5.0 The Design Strategies in Northern Kentucky

Chapter 4 introduced the green infrastructure strategies for stormwater management and basic characteristics of each strategy. This chapter explores opportunities for applying the strategies in street, parking lot, and building conditions found in Northern Kentucky. The example plans, diagrams, and sketches shown in the following section demonstrate a variety of ways that the toolbox strategies could be applied.

These examples are meant to give a taste of what is possible for both new and retrofit construction. Local decision-makers, residents, designers, developers, and other stakeholders will decide which strategies work best for their goals and site conditions (i.e., as soil type and topography). Northern Kentucky has a range of soil conditions from very well-draining, loamy soils to poorly-draining, clay soils. These conditions need to be taken into account in the selection and design of a particular strategy.

Several "before and after" sketches show the potential for green streets, parking lots, and building applications in Northern Kentucky. The majority of drawings are based on sites the team saw during its April 2008 visit to Covington, and some are from work in other areas of the country. All though represent similar opportunities that exist throughout Northern Kentucky. The goal of illustrating multiple site strategies is to give communities a broad range of site-scale design applications that could be used throughout the region.

SOURCE: NEVUE NGAN ASSOCIATES

Figure 5-1: *Residential streets offer some of the best opportunities to incorporate rain garden designs.*

SOURCE: NEVUE NGAN ASSOCIATES

Figure 5-2: *Parking lots can be designed or redesigned to maximize landscape area for stormwater management.*

SOURCE: NEVUE NGAN ASSOCIATES

Figure 5-3: *Landscape areas next to buildings can be converted into rain gardens as well.*

Figure 5-4: *A residential street within an established neighborhood in Northern Kentucky.*

Residential streets often offer the greatest potential for building green streets. Typically, most new developments use conventional engineering approaches to manage street runoff. Multiple green street opportunities exist for new construction and for retrofitting existing streets to recapture some of the attractive character of the older streets found in cities like Covington. This section illustrates possibilities for managing stormwater runoff from residential streets in Northern Kentucky.

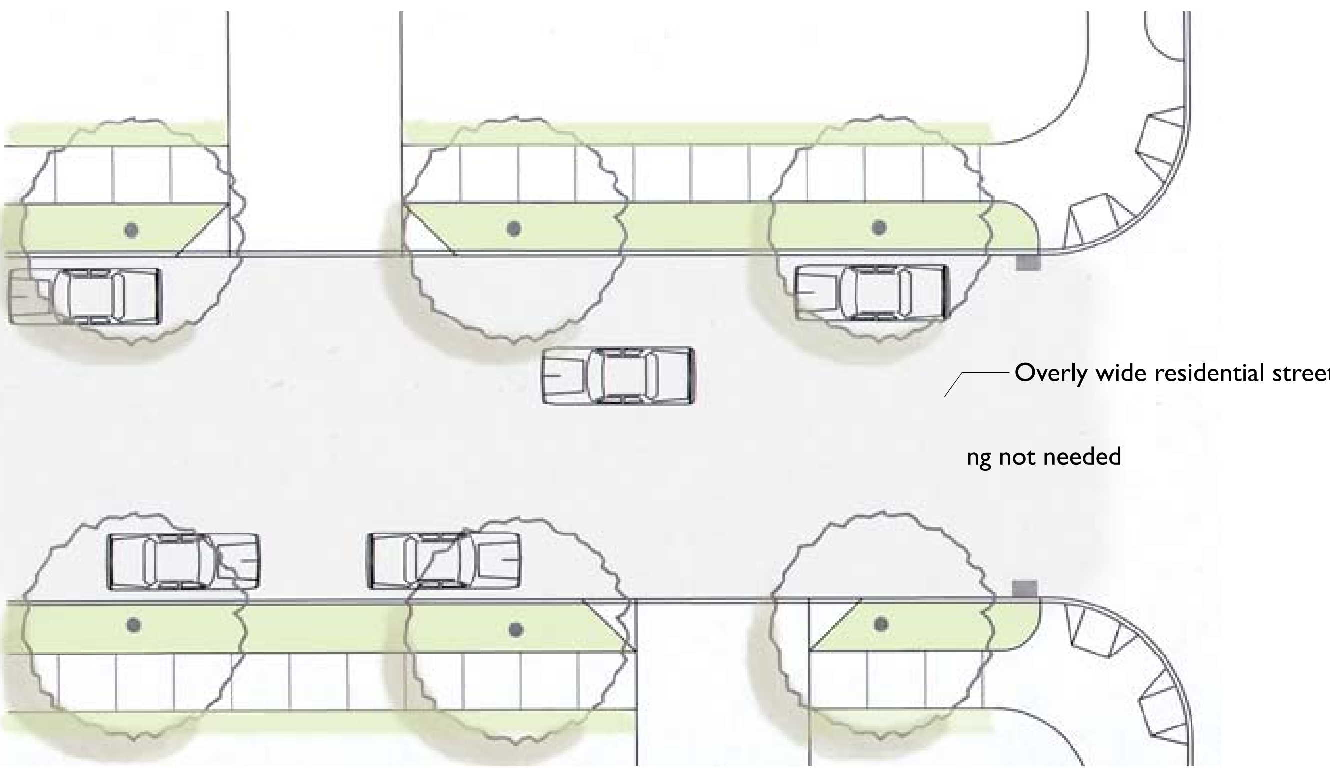


Figure 5-5: **Conventional Low-Density Residential Street-Plan View**

Using Stormwater Curb Extensions

Many streets in Northern Kentucky could be retroffited with stormwater curb extensions that could contain rain gardens while not affecting existing trees. This residential street example illustrates how stormwater curb extensions can be easily retrofitted alongside the existing curb line. Runoff from the street can simply enter these landscape areas and overflow into the existing drain inlets. Because this street has a lot of unused on-street parking, installing curb extensions would not take away needed parking. With the new stormwater curb extensions and street trees in place, the narrower street provides a more aesthetically pleasing and potentially safer traffic environment.

SOURCE: NEVUE NGAN ASSOCIATES

Figure 5-6: EXISTING: *A typical low-density residential street in Covington.*

SOURCE: NEVUE NGAN ASSOCIATES

Figure 5-7: RETROFIT OPPORTUNITY: *Same residential street retrofitted with stormwater curb extensions.*

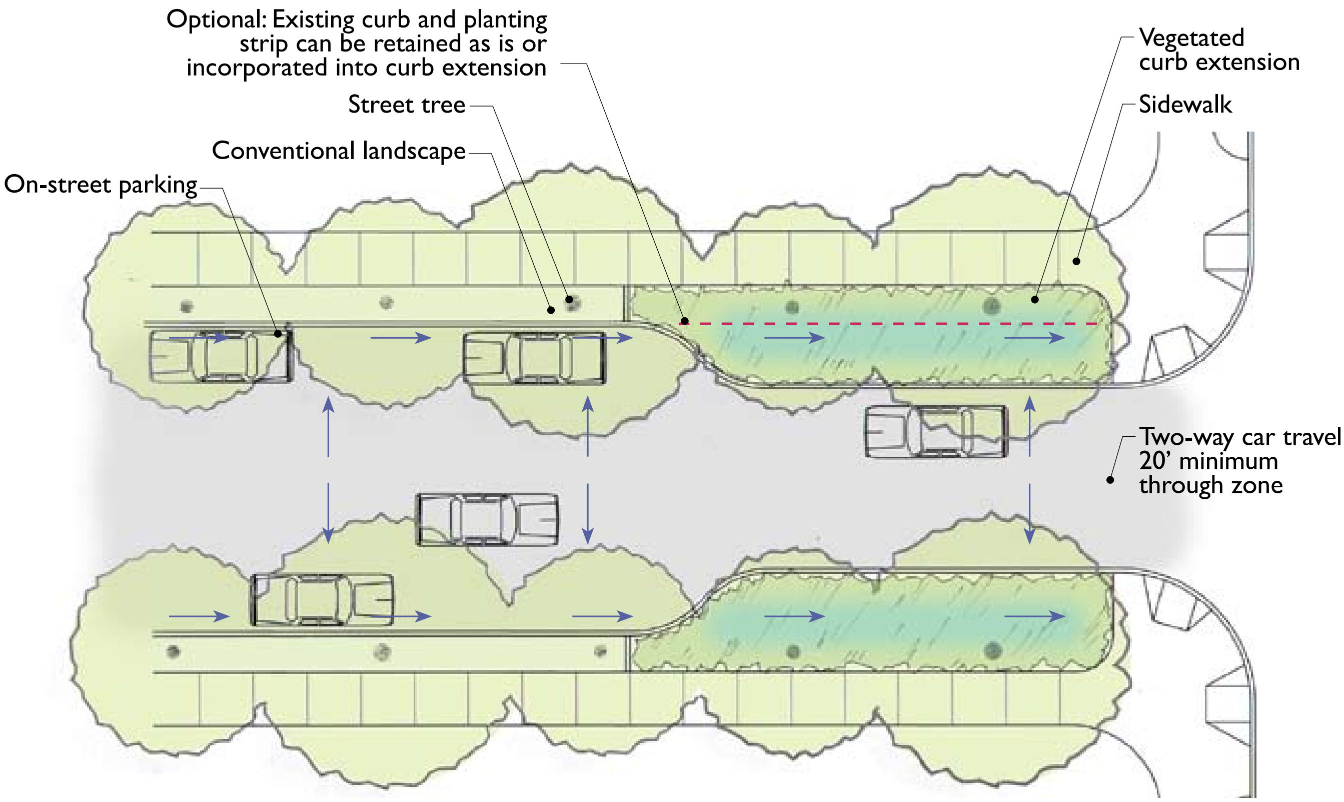


Figure 5-8: **Stormwater Curb Extension at Intersection-Plan View**

SOURCE: NEVUE NGAN ASSOCIATES

Figure 5-9: *A pair of stormwater curb extensions used in a residential street's parking zone in Portland, Oregon.*

Mid-block Stormwater Curb Extension Applications

The street in Figure 5-10 illustrates an opportunity to use stormwater curb extensions mid-block. Mid-block curb extensions can be designed in many shapes and layouts. Figures 5-12 and 5-13 show stormwater curb extensions in either a symmetrical or staggered pattern to calm traffic. Stormwater curb extensions do not have to be paired on both sides of the street. Figure 5-11 shows a mid-block curb extension on only one side of the street to accommodate existing driveways on the other side. Pervious paving on the driveway side of the street could complement the mid-block curb extension and better manage the street's stormwater runoff.

SOURCE: NEVUE NGAN ASSOCIATES

***Figure 5-10: EXISTING:** A typical, narrow, low-density residential street in San Mateo County, California.*

SOURCE: NEVUE NGAN ASSOCIATES

***Figure 5-11: RETROFIT OPPORTUNITY:** Same residential street retrofitted with mid-block stormwater curb extensions as well as additional street trees.*

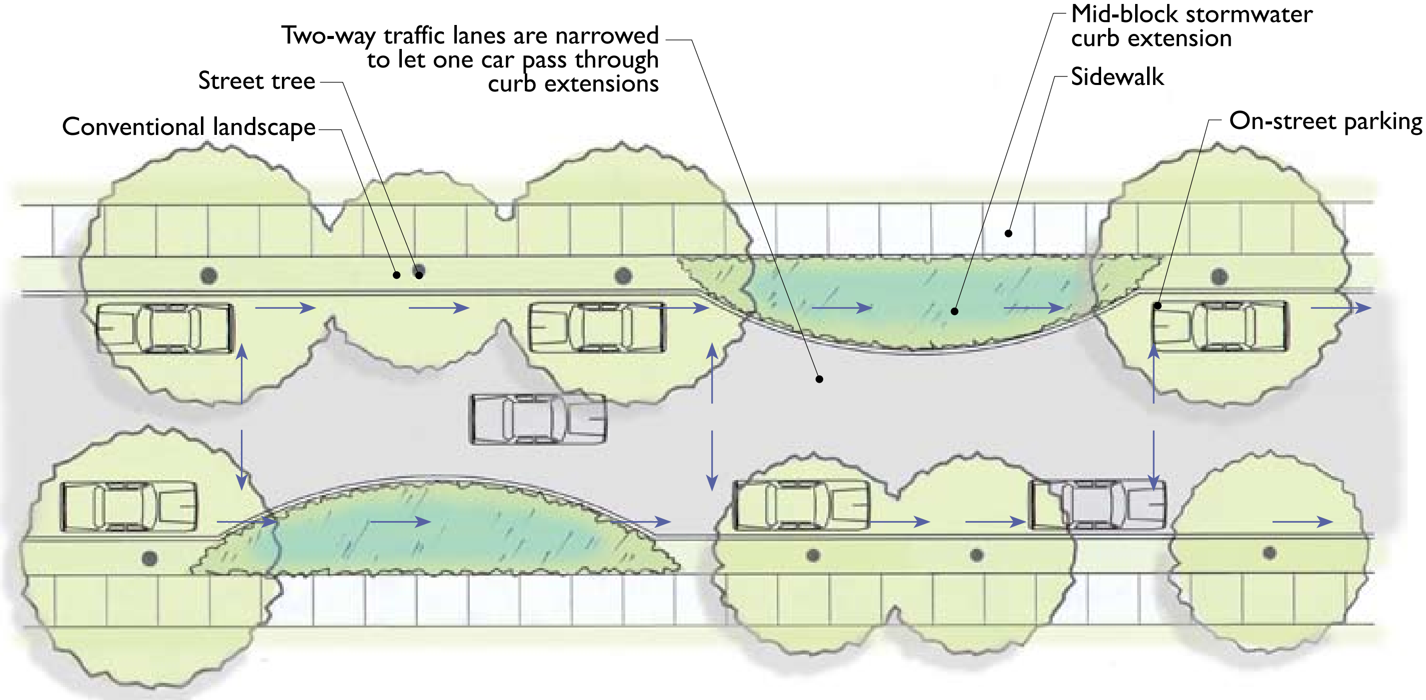


Figure 5-12: **Mid-Block Stormwater Curb Extension (Staggered Layout)-Plan**

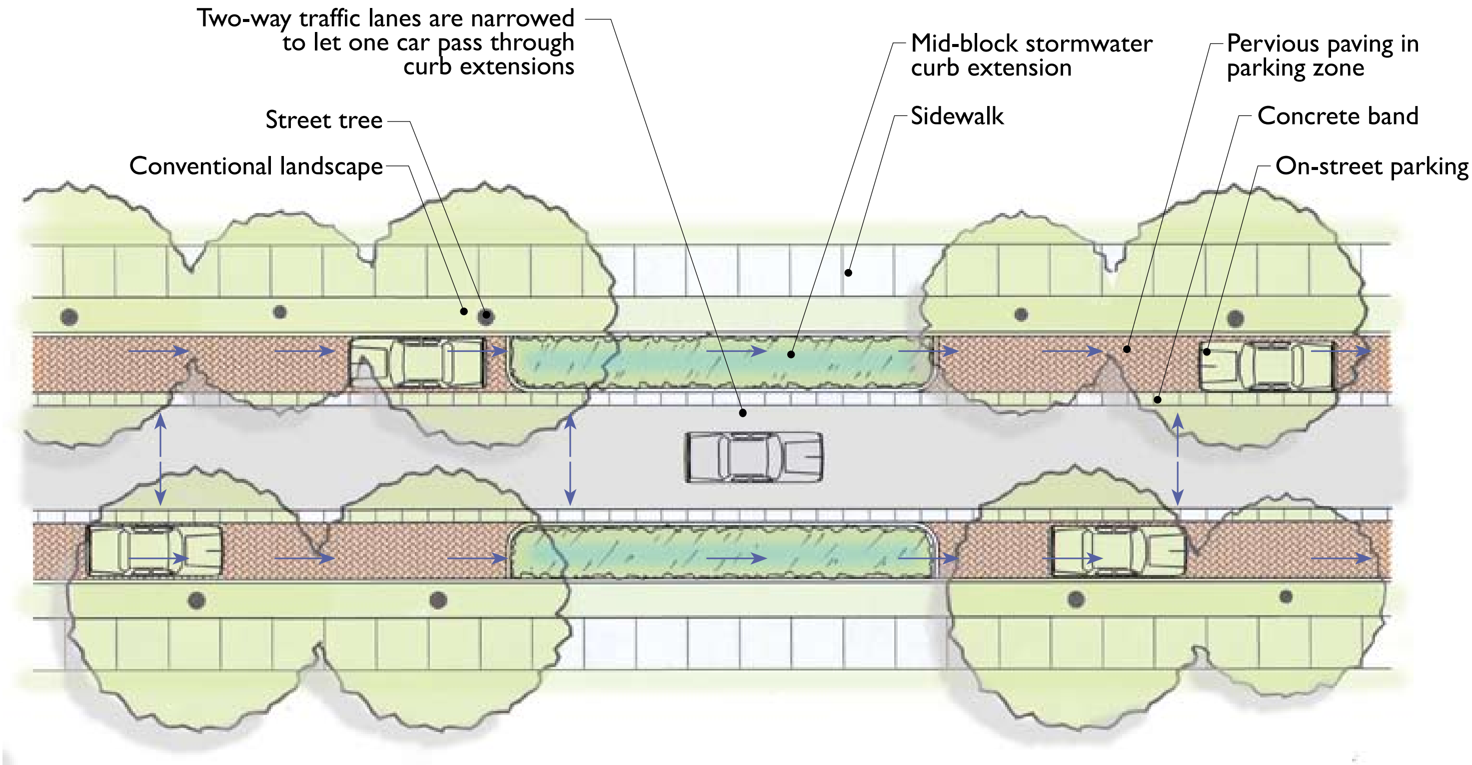


Figure 5-13: **Mid-Block Stormwater Curb Extension (Symmetrical Layout)-Plan**

Options for New Development

The street shown in Figure 5-14 has lawn in planting strips between the street and the sidewalks. The design could have substituted swales for lawn in the planting strips, with a curbless condition to allow water to sheet flow into the swales (see Figure 5-15). These design changes could provide significant stormwater management area, reducing the need for a larger facility to treat all the runoff from this development in one location. Figure 5-16 and Figure 5-17 show additional options for using swales depending on how streets are crowned (See Appendix C).

