

Stormwater Management Strategy Paper



Photo Courtesy of City of Naperville

**Chicago Metropolitan Agency for Planning
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Introduction

Water is undoubtedly one of the most vital natural resources. We need water to sustain our everyday lives. Water is also used daily in a variety of different capacities including cooking and cleaning. Yet water can also devastate communities when not properly managed. Flooding can destroy homes and bring transportation systems to a halt. Effective stormwater management can minimize damages associated with flooding and prevent the degradation of aquatic resources. The purpose of this report is to summarize existing mechanisms for managing stormwater in the region and to pose the question of what additional policies may need to be implemented.

Background on Stormwater

Stormwater runoff is excess precipitation typically from rainfall but may also result from snowmelt. Excess precipitation results when there is more water than the soil or surface can absorb. There are a number of factors that influence how much of the rainfall will become stormwater runoff. These factors vary from the intensity of the rainfall to the type of soil and land cover. Figure 1 describes the different mechanisms by which water is transported. Each case in Figure 1 represents different degrees of imperviousness (i.e., hard surface). Evapotranspiration describes the process by which plants and trees uptake water through their root systems or leaves and eventually release it back into the atmosphere. Water which is infiltrated into the soil may either become shallow or deep infiltration. Shallow infiltration provides soil with the necessary moisture to support the above plants and trees. Shallow infiltration may also travel through the soil and into downstream rivers and lakes. Deep infiltration will percolate through the soil and eventually recharge aquifers and groundwater sources. The upshot is that urbanization tends to increase runoff and makes stormwater management necessary. It also may decrease the recharge of aquifers that many outlying areas in the region depend on, although this threat is not understood as well.

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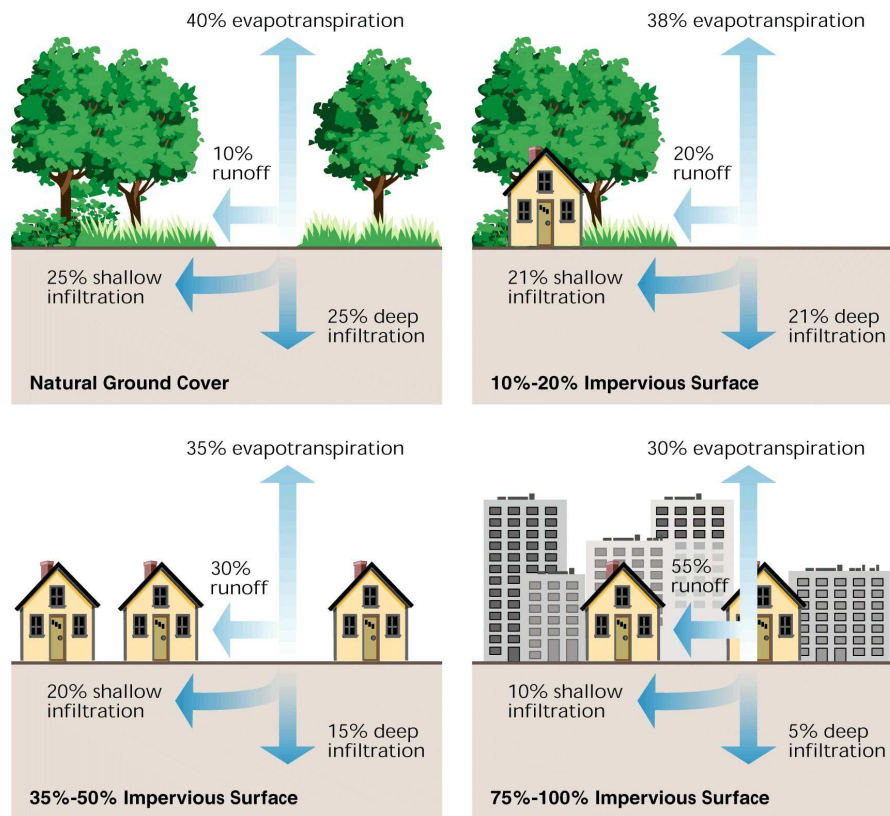


Fig. 3.21 -- Relationship between impervious cover and surface runoff. Impervious cover in a watershed results in increased surface runoff. As little as 10 percent impervious cover in a watershed can result in stream degradation. In Stream Corridor Restoration: Principles, Processes, and Practices (10/98). By the Federal Interagency Stream Restoration Working Group (FISRWG) (15 Federal agencies of the U.S.)

Figure 1: Degrees of Imperviousness and its Effect on Stormwater Runoff (Stream Corridor Restoration)

The Importance of Stormwater Management

Stormwater management is an important component of the Chicago Metropolitan Agency for Planning's (CMAP) *GO TO 2040* regional comprehensive plan. The 2040 Regional Vision states that "water will be treated as a critical natural resource and water resource planning will be a high regional priority." Strong stormwater management programs throughout the region play a significant role in accomplishing this goal. Regional interest in stormwater management has been strong for a number of years. A predecessor agency to CMAP, the Northeastern Illinois Planning Commission (NIPC), published the "Strategic Plan for Water Resource Management" in 2002. This document was prepared as long-term guidance for stormwater management in the region. A number of recommendations regarding stormwater management issues are outlined in this document that both NIPC and other regional and local actors have promoted.

