Urban Redevelopment Stormwater Retrofit Manual

October 2019

Gresham Smith

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LEXINGTON

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SNOW
EMERGENCY
ROUTE
PARKING AND
TRAVEL RESTRICTED
WHEN EMERGENCY
DECLARED

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Introduction

The Urban Redevelopment Stormwater Retrofit Manual is intended to highlight immediate opportunities for dramatically improving stormwater management. Urban Redevelopment may be Lexington's most valued opportunity for a sustainable landscape. This land-use condition affords:

1. Redevelopment opportunities exist throughout the county, many of which were developed prior to green infrastructure requirements, making them key contributors to the overall stormwater management challenges faced by Lexington.

2. Vacant and abandoned properties represent the most prevalent and available opportunities for urban redevelopment. In many cases, these properties are great locations for public plazas, street connectivity, grocery and produce access, and alternative transportation infrastructure; all of these elements aid in connecting people to bigger systems.

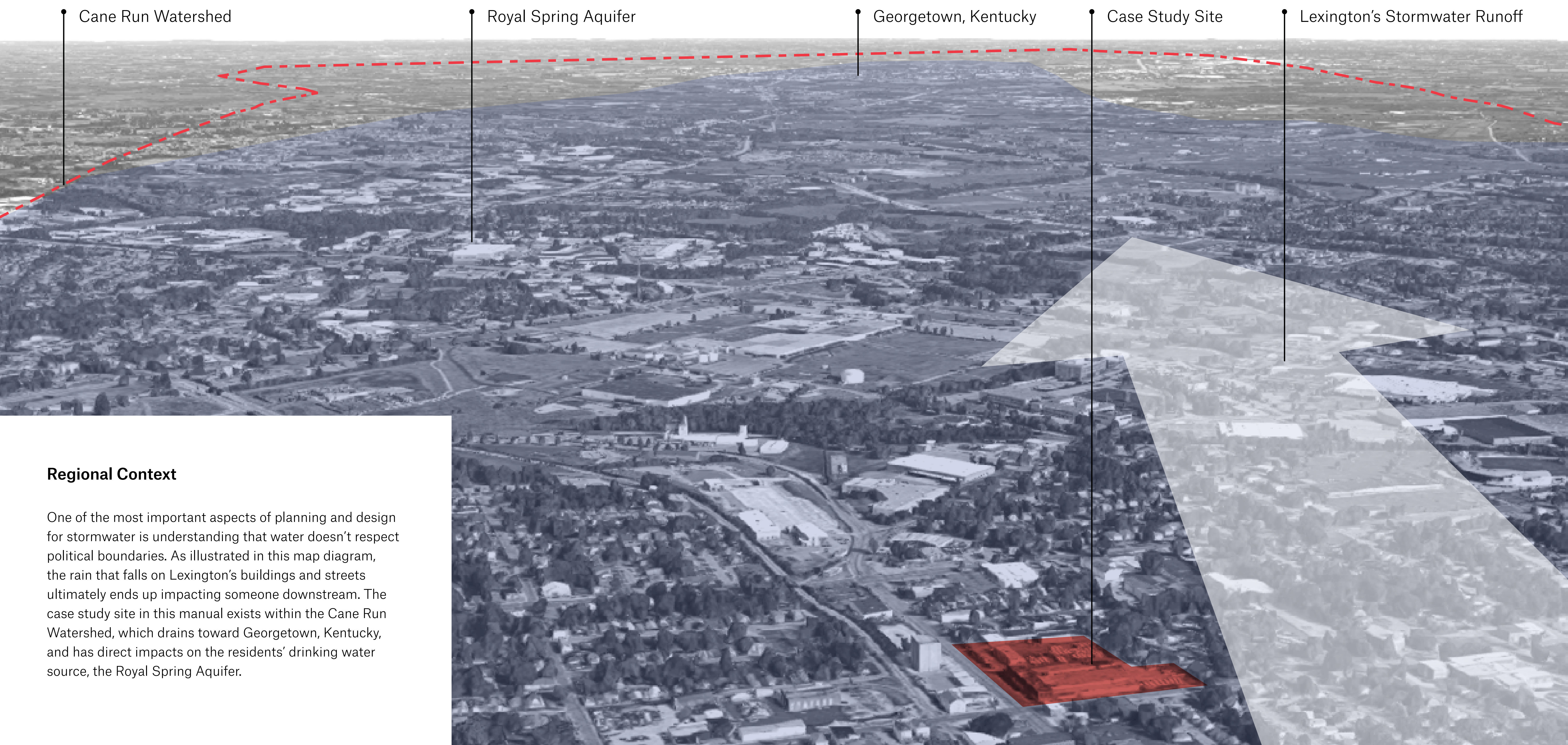
3. As Lexington faces mounting pressure to expand the Urban Services Boundary, the sustainable solution is urban redevelopment properties and opportunities.

4. Stormwater quality and innovative management techniques are often difficult to quantify, making it challenging for a city to invest in innovative approaches to planning and designing these systems. Urban redevelopment opportunities are an ideal location for experimentation and education because of the built-in visibility these properties offer.

The critical focus of this manual is to illustrate that sustainability does not require compromise.

Through redevelopment scenarios, this manual intends to showcase how redevelopment opportunities can be designed to improve water quality and reduce flooding, while also creating better places to visit, more environmentally resilient communities, and increasing value for our communities and property owners.

This manual takes a triple bottom line approach to sustainable design that looks beyond the natural resources typically associated with sustainability, and attempts to define how to measure and increase community sustainability: environmentally, socially and economically.



Regional Context

One of the most important aspects of planning and design for stormwater is understanding that water doesn't respect political boundaries. As illustrated in this map diagram, the rain that falls on Lexington's buildings and streets ultimately ends up impacting someone downstream. The case study site in this manual exists within the Cane Run Watershed, which drains toward Georgetown, Kentucky, and has direct impacts on the residents' drinking water source, the Royal Spring Aquifer.

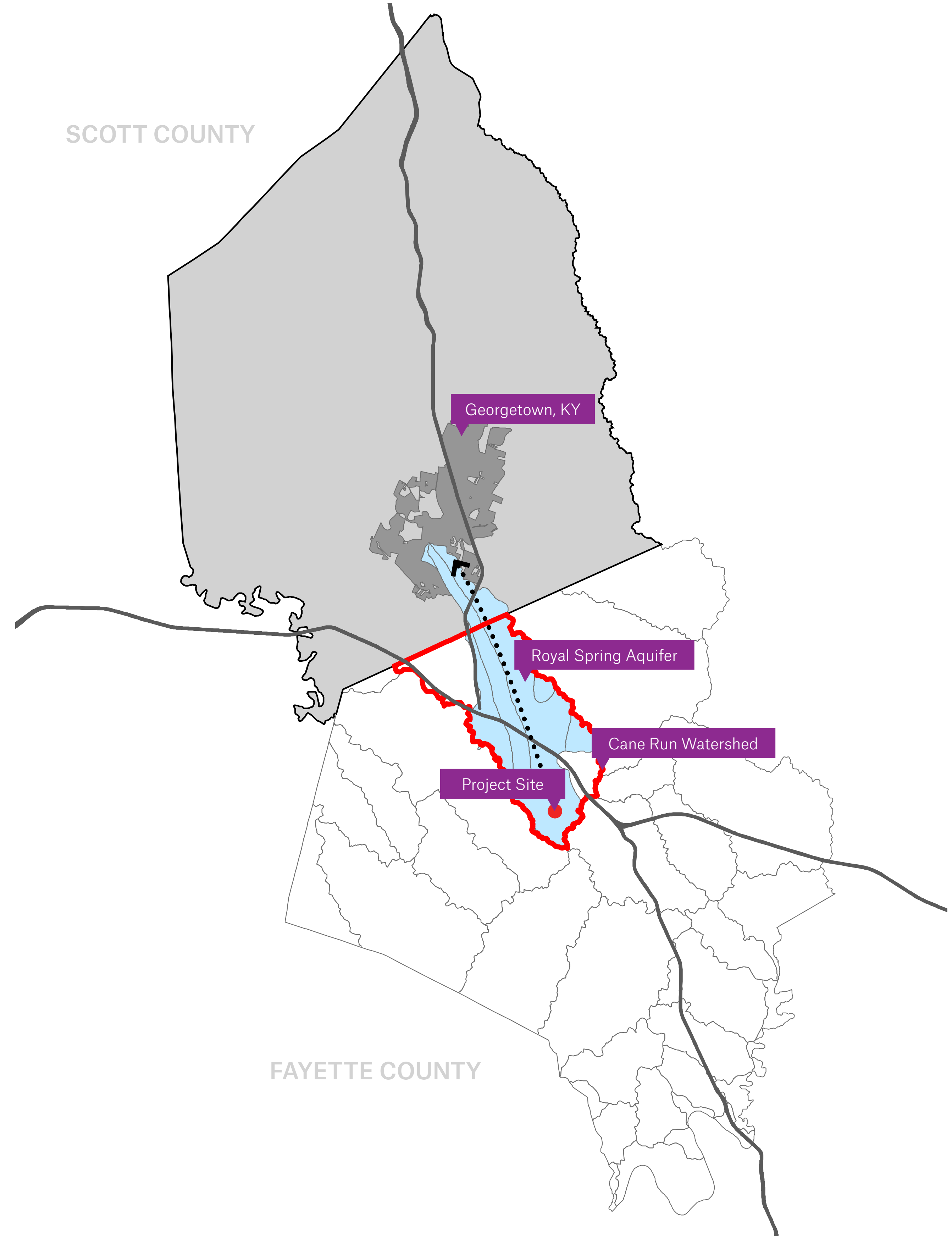
Understanding Watersheds

Watersheds can be complex systems with multiple layers. Watersheds are essentially areas of land where all the water goes to a common outlet. Watersheds can be small or large, and consist of rivers, lakes, streams and wetlands, and all the underlying groundwater- which is important in Central Kentucky because of the limestone geology.

Decisions made in one part of a watershed impact not only that watershed but also the adjacent watersheds that receive their water. For instance, the Royal Spring Aquifer (illustrated in blue on the adjacent map) is in the Cane Run Watershed and is an environmentally sensitive area in northern Fayette County and southern Scott County. As described in the following excerpt from the Rural Service Area Land Management Plan, the runoff on the Lexington side of this equation literally becomes drinking water in Georgetown, Kentucky:

"Unlike Lexington, which derives its water from the Kentucky River, Georgetown derives its drinking water from the Royal Spring Aquifer. Since 80% of the aquifer for that spring is located in Fayette County, rainwater that infiltrates the ground in Fayette County becomes the source of drinking water in Scott County. This is the largest spring-fed public water supply in the state, providing water to over 7,000 customers.

The Royal Spring Aquifer is particularly susceptible to pollution because it is located in an irregular limestone region with sinkholes, underground streams, and caverns. The sinkholes, streams and caverns allow pollutants to easily enter the water system. Within a matter of hours, groundwater and pollutants can travel from Lexington to Georgetown. In order to ensure that the water supply in Georgetown remains viable, Lexington-Fayette County must take particular care to ensure that pollutants do not enter this system."



Stormwater Standards for Redevelopment Projects

In 2001, the Lexington-Fayette Urban County Government (LFUCG) adopted the LFUCG Stormwater Manual. The LFUCG Stormwater Manual is a technical manual that serves as the regulatory policies to be used in the design, review, construction, repair and inspection of infrastructure in regard to stormwater. The stormwater manual contains the following:

- Overall stormwater management policies of LFUCG
- Minimum uniform standards to assure quality in the design and construction of stormwater infrastructure in development projects
- Construction site stormwater runoff control standards and post-construction stormwater management standards that comply with the requirements of the Commonwealth of Kentucky Municipal Separate Storm Sewer System (MS4) permit issued to LFUCG
- Stormwater management design information that must be submitted to LFUCG by the developer's engineer
- National Flood Insurance Program requirements.

For the purpose of this Retrofit Manual, we will be focused on section 1.8 Stormwater Standards for Redevelopment Projects of the LFUCG Stormwater Manual. This section's objective is as follows:

- Comply with the MS4 permit provisions related to post-construction stormwater management for redevelopment projects
- Provide flexible standards that do not act as a disincentive for redevelopment projects
- Achieve incremental improvement to water quality in previously developed areas.