SOURCE: NEVUE NGAN ASSOCIATES

Figure 5-14 EXISTING: *A new residential street in Lewes, Delaware.*

SOURCE: NEVUE NGAN ASSOCIATES

Figure 5-15: RETROFIT OPPORTUNITY: *Same residential street using vegetated swales in the street's planting strips.*

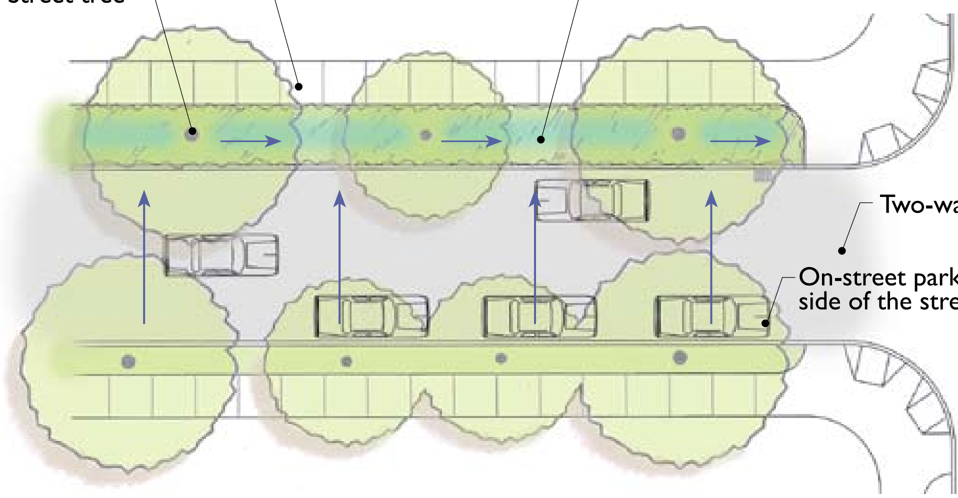


Figure 5-16: **Swale on One Side of Street, Parking on Other Side-Plan View View**

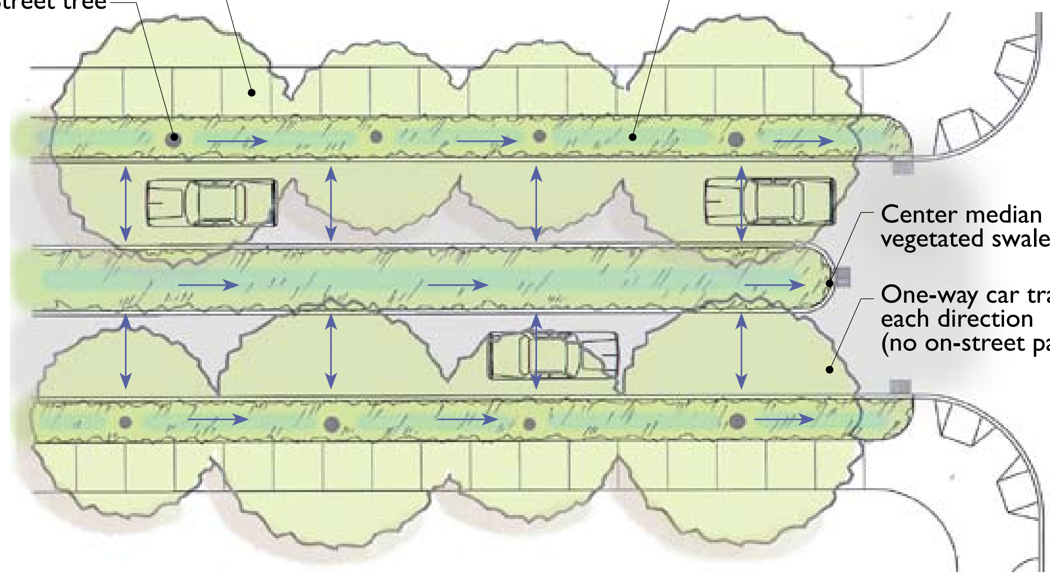


Figure 5-17: **Side Swales and Median Swale (No On-Street Parking)-Plan View**

5.1 Residential Streets

Pervious Paving in the Parking Zone

Pervious pavers in the parking lane can give the illusion of a narrower street and therefore help calm traffic. They convert impervious surface to allow stormwater to absorb into the ground, reducing the amount of runoff, without any loss of parking on the street.

SOURCE: NEVUE NGAN ASSOCIATES

Figure 5-18: EXISTING: *A typical urban residential street in Covington,.*

SOURCE: NEVUE NGAN ASSOCIATES

Figure 5-19: RETROFIT OPPORTUNITY: *Same residential street retrofitted with pervious paving in the parking zone of the street.*

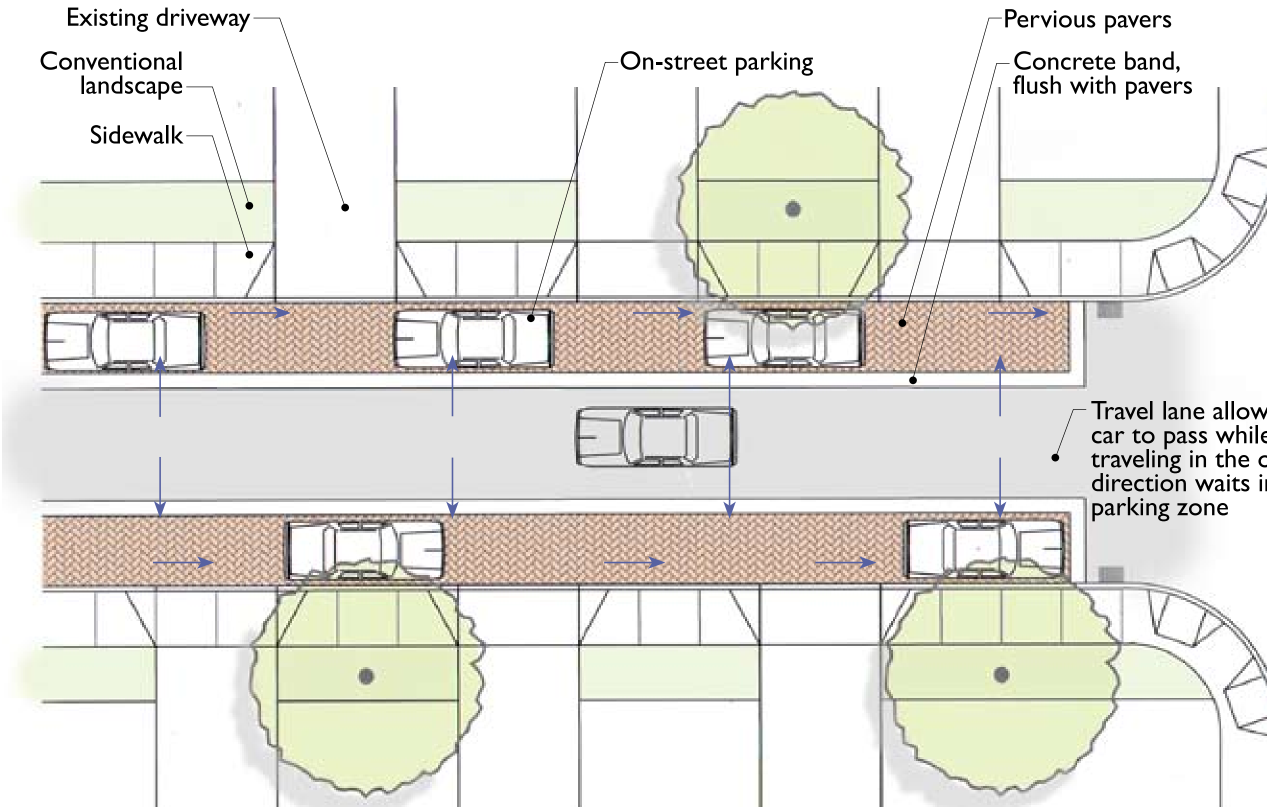


Figure 5-20: **Pervious Paving in Parking Zone-Plan View**

SOURCE: NEVUE NGAN ASSOCIATES

Figure 5-21: *Pervious paving used in a residential street's parking zone. Notice the visual "narrowing" of the street.*

Residential Alley Swales

Putting garages behind homes makes the street more pedestrian friendly, and the architectural detail of the home is no longer dominated by a front-entry garage. Providing alley access and eliminating the driveways at the front of homes not only enhances the overall streetscape, but also allows a more contiguous landscape area along the street frontage and front yards.

The example in Figure 5-23 transforms the alley in Figure 5-22 by draining water to the sides into narrow swales. The example shows a crowned alley, draining to both sides. An alternative would be to drain the whole alley to a swale on one side. This example shows a curbless condition, with sheet-flow of stormwater into the swale. The swale is shallow, and the street has a low traffic volume. Access across the swale for cars and pedestrians can be provided by either a culvert or small bridge.

SOURCE: NEVUE NGAN ASSOCIATES

Figure 5-22: EXISTING: *An alley in a new residential development in Sussex County, Delaware.*

SOURCE: NEVUE NGAN ASSOCIATES

Figure 5-23: RETROFIT OPPORTUNITY: *Same residential alley retrofitted with side stormwater swales.*

SOURCE: NEVUE NGAN ASSOCIATES

Figure 5-24: EXISTING: *A commercial main street example in Northern Kentucky.*

Many of the historic main streets in Covington and other cities of Northern Kentucky have a wonderful community-oriented and small-town character that the residents cherish. However, like most urban areas in the United States, it can be difficult to find available space for stormwater management and also accommodate space for parking, bikes, pedestrians, street trees, lighting, etc. There are, however, several design options cities could consider when looking to integrate stormwater in its most active streets. The following pages offer examples of how stormwater planters, swales, curb extensions, infiltration gardens, and pervious paving could be integrated into town center streets. These design options could be used in either new construction or retrofits and can fit beautifully with the character of the streetscape.

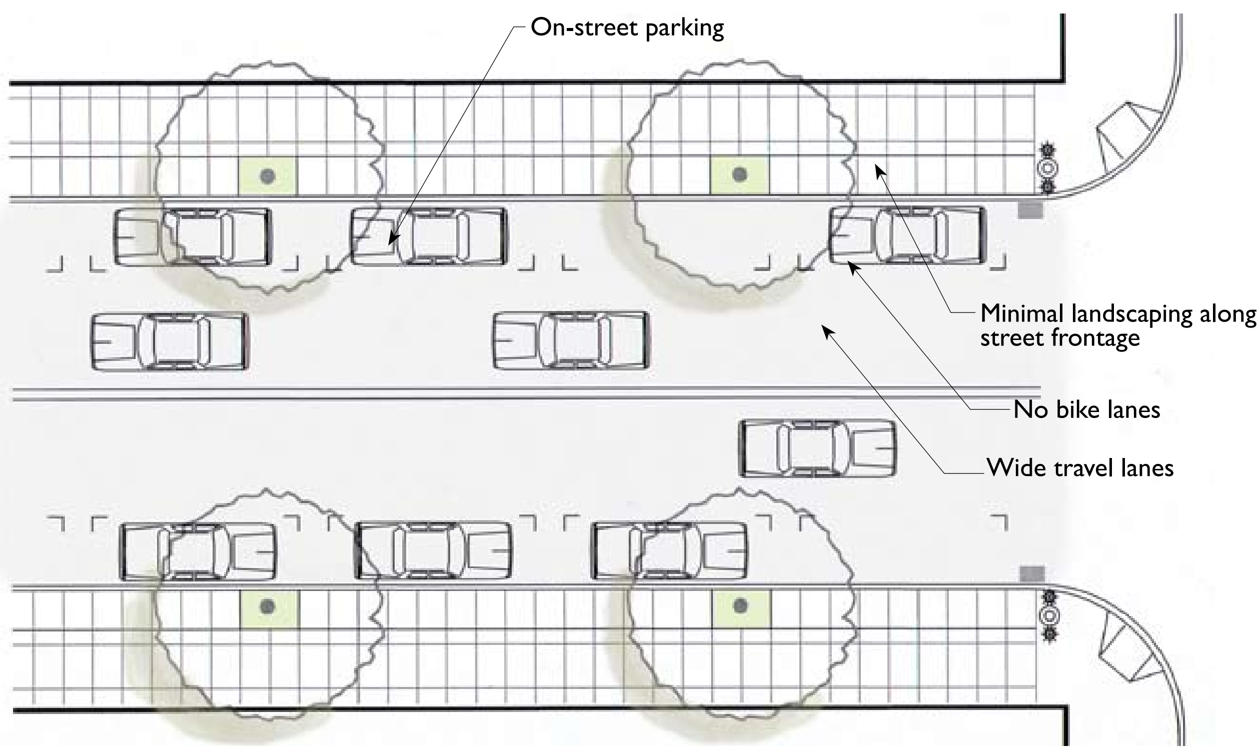


Figure 5-25: **Conventional Commercial Main Street-Plan View**

5.2 Commercial Main Streets

Main Street With Stormwater Planters

This design adds stormwater planters to be added to the furnishing zone while retaining on-street parking. A band of paving, which can be pervious paving or another paving material, allows access to cars parked on the street. This design links a series of flow-through planters or infiltration planters. Water flows into the first one; when it fills up, water can flow back out to the street gutter and into the next planter, and so on. If any stormwater overflows at the end, after the last planter, it flows into the existing catch basin. An advantage of using planters in downtown areas is that they treat a given amount of water in tighter spaces because of their vertical walls. In addition, they add greenery and make the streetscape more appealing.