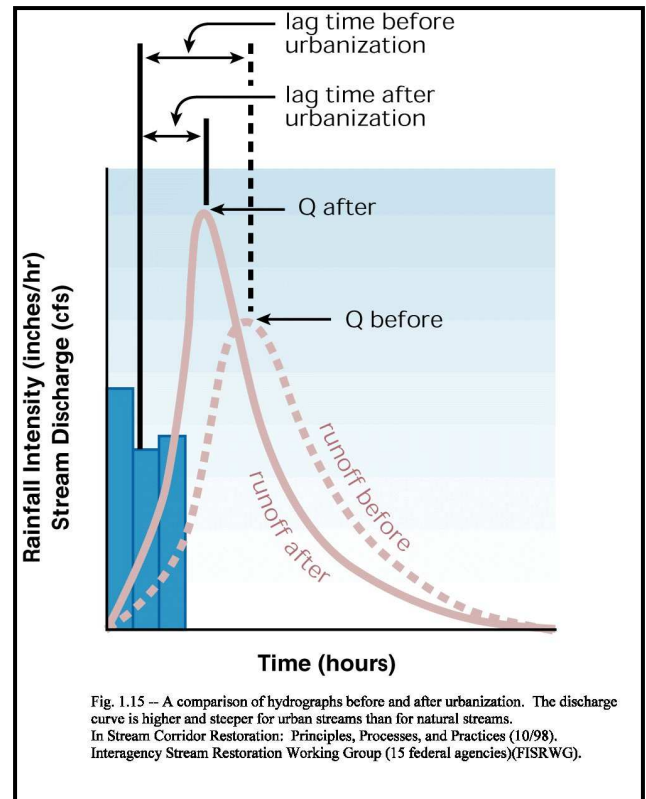
The first study that investigated the effects of urban stormwater runoff on water quality was the US Environmental Protection Agency's (USEPA) Nationwide Urban Runoff Program (NURP) in 1983. The program studied the quality of the stormwater runoff at 28 sites throughout the United States. Lake Ellyn in Glen Ellyn was site chosen for the region. The program found that untreated stormwater contains unsafe levels of heavy metals, especially copper, lead and zinc.

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Stormwater was also found to have high levels of coliform bacteria. This study was the first to specifically identify the pollutants that were responsible for the “water quality problem”. At the time it was acknowledged that there was a problem but what was causing it and the exact agents responsible were unknown. (Results of the Nationwide Urban Runoff Program: Executive Summary)

Stormwater pollutants commonly come from a variety of sources that are throughout the landscape, such as parking lots, roads, farm fields, etc. This type of pollution is called non-point source pollution. Non-point source pollution is becoming a larger problem throughout the metropolitan region. Since the region is very large and diverse, each area has its own unique set of challenges regarding stormwater quality.

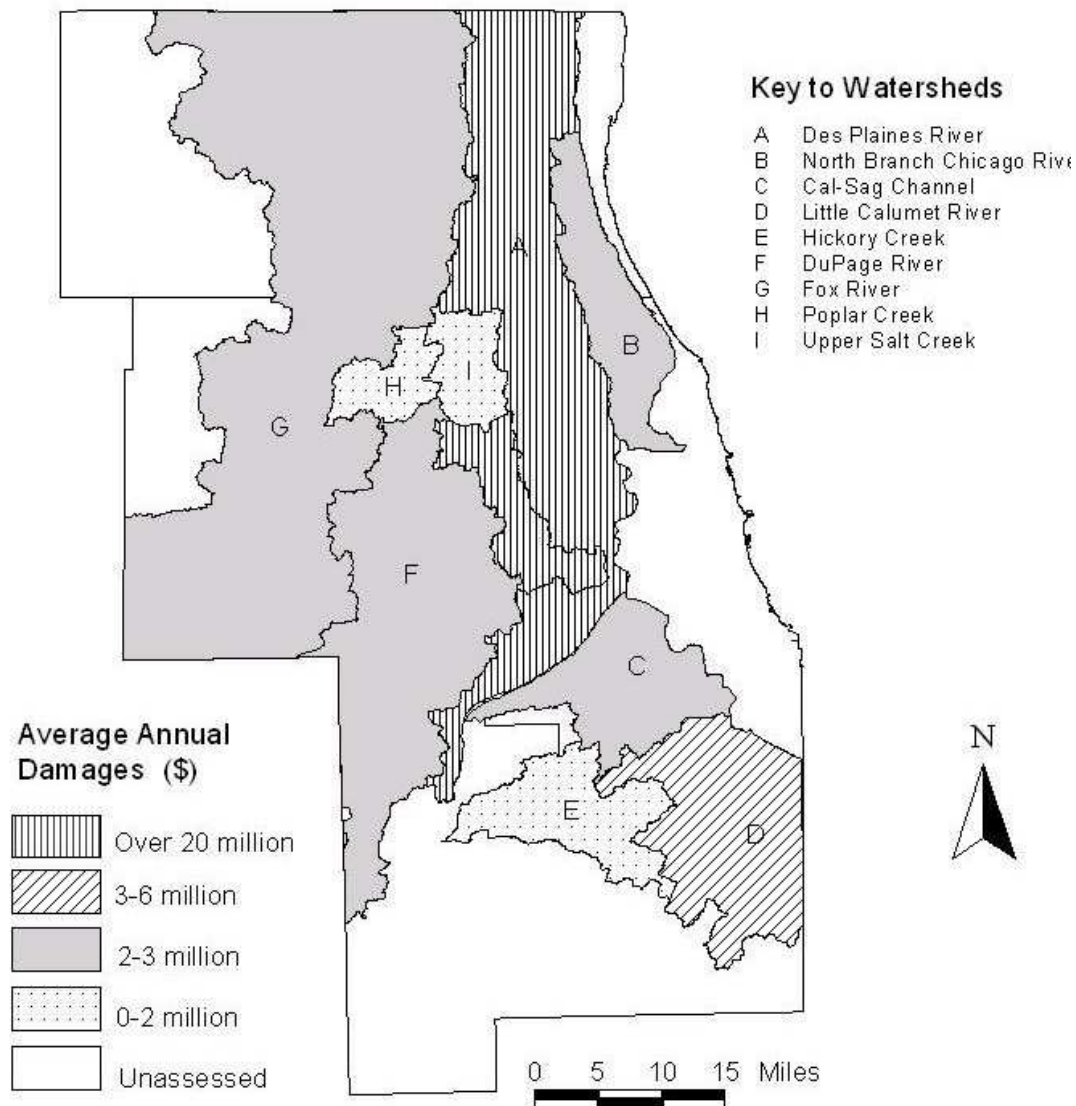
One reason stormwater management is an important consideration for local governments is that storm events in urban areas tend to be more “flashy” than rural storm events. This term describes how quickly the water appears in storm sewers or streams and how quickly it then recedes when compared to natural conditions. Figure 2 displays hydrographs before and after development. A hydrograph compares the runoff rate versus time. The hydrograph after urbanization peaks sooner and recedes much faster than the natural conditions hydrograph. The water post development travels at a much faster rate because of the increase in impervious and smooth surfaces. Water will travel down a concrete driveway much faster than it will through the adjacent lawn. Flashiness tends to damage streams by causing increased erosion with moderately large storm events. Stormwater management is partly meant to control this increased flashiness and keep it from damaging property and the natural environment. The usual means of doing so is to provide detention storage, releasing water more slowly than it would be otherwise.