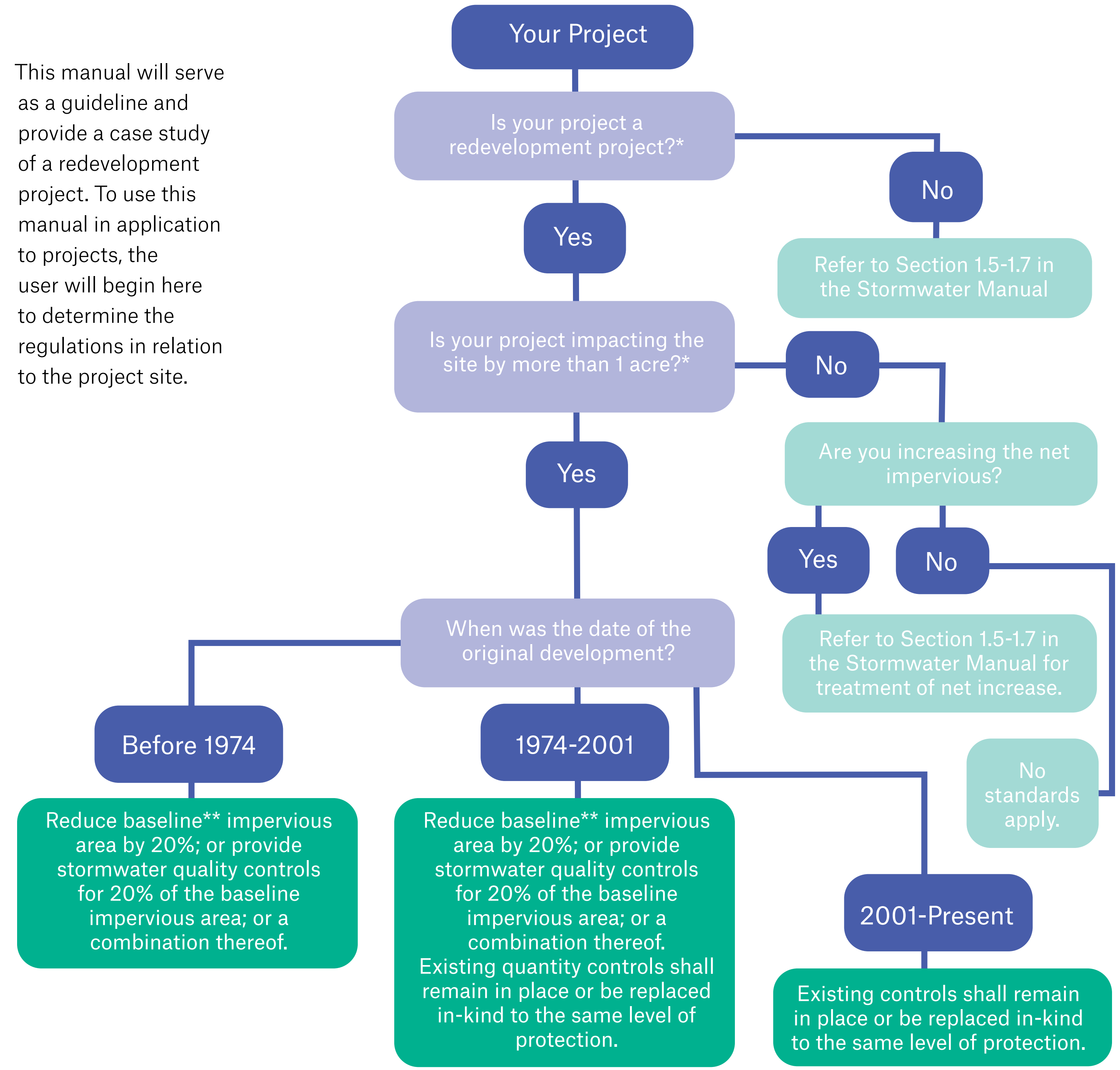
These standards are applied to properties that were previously developed (accommodate structures or large parking lots), and are seeking to alter the property equal to or greater than 1 acre of coverage. However, if a property is increasing the net impervious area of the site, regardless of property acreage, you are required to provide water quantity and quality. Typically these projects are commercial projects and begin with the process of redevelopment through demolition, then proceed to construction of new structures and parking lots.

To identify what standards your project will be required to achieve, you will first calculate the baseline conditions of the site. The baseline conditions refer to the condition of the site prior to the demolition. This baseline condition is comprised of two parts: the impervious surface on the site prior to the demolition, and the stormwater controls on the site prior to demolition.

Please note that structures and parking lots that are demolished and replaced with vegetation will be evaluated as redevelopment for future permit applications (Section 1.8.2.2.b).

Finding your Requirements

This manual will serve as a guideline and provide a case study of a redevelopment project. To use this manual in application to projects, the user will begin here to determine the regulations in relation to the project site.



Note:

*Redevelopment refers to "alterations of a property that change the "footprint" of a site or building in such a way that results in the disturbance of equal to or greater than 1 acre of land. The term is not intended to include such activities as exterior remodeling, which would not be expected to cause adverse stormwater quality impacts and offer no new opportunity for stormwater controls"

**The baseline condition is the site imperviousness and stormwater controls present prior to demolition.

Defining Regulations

Water Quality

Water quality refers to cleaning water before it contributes to an external stormwater system. This standard focuses on the treatment of stormwater runoff resulting from impervious surfaces found across a site. Some examples of water quality treatments are permeable pavement, bioinfiltration swales, vegetative roofs and other pervious features. Please refer to the LFUCG Stormwater Manual, Chapter 10, Post Construction Controls, for best management practices design criteria.

Water Quantity

Water quantity is only required for redevelopment scenarios if the impervious area increases from the baseline impervious condition. If a site does increase its net impervious, please refer to the LFUCG Stormwater Manual section 1.6 for Water Quantity Criteria.

20% Impervious Removal

20% impervious removal refers to the removal of 20% of the baseline impervious surface within the redevelopment site. This removal can be completed through the introduction of new ground cover, permeable paving, open green space, riparian buffer restoration and other pervious surfaces. If your site cannot meet the 20% impervious removal, then you must defer to 20% treatment or 20% combined.

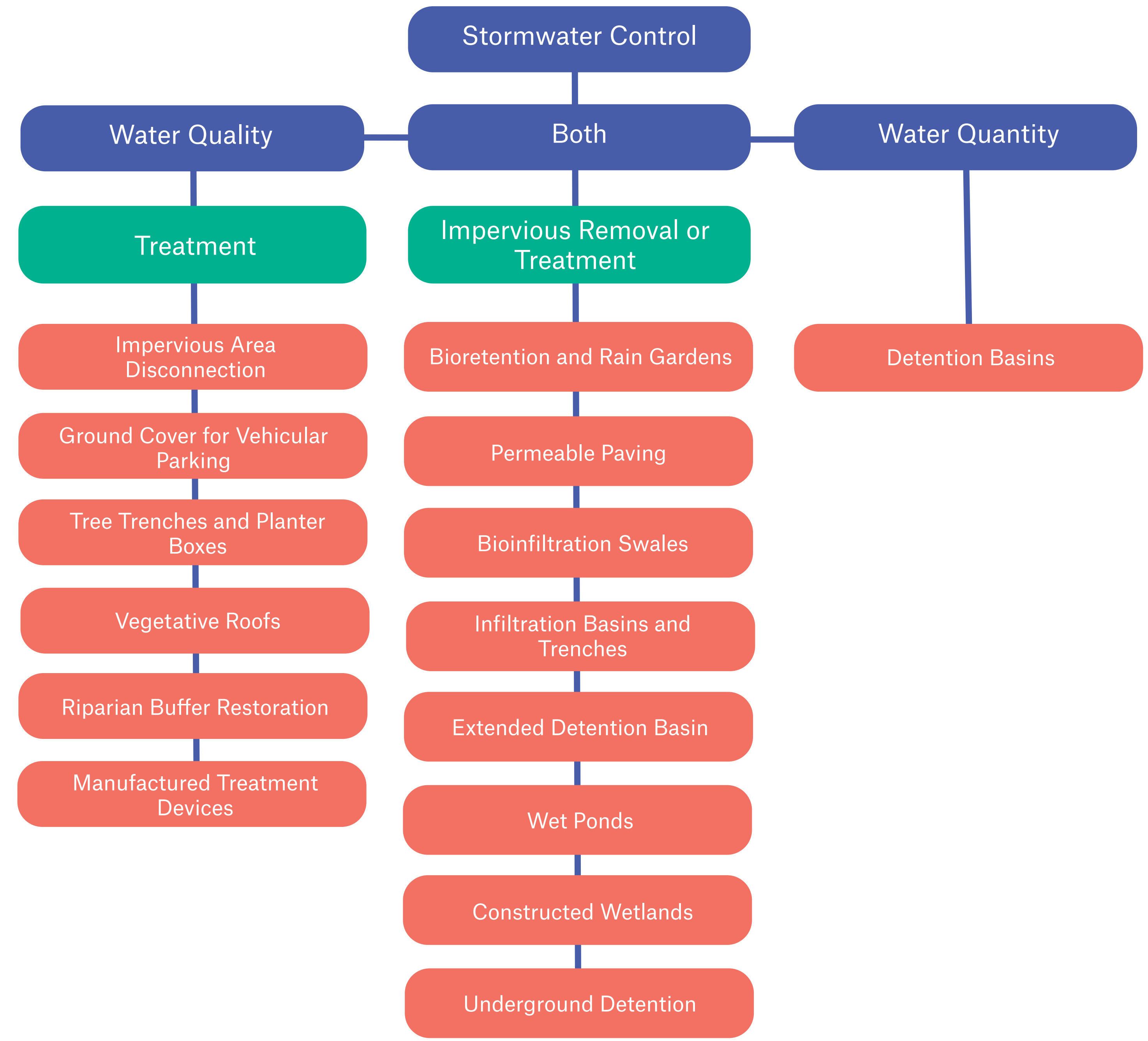
20% Treatment

20% treatment refers to the treatment of 20% of the baseline impervious surface. This means that the treatment system must treat 20% of baseline impervious surface before contributing to the off-site drainage system. Some examples of these systems include bio-retention basins, rain gardens, bioinfiltration swales and other retention systems.

20% Combined

The 20% combined option uses both impervious removal and treatment options to meet the redevelopment requirement outlined by the LFUCG Stormwater Manual. This option uses a combination of both impervious removal and impervious treatment to reach a total of the 20% requirement.

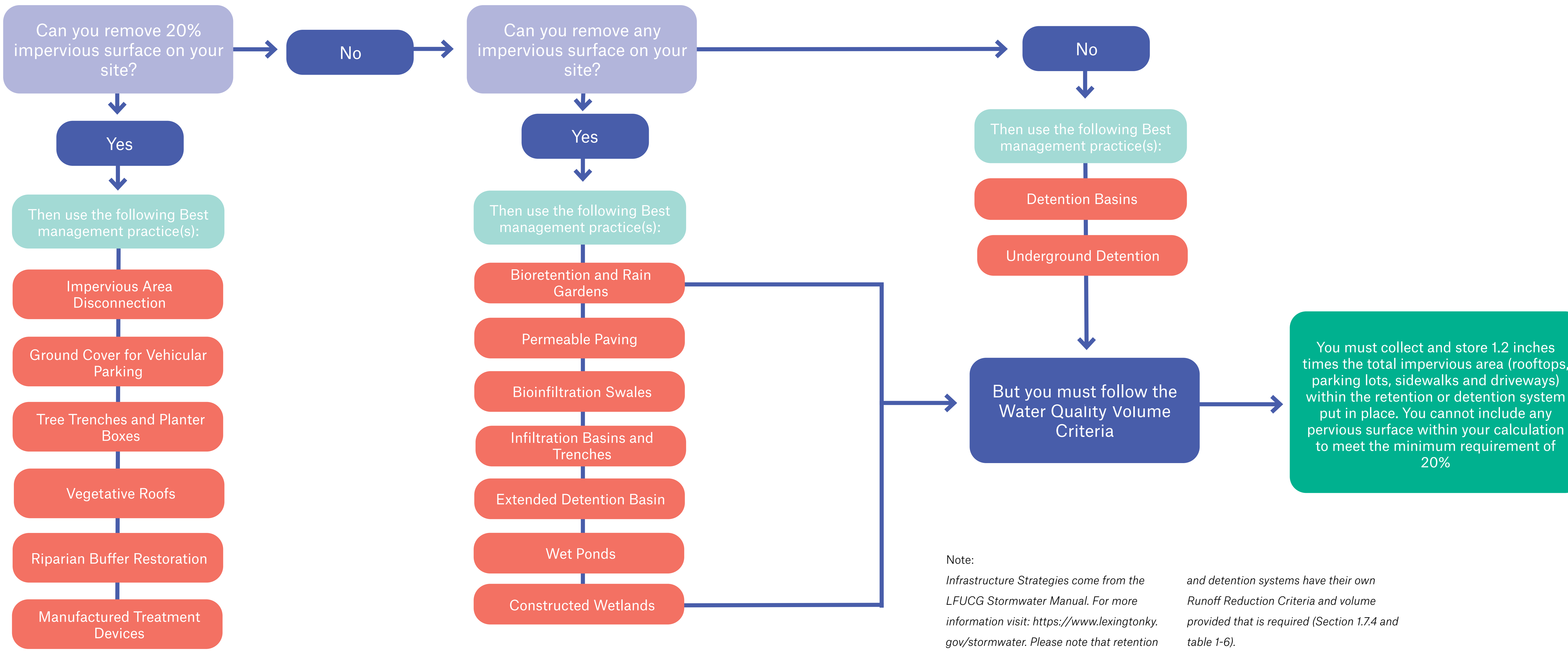
Options for Stormwater Management



Note:
Infrastructure Strategies come from the LFUCG Stormwater Manual. For more information visit: https://www.lexingtonky.gov/stormwater

Finding Your Best Management Practices

After finding your requirements, you will then determine the best management practice(s) for your property to properly manage stormwater runoff.



Note:

Infrastructure Strategies come from the LFUCG Stormwater Manual. For more information visit: https://www.lexingtonky.gov/stormwater. Please note that retention and detention systems have their own Runoff Reduction Criteria and volume provided that is required (Section 1.7.4 and table 1-6).

Stormwater Best Management Practices

As our communities continue into the 21st century, it is imperative that they are as efficient and thoughtful with land development as possible. Growth is continually on the rise, and as such, finding ways for necessary infrastructure to incorporate multiple societal benefits is a must.

Historically, stormwater has been seen as an engineering problem of excess water that should be removed as quickly as possible. For decades, stormwater systems have been designed to direct water to pipes and remove it from the site as quickly as possible to avoid potential flooding. This approach, often referred to as "gray" or "hard" infrastructure because of the use of pipes and impervious surfaces, has created unintended consequences for our communities.

At first glance, expedient removal of stormwater may make sense, but if left unchecked can cause unintended consequences downstream including: increased water velocities and erosion, depleted natural percolation, and reduced opportunity for biological water quality improvement. Untreated stormwater will carry pollutants with it that impact the health of natural water bodies, (rivers, streams and lakes), not to mention the effects on water quality for human consumption.

Finally, the dirtier the water supply, the more expensive it is to clean it. Municipal water companies expend massive amounts of funding to clean water, which also requires immense amounts of electrical energy. According to the Environmental Protection Agency (EPA) 3 to 4% of the nation's energy is used for treating and distributing potable water.

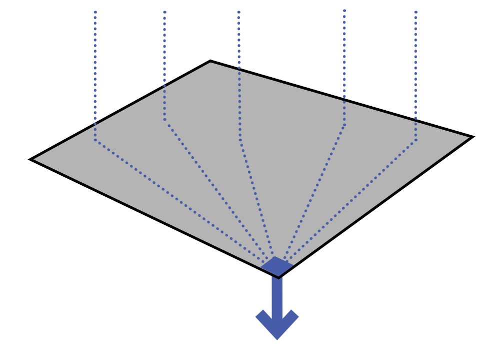
Increases in these types of gray infrastructure approaches also enable the continual increase of impervious surfaces. These surfaces increase urban heat island effects, and reduce the amount of water that naturally infiltrates to groundwater systems.

