs and pavements, encouraging rainwater to infiltrate in place. Stagnation--delay the peak time, reduce the drainage intensity, alleviate or reduce the risk of rain flood. Storage--cut down the peak flow, adjust the spatial and temporal distribution of storm water, and create conditions to store storm water resources. Purification--measures are taken to control pollution sources and reduce the pollution level of storm water runoff. Use--take rainwater recharge, rainwater irrigation, construction of urban center garden landscape, to achieve the effective and recycling of rainwater resources. Discharge--the construction of low-impact development rainwater system, urban rainwater pipe network system and urban excess rainwater treatment system, to create a safe urban drainage and water logging prevention system, to ensure the safety of urban rainwater.

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