

# Rethinking Stormwater: How Development Impacts the Land

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Every natural piece of land has already mastered and optimized the flow of its stormwater using resources such as trees, rocks, soil and grasses. Although rainfall runoff certainly occurs, much of the water is accommodated through infiltration, absorption or evaporation. Mother Nature knows what she's doing.



Land development projects alter the land's associated natural water flows and the environments in which these flows discharge. Humans impact the land, and the land goes on to affect the water that, in turn, alters the land. Managing this cycle requires constant reevaluation and vigilance to understand the impact and identify the desired outcomes.

## Land Development

In urban environments, stormwater flows originate from snowmelt and rain and are designed to be channeled away over parking lots, concrete and other impervious surfaces. Any land development project must manage the rainfall runoff and control the flow's impact downstream for both small and large storms.

Whether land improvement is from a greenfield or redevelopment project, the land parcel is typically stripped before the building phase begins. There are other construction options, but developers and contractors look for a clean slate

where they can build most efficiently. The land will change, and although design criteria for new projects strive to mimic the previous environment, it is often not achievable.

Land development has many positive outcomes for societies and communities, and if we plan and develop carefully, it can have a positive impact on the natural processes and the land as well. Below is a rundown of the process.

## Project Teams

The land development process typically involves a development team and a city and/or agency process team.

The development team focuses on surveying, engineering and constructing the project for the land owner. City teams focus on enforcing planning, public works and public safety criteria that must be met according to the community's regulations. Both teams steer development projects through ordinances, design criteria and permits.

Every land development project has an established a set of goals and requirements. The developer and city process teams work toward meeting these defined expectations to meet the desired development and the corresponding regulations.

### **Planning Review**

Land development projects often start with a planning review where a plat is overlaid on the site and changes to the land become evident. This is the first glimpse of what the changes to the land would be.

This review helps to identify existing flood plains, detention requirements, easements and land access. While the natural systems that moved the water flow in the past will be seen with an overlay of proposed changes, there often needs to be more consideration of stormwater at this stage.

### **Permitting**

At this stage, engineers submit plans for transportation, stormwater and other public improvements. Overland flow paths identify the existing natural water flows on the site. Next, an overlay of buildings, structures and impervious areas is introduced. It becomes apparent how humans will alter and control the water flow with this new land use.

Stormwater management techniques for developed land can include enclosing overland flow paths, developing detention and retention facilities, and identifying storage options, vaults and more. However, the focus is often on how the developed land will be used, not on how rainfall runoff can be generated and used by the land.

At this stage, the goal is to get the necessary permits so the project can get underway.

## **Realizing Resilient Watersheds**

Land development projects add impermeable roads, structures, roofs, sidewalks and parking lots. Land development also reduces natural vegetation cover, including grasses, trees and brush. In addition, development alters or eliminates the existing natural water flows and drives increased surface runoff volume.

As land development projects progress and address the challenge of moving stormwater, it is time to consider what will be built and what will be preserved — not just to keep moving and using stormwater on a site but also for the benefit of all downstream.

By adopting proactive design standards, weighing downstream risk and embracing stormwater management early, land development projects can create success for all.

### **Develop Design Standards**

Stormwater design standards consider the intensity-duration-frequency (IDF) of a hypothetical rainfall event. This hypothetical rainfall event has only one peak — like a bell curve — and lasts a defined timeframe, such as 24 hours. Unfortunately, the commonly used IDF standards and existing hydrologic criteria are based on data from the 1960s and focus on severe weather events rather than the changing weather patterns, such as back-to-back rain events that can greatly increase runoff volume. Today, we have historical rainfall data to show how rainstorms happen, including peak intensity and typical durations.

Design standards often provide guidance that is too simplistic for land development projects, focusing only on rerouting runoff and not incorporating all the impacts of weather events.