As our communities continue into the 21st century we face numerous issues related to water quality, flooding and related negative environmental impacts. It is becoming increasingly apparent that gray infrastructure must be balanced with "green" or "soft" infrastructure, which focuses on working hand in hand with natural processes to slow water down, spread water out, and soak water in whenever possible. These approaches also bring with them a plethora of broader communal and ecological benefits, which make green infrastructure a necessary path forward for growing cities.

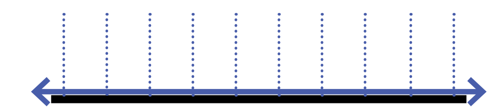
Green + Gray

TRADITIONAL APPROACHES

Traditional stormwater management removes water from a site as quickly as possible by directing it across impervious surfaces to gutters and then to pipes. This approach can decrease water quality and increase the likelihood of erosion downstream.

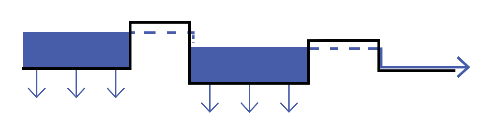


Traditional practices typically send runoff to as few outlets as possible as part of an efficiently designed system. This can increase flooding issues, and dramatically increase water velocities.

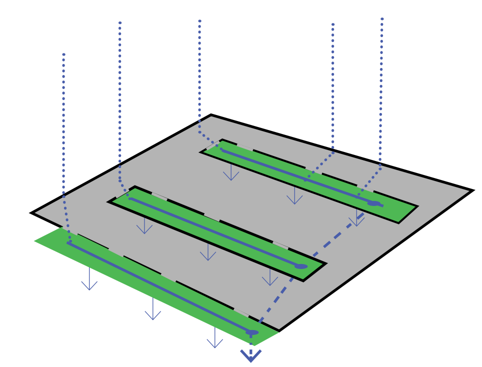


Traditional approaches rely on impervious surfaces to direct water away from a site. These approaches, however, reduce natural percolation, increase urban heat island effects and negatively impact soil health.

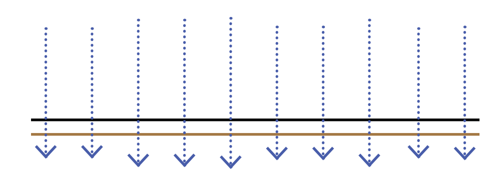
BMP APPROACHES



Green infrastructure can be designed to slow water down. This approach can be achieved through thoughtful control of site elevations, use of weirs and by developing systems which guide water to pervious surfaces that both slow water down, and allow it to percolate naturally into the soil.



By spreading water out across a site, stormwater can be slowed down and given more opportunities to percolate naturally before entering the gray system, which should operate as a failsafe.



Finding ways for stormwater to naturally infiltrate is imperative for a healthy and balanced urban ecology. Replenishing groundwater systems, cleaning water through biological processes, and reducing the effects of downstream erosion and sedimentation are all benefits of absorbing water where it falls.

BMP Examples

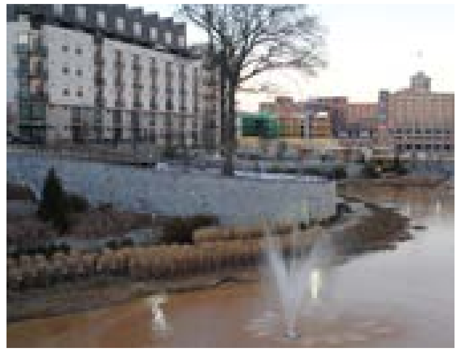
There are many examples of how the previously mentioned BMPs have been put to use in cities across the world.

Often, the best approaches are diverse and are designed to decrease stormwater speeds, distribute stormwater around the site, and allow the water to soak in naturally where possible.

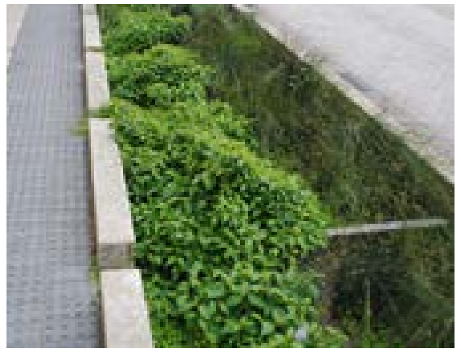
Allowing for this overlap of strategies will help provide the best stormwater management and quality improvements. Understanding how these strategies can benefit broader communities is important. The following images are simple examples from around the United States that show how these diverse approaches are being put to use.

SLOW

Using pervious surface materials like native grasses and crushed stone instead of asphalt can provide social spaces while improving natural percolation.

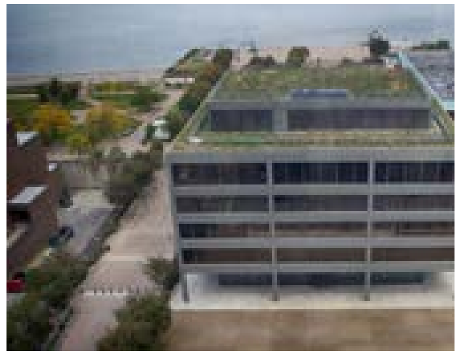


Providing detention/retention features within landscapes will allow water to percolate naturally over longer periods. When not filled with water, these can serve as both open and functional spaces.



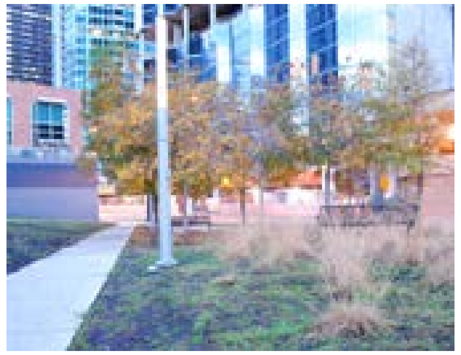
Features like bioretention basins along roadways can help slow water down in larger rain events by creating small pools with weirs, which overflow to the larger system.

SPREAD



Green-roof technology can help slow down and spread out stormwater runoff across large surfaces.

Linking stormwater collection points along green streets can create networks of stormwater features, providing multiple benefits to both the streetscape and the stormwater collection system.



Providing open spaces in mostly impervious environments can help disseminate stormwater runoff across a greater area.

SOAK

Where possible, larger features such as designed or natural wetlands can help absorb massive amounts of stormwater runoff.

Using topography like this designed basin will help capture and slow stormwater runoff while improving a community streetscape.

Pervious surface materials that allow the landscape to act more like a sponge, such as the materials used in this parking lot, can dramatically reduce runoff.

Making BMPs Add Value

Improving stormwater management on existing redevelopment properties can be an uphill battle, as it can be considered a cost versus an investment. The most critical component of evaluating these strategies is their ability to add value. Added value for redevelopment properties can come in a number of ways:

Lessening Water Quality Management Fee

The most direct benefit of these strategies is the reduction of impervious surfaces, which will lessen a property owner's Water Quality Management Fee that is based on the total square footage of impervious surfaces.

Beautification of Landscape Can Lead to Sustainable Practices

One way redevelopment properties differentiate themselves is the look and feel of the property. There are many landscape solutions that are beneficial to stormwater quality and local ecological systems while remaining beautiful. If designed well, these native landscapes can require less long-term maintenance, less water and minimal chemical treatment

The Sustainability Market

While the sustainability and "green living" markets vary from region to region, there is absolutely a growing public interest, and even a market demand, for consumers who want to live a more sustainable lifestyle. Using these stormwater features in marketing is one more way to add value and elevate the status of a multifamily, commercial and mixed-use development when users are choosing where to reside.

Add User Amenities

These features can be designed to not only lessen impervious surfaces and improve drainage problems and water quality, but can add amenities that will make a property stand out to prospective business owners and residences. This would allow the property owner to create more rental value on their respective property.

Pervious Parking Lots

Increased Density

Street Trees

Streetscape

Vegetative Buffer

Community Gardens

Water Features

Green Infrastructure

Open Space

BMP-menities

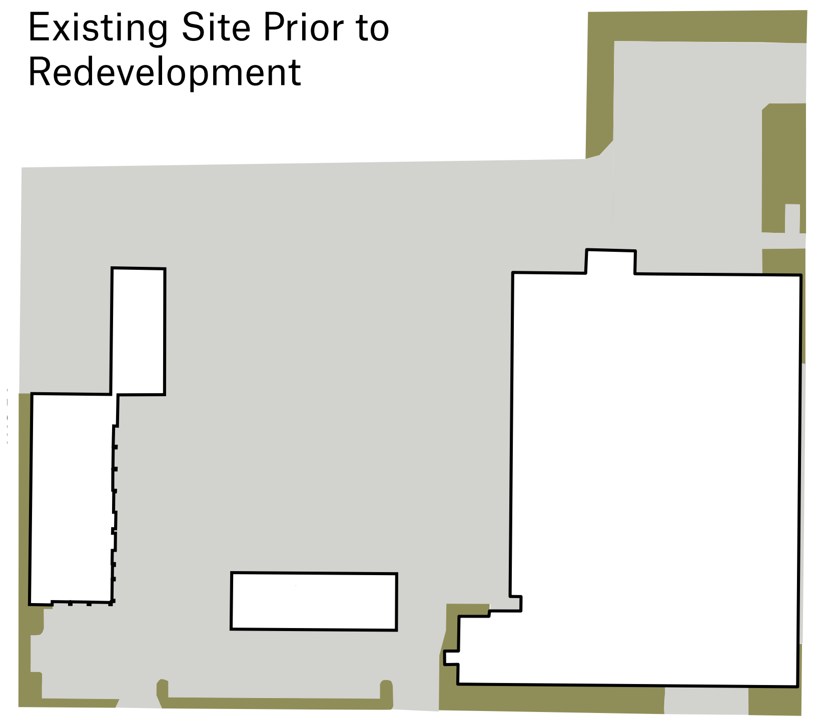
BMP-menities is a new way of thinking creatively about how stormwater infrastructure can be used to add value to any property. It is extremely hard to differentiate properties based on infrastructure that is underground, as out of sight is often out of mind. However, BMPs can be designed to act as site amenities that fit a number of different lifestyles and can improve the marketability of any site, regardless of scale.

These images represent just a few typical site amenities, which if designed thoughtfully, can also help improve overall stormwater quality and stormwater management.

Required Redevelopment Scenarios

Using a case study site at the corner of West Loudon and North Limestone, employed the previous flow chart to determine that a redevelopment scenario would require reducing the baseline conditions by 20%. The redevelopment of this site, which was established in 1976, would impact more than 1 acre. The site has no existing water controls and will need to reduce its baseline condition by 20% through impervious removal, treatment or a combined option. Seen to the right is a diagram of the existing site as it stands today. This site is 215,141 square feet, or 4.93 acres, with 91% of the site being impervious. The following three scenarios examine how this site can reduce the impervious footprint by 23% to 27% (which meet the minimum 20% requirement). These scenarios provide various spatial options that provide variety in open space, parking, and ultimately cost.

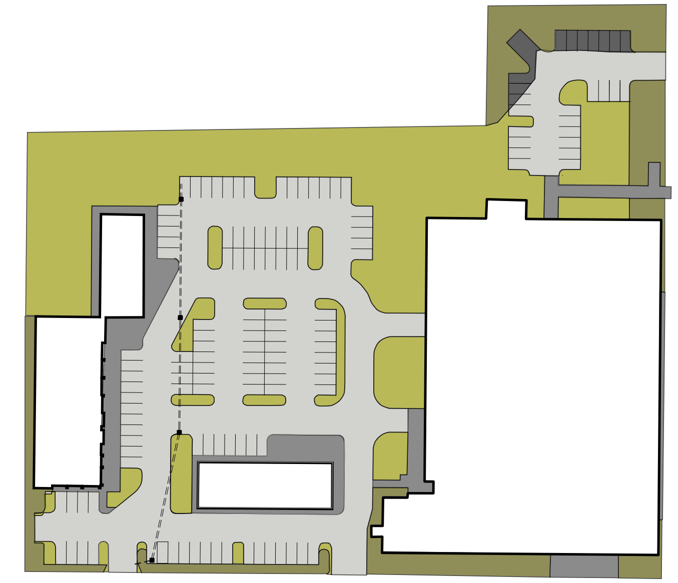
Existing Site Prior to Redevelopment



Total Area (SF)	**215,141**
Existing Pervious Area (SF)	19,026
Existing Impervious Area (SF)	196,115
Building Area (SF)	72,746

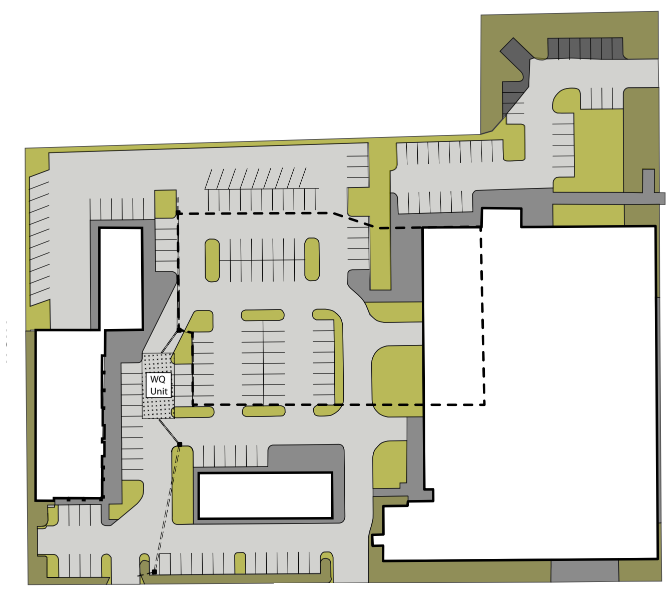
Legend

- Existing Impervious
- Existing Impervious (proposed sidewalk)
- Proposed Impervious
- Proposed Pervious
- Existing Pervious
- Water Quality (WQ) Treatment Area