Flooding damages many homes and properties throughout the region every year. Figure 3 displays estimates of annual damages per watershed. The watershed that experiences the greatest amount of damage is the highly urbanized Des Plaines River watershed. The main stem and tributaries of the Des Plaines River have experienced degradation due to flashy storm events and stormwater quality. According to the National Flood Insurance Program, the average annual flood losses are estimated at \$2.4 billion throughout the country (Flood Smart).

Figure 2: Before and After Development Hydrographs (Stream Corridor Restoration)

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From: The Resource Coordination Policy Committee's *Our Community and Flooding: A Report on the Status of Floodwater Management in the Chicago Metropolitan Area*, October 1998.

Figure 3: Average Annual Flood Damages

Reducing the volume of runoff can also be a goal of stormwater management. It is especially important because a number of areas in the region have combined sewers. Combined sewers are sewers that carry both sanitary and stormwater flows. During storm events the sewer system can frequently become overwhelmed and discharge the stormwater and sanitary water directly into bodies of water. These discharges are called Combined Sewer Overflows (CSOs). If the amount of stormwater runoff can be reduced, the number of CSO discharge events can also be reduced. CSOs are further described in the Wastewater Planning Strategy Paper.

Existing Policies and Programs

The Chicago area has been a leader in stormwater management since the 1960s when flood control and stream improvement projects were implemented. The Metropolitan Water Reclamation District of Greater Chicago (MWRDGC) was one of the first agencies to require detention storage in 1972. This same year the Tunnel and Reservoir Plan (TARP) was adopted. TARP is a series of underground tunnels and above ground reservoirs that hold stormwater runoff during large storm events to limit the number of CSOs (Metropolitan Water Reclamation District of Greater Chicago).

In 1986 and 1987 the Chicago area experienced two devastating storm events. The event of 1986 was preceded by two weeks of consistent rainfall. The event of 1987 was a single event in which 13 inches of precipitation fell in less than 24 hours. Although the two events were quite different, they both resulted in widespread flooding and record river stages (Office of Water Resources). These events spurred the General Assembly to pass Public Act 85-905 (55 ILCS 5/5-1062.2), which gave several northeastern Illinois counties the authority to create a Stormwater Management Planning Committee (SMPC) to prepare a stormwater management plan, to implement it through a countywide ordinance, and to fund stormwater management activities through a property tax levy. These counties were DuPage, Kane, Lake, McHenry and Will, and each has passed a countywide ordinance. In P.A. 94-675 (55 ILCS 5/5-1062.2) the authority was extended to Kendall and another five counties. Kendall has not yet adopted an ordinance. P.A. 93-1049 (55 ILCS 5/5-1062.1) gave the Metropolitan Water Reclamation District of Greater Chicago (MWRDGC) the authority to develop a countywide stormwater management program for Cook County. MWRDGC has completed its stormwater management plan and is now drafting the Cook County ordinance.

This unique system is central to stormwater management in northeastern Illinois and allows each county to prepare its own stormwater management plan, ordinance, and projects. The ordinances are adopted by the County Board and provide minimum standards for all municipalities and unincorporated areas within the county, although a municipality may then create stricter criteria if it chooses to do so.