SOURCE: NEVUE NGAN ASSOCIATES

Figure 5-26: EXISTING: *A commercial street in Covington with on-street parking.*

SOURCE: NEVUE NGAN ASSOCIATES

Figure 5-27: RETROFIT OPPORTUNITY: *Same commercial street retrofitted with a series of stormwater planters.*

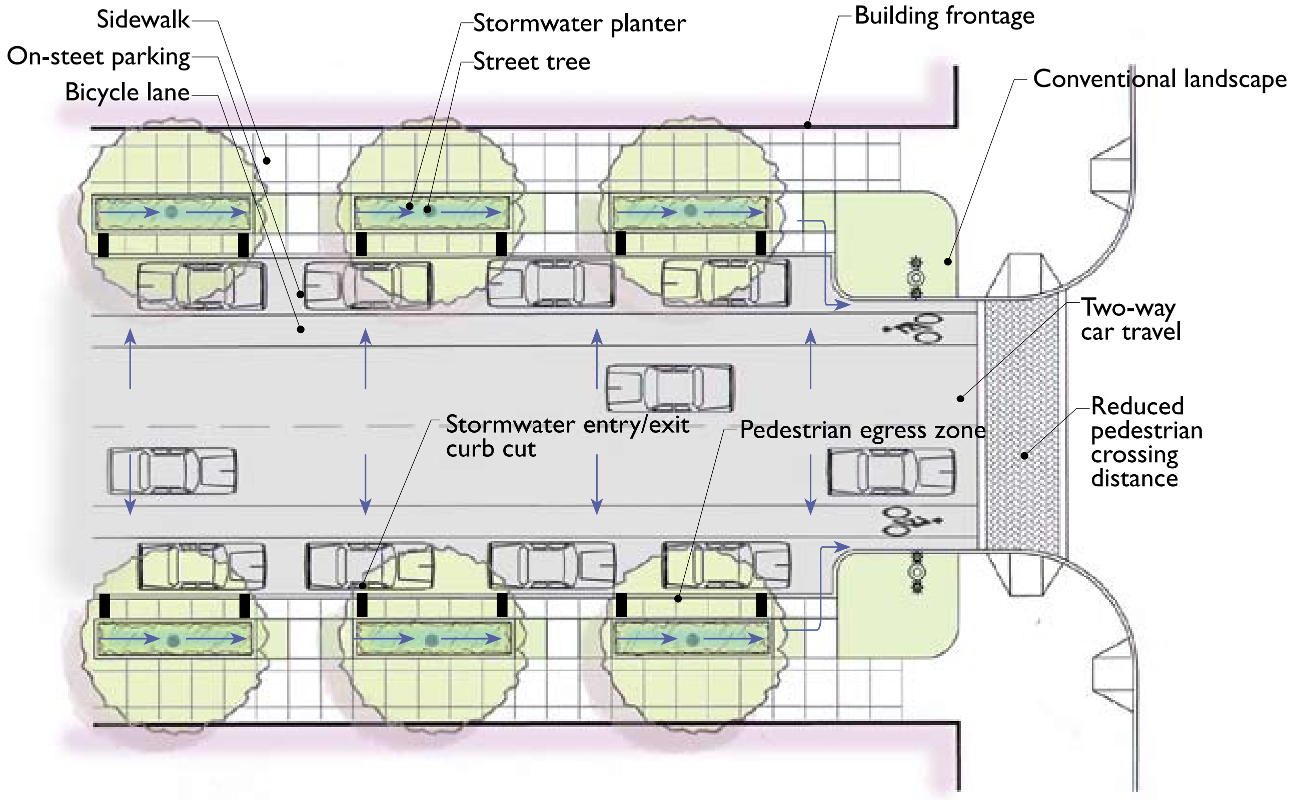


Figure 5-28: **Stormwater Planters With On-Street Parking-Plan View**

Figure 5-29: *Stormwater planters used along a downtown street. Space should be allocated for people to get in and out of their vehicles and access the sidewalk.*

Parking on One Side, Stormwater on the Other

This example shows stormwater planters on a two- or four-lane road without on-street parking. The underused travel lane next to the sidewalk has been consolidated into a rain garden and a bike lane. The stormwater planter or swale can be located right up to the edge of the curb because there is no on-street parking. Figure 5-31 illustrates a curbless condition that allows runoff to flow directly into the swale. Bollards are used to separate the bike lane from the swale.

SOURCE: NEVUE NGAN ASSOCIATES

Figure 5-30: EXISTING: *An urban street in Covington.*

SOURCE: NEVUE NGAN ASSOCIATES

Figure 5-31: RETROFIT OPPORTUNITY: *Same street without one traffic lane and retrofitted with a "curbless" street, vegetated swale, and bike lane.*

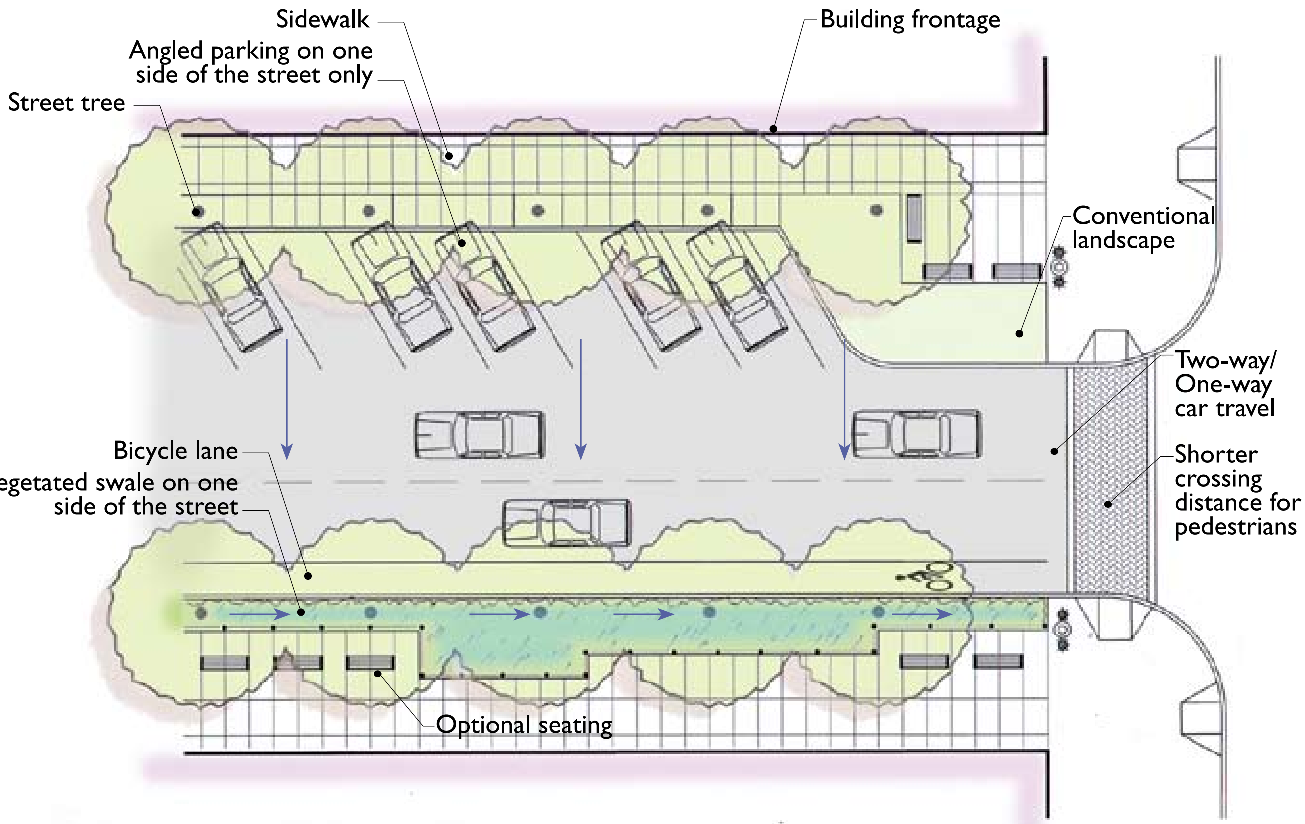


Figure 5-32: **Curbless Street With a Vegetated Swale/Planter on One Side-Plan**

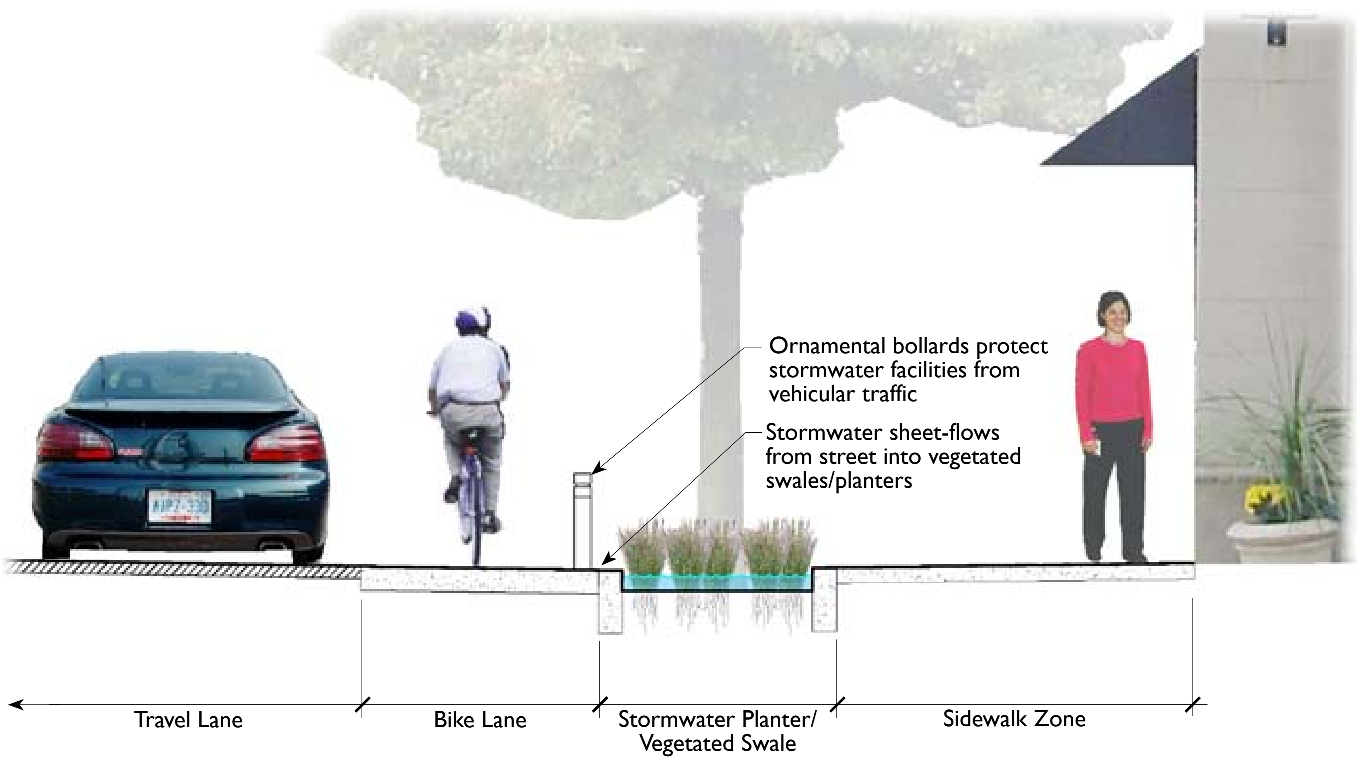


Figure 5-33: **Curbless Street With a Vegetated Swale/Planter on One Side-Cross Section**

5.2 Commercial Main Streets

"Green Gutter" Narrow Planter

As with previous examples, the underused portion of the street in Figure 5-35 is given a stormwater management purpose that in turn creates a more attractive streetscape. This design incorporates a landscape strip on the sidewalk and a three-foot wide strip of paved area converted to a narrow, shallow planter called a "green gutter."

SOURCE: NEVUE NGAN ASSOCIATES

Figure 5-34: EXISTING: *An urban street in Covington.*

SOURCE: NEVUE NGAN ASSOCIATES

Figure 5-35: RETROFIT OPPORTUNITY: *Same street retrofitted with a "green gutter."*

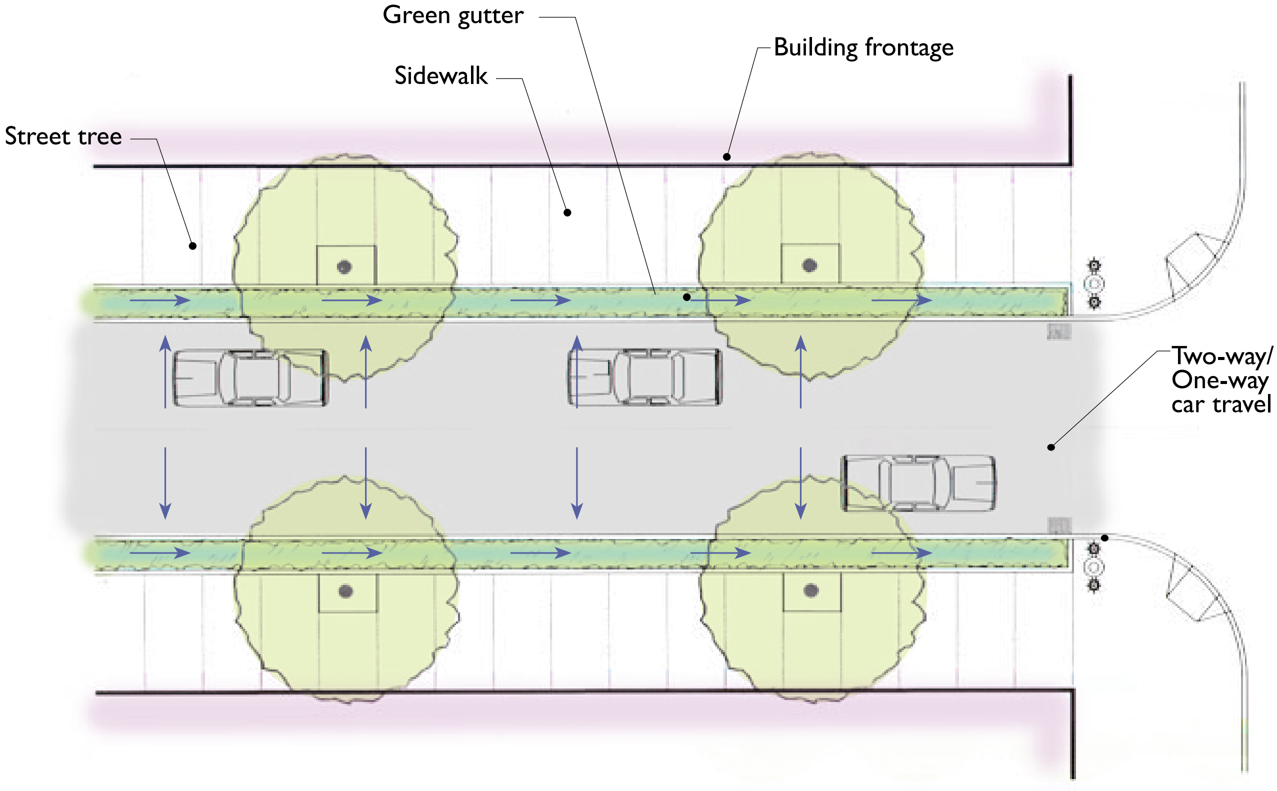


Figure 5-36: **Commercial Street Green Gutter-Plan View**

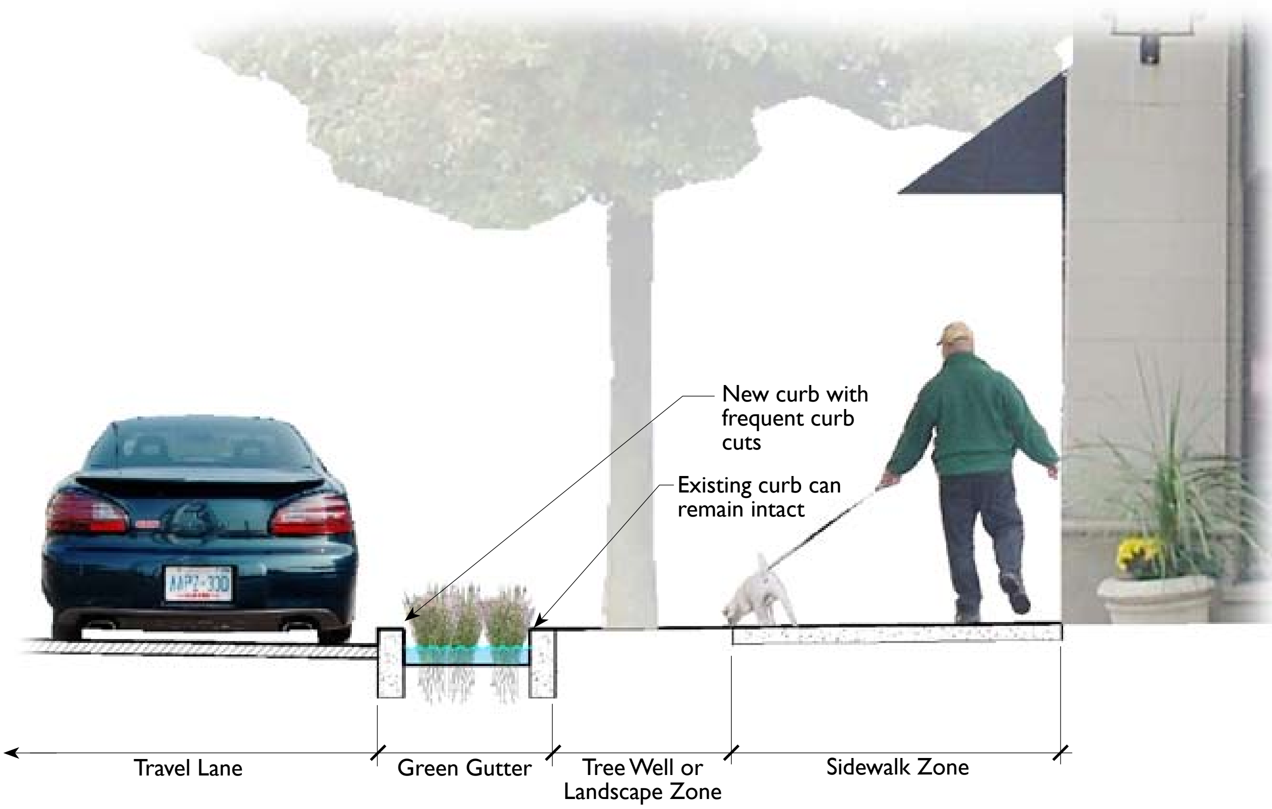


Figure 5-37: **Commercial Street Green Gutter-Section View**

5.2 Commercial Main Streets

Curb Extensions and Pervious Paving in Parallel Parking Zone

The curb extensions shown for residential streets in Section 5.1 can also be adapted to commercial streets. Figure 5-39 illustrates a curb extension with a rain garden planter that is about the size of one parking space. The planters can be built mid-block and serve as street tree planting pits if the sidewalk are too narrow to accommodate street trees.