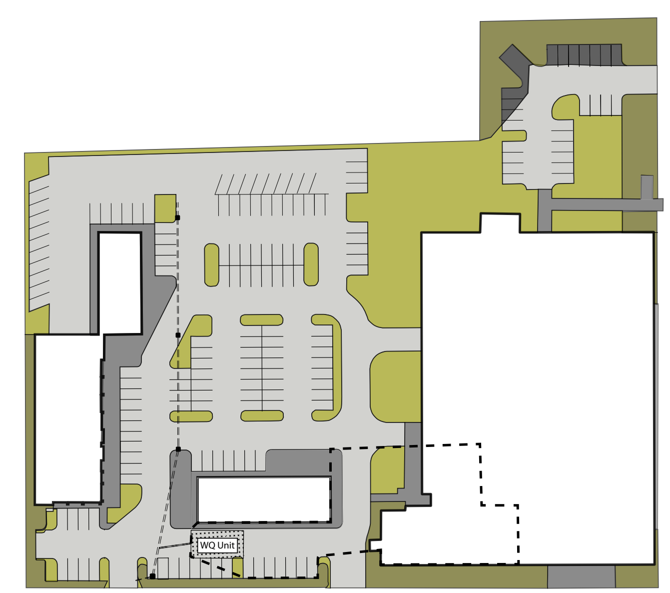
20% Impervious Removal

Total Impervious Area Removed (SF)	45,604
Percent Impervious Area Removed	23%
Total Treated Area (SF)	0
Percent Treated	0%
Total Combined Treated Percentage	**23%**
Parking Spaces	***139***



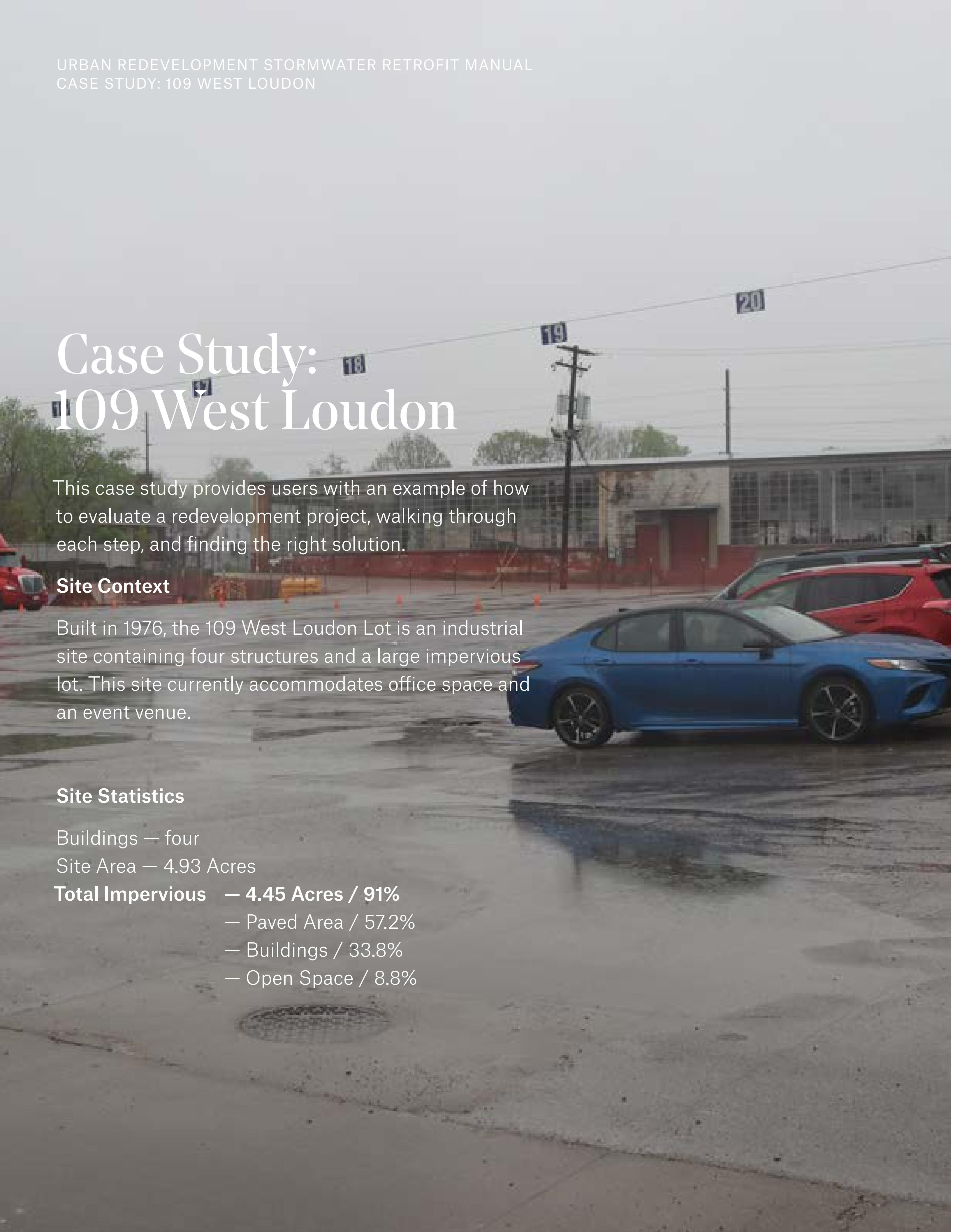
20% Treatment

Total Impervious Area Removed (SF)	19,351
Percent Impervious Area Removed	10%
Total Treated Area (SF)	32,662
Percent Treated	17%
Total Combined Treated Percentage	**27%**
Parking Spaces	***176***



20% Combined

Total Impervious Area Removed (SF)	27,468
Percent Impervious Area Removed	14%
Total Treated Area (SF)	17,079
Percent Treated	9%
Total Combined Treated Percentage	**23%**
Parking Spaces	***164***



Case Study: 109 West Loudon

This case study provides users with an example of how to evaluate a redevelopment project, walking through each step, and finding the right solution.

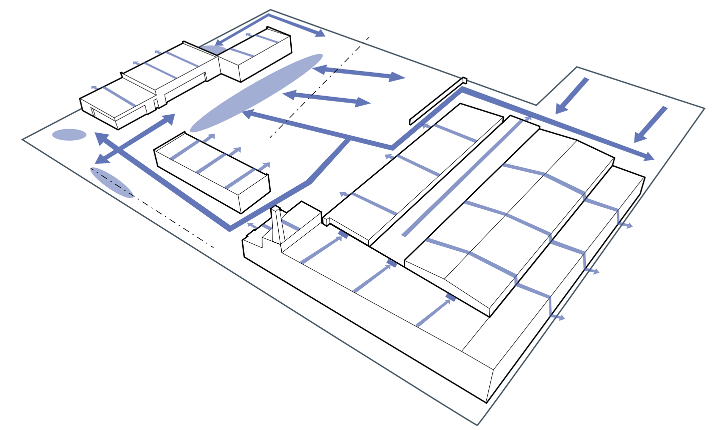
Site Context

Built in 1976, the 109 West Loudon Lot is an industrial site containing four structures and a large impervious lot. This site currently accommodates office space and an event venue.

Site Statistics

Buildings — four
Site Area — 4.93 Acres
Total Impervious — 4.45 Acres / 91%
— Paved Area / 57.2%
— Buildings / 33.8%
— Open Space / 8.8%

SITE ANALYSIS



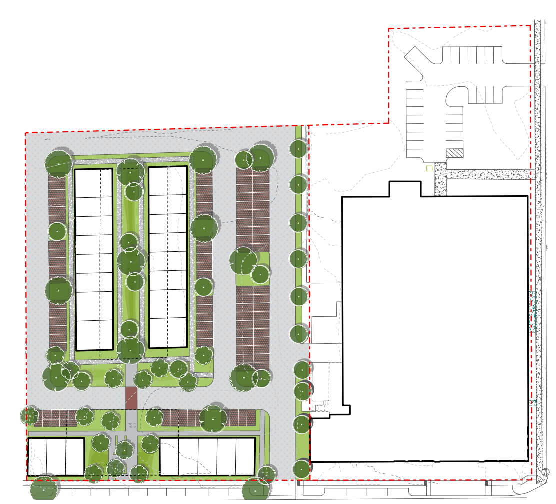
Site analysis begins with understanding the redevelopment site and its existing stormwater patterns by answering questions like:

- How big is the site?
- What are the proposed building uses?
- Where does stormwater runoff currently go?
- Are there current flooding issues?
- Where is there obvious room for improvement?
- How will outdoor space be used?
- What plants are on the site?
- Where does the site slope? How steep are the slopes?

STORMWATER STRATEGIES

After gaining a better understanding of the specific site, it is important to start thinking about ways that improved stormwater management can align with the issues and opportunities identified in the site analysis phase. For example, if the proposed redevelopment includes retail shops, and the current outdoor spaces are dominated by parking and turf grass areas, this may be an opportunity to create stormwater features that include both space for recreation and amenity space that makes the property more appealing to visitors who come to shop at the site.

DESIGN



Although identifying the opportunities is important, the design is critical. Engaging a local landscape architect who understands stormwater management, plant materials and community design is key to the success of your retrofit. Professionals incorporate the proper materials, slopes and plants into the design so that your project is functional as well as safe and beautiful.

Site Context

The site consist of four structures that have been readapted into commercial and office space. The site, once an industrial space with the need for large parking lot, is now underutilized space. This configuration of the buildings allows for commercial access from the road, while providing space for parking within the site.

Ⓐ INDUSTRIAL REUSE

This site already shows signs of industrial reuse, from the current uses of planned market space and event venues to public art located on structures. This site is primed for redevelopment.

Ⓑ ENTRANCE TO BUILDINGS

Current entry points into existing buildings lack appeal and accessibility. Entrances vary from garage doors to standard doorways.

Ⓒ STANDING WATER

Due to the majority of the site being an impervious surface, visible water runoff can be seen throughout the site.

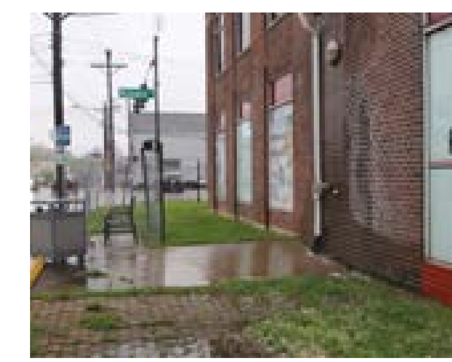
Ⓓ ENTRY

The entryway into the site arrives at surface parking with no clear circulation of the site.

Ⓔ PARKING

While the parking lot is large, formal parking is limited to the edge of the lot. This area is also supplemented with high volumes of standing water.

Ⓕ LOW-IMPACT LANDSCAPE



Little to no landscaping or tree canopy is present on the site. The only pervious surfaces are patches of lawn on the outer edge of the property.

Stormwater Analysis

The first step in stormwater analysis is understanding what impervious surfaces make up the site, followed by identifying rainwater flows during a storm event, and identifying key contributors to stormwater runoff as well as water-flow patterns across the site.

KEY CONTRIBUTORS

Paved Area

The parking lots and drive aisles make up nearly 2.7 acres of impervious surfaces. These surfaces drain toward seven inlets on the site.

Rooftops

The rooftops of the main structures account for over 72,746 square feet of impervious surfaces. These surfaces run off toward landscape areas and parking lots.

KEY FLOW PATTERNS

Paved Area

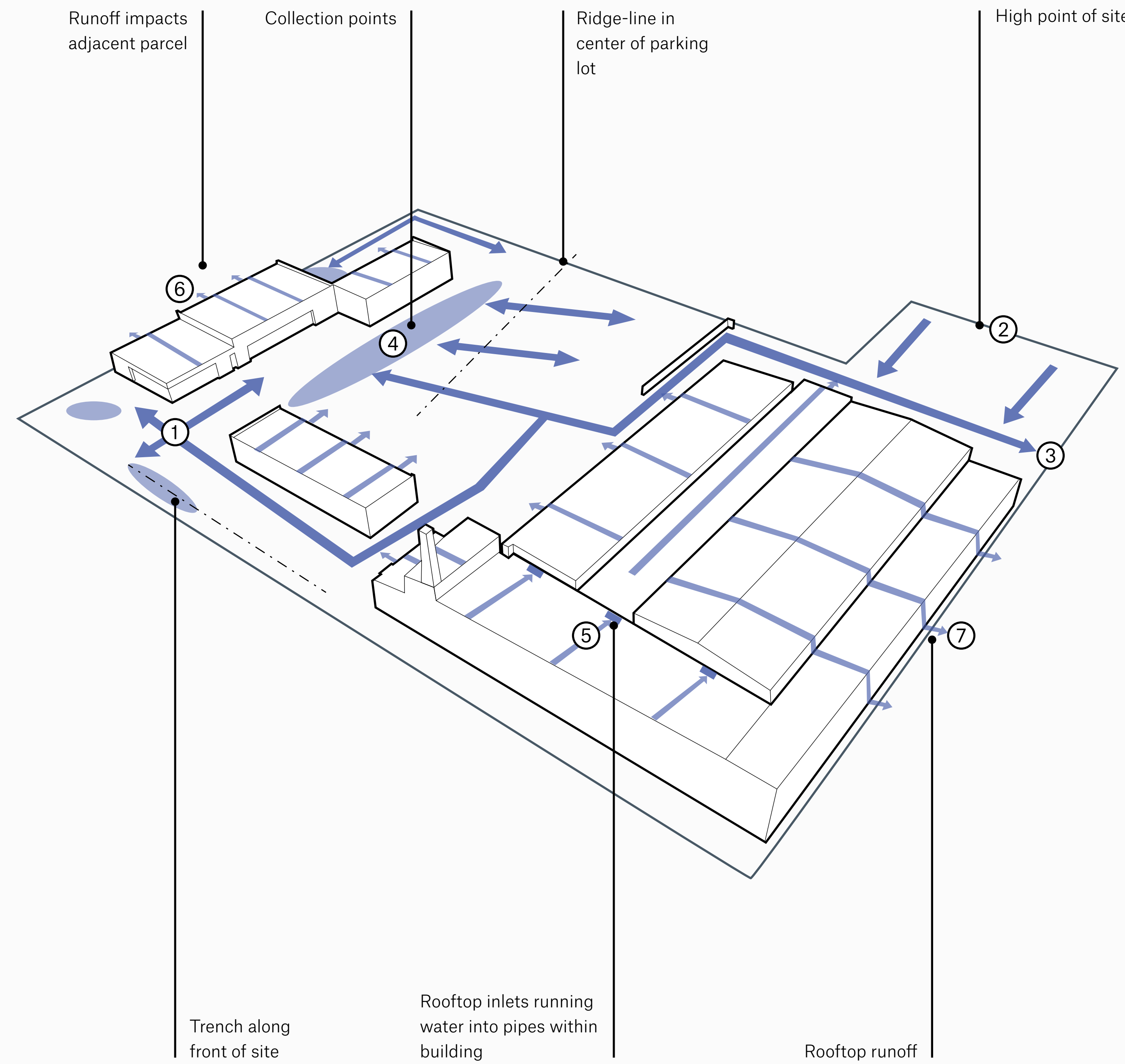
The main runoff channel is the parking lot and drive aisle, specifically nearest the main entryway (1) at the property edges (2) and the secondary entrance (3).