The objective of most stormwater management ordinances is to limit stormwater runoff to a prescribed maximum. This is accomplished mainly through onsite detention storage. Traditionally detention basins were constructed to properly hold a specified amount of runoff. This amount is based on the specific county ordinances as well as the size of the project and a number of other factors. The detention basins are then equipped with a flow restrictor to only release flow at a specified release rate. These release rates vary from county to county and can be seen in Table 1. In this table you can see that the rates are referred to as either 100 yr or 2 yr. A 100 year storm event is an event that has a 1 in 100 or a 1% chance of occurring in a particular year. Similarly, a 2 year storm event is an event has a 1 in 2 or a 50% chance of occurring in a particular year.

Current Countywide Regulations

County	Rate Control	Volume Control	Pollution Control
DuPage	0.1 cfs/ac - 100yr	Incorporate BMPs to the extent practicable and necessary	Incorporate BMPs to the extent practicable and necessary
Kane	0.1 cfs/ac - 100yr	Retention and infiltration of stormwater enhanced to the extent practicable	Storage facilities shall include BMPs, any BMPs required by Clean Water Act shall be included, BMPs are to be used in site drainage plan, 0.75" over impervious area retention requirement
Lake	100yr: 0.15 cfs/ac 2yr: 0.04 cfs/ac	Shall use Runoff Reduction Hierarchy	Divert and treat 0.2" to 1.0" of runoff based on impervious area
McHenry	100yr: 0.15 cfs/ac 2yr: 0.04 cfs/ac	Shall use Runoff Reduction Hierarchy	Shall provide water quality treatment for runoff from increased impervious areas using appropriate BMPs
Will	100yr: 0.15 cfs/ac 2yr: 0.04 cfs/ac	Retention of 0.75" over the impervious area required when agricultural property downstream	Storage facilities shall include BMPs, any BMPs required by Clean Water Act shall be included, special retention requirement for downstream agricultural properties

Table 1: Current Countywide Stormwater Management Regulations

Other levels of government also play a role in stormwater management. On the state level, the Illinois Department of Natural Resources (IDNR) and Illinois Environmental Protection Agency (IEPA) both play significant parts. The IDNR Office of Water Resources (OWR) is the regulatory agency for any construction that occurs floodway of waterways in the State of Illinois. The agency also oversees all floodplain management, water resources planning and the National Flood Insurance Program. The IEPA is the lead agency in Illinois charged with protecting the quality of surface water and ground water. (Office of Water Resources) On the national level the USEPA is responsible for setting policies to guide the states in implementing the Clean Water Act. The US Army Corps of Engineers is the regulatory agency for all navigable waters and surrounding areas within the United States. One of the important areas the Army Corps has jurisdiction over is wetlands, although USEPA also plays a role in this.

Impacts of Stormwater Management

Stormwater management ordinances that have been adopted by counties have been effective at controlling the rate of stormwater runoff, even as the construction of impervious surfaces is constantly creating larger and larger volumes of stormwater runoff. The ordinances in place now generally reduce the peak flow rate from a developed site, but have a more limited impact on the total volume of runoff.

The common method for transporting stormwater is routing it through storm sewers and eventually out to a receiving body of water. Under this scenario, stormwater is not easily able to infiltrate through soil and recharge aquifers, which may lead to lower groundwater levels. The stormwater will also travel faster through the smoother surfaces of the storm sewers than compared to stormwater traveling over natural surfaces. As mentioned previously, urban stormwater runoff is known to contain high amounts of pollutants. These factors combine and

may result in stream degradation and damage the ecosystem. A publication recently released by the USEPA entitled *Urban Stormwater Management in the United States* as part of the National Pollutant Discharge Elimination System (NPDES) addressed these specific issues. The publication discusses the current state of urban stormwater runoff and the affects on downstream bodies of water. The committee states “the creation of impervious surfaces that accompanies urbanization profoundly affects how water moves both above and below ground during and following storm events, the quality of that stormwater, and the ultimate condition of nearby rivers, lakes, and estuaries” (Committee on Reducing Stormwater Discharge Contributions to Water Pollution).

Strategies to Consider for Further Implementation

Although the current means of stormwater management have been successful, there are a number of strategies that can improve water quality and further reduce runoff volume. These strategies are detailed below. Their advantages are identified as well as any drawbacks or limitations.

Impervious Surface Limitation

The increase in urbanization brings with it additional impervious surfaces. Parking lots, sidewalks, rooftops and roadways are all examples of the impervious surfaces that are common in developed areas. These surfaces have limited infiltration capacity, causing all the precipitation on the surface to become runoff. As discussed earlier the water quality of stormwater runoff is very poor, especially in highly urbanized areas.

There are a number of ways to reduce the impervious area on site. Many of these specific techniques are discussed in the following sections of the paper. The effectiveness of these techniques are site specific and depend on a number of factors such as underlying soil type, local groundwater levels, rainfall intensity and current soil moisture.

Green Infrastructure

Green infrastructure can be used to describe a number of different practices. It can refer to site specific Best Management Practices (BMPs) that have environmentally friendly impacts. Green infrastructure can also refer to connecting open areas for wildlife to travel and to effectively convey runoff, as in the Green Infrastructure Vision. The following sections focus on types of Green Infrastructure BMPs and their effectiveness and any concerns regarding their implementation.

