College Street Stormwater Basin

Stormwater Opportunities Toolkit

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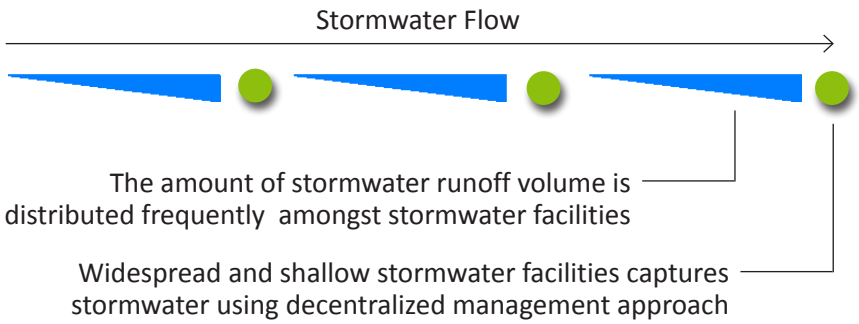
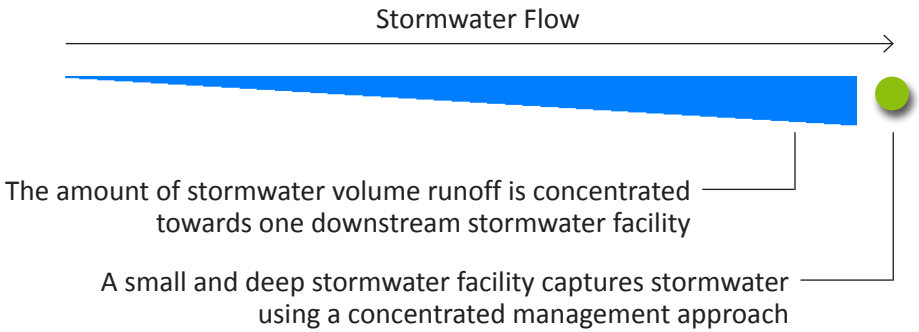
Stormwater Approach