Rooftop to Landscape Areas

Central landscape areas and the edges are encountering the totality of the rooftop runoff, but have nothing to protect them. This is prevalent in the central open space (4). Most rooftop drainage runs into the drainage pipes on buildings then onto the site (5).

Edge Runoff

Additionally, water runs off the "northern" boundary to an adjacent parcel (6) and along N. Limestone (7)



Site Analysis

Evaluation of Opportunities

At 109 West Loudon, there are three clear opportunities to redevelop the existing site so it can manage stormwater, and to increase the value of the property from both an owner and user standpoint. These opportunities include:

Vast Amount of Impervious Paved Area

Typical of most industrial developments, this site actually has more than the required amount of parking area. For example, based on the LFUCG zoning ordinance, a multifamily residential redevelopment on the site would typically require 1.5 parking spaces per unit, and in some instances less. Each parking space requires over 200 square feet of asphalt. In the case of a commercial development, the standard is typically four spaces per 1,000 commercial square feet. These standards can help reduce the amount of impervious paved area that exist on this site while improving the overall stormwater quality.

Underutilized Industrial Buildings

The vast amount of building area is drastically underutilized in comparison to the amount that is currently functioning as commercial, office and event space. The site can be restructured to accommodate multifamily housing, more commercial space or a combination of the two. Redevelopment and infill can adaptively reuse existing structures on-site, build new structures, or a combination of both. With the existing structures located in close proximity to the street, good access and street frontage amenities provide a good reason to reuse the buildings on-site. Additionally, historical buildings offer a place-making opportunity by telling a unique story of the site.

Inefficient Landscapes

Landscape space requirements associated with industrial developments typically result in minimal landscape considerations, which offer little value to the property, and even less for stormwater. These spaces, typically on the outer edge of the property, can be improved to not only look better, but to intentionally impact stormwater by slowing it down, allowing it to soak in and cleaning it. This opportunity enables the use of native plant species that provide a new habitat and beautiful educational landscapes.

A large, open parking lot can provide opportunities to establish planting areas and outdoor public space through depavement strategies.

Re-envisioning of large structures configuration can increase the potential of the site uses through the establishment of commercial or residential uses.

Close proximity to the street can provide commercial entrance opportunities.

Improved landscape surrounding buildings can enhance the overall perviousness as well as the comfort of users accessing and utilizing the site.

Three Redevelopment Scenarios

Three redevelopment scenarios are explored in the following section. They are focused on the 109 West Loudon property that currently exists as a light industrial site with a large, impervious parking lot. Each of these scenarios uses a minimum of 40% impervious reduction, 40% treatment or 40% combined, and explore opportunities for maximizing the potential on 109 West Loudon. They look at how the site can be re-envisioned for a commercial property, multifamily residential homes or a mixed-use development.

In each of these redevelopment scenarios, we explore various water quantity and water quality methods that could be utilized. All follow the Lexington-Fayette Urban County Government zoning ordinance for parking and landscape requirements.

Commercial

Within a commercial development, integrating green infrastructure into parking lot design can provide stormwater management and microclimate benefits that offset the otherwise highly impervious system.

Multifamily

In multifamily developments, green infrastructure can provide a gathering space within the development. If designed properly, green infrastructure can be interactive and offer residents opportunities for educational and recreational features.

Mixed-Use

Within a mixed-use development, green infrastructure can improve the aesthetics of the site. Through implementation of swales and permeable paving, these tools can provide wayfinding and improve the overall ambiance of the site.

Commercial

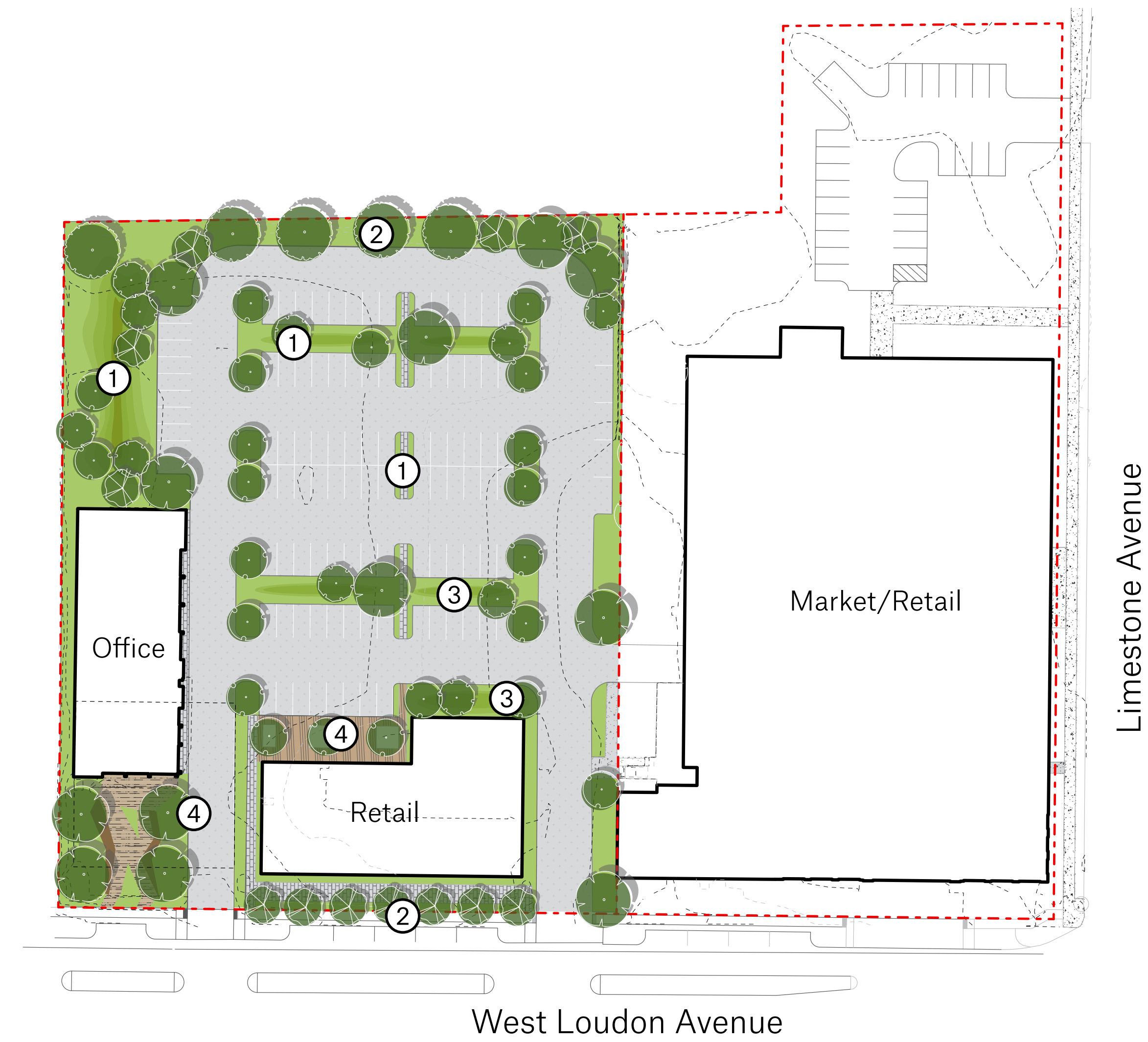
Commercial redevelopment is focused solely on retail and office space development. For this scenario, we explore how the 109 West Loudon property could integrate impervious removal and bioretention systems within the redevelopment project, while maintaining maximum parking and retail opportunities.

Throughout this section, a redevelopment plan will be shown, site makeup will be defined, infrastructure methods will be presented, and site-specific typology will be demonstrated.

Conceptual Design

This plan examines how a commercial development can be integrated within the site. Through the removal of an existing building, retrofitting an existing structure, and the removal of impervious surface, this redevelopment proposes two structures to house retail business. The proposed single-story structure is located at the entrance of the site. Through restriping and removing pavement, a new parking lot is designed to support the businesses.

To maintain water quality and quantity, four strategies are established. The first strategy is a detention system at the entrance to the site, which collects runoff from the building and the impervious drive. The second strategy is depaving of the site and introducing green space. The third strategy is a series of bioswales throughout the parking lot. The fourth strategy is a bio-buffer surrounding the entire site.



1 DEPAVE

Areas with excess asphalt will be DEPAVED and replaced with native landscapes and planted swales. These features will require new curbs, soil amendments, a drainage strategy and native plantings.

2 BIO-BUFFER

Vegetative buffers surrounding the site provide permeable areas while also creating space for visitors to interact. These buffers create barriers to neighboring properties and a safe buffer from the street.

3 NATIVE SWALES

Low areas of the site experiencing ponding will be graded as swales and planted with native landscape materials. These features require evaluation of plant material, soil amendments and spatial limitations.

4 DETENTION

Identifying key locations for pavement removal that is downhill can meet multiple strategies. This area of asphalt is removed and replaced with bioretention that captures surface runoff from remaining impervious surfaces to help improve water quality and slow flow.

Strategy Identification

In the case of the 109 commercial scenario, four main strategies were identified to decrease impervious surfaces, improve water quality, and make the property more attractive and valuable to the owner and the community.

Bio-Buffer
Using vegetation as a buffer between the street and the redevelopment can serve as a visual entrance and safety tool that buffers pedestrians from vehicles, and meets LFUCG landscape perimeter code requirements. This system also can serve as a water quality system that supports the vegetative environment on the site.

DEPAVE
The 109 property has a plethora of asphalt allowing for multiple opportunities to narrow drive aisles and remove excess parking spots that ultimately can improve vehicular and pedestrian circulation. These locations will be replaced with native landscapes that will further aid water quality, reduce runoff velocities, and decrease urban heat island effects.

Planted Swales and Native Landscapes
Planted swales can act both as vegetated filters and infiltration features because they slow runoff rates and allow for both particle settling and stormwater infiltration. Native landscapes act as sponges that soak up stormwater and reduce irrigation once established. Native species also increase biodiversity and habitat.

Underground Detention
In restrictive sites where space is often at a premium, underground detention can help supplement the amount of water stored and treated.

BIO-BUFFER

DEPAVE

PLANTED SWALES

UNDERGROUND DETENTION

Depave + [Park]ing

The Depaved landscape areas and bioswales will slow water down, allow water to percolate naturally, and catch pollutants and sediment from the runoff helping improve water quality. These areas will also increase biodiversity and reduce urban heat island effects.

Depaving will lessen the site's municipal stormwater fee and replace asphalt with beautiful landscape treatments, making the property more attractive to prospective renters. Depaving will also reduce ambient temperatures, which can positively impact utility rates for residents.

These features will provide a number of community benefits, including a more visually pleasing landscape for visitors. They will also improve the site's biodiversity, providing critical native habitat, and reducing the amount of water that runs onto adjacent properties.

Existing parking can be redesigned to maximize capacity and efficiency.

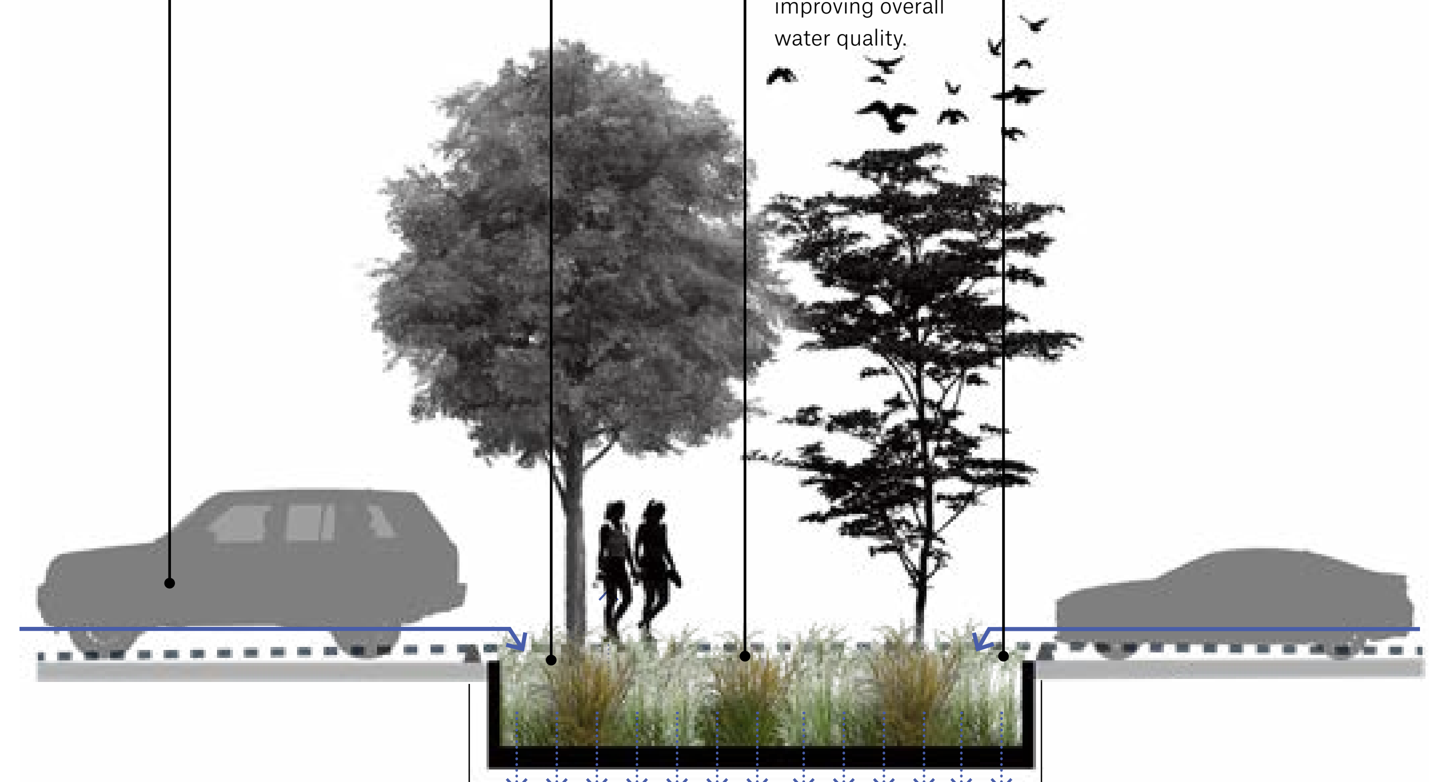
Excess parking spots can be removed and regraded as bioswales to clean and soak up runoff from the parking lot.