Permeable Pavements and Surfaces

Pervious concrete and asphalt can be used as an alternative to traditional methods. Pervious pavement and concrete are very similar to the traditional variety in their composition except they have more void space to allow the water to infiltrate. (Illinois Urban Manual: Practice Standard Permeable Pavement, 1999) Another alternative for replacing traditional pavement and

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concrete, are precast concrete blocks and plastic grids. The concrete blocks or pavers are placed above layers of porous materials like sand and gravel. The pavers are laid so there are gaps to further allow infiltration. The plastic grid can be laid over an already pervious material like grass and help provide structural support for driving and parking. All of these techniques increase the infiltration capacity of the surface.

The actual reduction in stormwater runoff depends on a number of factors including rainfall intensity and underlying soil conditions. Using traditional runoff calculations the average reduction in runoff volume can be estimated at 75%. Site specific calculations should be completed to properly quantify the potential reduction in stormwater volume. It is also worth noting that permeable pavements tend to perform best during low intensity storm events and may not have high reduction rates for large storm events.

There are a few drawbacks to using the pervious surfaces mentioned above. First, the current permeable mixtures do not always have the same structural capacity as the traditional variety. Pervious surfaces may be used for low traffic streets, sidewalks, driveways and parking lots but not loading docks, major highways or high traffic streets. The precast blocks or pavers may also work very well for driveways or sidewalks, especially because they are available in a variety of styles and shapes. However, if pervious materials are used for sidewalks or other pedestrian facilities, special consideration must be given to ensure that accessibility for the disabled is maintained. A plastic grid system is useful for temporary drives or emergency access drives. These applications all have their benefits but cannot supplant traditional paving materials used for high traffic streets and highways.

There are a few maintenance issues associated with permeable pavements that are unique to the permeable surfaces. The material located in the voids may be washed away over time and need to be replaced. An example of maintenance is the reapplication of sand or other permeable materials to the void space in the permeable pavers. That being said, impermeable surfaces also require regular maintenance such as repaving and resurfacing.

The City of Chicago began its Green Alley Program in the summer of 2006 by installing permeable pavements in five alleys that were in need of repair. The alleys were re-graded so that the stormwater would properly drain into the sewer system. Other green improvements were made to the lighting and the color of the surface. The older street lights were replaced with “dark sky” street lamps which project the light directly to street level, only projecting light to the alley. Lighter colored surfaces reflect more sunlight back to the atmosphere, thereby lowering the temperature of the surface. Stormwater volume has been decreased through the program. Figure 4 are images of before the green alley was installed and after. In this case the alley is not only more aesthetically pleasing it also has green benefits.



Figure 4: Green Alley Before and After (Chicago Department of Transportation)

Green Roofs

A green roof is a roof either above, below or at grade that is commonly covered with a carpet of plants. There are three different types of green roofs, intensive, extensive and semi-intensive. The main difference between the three types is the weight of the fully saturated media. For example an intensive roof is one that has more than 6" of growing medium depth and has a fully saturated weight of 50-300 lb/square foot. An extensive roof on the other hand has 6" or less of growing medium and only has a saturated weight of 10-35 lb/square foot. The type of surface chosen really depends on a few factors like the structural capacity of the roof and the available funds for the project (Peck and Bruce, 2007).

There are a number of layers involved in the green roof under the vegetation. These include the growing medium, drainage layer, roof barrier, insulation, root barrier, roofing membrane and structural support. Figure 5 is a cross section of a typical green roof. The exact configuration of a green roof will vary depending on the site specific conditions and the type of roof chosen.

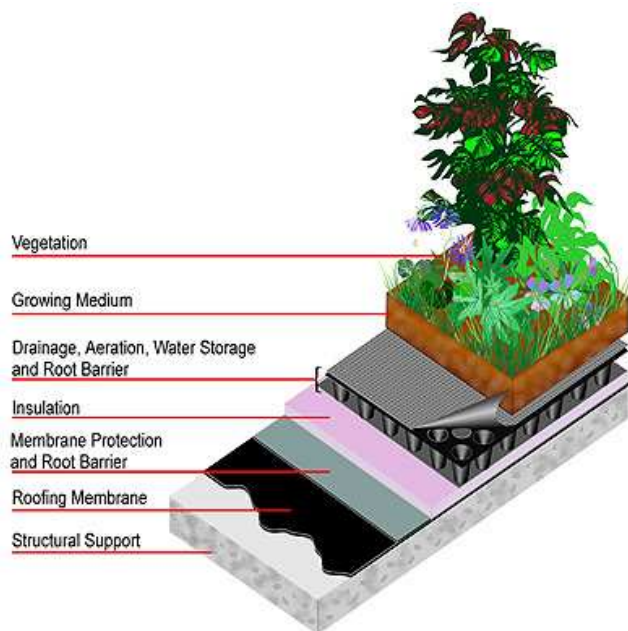


Figure 5: Green Roof Cross Section (American Wick Drain Corp.)

Green roofs help to decrease stormwater runoff volume as well as increase the quality of the water. Rain will fall on the roofs and the plants will absorb the water and either transpire back to the atmosphere or release the water at a much slower rate than if it had been a regular roof. A drainage system needs to be in place to allow the water that percolates through the green roof to be released off of the roof. The water that is released will have high water quality because not only is it rain water, it has also gone through the roof's plant system which helps to filter the water.