SOURCE: NEVUE NGAN ASSOCIATES

Figure 5-38: EXISTING: *A typical commercial main street with on-street parking in San Mateo County, California.*

SOURCE: NEVUE NGAN ASSOCIATES

Figure 5-39: RETROFIT OPPORTUNITY: *Same commercial street with pervious paving in the parking zone and stormwater curb extensions.*

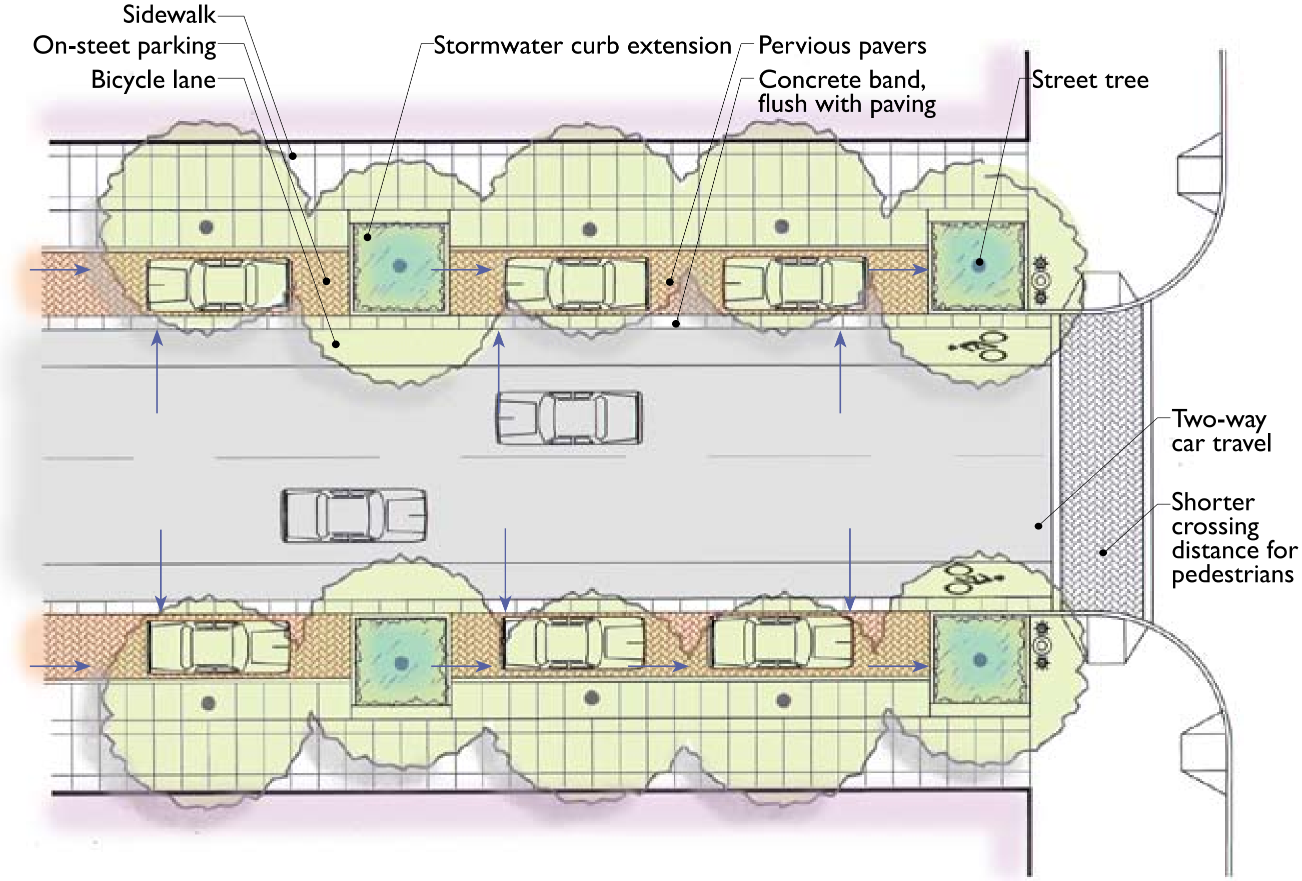


Figure 5-40: **Combination of Pervious Paving and Curb Extensions in Parking Zone-Plan**

SOURCE: NEVUE NGAN ASSOCIATES

Figure 5-41: *This urban street in Portland, Oregon uses pervious paving in its parking zone and could have provided more stormwater management by adding stormwater curb extensions.*

5.2 Commercial Main Streets

Angled Parking Solutions

Angled parking along commercial main streets is common in cities in Northern Kentucky. One green street design scenario consolidates one or more parking spaces into a curb extension. Converting angled parking spaces into curb extensions can add more landscaping to the street which could also make storefronts more attractive.

SOURCE: NEVUE NGAN ASSOCIATES

Figure 5-42: EXISTING: *A typical commercial main street with angled parking in San Mateo County, California.*

SOURCE: NEVUE NGAN ASSOCIATES

Figure 5-43: RETROFIT OPPORTUNITY: *Same commercial street with two angled parking stalls converted into stormwater curb extensions.*

Figure 5-44: **Angled Parking Curb Extensions-Plan ViewView**

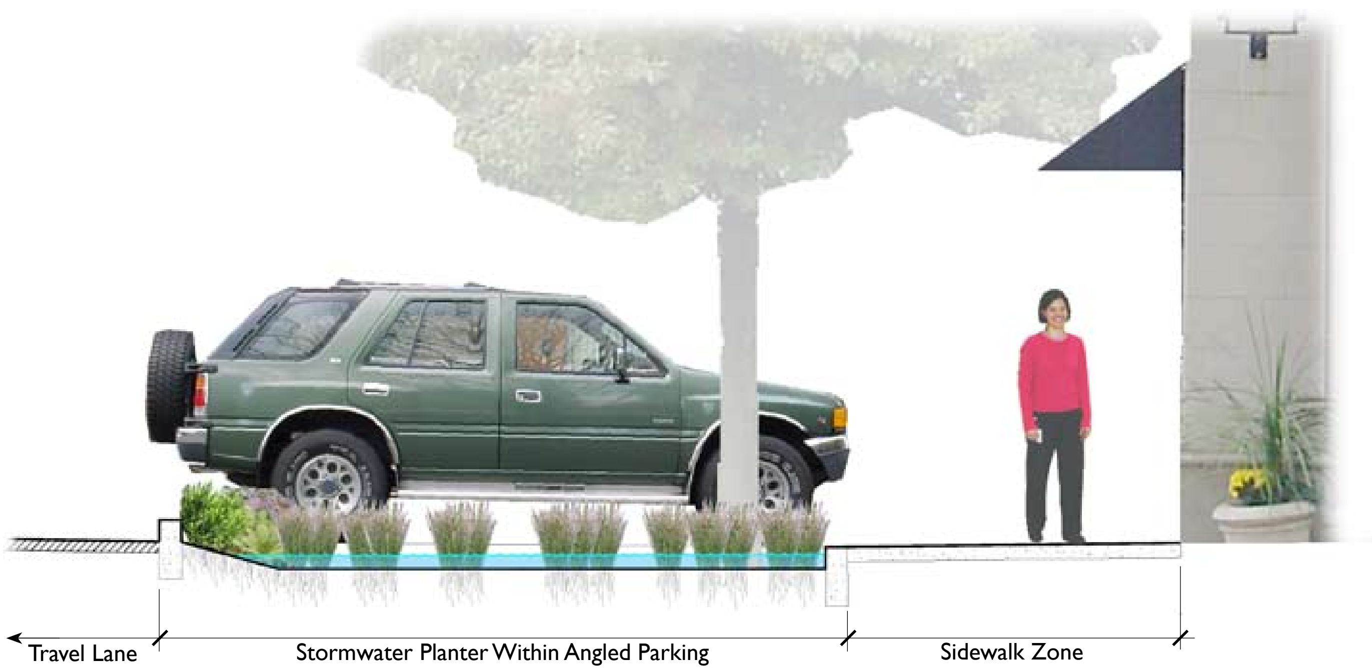


Figure 5-45: **Angled Parking Curb Extensions-Cross Section**

Converting "Gray Space" into "Green Space"

This design illustrates how a more efficient street design can create space for rain gardens. Figure 5-46 shows a streetscape with an oversized travel lane and sidewalk andno street trees or landscaping. The retrofit in Figure 5-47 provides a bike lane, a swale, a landscape strip and a narrow buffer between the sidewalk and the adjacent parking lot.

SOURCE: NEVUE NGAN ASSOCIATES

Figure 5-46: EXISTING: *A typical urban street in Northern Kentucky with no on-street parking. The travel lane and sidewalk are twice as wide as needed.*

SOURCE: NEVUE NGAN ASSOCIATES

Figure 5-47: RETROFIT OPPORTUNITY: *Same street retrofitted with a bike lane, stormwater swale, and additional landscaping and street trees.*

SOURCE: NEVUE NGAN ASSOCIATES

Figure 5-48: EXISTING: *An existing urban alley in downtown Covington.*

An Urban Alley Retrofit

A variety of pervious paving options are available for retrofitting urban alleys with green infrastructure. This example uses pervious concrete with a distinctive serpentine valley gutter that collects any overflow runoff. Simply greening the space alongside buildings can make the alley a more attractive. Swales and planters can achieve this; however, the alley must have adequate space to incorporate these elements with the daily transportation requirements.

SOURCE: NEVUE NGAN ASSOCIATES

Figure 5-49: RETROFIT OPPORTUNITY: *Same alley retrofitted with pervious concrete and an artistic valley gutter to convey overflow.*

5.3 Arterial Streets and Boulevards

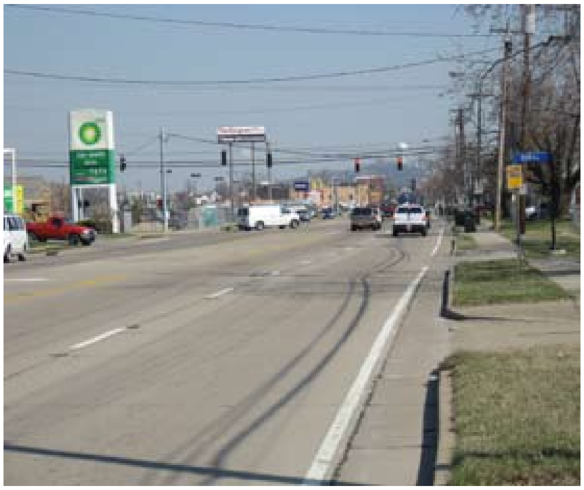

SOURCE: SANITATION DISTRICT NO. 1 OF NORTHERN KENTUCKY

Figure 5-50: EXISTING: *A multi-lane arterial street example in Northern Kentucky.*

Many of Northern Kentucky's arterial streets have large landscape areas adjacent to the roadway. Even though some of these streets have grassy medians and side strips, many do not allow for stormwater management. Hence, retrofitting existing arterials to manage stormwater could help protect water quality. Like residential streets, arterial roadways are great street types for swales because they typically have long, linear stretches of uninterrupted space that could be used to manage stormwater. Some arterials may not have landscape space in place but do have travel lanes or paved shoulders that could be narrowed to create space for swales. This space might also be used for sidewalks, on-street bike lanes, or landscape-separated bike greenways.

Examples in the following section illustrate ways that arterial streets can be built or retrofitted to provide both stormwater management and more transportation choices.

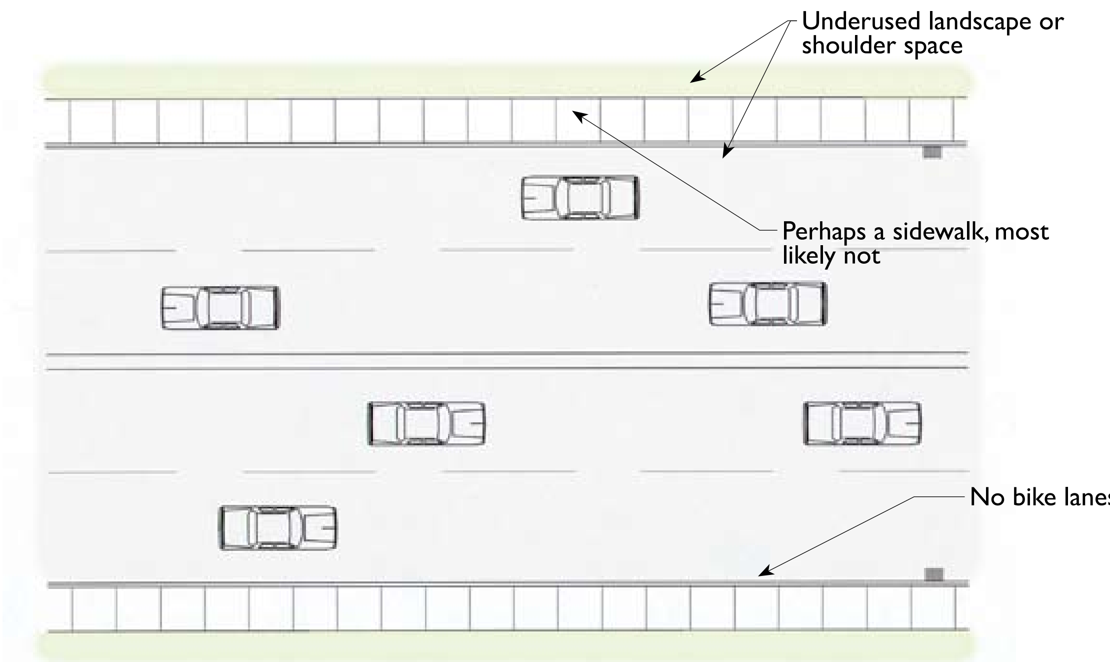


Figure 5-51: **Conventional Highway/Arterial Street-Plan View**

Four-Lane Arterial: Retrofit or New Construction

This four-lane arterial has enough room in the shoulder and utility zone to build a bike lane, sidewalk, safety buffer, and swale. The design can be modified to preserve the shoulder, if it is critical.


SOURCE: NEVUE NGAN ASSOCIATES

Figure 5-52: EXISTING: This arterial street in Lewes, Delaware has an extra wide shoulder that could be used more efficiently.


SOURCE: NEVUE NGAN ASSOCIATES

Figure 5-53: RETROFIT OPPORTUNITY: This retrofit example meets multiple goals by adding a bike lane that is buffered from the road, a sidewalk, and a stormwater swale.


SOURCE: NEVUE NGAN ASSOCIATES

Figure 5-54: EXISTING: *A multi-lane boulevard with an extra wide sidewalk in Nashville, Tennessee.*

Oversize Sidewalk Converted Into a Stormwater Swale

This example shows how a part of an overly wide sidewalk adjacent to an arterial could be reclaimed and used for a swale while still being safe and attractive for pedestrians.


SOURCE: NEVUE NGAN ASSOCIATES

Figure 5-55: RETROFIT OPPORTUNITY: *Same street consolidates the wide sidewalk space for a stormwater swale and street trees along the boulevard.*

Option for an Arterial Street With Multiple Swales

This is another example of how a typical four- or two-lane highway could be designed to not only manage stormwater runoff, but also allow for multiple transportation options, including biking and walking. On-street bike lanes can be used or, if there is adequate space, a separated bike path can provide more protection for bicyclists and pedestrians. Also, depending on the drainage pattern of the roadway, median grassy swales could also manage a portion of the road's runoff.

