Figure 1: Existing Bike Lanes

1.1 Driveways and Parking

A moderate number of 36 residential and commercial driveways exist within the 0.9-mile study corridor; 15 on the northwest side; and 21 on the southeast side of the street. A mix of parallel, perpendicular, and angle on-street parking is provided on both sides of Commercial Street in the two-block section from Harrison to Washington Street. Off-street parking is available for the businesses between Washington and Osage Streets.

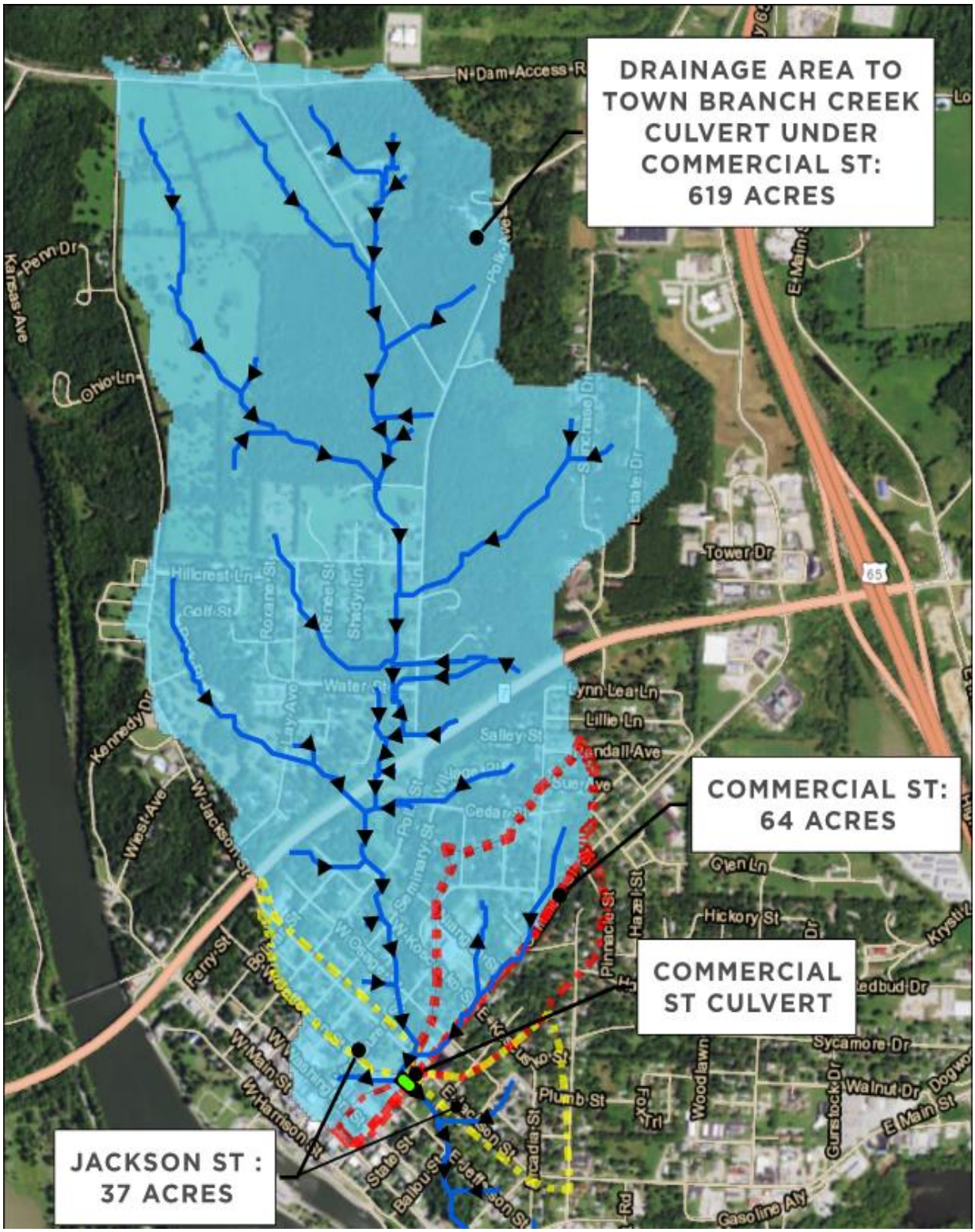
1.2 Stormwater Drainage

Commercial Street stormwater drainage is conveyed through open roadside ditches on both sides of the street north of Washington Street. In the short two-block section between Harrison and Washington Streets, stormwater drains along concrete curbs north and south of the crest at Main Street. The roadway profile shown on **Figure 2-3** indicates that the entire area between Main Street and Hazel/Burlin Street drains to Town Branch Creek which serves as the primary stormwater drainage corridor through the City. The creek crosses under Commercial Street through a concrete box culvert between Jefferson and Jackson Streets where there is a history of flooding issues. The flooding issues are further demonstrated by the Flood Emergency Management Agency (FEMA) 100-year floodplain showing a Base Flood Elevation (BFE) of 669, which is roughly 3-feet higher than Commercial Street. **Figure 2-10** shows the approximate limits of the 619-acre tributary area to the Town Branch Creek box culvert.

Jackson Street roadway improvements are being evaluated under a separate study. Stormwater drainage along the Jackson Street corridor is also conveyed through open roadside ditches to Town Branch Creek. Stormwater from both the Commercial and Jackson Street corridors converge at the concrete box culvert

under Commercial Street resulting in significant concern that the roadway improvements along both corridors combined could exacerbate the Town Branch Creek flooding issues. It is imperative that a stormwater study be performed to evaluate increased stormwater flow to the creek and recommend innovative stormwater management solutions to mitigate the additional runoff and reduce the risk of flooding to adjacent homes and businesses.