### **Assess Downstream Risk**

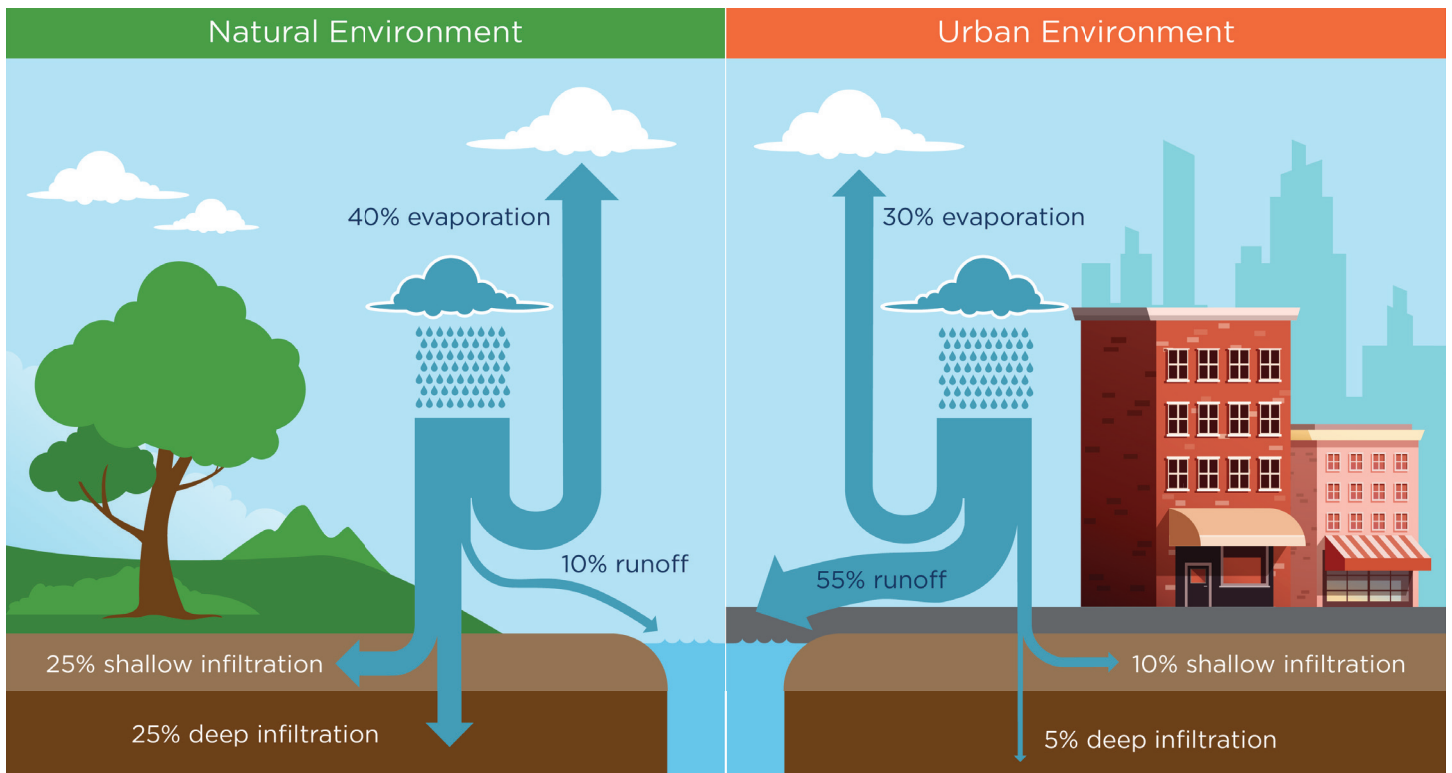
Current design and planning guidance passes the risk of water runoff and flooding downstream. As the land is changed and the existing hyperefficient natural water flow paths are disrupted, land development projects must take responsibility for the runoff generated by their site to avoid passing on costly problems to surrounding communities. Projects must look beyond simply meeting regulations and provide practical steps for incorporating runoff.

An increase in water flow presents a significant increase in energy and strength. An inaccurate design of runoff mitigation can push flooding downstream, tear up river banks, widen waterways, undermine road crossings, degrade existing stormwater infrastructure and more.

Understanding and appreciating the natural flow paths and land cover at the project site and beyond is essential to the best long-term stormwater development strategy. Respecting naturally established watersheds and water runoff patterns is an important part of taking a holistic approach toward creating an optimum plan while mitigating unnecessary risk. There are opportunities within the design development phase to integrate stormwater management strategies throughout the land parcel — look for options to infiltrate water, reduce impervious surfaces, integrate diverse vegetation, and retain and reuse water.

### **Engage Early Collaboration**

There is value in understanding, accommodating and leveraging the way water naturally flowed on a piece of land for centuries. Expanding the land development team to include stormwater management from the start helps create the most effective design plans.



**Figure 1: Utilizing stormwater in natural and urban areas.**

Stormwater should no longer be considered waste that must be removed but a resource that can be incorporated into land development. In addition to focusing on pollutant reduction from runoff mitigation, stormwater management brings a range of tools and solutions that can enhance a development project by using rainfall where it falls.

Smarter stormwater designs explored and incorporated early in a land project can introduce flexible solutions that meet regulations and provide benefits to the landowner and community. Collaboration among planners, engineers, architects, landscape professionals and scientists can identify and present a range of options that meet the intent of the regulations while building infrastructure that has multiple uses for the community.

### Conclusion

Resilient and thoughtfully engineered watershed systems can be an incredible resource. Land development can improve environmental and infrastructure outcomes if we make the effort to learn more innovative design standards, understand the risk to areas at the bottom of the watershed and embrace stormwater knowledge early in each project.

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