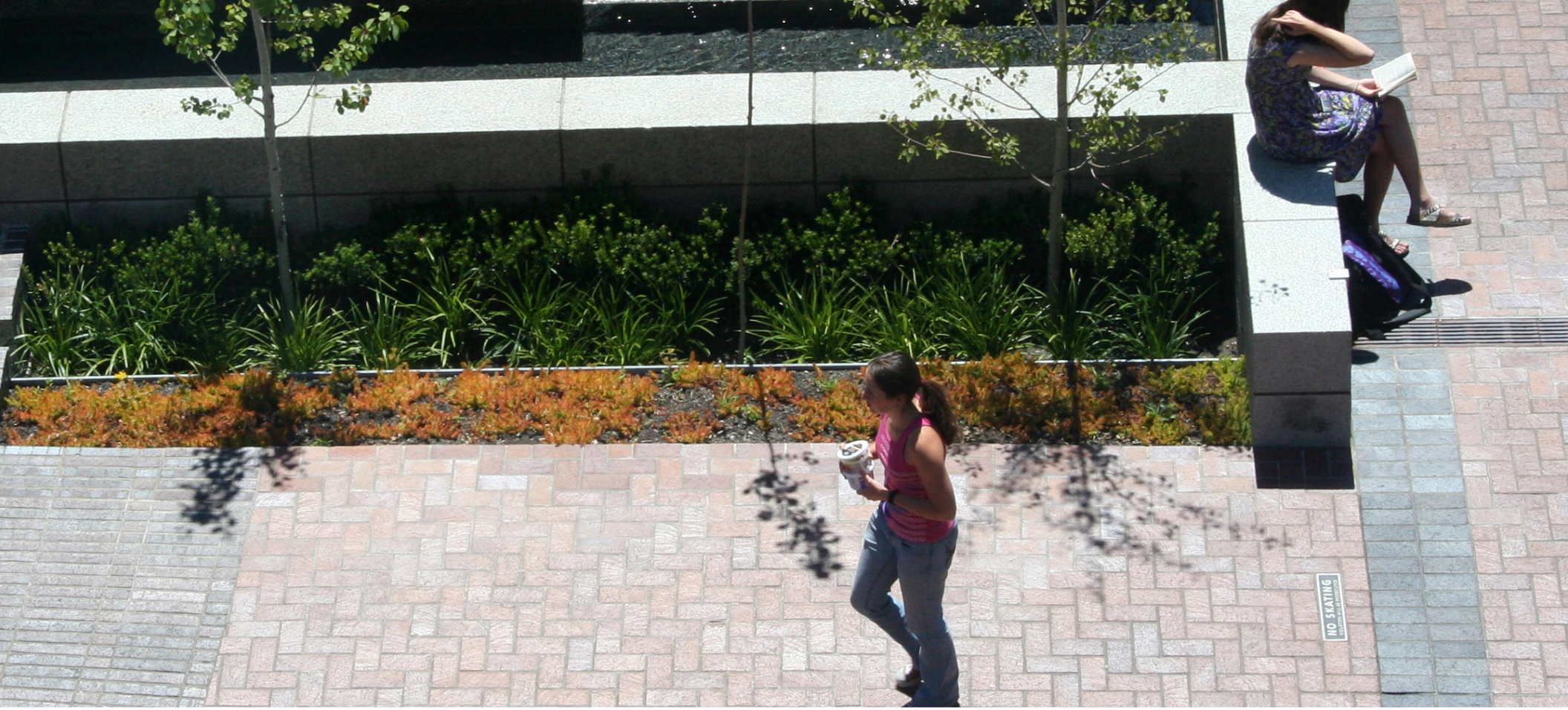
The overall approach to manage stormwater runoff within the College Street Drainage Basin is a rather simple one of creating a decentralized, shallow, and widespread stormwater system used to capture, slow, cleanse, and infiltrate runoff. In the past, stormwater runoff in ultra-urban conditions has been managed in a opposite way by concentrating a lot of runoff, flow, and pollutant loads to small and deep stormwater facilities (most likely in the form of planters or curb extensions sited near existing inlets). Though this approach does work in some situations, it limits the choice of plant material, creates awkward pedestrian conflicts, and can often be aesthetically unattractive. The decentralized approach for downtown Burlington suggests spreading shallow stormwater facilities along the entire streetscape frontage as much as possible thereby capturing runoff before it becomes too concentrated and heavy in volume. In addition, the approach would allow for much greater plant diversity and integration with other streetscape amenities. For example, the High Line Park project in New York City (shown to the left of the opposite page) uses a shallow, widespread, and decentralized approach to stormwater management. In contrast, the example shown in Portland illustrates a concentrated and deep stormwater curb extension located at the bottom of the street's catchment that is not well integrated with the pedestrian zone.

Decentralized Natural Capture Approach



Concentrated Capture Approach





The Stormwater Management Opportunities Toolkit

Based on Burlington's College Street Drainage Basin existing conditions, site constraints, and the latest streetscape design thought, we have identified 16 different design opportunities that could potentially be employed throughout the project area. The 16 opportunities listed on the following pages are separated into three specific sub-groups based on their stormwater management style and location: Impervious Area Reduction/Site Improvements, At-grade Stormwater Facilities, and Above-Ground Runoff Capture and Management. It is envisioned that many of these opportunities will be used as a combined effort to develop an overall stormwater management goal and/or design theme. Many of the opportunities have been successfully designed and built and can be modified to fit the vernacular of downtown Burlington. Some opportunities are new ideas that have yet to be built, but would have very good applicability to the overall downtown area.

Impervious Area Reduction/Site Improvements

1. Conventional Landscaping with Pedestrian Paths at Sidewalk Zones

At-Grade Capture Stormwater Facilities

2. Stormwater Curb Extensions (Parallel Parking)
3. Stormwater Curb Extensions (Diagonal Parking)
4. Rain Garden (Urban Context)
5. Rain Garden (Landscape Context)
6. Stormwater Planter (Without On-Street Parking)
7. Stormwater Planter (With On-Street Parking)
8. Stormwater Planters (Parking Lot Condition)
9. Stormwater Swale (Parking Lot Condition)
10. Stormwater Planters (Along Pathways)
11. Stormwater Planters (Terraced)
12. Green Gutter (Along Street)
13. Green Gutter (Along Pathways)
14. Green Infiltration Joints/Pervious Paving