Figure 2-10: Drainage Area to Town Branch Creek Box Culvert under Commercial Street



3.2 Pedestrian Accommodations

Because Commercial Street is the main thoroughfare in this part of the community, providing ADA compliant sidewalks throughout the corridor is essential to satisfy a fundamental need to provide safe pedestrian access to the school, places of employment, and commercial businesses for citizens within the community. Sidewalks would promote active lifestyles and contribute to pedestrian-friendly activities as the city expands its recreational and tourist attractions including recreational trails, parks, historic downtown, retail shops, and fishing and boating along the riverfront area.

New minimum 5-foot wide ADA compliant sidewalks are recommended along both sides of Commercial Street between Washington and Gold Streets. North of Gold, a new sidewalk/walking path is recommended on the northwest side only where development is somewhat less concentrated. Between Gold and Burlin Streets, a meandering walking path is recommended through the landscape area behind the residences to add interest to the walking path and increase separation between pedestrians and vehicular traffic. Between Burlin and Louise Streets the new sidewalk would parallel Commercial Street. The sidewalk would parallel Summit Avenue between Louise and Randall Avenue at the north project limits where it would tie into a future walking path to the north. Refer to **Attachment B** for a conceptual layout of the recommended sidewalk locations.

Elimination of the uncontrolled crosswalk near the elementary school at the vacated alley between Kosciusko and Niangua Streets is recommended. Eliminating this crosswalk would encourage school children to cross the street in one location at Kosciusko Street where additional pavement markings, signage and overhead flashing beacon meeting requirements of the Manual on Uniform Traffic Control Devices (MUTCD) are recommended. It is also encouraged to have an adult school crossing guard or law enforcement officer on duty in this location before and after school hours.

Crosswalk pavement markings should be provided on stop-controlled side-street intersection approaches with sidewalk. All four intersection approaches should have crosswalk pavement markings at the 4-way stop intersections at Main and Jackson Streets.