Like many industrial lots, the 109 West Loudon site has underutilized parking lots and can afford to reduce overall parking to gain back pervious/ landscaped area.

Existing parking would be removed for additional pervious landscape treatment.

These landscaped areas will increase overall site porosity and provide room for native plantings, including trees and other plant material that will provide a more ecologically friendly site. The landscaped areas will also reduce stormwater velocity and increase stormwater percolation, improving overall water quality.

At the low points of the parking lots, bioretention facilities will be put in place. These facilities will include native plantings to reduce overall impervious surface, and offer aesthetically pleasing landscapes where currently only parking and asphalt exist.



Parking Lot

Parking Spaces Removed for New Bioretention Facility

Parking Lot

Stormwater Plaza

The stormwater runoff from the existing roof and adjacent surface lot will be collected underground in detention. Site amenities are planned above the underground detention system, including an attractive and functional open space with seating and lush landscape.

Underground detention will lessen the site's municipal stormwater fee, replace asphalt with beautiful landscape treatments, and provide a visual entrance into the retail spaces for pedestrians, making the property more attractive to prospective renters.

These features will provide numerous community benefits, including a more visually pleasing landscape for visitors. They will also improve the site's biodiversity, providing a critical native habitat, and reducing the amount of water that runs onto adjacent properties.

Improving the vegetative buffer can provide a pedestrian entrance and a pervious surface for stormwater.

Excess parking spots can be removed and an underground detention system can be placed to collect runoff.

Plaza space allows for gathering space on the site.

Permeable paving manages stormwater while denoting spaces for gathering.

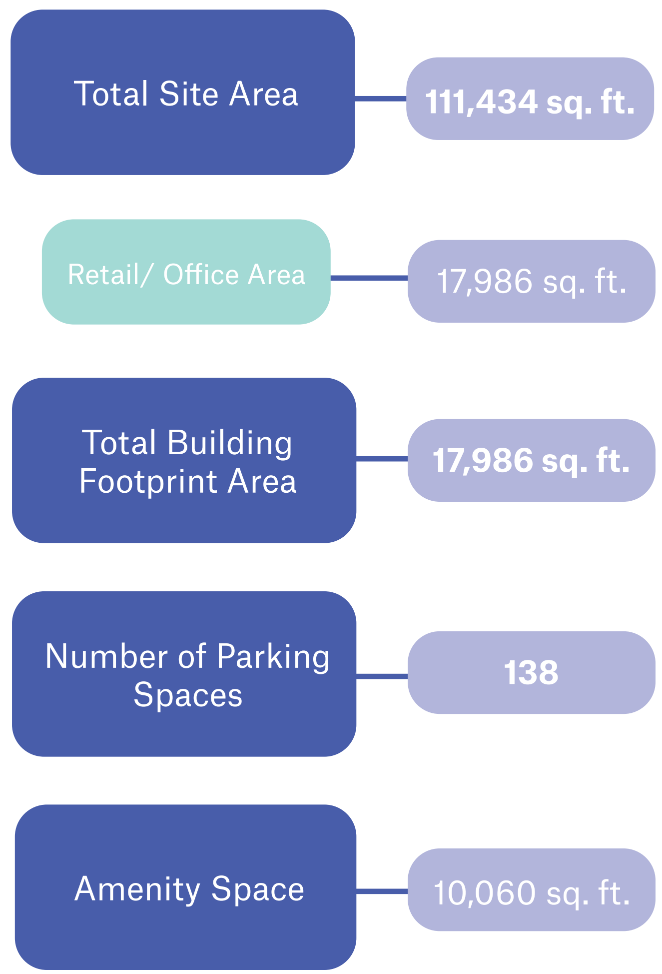
Introducing tree canopy helps reduce urban heat island effect while soaking up stormwater.

Improved connection to and from the site via a pedestrian entrance enhances the aesthetics of the site.

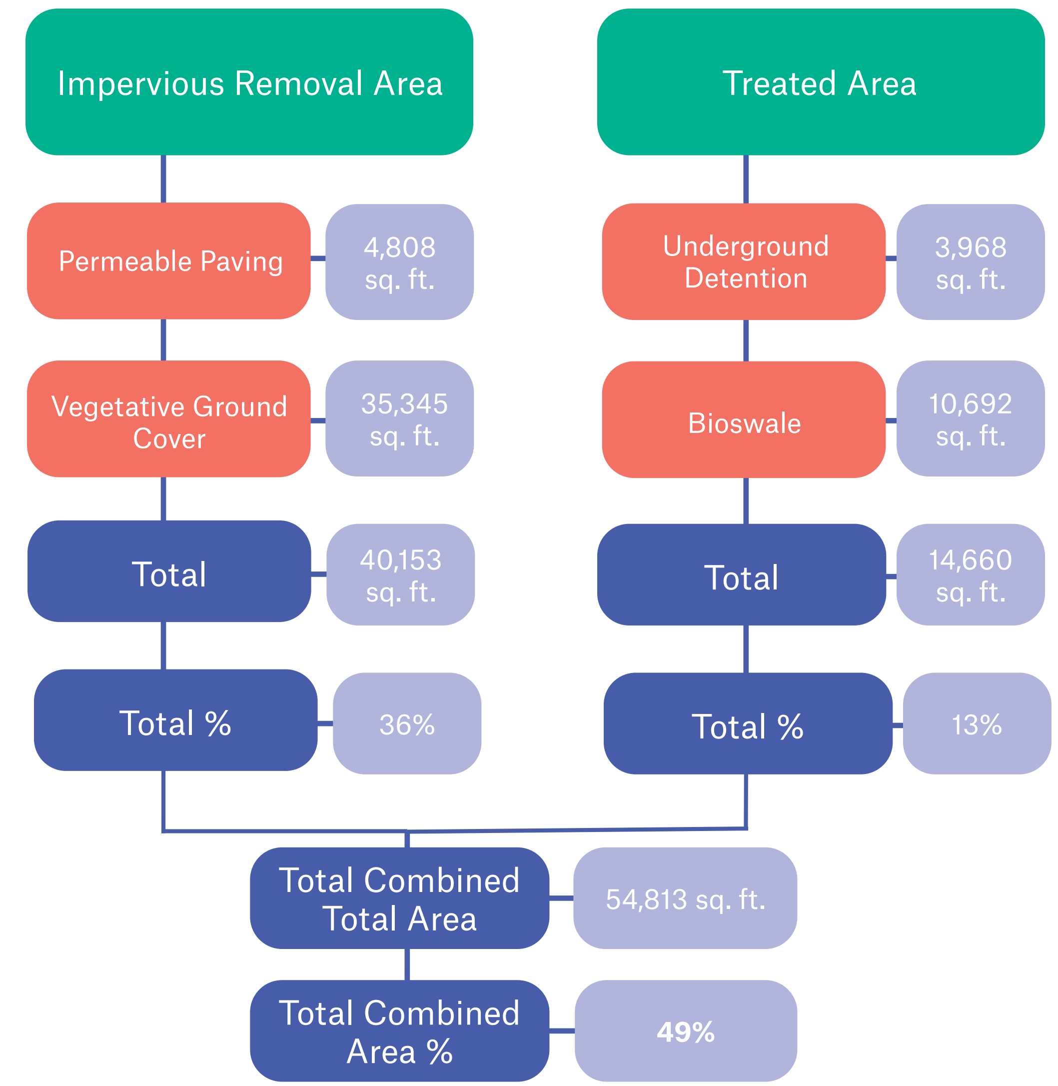
An underground detention system allows for space to be utilized above above ground while still managing stormwater runoff.

Site Calculations and Make-up

Using the LFUCG parking requirements, landscape requirements and stormwater regulations, as well as the LFUCG Stormwater Manual, the following results were made. Through reconfiguration of the site 17,986 square feet of retail/ office space is envisioned. This reconfiguration supports 138 parking spaces and 10,060 square feet of amenity space. In addition to the programmed elements, the space met the requirements of the stormwater manual by +29% using a combination of impervious removal and treating impervious areas. The tools used for this option included permeable paving, underground detention and bioswales throughout the site.



Stormwater Management



Multifamily Residential

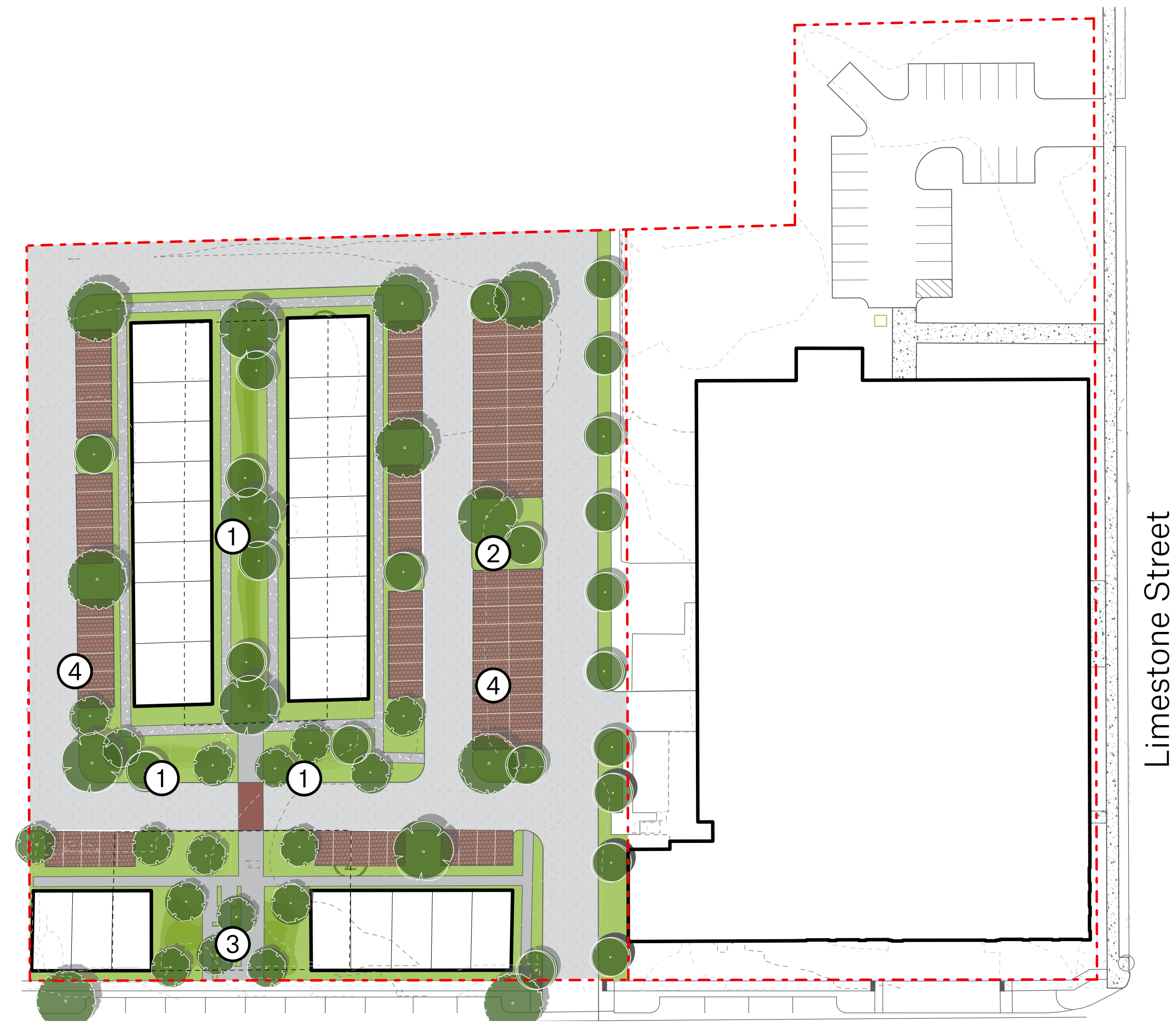
Multifamily redevelopment is focused solely on housing only development. For this scenario, we explore how the 109 West Loudon property could integrate impervious removal, bioswales, permeable paving and bioretention systems within the redevelopment project, while maintaining parking requirements and housing opportunities.

Throughout this section, a redevelopment plan will be shown, site makeup will be defined, infrastructure methods will be presented, and site specific typology will be demonstrated.

Conceptual Design

This plan examines how a multifamily development can be integrated within the site. Through removal of existing buildings and impervious surface, this redevelopment proposes a series of townhomes. These townhouses each have a parking space, a personal patio area, and access to the common green space.