Above-Ground Capture and Management

15. Stormwater Planter (On Top of Parking Structure)
16. Rooftop Stormwater Canopies Directing Water to Landscape

1
STRATEGY

Conventional Landscaping with Pedestrian Paths at Sidewalk Zones

Enhancing conventional landscaping and pedestrian circulation along the street frontage has a lot of benefits and is a commonly undervalued approach to stormwater management. Many downtown streets are often paved from the building zone to the curb zone with little or no ground plane landscaping. From a stormwater perspective, every square foot of new conventional landscape space is essentially removing the same amount of impervious area off the stormwater collection system. Many cities, such as Chicago, New York, and Washington D.C. have made a conscious effort to introduce more landscaping to the streetscape in order to redefine the character of downtown streets and enhances the pedestrian experience. The photo to the right shows a downtown street in Nashville not only functioning as a vibrant streetscape, but also reduces the impervious area of the sidewalk zone significantly.

Range of Cost: $10 to $20/Square Foot

$0/SF ▲ $100/SF

Ability to Avoid Underground Utilities:

Low Med ▲ High

Use with Poor Soil Conditions:

Low Med ▲ High

Ability to Green the Overall Streetscape:

Low Med ▲ High

Opportunities:

- Helps provide landscape areas as well as defined zones for pedestrian circulation
- Offers a low-tech, landscape approach to impervious surface removal
- Can be placed over most utilities
- Reduces or eliminates soil erosion

Constraints:

- Little or no stormwater retention depth
- May not be considered, from a policy, funding, and maintenance perspective, a viable stormwater management solution

Existing Condition

2

STRATEGY

Stormwater Curb Extensions (Parallel Parking)

There are many instances along streets within the College Street Drainage Basin where the parking zones could be reconfigured to allow for stormwater curb extensions. These types of stormwater facilities replace either existing parking spaces or areas within the parking zone striped as “no parking” with a landscape system that captures stormwater runoff. The example above shows the existing street condition with parallel parking along College Street and the sketch to the right depicts a parking zone with a stormwater curb extension inserted.

Range of Cost: $25 to $30/Square Foot

$0/SF ▲ $100/SF

Ability to Avoid Underground Utilities:

Low Med High

Use with Poor Soil Conditions:

Low Med High

Ability to Green the Overall Streetscape:

Low Med ▲ High

Opportunities:

- Can significantly "green" a street with minimal investment.
- Can be inexpensive to build
- Can act as a "backstop" to capture stormwater flow on steep streets
- Can narrow portions of a street and provide traffic calming benefits
- Allows for ease of pedestrian access to parking meters

Constraints:

- Generally requires the removal of on-street parking
- Can sometimes conflict with bike travel if adequate space is not allowed between edge of curb extension and a street's travel lane

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STRATEGY

Stormwater Curb Extensions (Angled Parking)

Pine Street offers a unique opportunity to convert the existing parallel parking spaces on one side of the street into 45 degree angled parking. This can be done because Pine Street has a rather wide curb-to-curb distance. Within the newly created angled parking zone, intermittent stormwater curb extensions can be inserted. The photo to the right shows a downtown street with angled stormwater curb extensions.

Example

Range of Cost: $25 to $60/Square Foot

$0/SF ▲ $100/SF

Ability to Avoid Underground Utilities:

Low Med High

Use with Poor Soil Conditions:

Low Med High

Ability to Green the Overall Streetscape:

Low Med ▲ High

Opportunities:

- Can significantly "green" a street with minimal investment.
- Can act as a "backstop" to capture stormwater flow on steep streets
- Can narrow portions of a street and provide traffic calming benefits
- Maximizes available space in dense urban streescape for stormwater management
- Range of treatment capabilities depending on site conditions

Constraints:

- Generally requires the removal of on-street parking
- Can sometimes conflict with bike travel if adequate space is not allowed between edge of curb extension and a street's travel lane
- Can become complicated depending on if there are substantial existing utilities in the green belt

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STRATEGY

Rain Garden (Urban Context)

The existing grassy area shown above is an excellent opportunity to create a large public plaza space and urban rain garden at the intersection of College and Battery Street. Located at the low point of the overall study area, a terraced rain garden at this location could potentially redirect stormwater from the existing storm drainage system into the landscape area. The rain garden and associated plaza could be a well-designed showcase of environmental sustainability at a prominent public location. In addition, since there is significant grade change at this location, this provides the opportunity for people to “watch the water” move from terrace to terrace in an artful way. The photo to the right illustrates an example of a rain garden and adjacent public plaza space.