There are a few things to keep in mind when constructing a green roof. One that has already been mentioned is the structural capacity of the roof. Installing a green roof to the surface of an existing roof will add loading to the structure below. The majority of the loading will be "dead loading" due to the actual weight of the roof but it is also important to remember the live loads that will occur when installing the roof and performing maintenance. It is recommended that an analysis be preformed to determine exactly how much the existing structure can handle. Another important aspect to remember is insuring the integrity of your building by properly waterproofing the roof. This step will require contacting a roofer with green roof experience.

The intensity of a rainfall event will have an impact on the amount of water the green roof is able to collect. A low intensity storm event will allow the soil to absorb the precipitation and release it at a slower rate. The trouble arises during high intensity storm events when the roof cannot accommodate the precipitation. In this case, it is important to design the roof to carry the excess water safely off the roof.

Rain Barrels

Rain barrels collect rainwater so the water can be reused for watering or other landscaping purposes. There are a number of organizations that provide rain barrels at a discounted price. MWRDGC has a program that supplies each resident of Cook County 2 rain barrels for \$40 each. The benefit of rain barrels is that they hold water that would otherwise become

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stormwater runoff and allow it to be used later. When this water is later used, it will more than likely be infiltrated into the then dry soil or be transpired through the plant into the atmosphere.

A typical rain barrel is approximately 55 gallons which is approximately 7.35 ft³ of water. For a 1000 square foot regular roof during a 1" storm event, approximately 9.5 rain barrels would be necessary to collect all of the runoff. Although rain barrels do not make a significant impact during large storm events, they can greatly reduce the runoff from small seasonal events. They must be drained during the winter months, to prevent damage due to freezing. A typical rain barrel configuration can be seen in Figure 6.

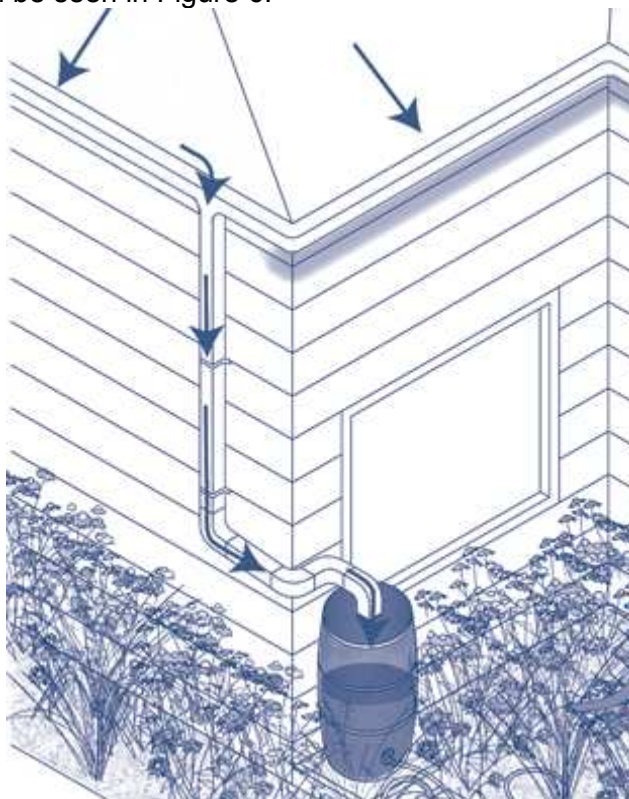


Figure 6: Rain Barrel (City of Chicago Department of Water Management)

Rain Cisterns are typically larger than the average rain barrel. They are available in a number of different sizes and shapes. At Chicago's Center for Green Technology there are four 3,000 gallon cisterns used to collect the rainwater and reuse it for landscaping purposes. The same concerns apply for cisterns as rain barrels. They also should be properly drained during the winter season.

Rain Gardens

Rain gardens are areas created in naturally wet areas to help slow runoff and increase infiltration. They are usually planned in areas where water naturally flows or is forced to flow. Examples of locations would be at the downgrade of a downspout or a parking lot. Rain gardens can be a great way to reduce stormwater volume and improve the water quality. Rain gardens are typically constructed from natural plants that have deeper root systems to absorb the water and filter the pollutants. Pollutants that are commonly found on surfaces before a rain storm are called first flush pollutants. Rain gardens are especially effective at removing these pollutants.

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The Center for Neighborhood Technology (CNT) partnered with the Village of Bellwood to demonstrate the positive affects of a rain garden. Over 40% of the village is in the floodplain of Addison Creek, which leads to shallow flooding throughout much of the area during large storm events. The village is also on a combined sewer system and therefore experiences a high amount of CSO events. The ultimate goal of the test site is to show residents that they can disconnect their downspout from their sump pump and avoid ponding in their yard. Rain gardens were constructed at the Bellwood Water Department to absorb runoff from an adjacent roof. One rain garden was planted with native plant species, while the other one was typical turf. A monitoring system was installed and a firm was hired to collect and analyze data obtained from the test sites. The data is still being obtained and analyzed. Figure 7 shows both of the test sites, the plot on the left has natural plantings and the one of the right has turf grass. (Center for Neighborhood Technology) A similar study preformed in Connecticut found that 98.8% of runoff was infiltrated through the rain garden over the 56 week observation period (Dietz and Clausen). It is important to reemphasize that the effectiveness of a particular BMP is dependent on a number of site specific factors, such as soil conditions and site design.