Figure 5-56: *Stormwater side swale with bike lanes on arterial street in Oregon City, Oregon.*

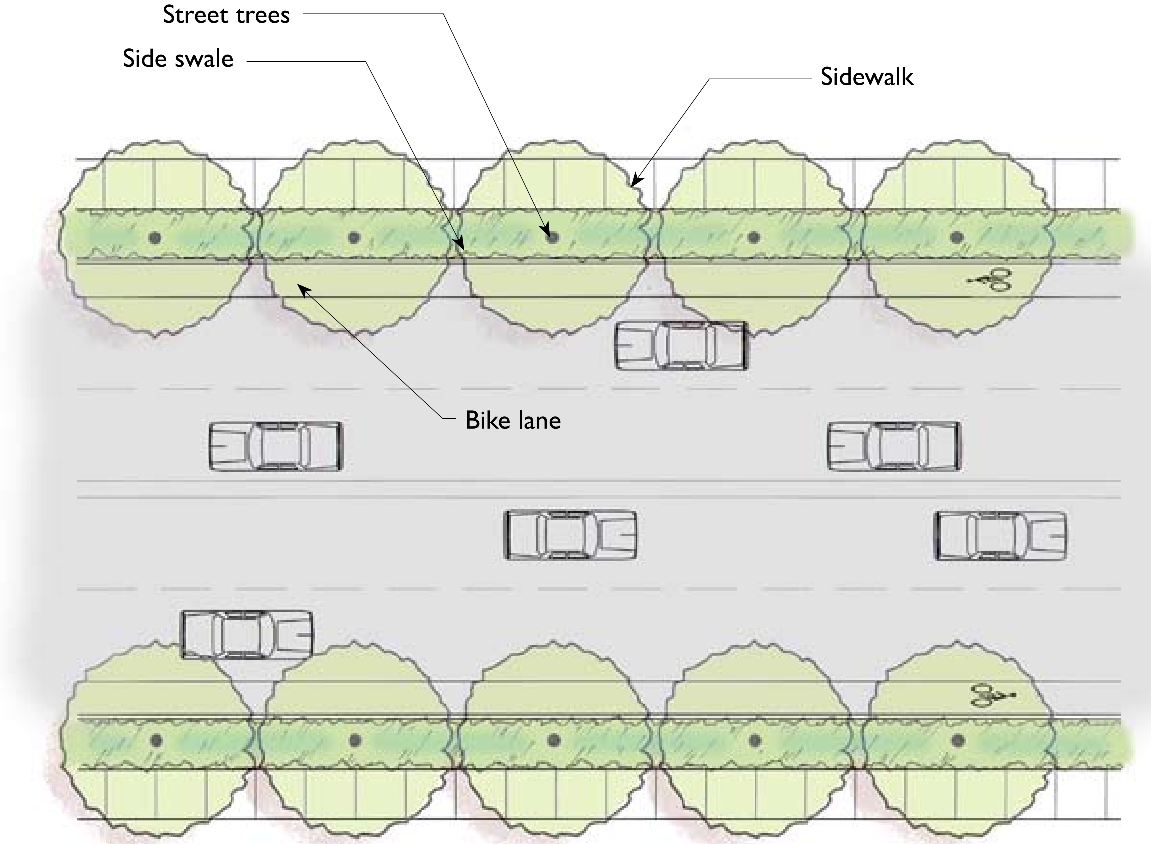


Figure 5-57: **Side Swales on a Multi-Lane Arterial-Plan View**

5.4 Parking Lots

SOURCE: NEVUE NGAN ASSOCIATES

Figure 5-58: *A typical parking lot in Northern Kentucky.*

Previous sections of this handbook have described how designing sites such as parking lots efficiently can yield significant space for landscape areas. Even if landscape areas are not used for rain gardens, they remove impervious area and can be used for planting large canopy trees, native shrubs, and groundcovers. Pervious paving is widely accepted in parking lots and is particularly useful in small parking lots where space is tight, but generally most appropriate for areas with infiltrative soils. Stormwater swales are the most common rain garden strategy used in parking lots. Long, linear swales fit well in between rows of parking. Even curb extensions and infiltration gardens can be used in parking lots. As with street applications, rain gardens in parking lots should be carefully designed to ensure safe pedestrian circulation (see Appendix D). The following pages illustrate different rain garden strategies that could be used in parking lots throughout Northern Kentucky.

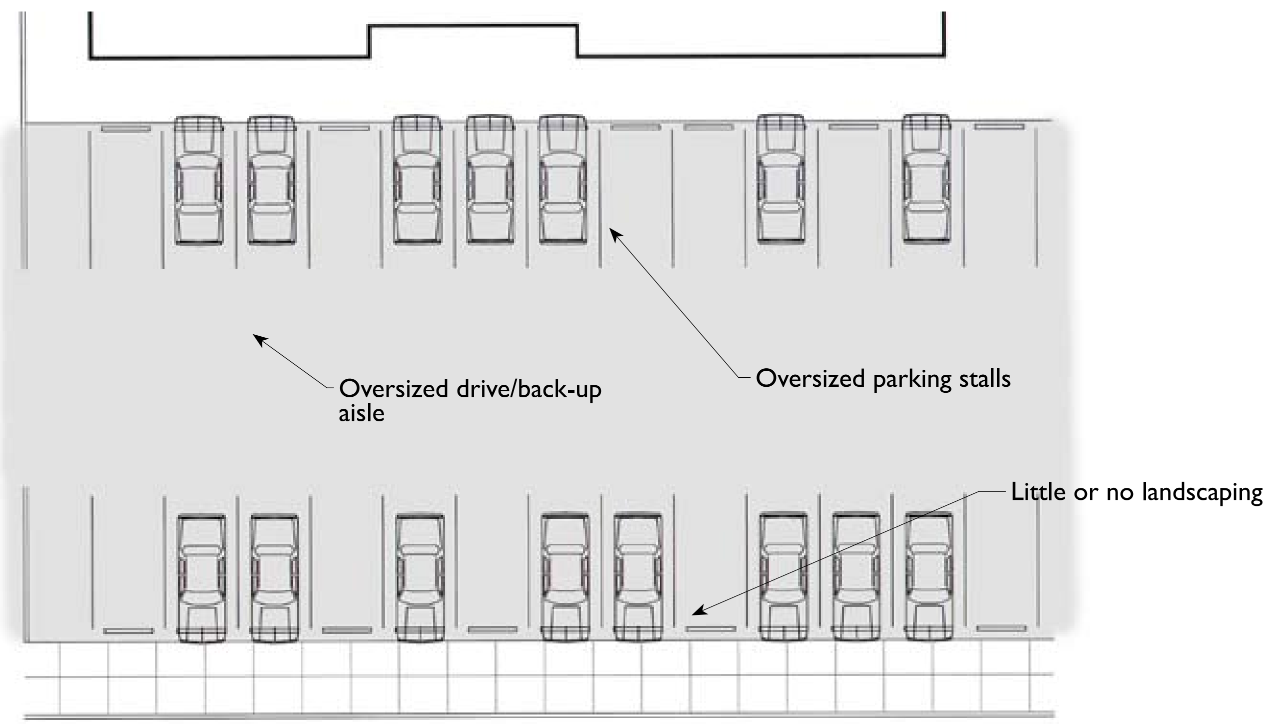


Figure 5-59: **Conventional Parking Lot Conditions-Plan View**

Parking Lot With Side Swale

The top consideration for green parking lot design is the grading of the parking lot and how the water flows into the rain gardens. It is best to sheet-flow the water across the surface of the lot and get it into swales or planters as soon as possible.

When grading a parking lot, remember that it doesn't take a large obstacle to redirect sheet-flow of water; even speed bumps can also be used for water diversion (see Appendix I).

The plan illustration in Figure 5-61 shows a parking lot with a side swale that separates the parking from the adjacent sidewalk.

SOURCE: NEVUE NGAN ASSOCIATES

Figure 5-60: *A parking lot swale located at the Sanitation District No. 1 headquarters.*

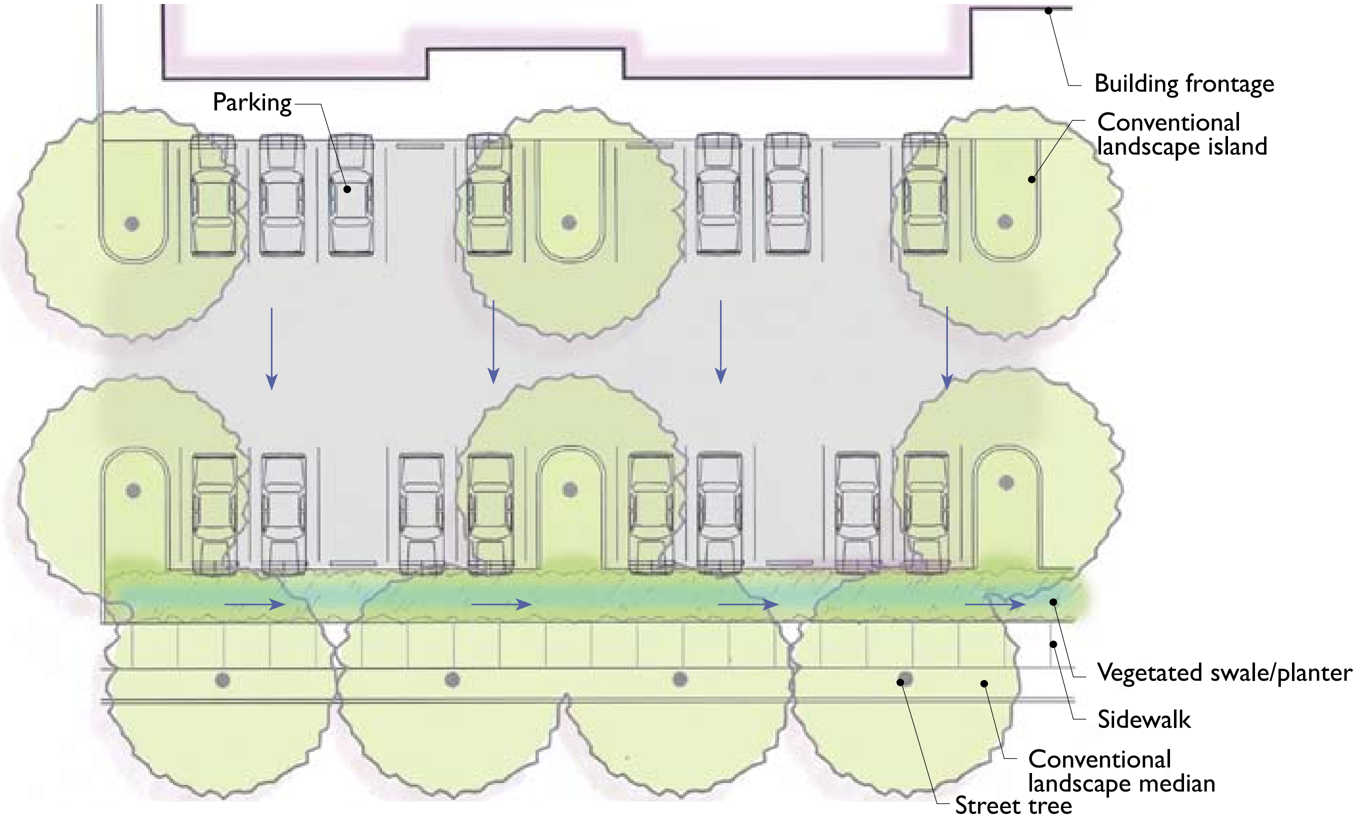


Figure 5-61: **Vegetated Side Swale/Planter With 90-Degree Head-In Parking-Plan View**

Side Swale in Parking Lot With Angled Parking

In this example, angled parking creates an unused space between the wheel stop and the edge of planter strip. This could easily be converted to a swale (or could have been designed as a swale initially). Planting trees would make this a more attractive sidewalk and would also intercept and absorb rainfall.

***Figure 5-62: EXISTING:** An angled parking lot example in Covington.*

***Figure 5-63: RETROFIT OPPORTUNITY:** Same parking lot retrofitted with a stormwater swale/planter.*

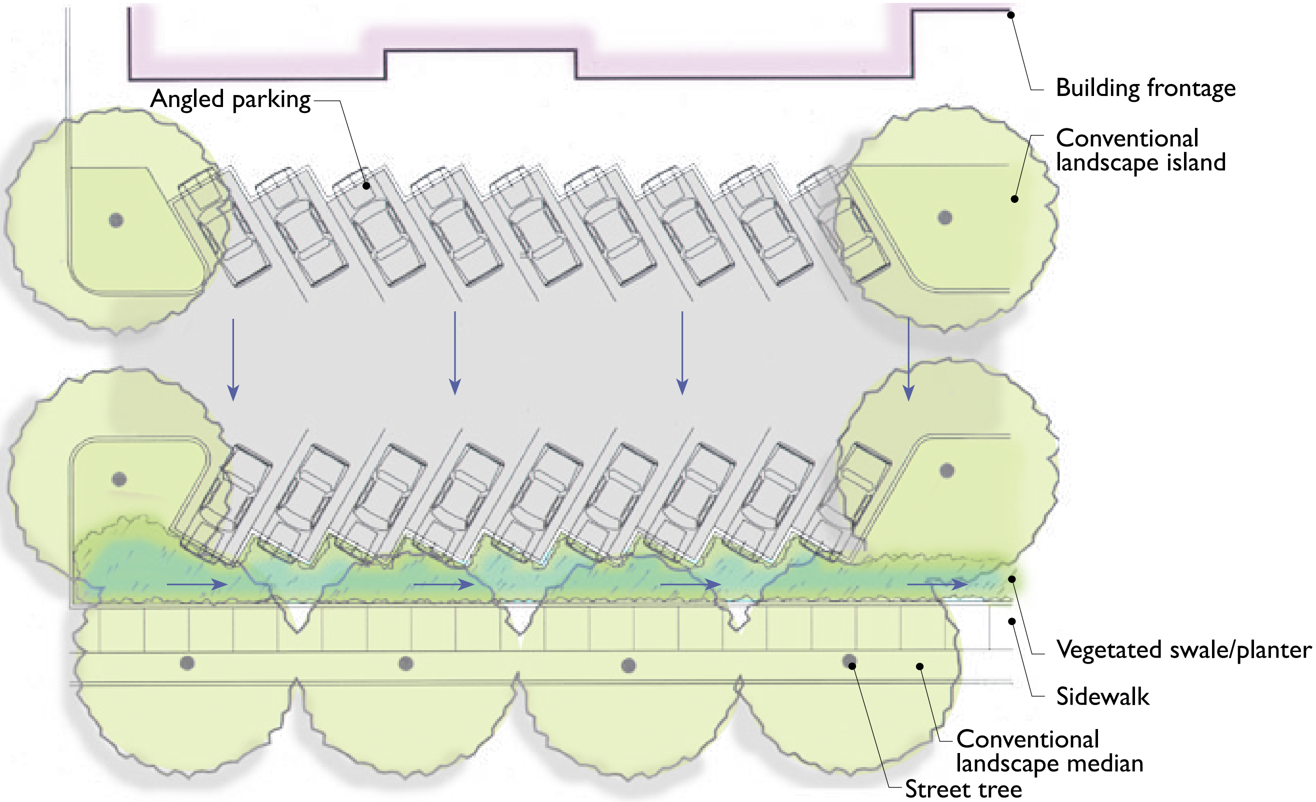


Figure 5-64: **Vegetated Side Swale/Planter With Angled Parking-Plan View**

Figure 5-65: *This parking lot with angled parking has a series of curb cuts that allow stormwater runoff to enter a landscaped area.*

Center Median Stormwater Swale in a Parking Lot

This example illustrates how a swale can be incorporated between parking rows in larger parking lots. Shortening the length of the stalls creates space for landscaping to infiltrate stormwater and plant trees. Trees help cool the asphalt and reduce the urban heat island effect.