Range of Cost: $25 to $60/Square Foot

$0/SF ▲ $100/SF

Ability to Avoid Underground Utilities:

Low Med High

Use with Poor Soil Conditions:

Low Med High

Ability to Green the Overall Streetscape:

Low Med ▲ High

Opportunities:

- Opportunity to create an urban plaza with a strong landscape component
- Can accept stormwater overflow from upstream storm pipe infrastructure
- Can provide the greatest stormwater flow and volume
- Offers versatility in shape

Constraints:

- Often more maintenance required because of the rain garden's large size
- Can be more expensive to build depending on their context and materials used

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STRATEGY

Rain Garden (Landscaped Context)

The existing grass depression at the front of the People's Bank along Pine Street offers a unique opportunity to create a tranquil rain garden space that could potentially accept stormwater runoff from the building rooftop and upper portion of the watershed if it could be routed to this spot. Not only could this rain garden space provide stormwater management benefits, but it could also be an area for passive seating for building employees as demonstrated by the photo to the right.

Range of Cost: $25 to $50/Square Foot

$0/SF ▲ $100/SF

Ability to Avoid Underground Utilities:

Low Med High

Use with Poor Soil Conditions:

Low Med High

Ability to Green the Overall Streetscape:

Low ▲ Med High

Opportunities:

- Can manage stormwater runoff from building rooftops and stormwater canopies as well as general site area
- Can provide significant stormwater flow and volume benefit
- Offers versatility in shape

Constraints:

- Often more maintenance required because of the rain garden's large size
- Can be more expensive to build depending on the scale and materials used

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STRATEGY

Stormwater Planters (Without On-Street Parking)

There are several sites within the watershed where space is limited to manage stormwater within the street, which offers an opportunity to retrofit the existing greenbelt with stormwater planters and/or vegetated swales. These opportunities are especially prevalent along Battery Street. Intermittent stormwater planters can be inserted into the existing landscape areas to accept street runoff without compromising existing trees.

Range of Cost: $25 to $50/Square Foot

Ability to Avoid Underground Utilities:

Use with Poor Soil Conditions:

Ability to Green the Overall Streetscape:

Opportunities:

- Can fit between other streetscape/ parking lot elements (trees, utilities, signage, etc.) and are highly versatile in shape and size
- Can provide both volume and flow stormwater benefits

Constraints:

- Are generally more expensive due to increased hardscape infrastructure
- Need to provide for adequate pedestrian circulation
- Will need to accommodate street trees and utilities

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STRATEGY

Stormwater Planters (With On-Street Parking)

Where space exists between the street curb and the building face, stormwater planters can be inserted and accommodate on-street parking. There would need to be adequate space for a decent sidewalk zone, stormwater planting, and a pedestrian egress zone along the street edge for people to be able to access their vehicles and the sidewalk. A built example of this stormwater strategy is shown to the right.

Range of Cost: $25 to $50/Square Foot

$0/SF ▲ $100/SF

Ability to Avoid Underground Utilities:

Low Med High

Use with Poor Soil Conditions:

Low Med High

Ability to Green the Overall Streetscape:

Low Med High

Opportunities:

- Can fit between other streetscape/ parking lot elements (trees, utilities, signage, etc.) and are highly versatile in shape and size
- Can provide both volume and flow stormwater benefits
- On-street parking is retained

Constraints:

- Are generally more expensive due to increased hardscape infrastructure
- Need to provide for adequate pedestrian circulation

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STRATEGY

Stormwater Planters (Parking Lot Condition)

In areas of oversized parking spaces and inefficient use of landscape areas, stormwater planters can be inserted to capture runoff. The example above shows an existing condition on the back side of ??? church with both oversized parking spaces and under-performing landscape area. This zone can easily be converted into a stormwater planter as illustrated by example to the right.