Figure 7: Village of Bellwood Rain Gardens (CNT)

The US Fish and Wildlife has recognized the importance of rain gardens and has awarded the State of Illinois \$10,000 annually since 2005. These funds have been conferred in \$500 grants to community organizations and schools to build rain gardens. This program is called the [Rain Garden Initiative](#).

Volume Control Regulations

A number of SMPs have implemented some kind of volume control regulations, as can be seen in Table 1. An example of a volume control regulation is one that requires that a specified volume of water be kept and infiltrated on site. Infiltration is the process by which water is absorbed into soil. The water is then taken up by plants or percolates through the soil and becomes groundwater. Infiltration is a natural mechanism by which water travels which

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improves water quality and recharges aquifers. As discussed earlier, impervious surfaces limit the amount of infiltration that can take place. Current technologies may limit a site from being completely free of impervious surface, but BMPs can be utilized to maximize infiltration.

The first inch of runoff is commonly referred to as the first flush due to the high amount of pollutants it typically contains. Using a traditional runoff calculation analysis, one inch of runoff from a paved surface corresponds to approximately 1.21 inches of rainfall. This analysis is based on the amount of rainfall and the land cover.

In the Draft Cook County Watershed Management Ordinance, properties which develop over 5,000 square feet of impervious area are required to capture and retain an inch of runoff. This can be achieved through the use of volume control practices. Examples of these practices may be the green technologies described earlier or through traditional infiltration practices such as trenches or retention ponds. The ordinance does allow for a fee in lieu of program for sites where it may not be practical to implement volume control practices.

Stronger volume control ordinances like the one proposed for Cook County could have a dramatic effect on the quality and quantity of stormwater runoff. One inch of runoff over a 5,000 square foot parking lot relates to approximately 3,116 gallons.

Redevelopment

Redevelopment and infill offer opportunities to decrease the amount of impervious surfaces on an existing site. These lots can often be unused parking lots or abandoned buildings. Some of the sites may also pose health and environmental hazards if they are left in their current state, these are typically called brownfields. According to the Brownfield Redevelopment Strategy, there are potentially 8,195 sites throughout the region, although not all of these have been formally designated in brownfields. Brownfields in particular offer opportunities to reduce stormwater volume and improve quality by increasing the amount of green space on the site.

Teardowns provide unique challenges in stormwater management. A teardown is described as “one-to-one replacements of housing stock,” by the Teardowns Strategy Report. Typically teardowns are much larger than the house they replace creating more impervious area on site. Since these lots are typically less than an acre, it is impractical to require land consuming stormwater management practices. The [Teardown Strategy Report](#) lists a number of recommendations for stormwater ordinances. These include maximum percent impervious on lots, strict setback requirements, maximum yard slopes, restrictions on topography alteration, site plan submittal requirements and maintenance of adequate overflow routes. These suggestions would increase the permeable area on site and reduce off site flooding.

DuPage County has updated its Stormwater Ordinance to encourage redevelopment in downtown areas by defining Stormwater Economic Development Zones (SERZ), which contain sites greater than one acre and which have existing impervious area over 80% of the site. The SERZ requires that the two-year detention requirements are met. This means that the post development release rate will be less than 0.04 cfs/acre half of the time. This ordinance tends to encourage redevelopment because a larger portion of a property can be built on rather than being set aside to meet the 100 year detention requirements. (Stormwater Management Division)

Conservation Design

Conservation design is an approach to development that first looks at the natural landscape and ecology of a development site. The preservation of the natural features of a site is the priority of the design. Many conservation design developments have smaller lot sizes in order to preserve a larger amount of open space or wooded area. This open area is shared area for the entire development. The open space can be used for recreational purposes, kept in a natural state (or actively restored), or can be used for other purposes such as an organic farm.

An example of a successful local conservation design development is [Prairie Crossing](#) located in Grayslake. Prairie Crossings is a development consisting of single family homes, condominiums, charter school, organic farm, Metra train station and a recreational lake. Over 60% of the development is shared open land. Figure 8 is the site plan for Prairie Crossings.



Figure 8: Site Plan for Prairie Crossing (Prairie Crossing)

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The stormwater benefits of conservation design are drawn from the decrease in impervious surfaces. By clustering lots and limiting the impervious areas to one area, stormwater runoff is allowed to travel to the receiving body of water through the natural open spaces and riparian areas. The natural landscaping of the open areas generally have deeper root systems, which minimize erosion and increase water quality. The naturalized system is also expected to help reduce utility costs of storm sewer infrastructure. The benefits of conservation design are further described in the [Conservation Design Strategy Paper](#).

Compact development

Compact development is in some respects related to redevelopment. In recent years the USEPA has begun to promote compact development as a means of protecting water resources, referencing ten principles:

1. Create a range of housing opportunities and choices
2. Create walkable neighborhoods
3. Encourage community and stakeholder collaboration
4. Foster distinctive, attractive places with a strong sense of place
5. Make development decisions predictable, fair, and cost effective
6. Mix land use
7. Preserve open space, farmland, natural beauty, and critical environmental areas
8. Provide a variety of transportation choices of smart growth
9. Strengthen and direct development toward existing communities
10. Take advantage of compact building design

These principles all have an effect on stormwater management. The USEPA states that smart growth can decrease the amount of impervious surfaces, improve stormwater detention, protect environmentally sensitive areas, increase transit accessibility, and promote pedestrian and bicycle transportation. Smart growth also encourages growth in areas where urban development has already taken place. This protects unimpaired streams that have not yet experienced urbanization. The USEPA also states that smart growth can protect water quality through compact development and open space preservation. More information can be found on the USEPA's [Smart Growth](#) website (Smart Growth).