To maintain water quality and quantity, four strategies were identified. The first strategy is a bioswale running through the middle of the townhouses. This system collects runoff from the buildings and the nearby sidewalk. The second strategy is depavement through the introduction of permeable paving and green space. The third strategy is a bioretention system at the front of the site, which collects and stores water from the nearby structures and paving areas. The fourth strategy is the introduction of permeable paving where there is parking on the site.



① SWALES

In narrow areas between buildings, native plantings and river rock make up swales that will not only look great but also improve water quality while reducing runoff velocities. These swales will turn small, excess spaces into efficient stormwater features that will slow and clean stormwater.

② DEPAVE

As an alternative to traditional turf lawns, rain gardens will be installed to handle small rain events. While providing aesthetic benefits, these gardens will also improve water quality, microclimates, biodiversity and the ecological habitat.

③ BIORETENTION

In order to fully capitalize on potential on-site educational opportunities, immersive infrastructure will be used to integrate social spaces and infrastructure so that residents can see, hear and touch the features while learning about their benefits.

④ [PARK]ING

The consolidated parking strategy will utilize pervious parking to improve water quality and reduce urban heat island effects, while improving parking-lot functionality and accessibility. This strategy will also free up prime, open spaces for resident amenities.

Strategy Identification

In the case of the 109 multifamily residential scenario, four main strategies were identified to decrease impervious surfaces, improve water quality, and make the property more attractive and valuable to the owner and the community.

Planted Swales
Planted swales can act as filters and infiltration because they slow runoff rates and allow for both sediment settling and stormwater infiltration.

Bioretention
Rain gardens within the site will serve as highly visible landscape features that capture runoff from the buildings and surrounding walkways as well as yard areas. The gardens will support educational opportunities while providing a numerous ecological benefits to the site.

DEPAVE
109 Loudon has a plethora of asphalt allowing for multiple opportunities to narrow drive aisles and remove excess parking spots. These locations will be replaced with native landscapes that will further aid water quality, reduce runoff velocities, and decrease urban heat island effects.

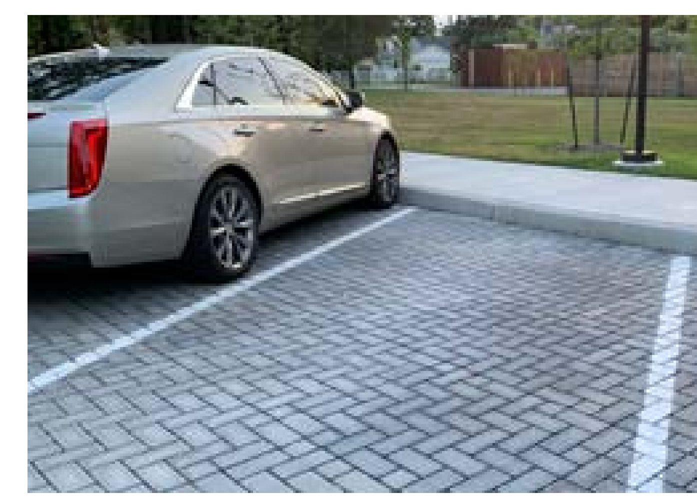
[Park]ing
Where feasible, pervious parking could be utilized for further treatment of stormwater runoff. The site has a significant amount of paved area in the rear, which runs off to the main frontage road (West Loudon). This area will play a large part in reducing the overall impact this site has on flooding, water quality, and the velocity of stormwater runoff.

PLANTED SWALES

BIO-RETENTION

DEPAVE

[PARK]ING



Swale Commons

Areas that already pond in rain events illustrate low points that would make ideal locations for stormwater infrastructure. Installing swales will help improve soil and clean water through biological processes.

Adding more definition to the landscape will offer units more privacy while improving site aesthetics. The plant materials will help cool ambient temperatures with shade, allowing for utility fee benefits. Once established, these landscapes can also lessen long-term maintenance costs.

Improving the site's biodiversity benefits larger ecological systems as well as the watershed. These spaces will better define public versus private space, allowing residents more use and comfort in their respective homes.

Little to no clear circulation or designated areas for pedestrians exist currently.

As the site exists, during rain events, water ponds in low spots and creates standing water on the impervious surface.

Trees should be incorporated within the swale to help increase stormwater take up, provide shade and benefit microclimates.

The swale will be planted with native perennial plant materials. Native plants are more well adapted to the climate zone, hardier and lower maintenance long term. In addition, these native landscapes provide both biodiversity and aesthetic benefits for residents.

Resident spaces are better delineated with the use of the swale and planting as buffers.

The swale will feature river stone as an aesthetic element that also slows water down and helps provide a limited amount of short-term storage capacity in void spaces.

Site Calculations and Makeup

Using the LFUCG parking requirements, landscape requirements and stormwater regulations, as well as the LFUCG Stormwater Manual, the following results were made. Through reconfiguration of the site, 43,390 square feet of multifamily residential space is envisioned. This reconfiguration supports 127 parking spaces and 17,294 square feet of amenity space. In addition to the programmed elements, the space met the requirements of the stormwater manual by +29% using a combination of impervious removal and treating impervious areas. The tools used for this option included permeable paving, a retention pond and bioswales throughout the site.

Total Site Area	**111,434 sq. ft.**
Residential Area	43,390 sq. ft.
Total Building Footprint Area	**21,695 sq. ft.**
Number of Parking Spaces	**127**
Amenity Space	17,294 sq. ft.

Stormwater Management

Impervious Removal Area		Treated Area	
Permeable Paving	14,256 sq. ft.	Retention Pond	2,070 sq. ft.
Vegetative Ground Cover	28,302 sq. ft.	Bioswale	9,742 sq. ft.
Total	42,558 sq. ft.	Total	11,813 sq. ft.
Total %	38%	Total %	11%

Total Combined Total Area	54,370 sq. ft.
Total Combined Area %	**49%**

Mixed-Use

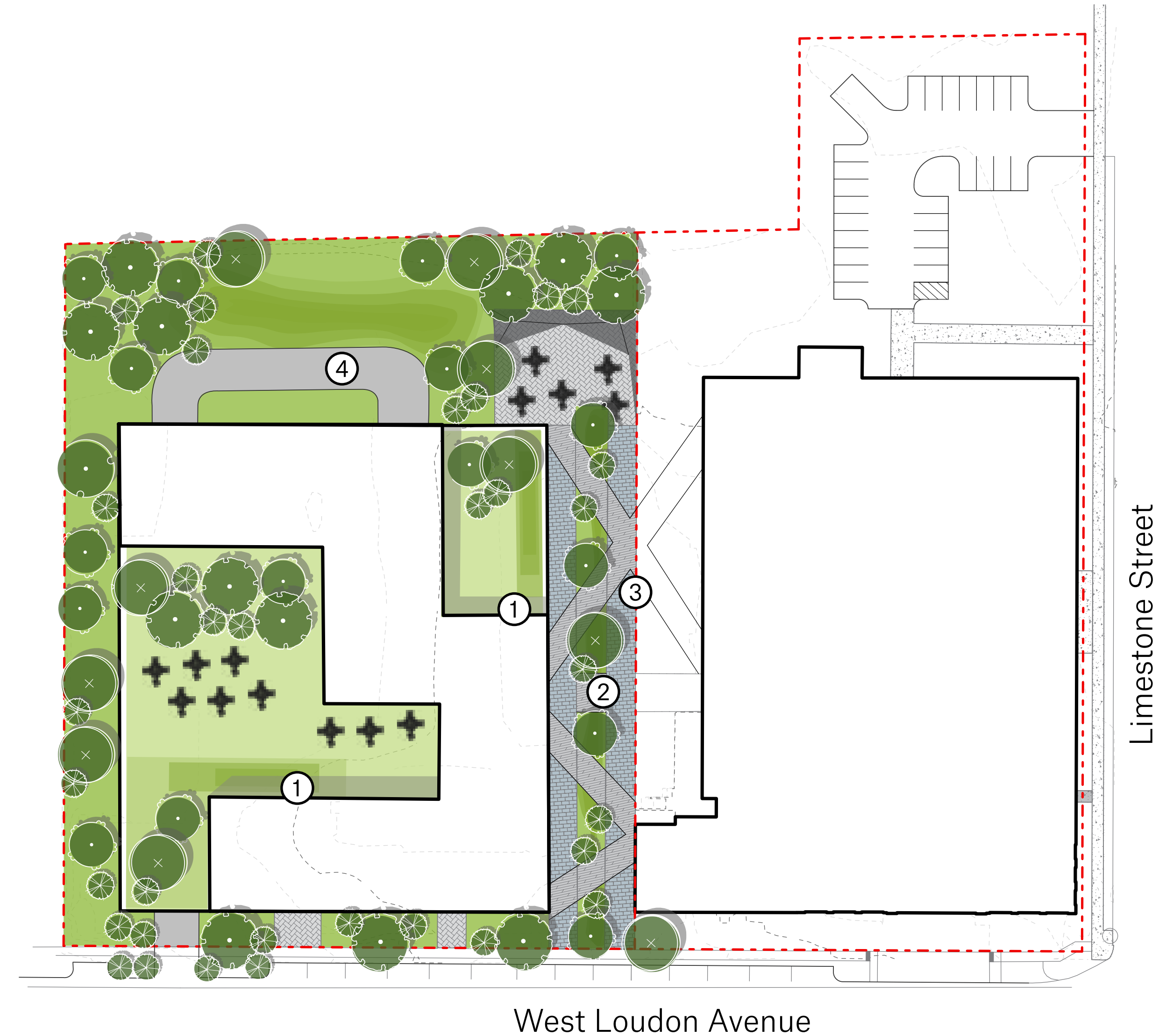
Mixed-use redevelopment is focused solely on providing housing and retail space within the development. For this scenario, we explored how the 109 West Loudon property could use permeable paving, bioswales and bioretention systems within the redevelopment project, while maintaining a unique mixed-use experience, and maximizing on-site amenity space.

Throughout this section, a redevelopment plan will be shown, site makeup will be defined, infrastructure methods will be presented, and site-specific typology will be demonstrated.

Conceptual Design

This plan examines how a mixed-use development can be integrated within the site. Through removal of existing buildings and impervious surface, this redevelopment proposes a single structure with multiple uses. The first floor hosts retail space, the parking garage entrance and parking. The second floor houses the majority of the parking for the site. The third floor is dedicated to the housing options for the site.

To maintain water quality and quantity, three systems are established. The first system is the large bioretention system along the back side of the site that collects the water from the building and a portion of the runoff from the surface drive. The second system is the bioswale within the plaza space. The third system is the pedestrian-only permeable paving throughout the site.



① ROOFTOP GARDEN

Utilizing rooftop space on the building can help capture and filter water that usually falls on an impervious rooftop while also providing a gathering space for residents.

② BIOSWALE

The bioswale through the plaza area would serve to support the runoff from the proposed plaza, while providing educational experiences for visitors, allowing them to view and interact with a stormwater management system.

③ PERMEABLE PAVING

To address the parking lot, pervious paving will be used to improve water quality, reduce urban heat island impacts, and improve vehicular and pedestrian circulation.

④ BIORETENTION

The use of bioretention will help capture high water volumes during major rain events, slow water velocities to reduce downstream erosion.

Strategy Identification

In the case of the 109 mixed-use scenario, four main strategies were identified to decrease impervious surfaces, improve water quality, and make the property more attractive and valuable to the owner and the community.

Rooftop Garden
Integrating a rooftop garden onto the building can help with the heat island effect. A vegetative roof can also reduce the amount of impervious surface, helping with stormwater runoff from the building.

Bioretention Swale
In restrictive sites where space is often at a premium, swales located alongside buildings could help amplify the amount of water stored and treated. A swale can also serve as a visual aspect of the site to improve the experience within the plaza areas.

Bioretention Garden
The rear parking lot is currently inefficient and could allow for a retrofit that offers enough space for a bioretention feature; one that could handle small rain events from the rooftop, while also providing a beautiful landscape.

Permeable Paving
Permeable paving could be utilized throughout the site to offer new opportunities for stormwater infiltration as well as potential water-quality benefits from the stone and sand layers that act as filters. Ambient temperature and overall aesthetics and functionality are other benefits.