Range of Cost: $25 to $50/Square Foot

$0/SF ▲ $100/SF

Ability to Avoid Underground Utilities:

Low Med High

Use with Poor Soil Conditions:

Low Med High

Ability to Green the Overall Streetscape:

Low Med ▲ High

Opportunities:

- Can fit between other streetscape/ parking lot elements (trees, utilities, signage, etc.) and are highly versatile in shape and size
- Can provide both volume and flow stormwater benefits

Constraints:

- Are generally more expensive due to increased hardscape infrastructure
- Need to provide for adequate pedestrian circulation

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STRATEGY

Stormwater Swale (Parking Lot Condition)

Oversized parking stalls, as illustrated in the existing condition above, can be redesigned to convert the excess space into a stormwater swale place at the front of the parking stalls. Alternatively, the existing landscape space shown above could also be regraded and planted to accommodate runoff. Given the two alternatives, placing the stormwater swale within the existing excess space offers the best scenario because it helps reduce overall impervious area and it provides more space for stormwater management and space separation against the existing retaining wall.

Range of Cost: $20 to $30/Square Foot

$0/SF — $100/SF

Ability to Avoid Underground Utilities:

Low — Med — High

Use with Poor Soil Conditions:

Low — Med — High

Ability to Green the Overall Streetscape:

Low — Med — ▲ High

Opportunities:

- Swales are a widely-accepted stormwater strategy
- Swales often require less infrastructure to build and as a result are simple to construct and relatively low cost to implement

Constraints:

- Swales need long, continuous spaces which can be difficult to find in retrofit conditions
- Swales are often designed to be “too deep” and, as a result, are not aesthetically pleasing
- Need to provide for adequate pedestrian circulation

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STRATEGY

Stormwater Planters (Along Pathways)

If there is a desire to manage both pathway runoff and adjacent parking structure/building runoff within the existing landscape areas shown above, a series of stormwater planters might be the best choice because they can be built to retain more stormwater than a swale or green gutter system might offer. Stormwater planters could be placed on both sides of the pathway or simply on one side and water directed to it. The photo to the right actually shows an example of a stormwater planter next to a parking garage and pedestrian pathway.

Example

Range of Cost: $25 to $50/Square Foot

$0/SF ▲ $100/SF

Ability to Avoid Underground Utilities:

Low Med ▲ High

Use with Poor Soil Conditions:

Low Med High

Ability to Green the Overall Streetscape:

Low Med ▲ High

Opportunities:

- Can capture runoff from both parking structures and building rooftops
- Can be placed over most types of utilities if they are designed to be shallow
- Can retain water volumes in a small area of space

Constraints:

- More expensive to build because the terracing requires more hardscape material

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STRATEGY

Stormwater Planters (Terraced)

In areas of steep grade, stormwater planters can be placed and terraced to capture stormwater, slow down flow, and minimize erosion. These planters can be made of a variety of material, however metal is a top choice because it offers a very thin profile for saving space. Terraced planters, depending on how extensively used in the existing condition above, can accept stormwater from the new pathway, but also from the downspouts of the parking garages. The photo example to the right shows a terraced stormwater planter system accepting water from an adjacent roof downspout in Portland, Oregon.

Range of Cost: $40 to $60/Square Foot

$0/SF ▲ $100/SF

Ability to Avoid Underground Utilities:

Low Med ▲ High

Use with Poor Soil Conditions:

Low Med High

Ability to Green the Overall Streetscape:

Low Med ▲ High

Opportunities:

- Can capture runoff from parking structures and building rooftops
- Can be placed over most types of utilities
- Can be made of a variety of materials such as metal as concrete
- Can retain water volumes in a small area of space

Constraints:

- More expensive to build because the terracing requires more hardscape material

Existing Condition

12
STRATEGY

Green Gutter (Along Street)

Along many streets that only have parking on one side of the street, there is often an opportunity to integrate a narrow landscape strip, called a green gutter along the vehicular travel lane. The existing photo shown above along Bank Street shows the potential to consolidate space between the existing landscape strip and vehicular travel lane where there is no parking allow on that side of the street. A 2-3 foot wide green gutter system to capture half of the street's runoff and would be placed intermittently between existing driveway access areas. The photo to the right illustrates a narrow green gutter next to an existing landscaped space. One can also detect the check dams placed within the landscape area to slow water as it moves down the steep grade of the street.