SOURCE: NEVUE NGAN ASSOCIATES

Figure 5-66: EXISTING: *A parking lot at a high school in Covington.*

SOURCE: NEVUE NGAN ASSOCIATES

Figure 5-67: RETROFIT OPPORTUNITY: *Same parking lot retrofitted with a center median stormwater swale. Introducing this new landscaped area can help cool the parking lot surface and increase overall aesthetics.*

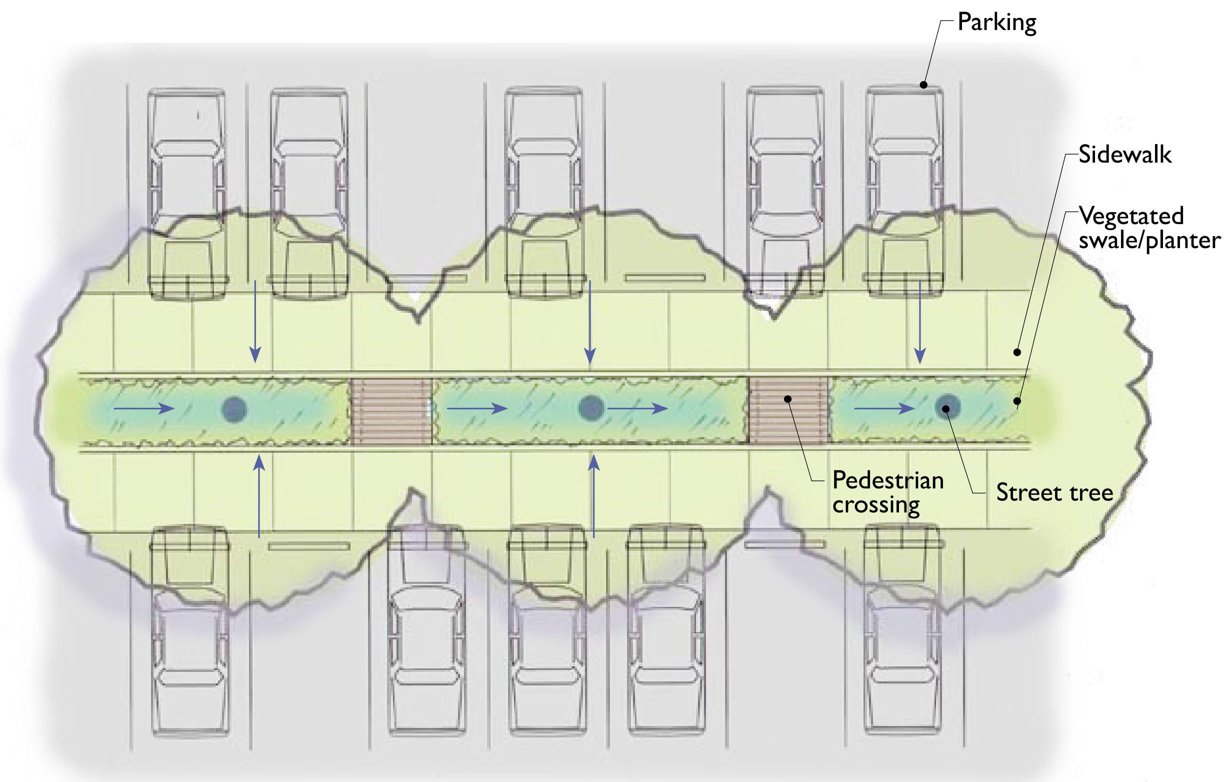


Figure 5-68: **Center Median Swale-Plan View**

SOURCE: TOM LIPTAN - CITY OF PORTLAND

Figure 5-69: *This parking lot in Portland, Oregon was built with a center median stormwater swale.*


SOURCE: KEVIN ROBERT PERRY - CITY OF PORTLAND

Figure 5-70: *This infiltration garden captures, slows, absorbs, and filters runoff from a nearby street and parking lot.*

Parking Lot Infiltration Garden

Often times larger underused asphalt or landscaped space is located at the periphery of parking lots. The design example illustrated in Figure 5-70 shows a parking lot with stormwater flowing to a large infiltration garden. As with the previous swale examples, the parking lot is graded so that water flows into a valley gutter, which carries runoff to a infiltration garden.

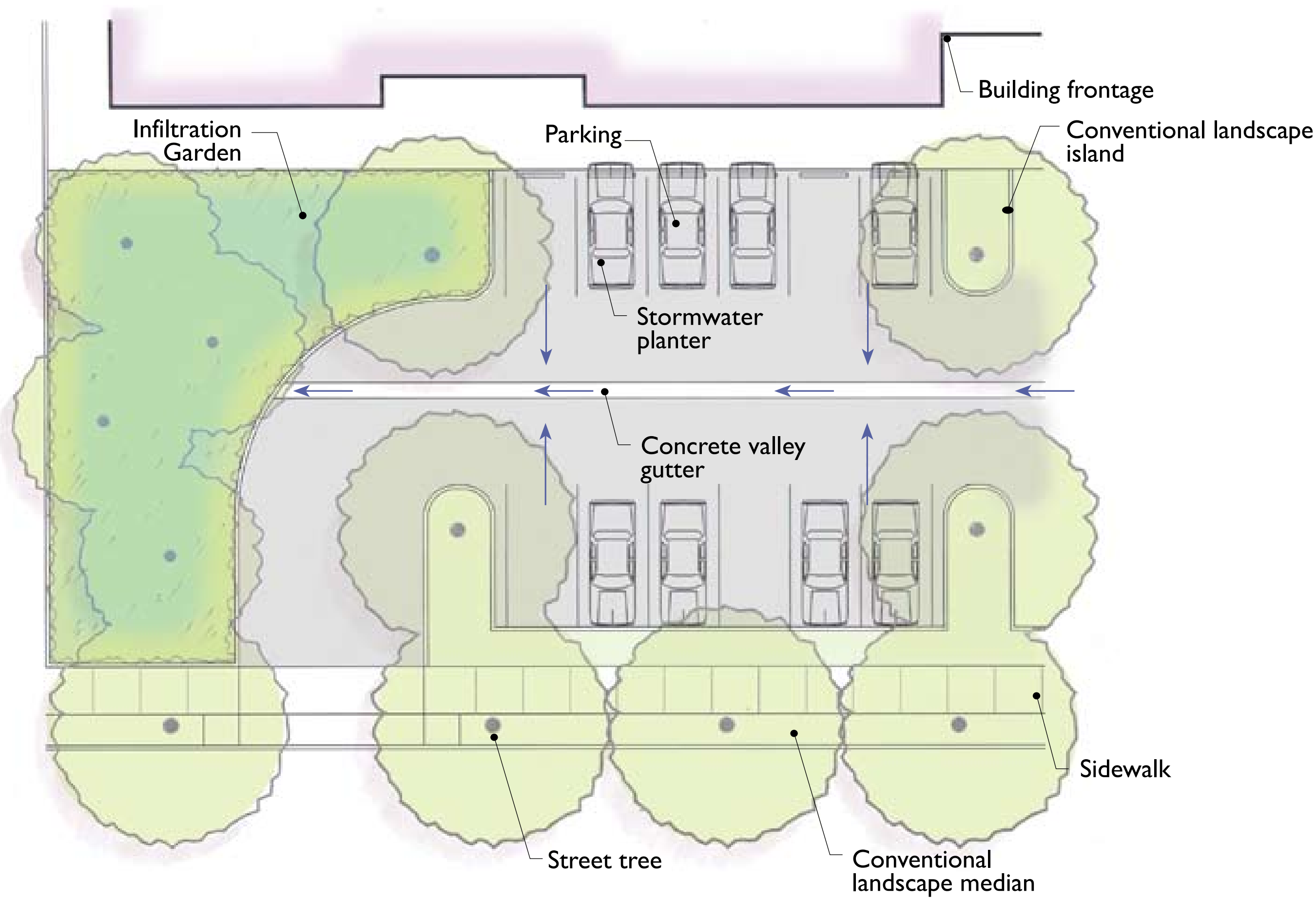


Figure 5-71: **Parking Lot Infiltration Garden-Plan View**

Parking Lot With Pervious Paving and Stormwater Planters

This example shows a parking lot using a combination of stormwater management strategies. The pervious pavers capture and infiltrate some runoff. Any overflow from the pervious pavers sheet-flows over a slightly graded slope to stormwater planters at the end of the parking bay.

Figure 5-72: This parking lot manages a portion of its stormwater runoff with multiple stormwater planters.

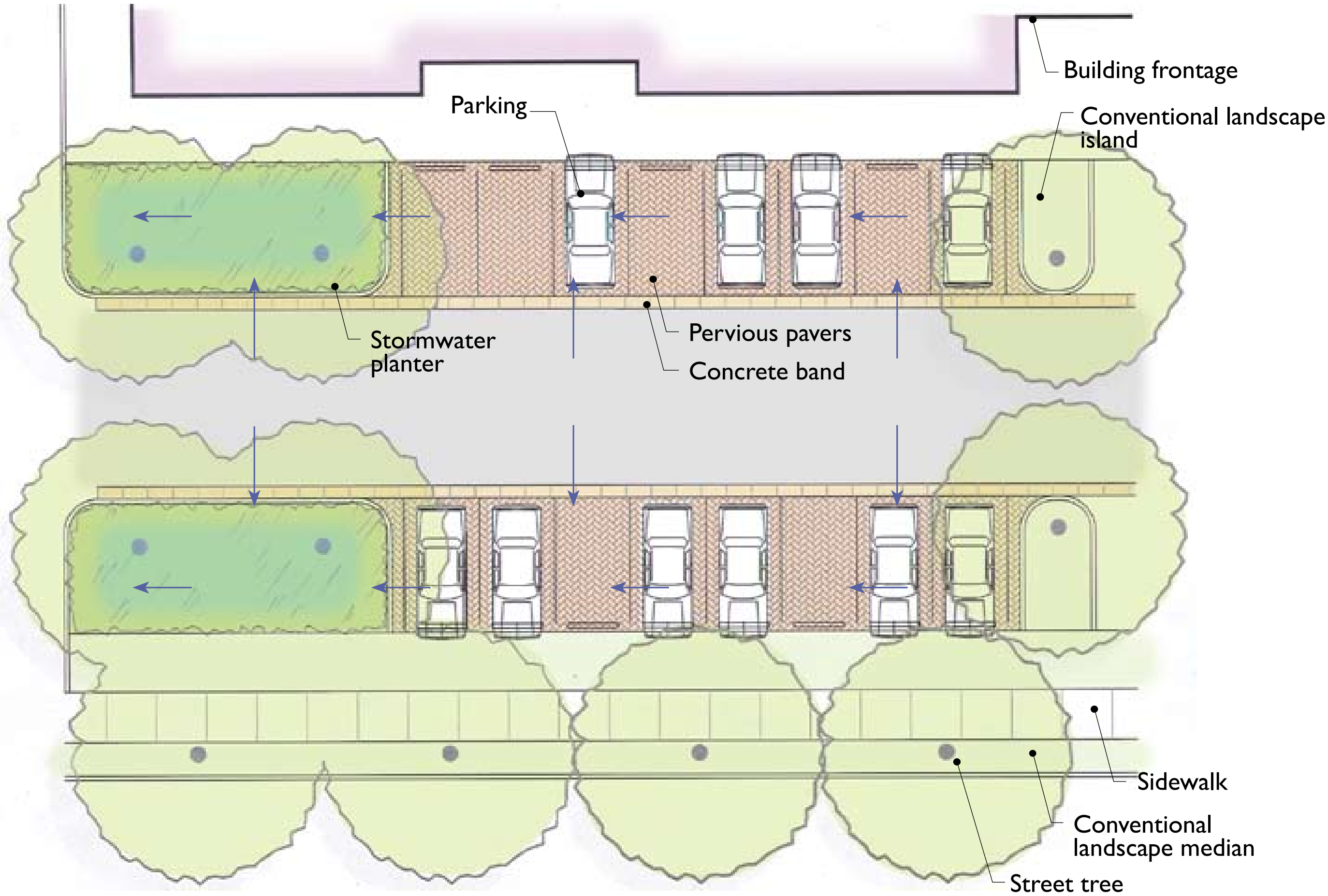


Figure 5-73: **Parking Lot With Pervious Paving and Stormwater Planters-Plan View**

Northern Kentucky has many different building types, ranging from historic town center buildings in Covington and Newport, to newer commercial centers and residential communities. Stormwater management techniques include green roofs, rainwater harvesting, flow-through planter systems, and downspout disconnection that redirects stormwater to rain gardens. Each strategy or combination of strategies depends on the building type and the amount of landscape space surrounding the building.

In most urban settings, the lack of surrounding landscape area may mean that the only feasible stormwater strategies might be green roofs or narrow flow-through planters. In some cases, green roofs can be cost prohibitive to implement, so planters (both infiltration and flow-through) might be the best option. Conversely, buildings in less dense situations have more stormwater management options because perimeter landscaping is often available.

This section illustrates some ideas to incorporate stormwater management can into building design.

Figure 5-74: *A green roof project in Washington, D.C.*

Figure 5-75: *An infiltration planter along a building in Portland, Oregon manages stormwater runoff.*

Figure 5-76: *Disconnected downspouts at a school site in Portland, Oregon convey water into nearby infiltration planters.*

Foundation Planting Converted into a Rain Garden

This example illustrates how existing foundation planting could be converted into a flow-through planter that would capture and filter water from the building's roof. Depending on the site conditions, planters and swales next to buildings can be flow-through or allow for infiltration.

SOURCE: NEVUE NGAN ASSOCIATES

Figure 5-77: EXISTING: *A typical grocery store foundation planting in Northern Kentucky.*

SOURCE: NEVUE NGAN ASSOCIATES

Figure 5-78: RETROFIT OPPORTUNITY: *Same store retrofitted with a stormwater planter in the existing foundation planting space.*

5.5 Buildings

Small Roof To Green Roof

This example shows a typical rooftop on a school. Though this is a small roof, converting this space into a green roof helps capture and filter stormwater. It also better insulates the roof during winter cold and summer heat.

SOURCE: NEVUE NGAN ASSOCIATES

Figure 5-79: EXISTING: *A small conventional roof at a high school in Northern Kentucky.*

SOURCE: NEVUE NGAN ASSOCIATES

Figure 5-80: RETROFIT OPPORTUNITY: *Same rooftop retrofitted with a small green roof. Capitalizing on small opportunities like this can help make a difference in mitigating stormwater runoff.*

SOURCE: NEVUE NGAN ASSOCIATES

Figure 5-81: EXISTING: Linear spaces between buildings, such as side yards, are a good opportunity for beautifying the yard and treating stormwater with a swale.

Residential Rain Garden

In this example, the homeowner has directed their roof downspouts to allow stormwater to enter the new rain garden. The result is a beautiful garden and better stormwater management.

SOURCE: NEVUE NGAN ASSOCIATES

Figure 5-82: RETROFIT OPPORTUNITY: Same side yard with a new rain garden. The day the rain garden was planted, the narrow space was animated by butterflies and filled with the sounds of birds.

6.0 Putting It All Together: Applying Green Infrastructure at the Regional and Neighborhood Scale in Northern Kentucky

This chapter outlines ideas for how Northern Kentucky communities might combine the range of green infrastructure strategies presented in this handbook to protect water quality and create vibrant, livable neighborhoods.

The technical assistance team explored as part of its planning and architectural design exercise four study sites in the city of Covington: the Riverfront, City Heights, Latonia Terrace, and the Retail Center. The location of each site is shown on the poster created for the project (Figure 6-3). For each site, the team focused on what was being heard from community members and stakeholders: address stormwater management issues but also create and revitalize streets and neighborhoods to help Northern Kentucky communities grow sustainably.