ROOFTOP GARDEN

BIORETENTION SWALE

BIORETENTION GARDEN

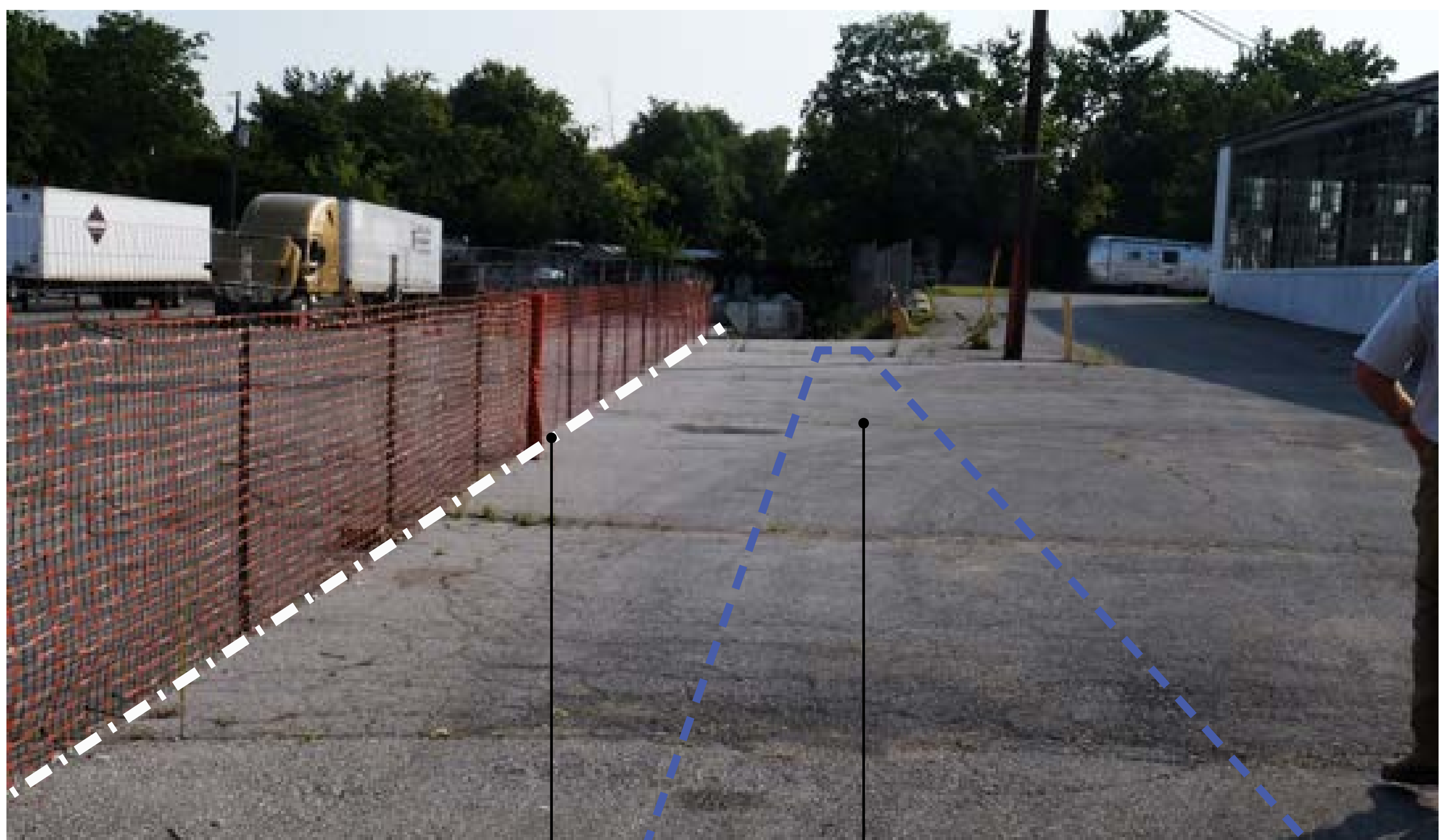
PERMEABLE PAVING

Bioretention + Permeable Paving

Previously unprogrammed space will be retrofit as a purposeful social space that integrates a bioswale as a central feature. This will capture and clean runoff while providing for new native landscapes and stormwater educational opportunities.

These new landscapes can positively impact utility fees, while the addition of the social spaces will also make this property more attractive to prospective and current residents, helping increase occupancy, and making the units more desirable.

Integrating quality social spaces within a development that is geared toward lower market-rate renters helps create more equitable housing conditions while solving stormwater quality issues.



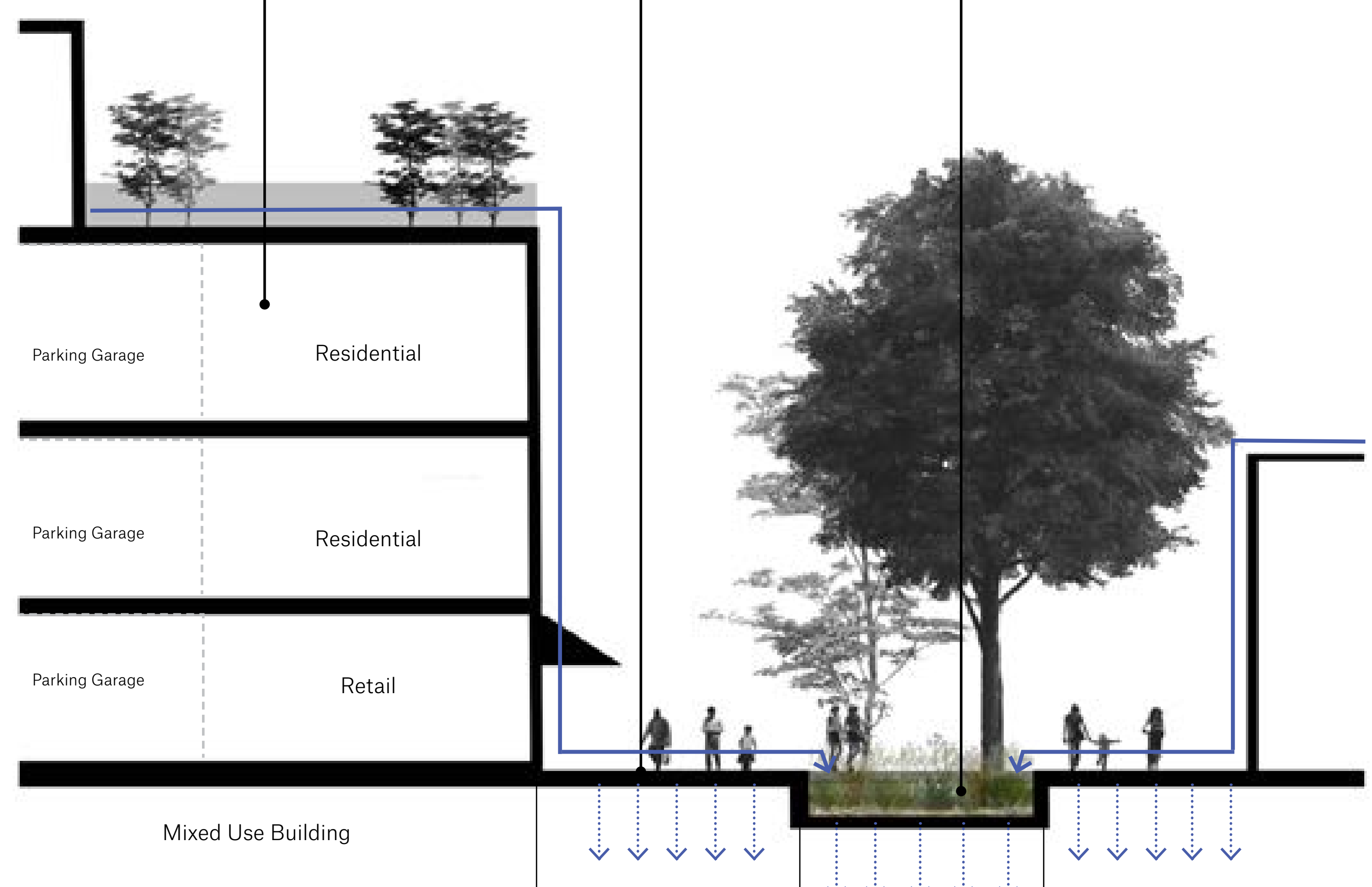
Current barrier divide the two sites. Improved pedestrian connections can help alleviate the separation.

Development of a swale system an help collect stormwater before entering into the site.

Rooftop green space will help alleviate heat index on the building and provide open space for residents.

Retail amenity space would be denoted by the permeable paving. This wide area can host space for retail as well as walking area for visitors.

These landscaped areas will increase overall site porosity. They will also provide room for native plantings, including trees and other plant material, that will offer a more ecologically friendly site, reduce stormwater velocity, and increase stormwater percolation, improving overall water quality.



Water Education

Throughout this interactive plaza space, educational signage highlighting the benefits of stormwater management systems will be provided to visitors. This education system will serve to support and further the knowledge of stormwater impacts. An emersive landscape will help individuals to touch and see how these systems function and operate within the site.

Rooftop garden will help with the heat island effect, while slowing runoff from the building.

Stormwater runoff from the building can run off through drainage pipes into smaller retention systems before flowing into the larger swale system .

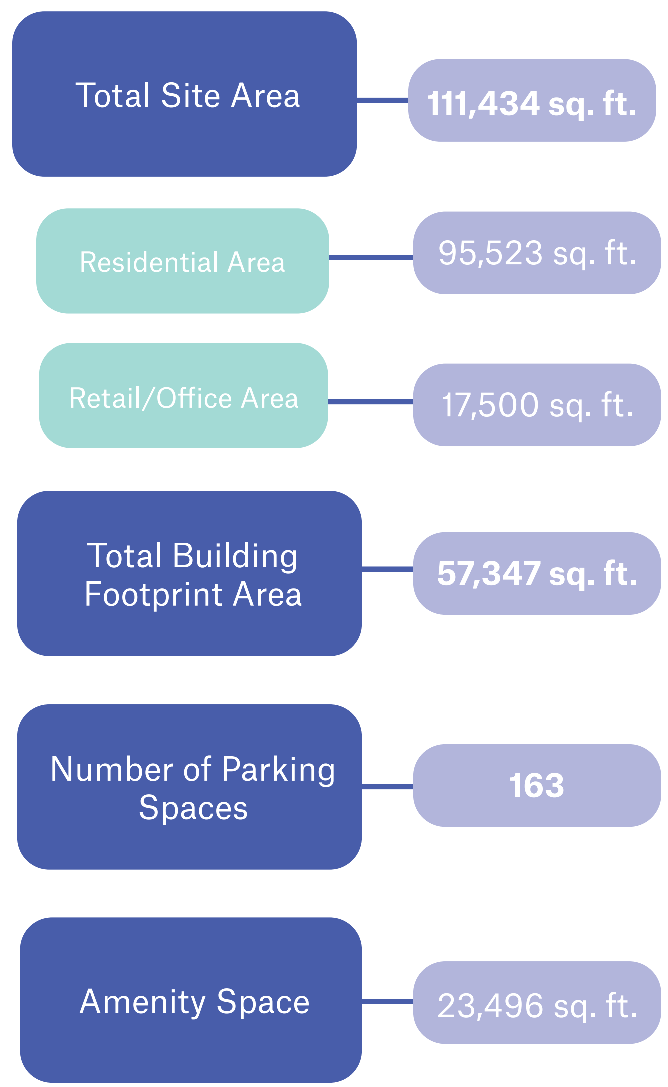
Signage will be present on the overpasses and along the walkways.

Overpass walkways provide visualization into the swale system.

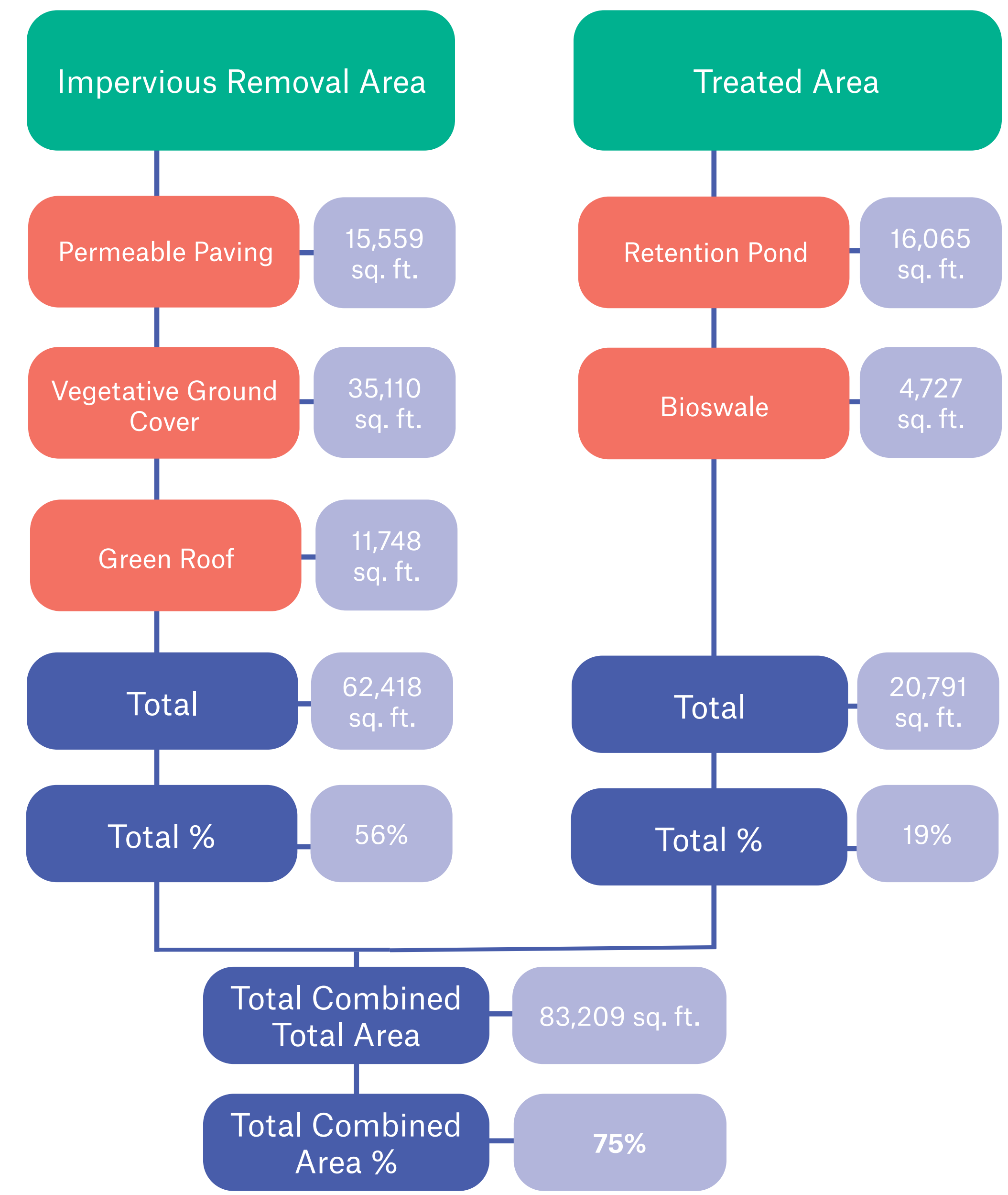
Accessible swale system will provide users with a visual representation of a stormwater system.

Site Calculations and Make-up

Using the LFUCG parking requirements, landscape requirements and stormwater regulations, as well as the LFUCG Stormwater Manual, the following results were made. Through reconfiguration of the site 95,523 square feet of multifamily residential space and 17,500 square feet of retail/office space is envisioned. This reconfiguration supports 163 parking spaces and 23,496 square feet of amenity space. In addition to the programmed elements the space met the requirements of the stormwater manual by +55% using a combination of impervious removal and treating impervious areas. The tools used for this option included permeable paving, a retention pond, green roofs and bioswales throughout the site.



Stormwater Management



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Gresham Smith

Genuine Ingenuity