Range of Cost: $25 to $50/Square Foot

$0/SF ▲ $100/SF

Ability to Avoid Underground Utilities:

Low Med ▲ High

Use with Poor Soil Conditions:

Low Med High

Ability to Green the Overall Streetscape:

Low Med ▲ High

Opportunities:

- Can be placed over most types of utilities if they are designed to be shallow
- Helps further separate pedestrians and vehicles

Constraints:

- Because green gutters are shallow, they do not retain the same volume of water as other stormwater strategies. However, they are excellent for achieve flow reduction and water quality benefits

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STRATEGY

Green Gutter (Along Pathways)

Shallow green gutter system along existing pathways would be used to only capture stormwater generated from the pathway itself. This could help remedy the issue of soil erosion due to stormwater runoff and also provide a new aesthetic to the pathways. The photo example to the right is a pedestrian and bike path system supported by a sedum-filled green gutter in Stockholm, Sweden.

Range of Cost: $20 to $30/Square Foot

$0/SF — $100/SF

Ability to Avoid Underground Utilities:

Low — Med — ▲ High

Use with Poor Soil Conditions:

Low — Med — High

Ability to Green the Overall Streetscape:

Low — Med — ▲ High

Opportunities:

- Can capture runoff from both parking structures and building rooftops
- Can be placed over most types of utilities if they are designed to be shallow
- Can be built fairly expensively to regrading and replanting existing landscape space

Constraints:

- Because green gutters are shallow, they do not retain the same volume of water as other stormwater strategies. However, they are excellent for achieve flow reduction and water quality benefits

Existing Condition

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STRATEGY

Green Infiltration Joints/Pervious Paving

Green infiltration cracks within parking lots is an alternative to pervious paving in that it provides more structural support for vehicular travel, but allows stormwater to sheet flow into vegetated infiltration joints. Vegetation would grow within the infiltration joints, however, water would be able to infiltrate within the aggregate subgrade beneath the concrete slabs. This is a very new technology that has not been built before.

Range of Cost: $5 to $25/Square Foot

$0/SF ▲ $100/SF

Ability to Avoid Underground Utilities:

Low Med ▲ High

Use with Poor Soil Conditions:

Low Med ▲ High

Ability to Green the Overall Streetscape:

Low Med High

Opportunities:

- Helps reduces the parking lot's overall impervious surface
- Offers a low-tech, landscape approach to impervious surface removal
- Can be placed over many types of utilities
- Can help provide any artful means of stormwater management

Constraints:

- Technology needs to take into account ADA requirements
- May not be considered, from a policy, funding, and maintenance perspective, a viable stormwater management solution
- Infiltration cracks within the sidewalk zone is a new and unproven technology

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STRATEGY

Stormwater Planters (On Top of Parking Structure)

The parking structure adjacent to People's Bank offers a unique opportunity to divert stormwater that currently flows into the storm infrastructure into two landscaped planters placed in lieu of two parking spaces. These stormwater planters would sit directly on the parking structure deck with a predefined depth, soil, and planting media. The existing downspouts with be retrofitted to convey runoff into the planter systems, but flow would be allowed to overflow back into the existing storm drainage system. This is a relatively new stormwater strategy with not many built examples, however, the example photo to the right illustrates a raised stormwater planter condition.

Range of Cost: $25 to $50/Square Foot

Ability to Avoid Underground Utilities:

Use with Poor Soil Conditions:

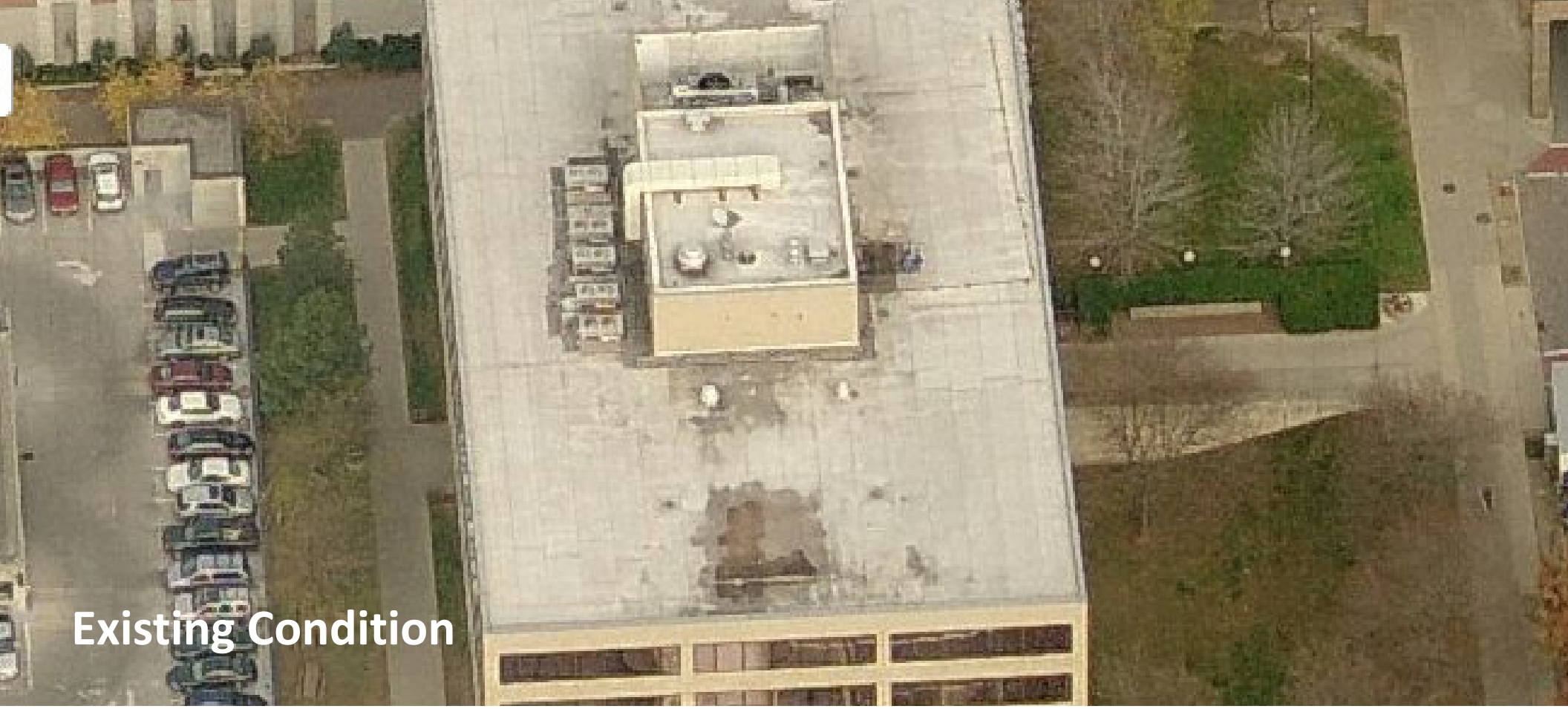
Ability to Green the Overall Streetscape:

Opportunities:

- Can manage stormwater without impeding surface infrastructure
- Can be placed over most types of utilities
- Can be made of a variety of materials such as metal or concrete
- Overflow from planters can easily be directed back into existing storm line

Constraints:

- Will need to lose a parking space at the location of each planter
- Will need to develop a means to irrigate the parking deck planters during summer months
- Stormwater facility offers no infiltration ability, but can slow water and provide evapotranspiration



16
STRATEGY

Rooftop Stormwater Canopies Directing Water to Landscape

Many building rooftops have drainage systems that are internally plumbed rather than directed to exterior downspouts making it difficult to capture this rainfall. There are however some exciting opportunities to manage rainfall before it even hits these types of building rooftops. Using stormwater canopies that collect and direct stormwater runoff into perimeter landscape areas could help manage stormwater at these difficult locations. Furthermore, these stormwater canopies can double as photo voltaic panels for energy creation.

Range of Cost: $80 to $100/Square Foot

$0/SF ▲$100/SF

Ability to Avoid Underground Utilities:

Low Med ▲ High

Use with Poor Soil Conditions:

Low Med ▲ High

Ability to Green the Overall Streetscape:

Low Med High

Opportunities:

- Allows for capture of rainfall before it hits the ground without impeding with pedestrian zones and underground utilities
- Stormwater can be directed in an artful way to cisterns or landscape

Constraints:

- Infrastructure is expensive to build depending on the size of the canopy
- Stormwater Canopies are a new and unproven technology
- Canopies need to be designed to not conflict with overhead utilities/ infrastructure