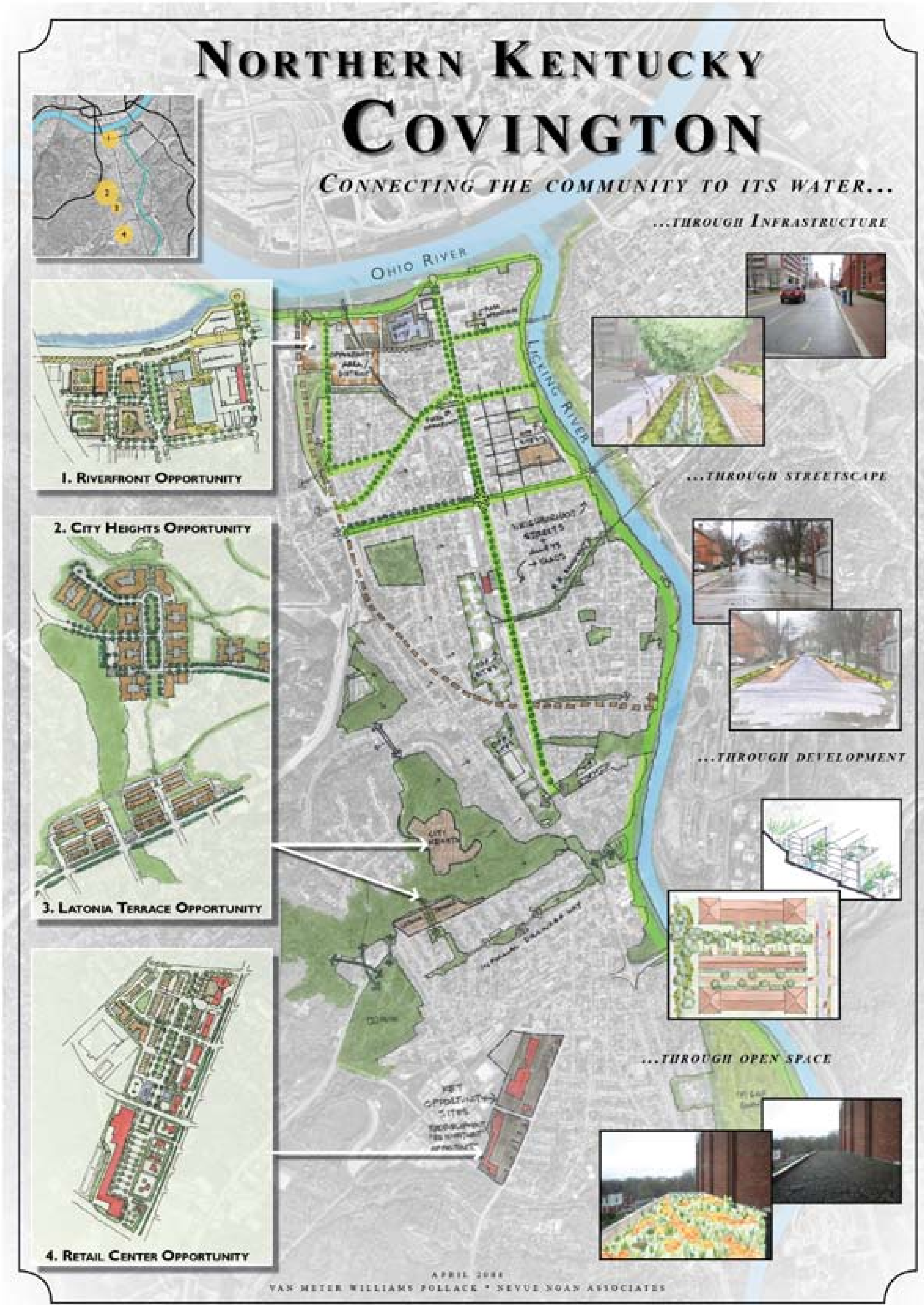
The design ideas are offered solely to engage the community's interest and curiosity and to provide a starting point for brainstorming potential solutions to Northern Kentucky's stormwater-related challenges. The sites have not been studied in detail, and the team recognizes that some options might not be feasible due to financial, political, or other constraints.

SOURCE: NEVUE NGAN ASSOCIATES

Figure 6-1: *Implementing green infrastructure demonstration projects, such this green street in Portland, Oregon, is the next step for Northern Kentucky.*

SOURCE: CLARK WILSON - US EPA

Figure 6-2: *The various stormwater management strategies showcased at the Sanitation District No. 1 headquarters were applied during the design team's concept plans for the four study sites. The team also incorporated some techniques that have yet to be tried in Northern Kentucky.*



SOURCE: VAN METER WILLIAMS POLLACK

Figure 6-3: *The technical assistance team looked at several opportunity sites around the Covington area to showcase how Northern Kentucky communities can apply green infrastructure strategies.*

6.1 The Riverfront

The Riverfront site is located in downtown Covington, bounded by the Ohio River to the north, West 5th Street to the south, Madison Avenue to the east, and the Route 42/127 bridge approach to the west (see Figure 6-4). The majority of the site is currently occupied by a large, one-story office building used as a processing center by the Internal Revenue Service (IRS) and by several adjoining parking lots.

The design for the site is a compact, pedestrian-oriented, mixed-use development that integrates homes, office space, and retail space; provides open space and public access to the river; and incorporates stormwater treatment measures. The team relocated the IRS operations to two mid-rise office towers and consolidated parking into a multi-story parking garage with street-level retail storefronts to make the building more pedestrian-friendly. One or two additional mid-rise towers for homes or offices would be built along the river to allow more people to take advantage of the open views and easy access to the waterfront. The team envisioned a central open space in the form of a broad linear park running through the middle of the development and lined with residential buildings. The park would serve as a community gathering space for neighborhood residents and workers. The park would provide connection to the river, and, along with the streets, be designed to incorporate stormwater treatment measures such as vegetated swales, planters, and landscaped curb extensions.

SOURCE: VAN METER WILLIAMS POLLACK

Figure 6-4: *A conceptual plan view of the Riverfront site near downtown Covington.*

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The Covington Housing Authority volunteered two of its residential properties as study sites for the design exercise. The first, City Heights, is approximately 1.5 miles south of downtown Covington. It is located on the top of a wooded hill roughly bounded by Highland Avenue to the north and Madison Avenue to the east and south. The site consists of 64 multi-family apartment buildings owned and operated by the Housing Authority.

The design team identified opportunities to use the site more efficiently, beautify the open space, and better connect the site with the surrounding neighborhoods, schools, and Madison Avenue. The team offered three development options:

Design Option 1 (Figure 6-7)

The first option is to redevelop the site, retaining the same number of units by replacing the existing buildings with three- to four-story structures, integrating market-rate residential units, and organizing the units around the communal open spaces and a new set of streets that incorporate stormwater treatment measures. Parking lots would be replaced with on-street parking or with podium parking in some of the new buildings. A stairway would connect to Latonia Terrace and Madison Avenue, and a new road would extend from Muse Drive to 26th Street to provide a new connection to the site.

Design Option 2 (Figure 6-8)

This option doubles the number of residential units on the site. The existing buildings would be replaced with new structures consisting of market-rate condominiums or mixed-income housing. This would entail selling the site to a private developer; the Housing Authority could use the proceeds to construct replacement units, either by redeveloping one or more of its other sites or acquiring and developing a new property. Like Option 1, this option would also provide new streets and open space incorporating stormwater treatment measures and would establish new pedestrian and vehicular connections to the surrounding community.

***Figure 6-5:** The existing conditions at the City Heights site in Covington.*

***Figure 6-6:** A conceptual sketch of the City Heights Rose Garden accepting stormwater runoff as presented in Design Option 3.*

Design Option 3 (Figure 6-9)

The third option would redevelop the site as a hilltop park serving the whole city with a complex of recreational facilities; including baseball and soccer fields, basketball and tennis courts, walking trails, community gardens, a stormwater rain garden, and buildings that could be used for community meetings and other special functions. Public-housing units would be relocated to new mixed-use development throughout the city.

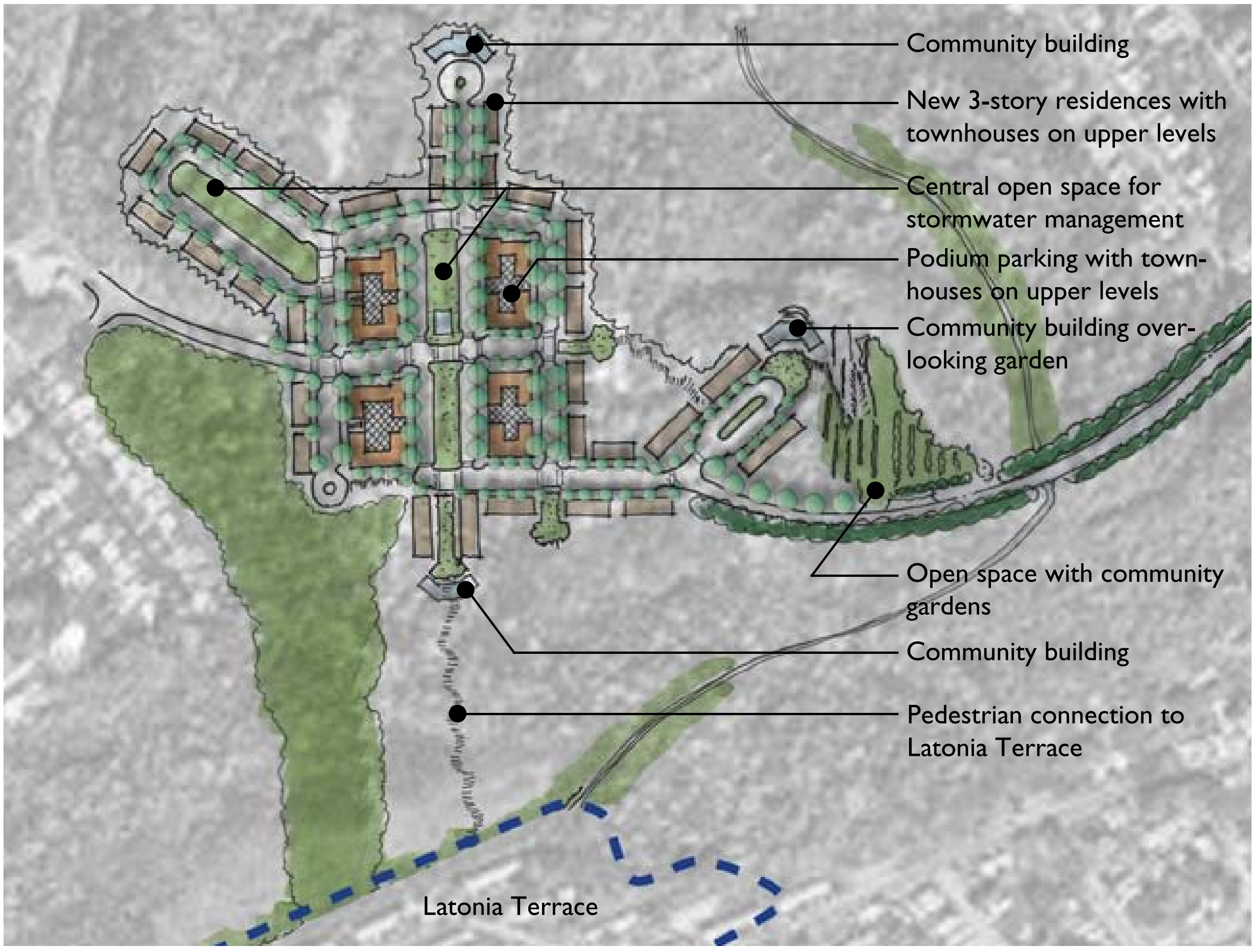
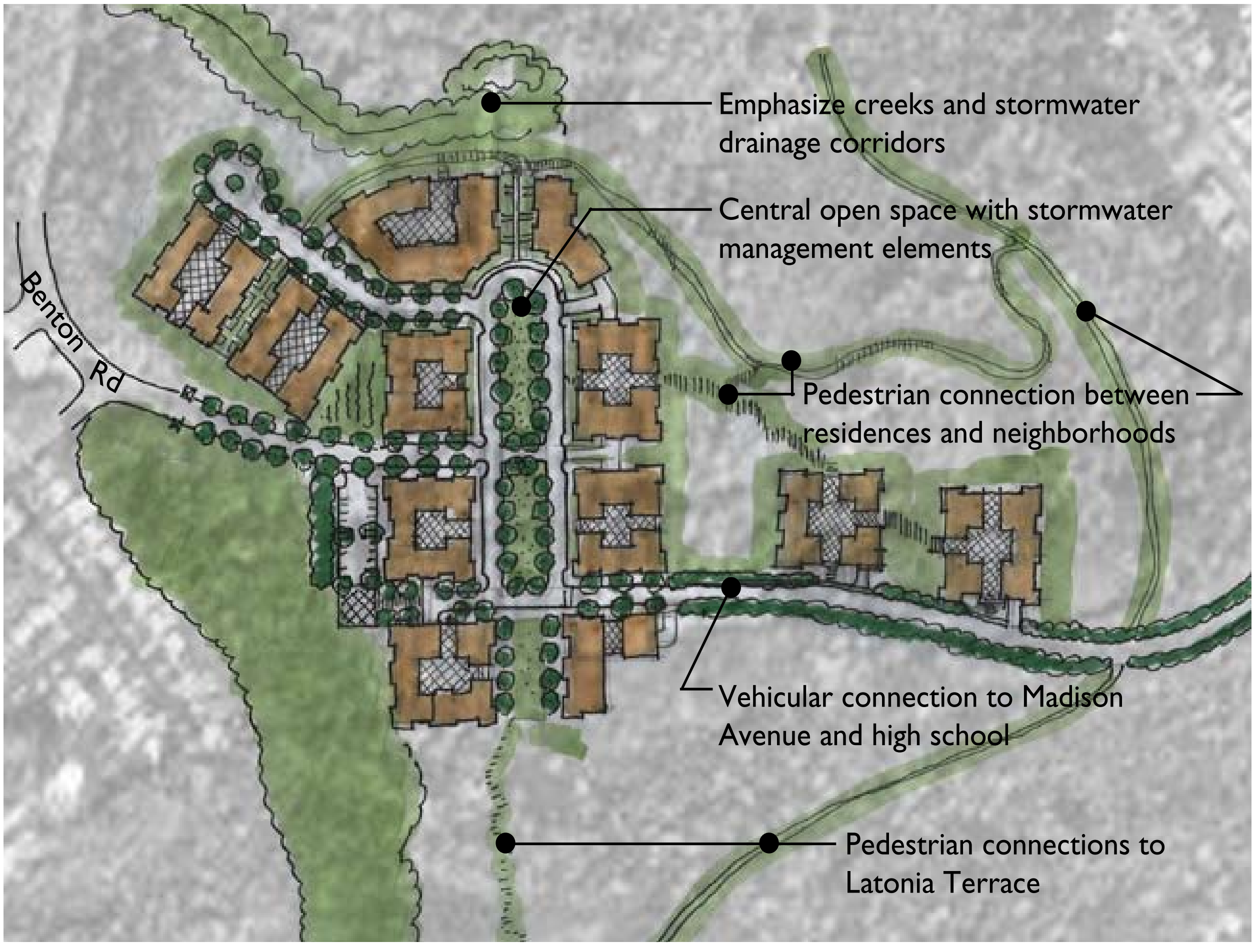


Figure 6-7: *A conceptual plan view of Design Option 1.*

DESIGN OPTION 1 KEY ELEMENTS: Replacement of existing residences, with the addition of market-rate residential units.

- Reconstruct all existing housing flats and townhouses.
- Organize housing around new streets and open spaces.
- Incorporate stormwater management into new streets and open spaces.
- Establish pedestrian and vehicular connections to Latonia Terrace and Madison Avenue to and to the high school.
- Replace residential parking lots with on-street parking.
- Increase density with three-story buildings.
- Add podium parking with three stories of residences above to use land efficiently.



SOURCE: VAN METER WILLIAMS POLLACK

Figure 6-8: *A conceptual plan view of Design Option 2.*

DESIGN OPTION 2 KEY ELEMENTS: Mixed-income housing or private development 100% replacement plus 50-100% additional units.

- Double residential density with condominiums.
- Incorporate stormwater management in the construction of new streets and open space.
- Create a common, central open space.
- Add podium parking with courtyard, provide private open space, and three stories of residences above.