Stormwater Utility

The idea behind a stormwater utility is that stormwater management is like other public services, such as wastewater and electricity, which are priced based on use. In a stormwater utility, fees are collected from residents and businesses and used for water resource improvement projects and for implementing BMPs on a local level. Sometimes the fees are used to keep up with the costs of replacing and repairing aging stormwater infrastructure. Typically programs assess a fee based on the amount of impervious area on a site.

Since a fee is charged on the basis of use, it is not a tax and therefore tax exempt land owners are still held responsible. Stormwater utility fees were contested by a group of twelve churches in the Rock Island, Illinois area. Case No. 3-04-0480 of the Illinois Appellate Court dealt with this

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particular issue. The court found that under Illinois law the stormwater utility was in fact a fee, not a tax. This case has allowed other municipalities in Illinois to develop their own ordinances and collect fees from tax exempt land owners.

The city of Bloomington, Illinois implemented a stormwater utility plan that charges fees to single family homes based on the total overall size of the lot. The City divided homes into three categories: small, medium and large. The owners were then assigned a fee based on the assigned category. Industrial, commercial, multifamily dwellings and government areas are charged in Impervious Area Units (IAU), where 1 IAU is equal to 1,000 square feet of impervious area. The fees have been used to educate the public, implement controls on stormwater runoff during construction, investigate illicit discharges and increase street sweeping. So far the utility has been successful and has been fairly well received (City of Bloomington).

The town of Fishers, Indiana also has a stormwater fee in place. The fee was implemented to cover the costs to develop a stormwater management plan and to manage the stormwater ordinance currently in place. The program is based on Equivalent Runoff Units (ERUs). An ERU is approximately equal to 3,318 square feet, which is the average amount of impervious area on a residential lot in Fishers. All residential properties are charged 1 ERU a month. Other properties are charged based the number of ERUs on site. The current rate in Fishers is \$4.95 per ERU (Town of Fishers: Stormwater Fees). Overall, since the program has been implemented, it has been well-received. There was a general resistance to another bill but the town preceded the bill with a letter explaining why the fees were necessary and where the money would go. The fee is billed quarterly to help distribute the costs over the year.

DuPage County has extensively looked at implementing such a program. The main problem the County encountered is that the properties with the largest impervious areas are schools, churches, and government owned buildings. As mentioned before, these properties would still be subject to the fee. According to the [School Siting Strategy Paper](#), schools are being built on larger sites and farther away from the students. This is creating a number of traffic and stormwater issues. The paper suggests that minimum acreage requirements be reduced for schools therefore reducing the schools footprint and amount of impervious area.

Another worthwhile note is that within the state of Illinois, a non-home rule local government wishing to implement a stormwater fee would have to pass a state statute to do so. Depending on the structure of the organization a referendum may need to be proposed to the public in order to get the fee passed.

Stormwater utility fees can provide funding for infrastructure updates and if necessary replacements. The fees can also fund special projects like stream bank restorations and the implementation of BMPs.

Education

Education should be the cornerstone of a good stormwater management plan. In order to reduce nonpoint source pollution, the public has to be aware of the problem and know what they can to do help.

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When public agencies cannot provide a public education program, private conservation organizations can help. For many years, organizations throughout the area have provided education and outreach opportunities. An example of one such organization is the [Upper Des Plaines River Ecosystem Partnership](#). This partnership is one that consists of local organizations, scientists, outdoor enthusiasts and local leaders. The group publishes a newsletter entitled “River Talk.” The newsletter typically highlights events sponsored by the partnership and provides information on watershed friendly activities. Some of the events the partnership hosts are Brownbag Briefings and It’s Our River Day. The Brownbag Briefings cover topics such as “Road Salt and Water Quality” and “Easements on Public and Private Property.” “[It’s Our River Day](#)” is a statewide event that recruits volunteers to help clean up their local rivers. The partnership supports this effort by gathering people together and organizing events within the Upper Des Plaines River watershed.

Conclusion

Strong stormwater management policies can protect one of our most important natural resources. The reduction of impervious surfaces can increase groundwater recharge and water quality. New strategies such as stormwater utilities can help fund much needed infrastructure repair and stormwater management projects. Conservation design and smart growth make open space and natural resource preservation a design priority rather than an afterthought. The recommended strategies in this paper can help strengthen the existing successful stormwater management ordinances.

Definitions

The definitions are provided by United States Geological Survey (USGS).

Evaporation: The process by which water is changed from the liquid or the solid state into the vapor state. In hydrology, evaporation is vaporization that takes place at a temperature below the boiling point.

Hydrograph: A graph showing stage, flow, velocity, or other property of water with respect to time.

Infiltration: The flow of a fluid into a substance through pores or small openings. It connotes flow into a substance in contradistinction to the word percolation, which connotes flow through a porous substance.

Transpiration: The process by which water is changed from the liquid or the solid state into the vapor state. In hydrology, evaporation is vaporization that takes place at a temperature below the boiling point.

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