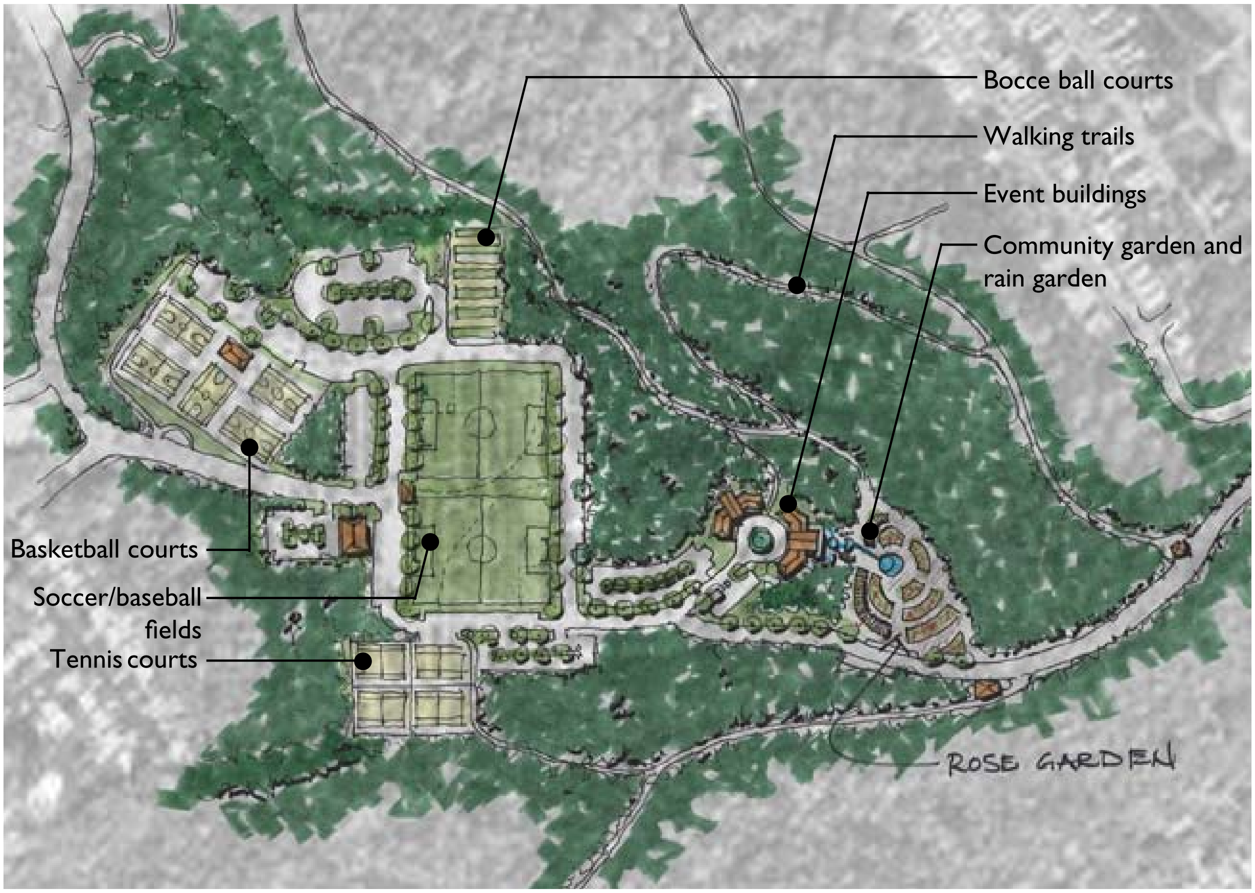


Figure 6-9: *A conceptual plan view of Design Option 3.*

DESIGN OPTION 1 KEY ELEMENTS: New city recreational park on hilltop. Housing relocated to new mixed-use development sites in Covington.

- Reconstruct, preserve, and protect hillsides and hilltops for stormwater management strategies, and connect with open space corridors to community below.
- Create common open space on the hilltop with athletic fields, basketball and tennis courts, and a rose garden and native plant garden.
- Site various community-oriented buildings to support the recreational park.

Latonia Terrace

The second Housing Authority site is Latonia Terrace, a complex of 25 multi-family apartment buildings located just downhill from City Heights, along Madison Avenue. Much as under Option 2 for City Heights, this property would become a new mixed-income residential development, and the site would be redeveloped—including rebuilding the existing buildings—at twice the current residential density (see Figures 6-11 to 6-13).

For this site, Madison Avenue would be rebuilt as a green street, with stormwater planters, street trees, landscaped curb extensions, and parking lanes surfaced with pervious paving. An open space corridor extending downhill from City Heights would be maintained across the development and would continue across Madison Avenue to connect to undeveloped parcels on the east side of the street. The functions of this green corridor would be to convey hillside runoff to the lowlands and the rivers keeping the runoff out of the combined sewer, and to serve as a pedestrian connection between Madison Avenue and City Heights. Courtyards between the buildings would accommodate stormwater swales and planters that would accept stormwater runoff from adjacent impervious areas. Mature trees around the development would be retained, and ample landscaping, groundcover, and pervious surfaces would be provided throughout the site. Green roofs would capture rainfall on building rooftops. Stormwater planters would capture any runoff from building rooftops and overflow either into the stormwater swales or into cisterns located in the underground parking garages for later reuse for irrigation.

SOURCE: NEVUE NGAN ASSOCIATES

Figure 6-10: *The existing conditions at the Latonia Terrace site in Covington, Kentucky.*

6.3 Latonia Terrace

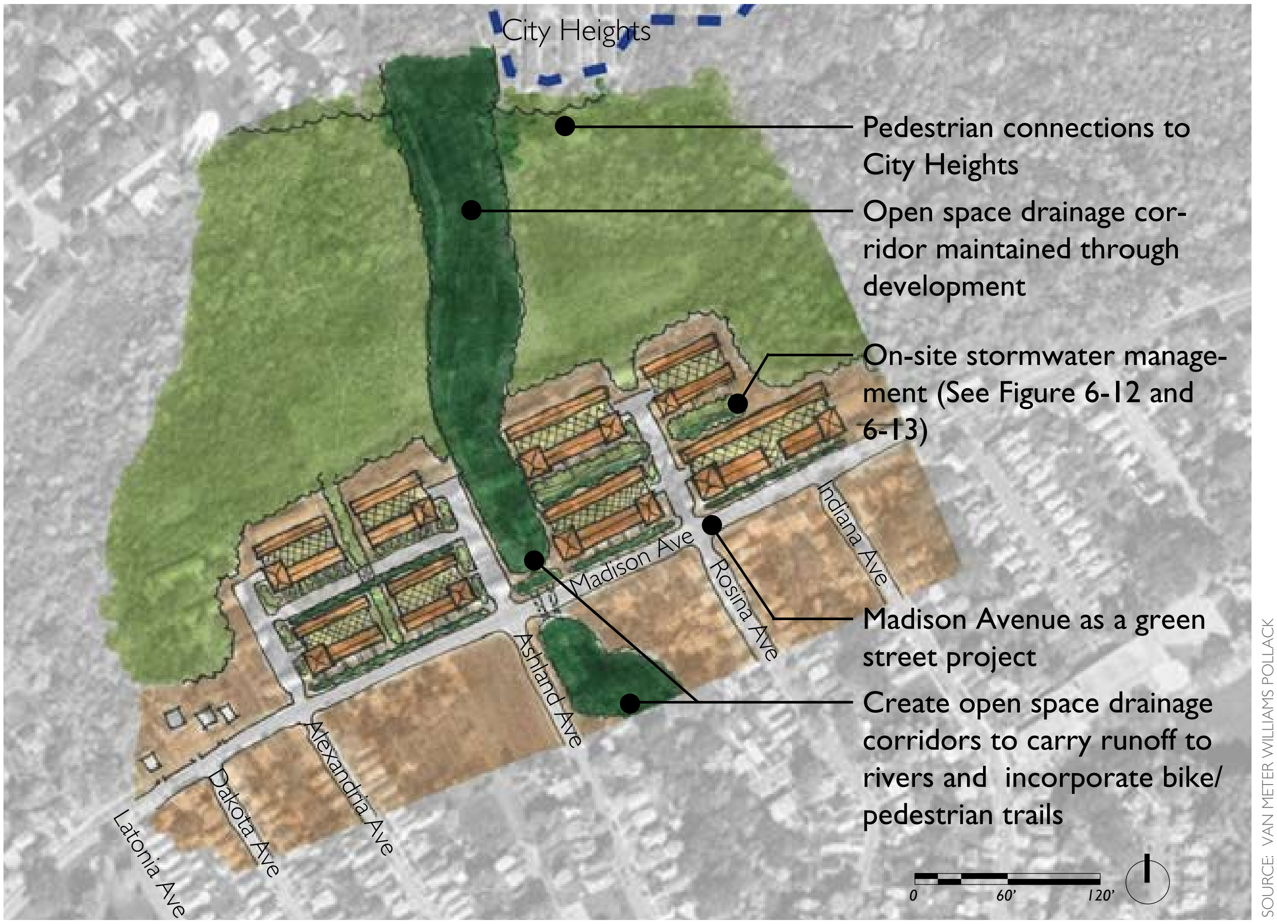


Figure 6-11: *A conceptual plan view of Latonia Terrace.*

LATONIA TERRACE: New mixed-income residential development

- Double residential density.
- Replace existing Housing Authority housing and add new residences.
- Incorporate stormwater management.

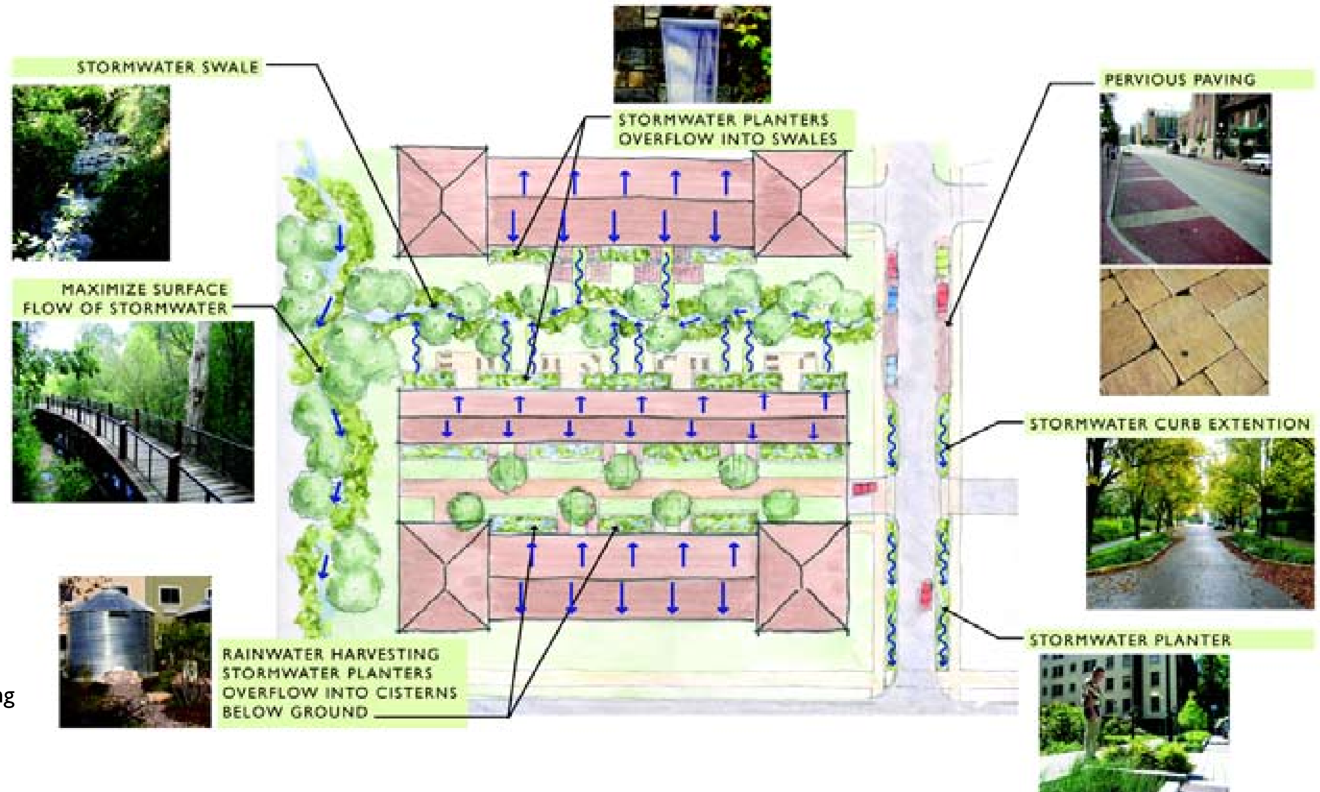


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Figure 6-12: *A plan view of a portion of the site that uses many of the stormwater strategies presented within this handbook.*

Located in South San Francisco, CA, Bay Oaks is an example of a podium housing development on a steep hillside with integrated stormwater management elements.

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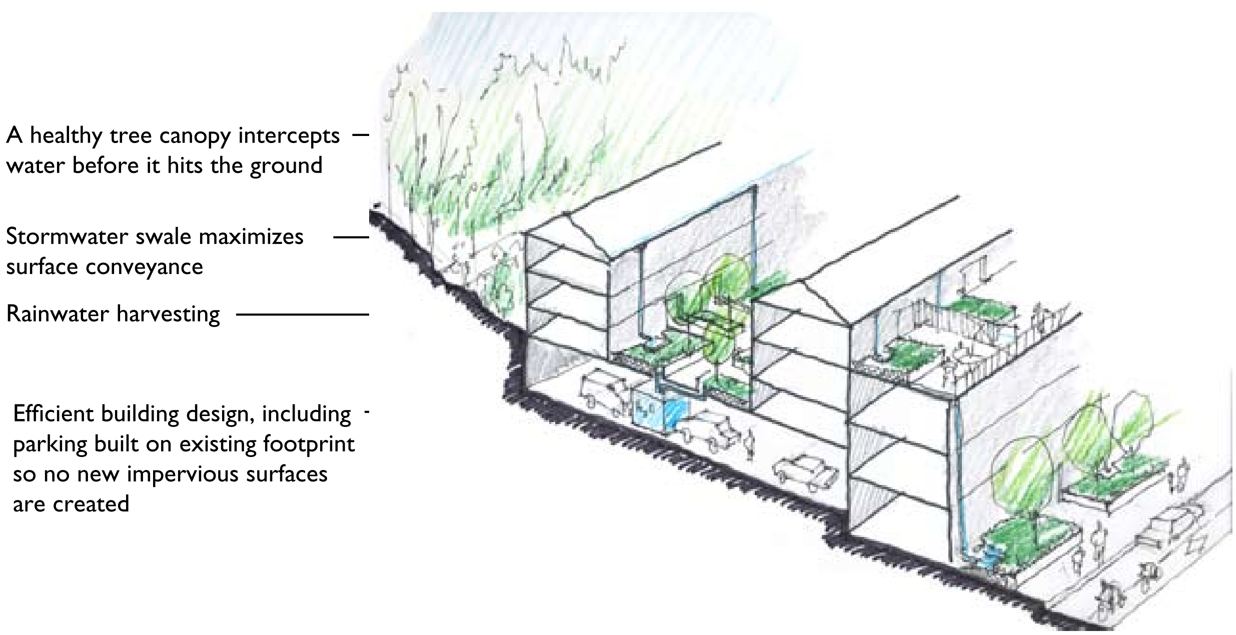

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Figure 6-13: *A view into the various stormwater management and site design features at the redesigned Latonia Terrace site.*

6.4 The Retail Center

The fourth site identified by the design team is roughly 2.5 miles south of downtown Covington. It is located along Winston Avenue, between West 38th Street to the north and Howard Litzler Road to the south (see Figure 6-14). The site has two strip malls set behind large, underused, parking lots. There is a smaller undeveloped parcel on the northwest corner of the site along the railroad. Across Winston Avenue is an older, established neighborhood of single-family homes.

This site offered the design team the opportunity to explore revitalizing an aging in-town commercial area through compact, pedestrian-oriented, mixed-use development. The team envisioned redeveloping the northern half of the site (between West 38th and West 43rd streets) with a well-integrated mix of residential, office, and retail space. The western side of Winston Avenue would be lined with four- to five-story buildings, with shops on the ground level and apartments or condos above. Behind them would be lower-rise townhouses, accessed by alleys, flanking a linear park. The site would be threaded with narrow, pedestrian-friendly streets and alleys featuring attractive streetscapes that accommodate stormwater treatment measures such as vegetated swales, pervious paving, and landscaped curb extensions. The currently undeveloped parcel would be turned into a neighborhood park. Both the neighborhood and linear parks would serve double duty as open space and as stormwater treatment areas for the surrounding streets, buildings, and parking lots.

SOURCE: VAN METER WILLIAMS POLLACK

Figure 6-14: *A conceptual plan view of the Retail Center site in Covington.*

In recent years, new approaches to stormwater management have been adopted and implemented by communities across the nation. For some, this evolution in stormwater management reflects the need to meet water quality regulations while also improving the community's character. Northern Kentucky has taken an important step in responding to these challenges with the *Stormwater Management Handbook: Implementing Green Infrastructure in Northern Kentucky Communities*.

This handbook introduced what green infrastructure is and how it can be applied at the regional, neighborhood and site-level scale within Northern Kentucky. The handbook also illustrated just a few of the many strategies and opportunities to implement green infrastructure–in particular, retrofitting streets and parking lots to protect water quality and create vibrant, livable neighborhoods and attractive walkable streets.

To ensure the continued economic development of Northern Kentucky, it will become increasingly important to grow in a manner that allows for the protection of natural resources while maintaining a high quality of life for its residents. The next logical step toward a comprehensive green infrastructure approach in Northern Kentucky is to develop several successful demonstration projects. These projects will help act as a "catalyst" for bolder efforts in the future. Some examples have already been built, as demonstrated at the Sanitation District No. 1 headquarters. Hundreds of other green infrastructure opportunities, both large and small, exist in Northern Kentucky. The ultimate goal of this handbook is to provide the inspiration for their discovery.

SOURCE: JAN HALLIN

Figure 6-15: *Sunset on the Ohio River in Northern Kentucky.*