3.3 Innovative Stormwater Management

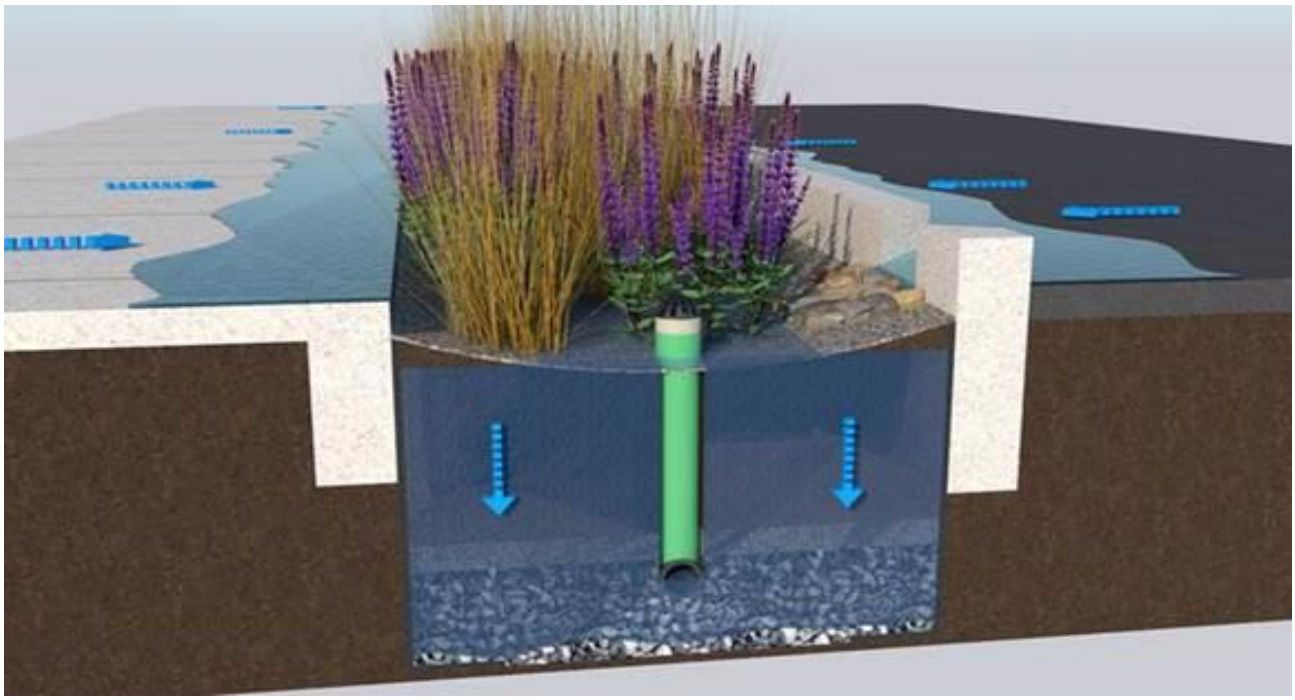
As indicated in Section 2.6, Town Branch Creek serves as the primary stormwater drainage corridor through the City and has a history of flooding issues along the creek and at the box culvert crossing under Commercial Street between Jefferson and Jackson Streets. There is significant concern that the Commercial Street improvements combined with similar improvements planned along the Jackson Street corridor could exacerbate the Town Branch Creek flooding issues. It is imperative that a stormwater study be performed

for both corridors combined to evaluate increased stormwater flow to the creek and recommend innovative stormwater management solutions to mitigate the additional runoff and reduce the risk of flooding to adjacent homes and businesses.

Widening the Commercial Street and Jackson Street roadways and adding new sidewalks is necessary for safe travel for bicyclists and pedestrians within the community. The new wider roadway/sidewalk section would require replacing the existing open roadside ditches with enclosed storm sewer systems to convey stormwater drainage. If a typical curb and gutter and storm sewer system is installed, peak flows would reach the creek much quicker, potentially adding to flooding problems downstream. The current time of concentration with unpaved roadside ditches for the primary drainage area is estimated to be a minimum of 15 minutes, resulting in about 147 cubic feet per second of peak stormwater flow reaching Town Branch Creek in a typical 10-Year design storm. However, with a conventional storm sewer system, the time of concentration would likely be reduced to 5 minutes or less, resulting in an estimated 50% increase in stormwater flows to the creek. For this reason, it is recommended to manage stormwater in a more innovative and sustainable way, by implementing green stormwater infrastructure practices for continuous stormwater collection along Commercial Street. Continuous collection uses green stormwater infrastructure infiltration and storage practices such as bioretention and pervious pavement along the shoulder of the roadway to collect stormwater, filter it though a soil and/or aggregate subbase layers, and slowly release it through a small diameter perforated underdrain system. Green stormwater infrastructure practices provide both a stormwater quantity control, and stormwater quality benefit.

In lieu of paved concrete gutters, it is recommended to provide bioretention type green stormwater infrastructure, such as "green gutters" between the roadway and sidewalks. Green gutters are a type of bioretention practice implemented in narrow, shallow landscaped strips along the roadway designed to manage stormwater runoff by placing the top of the planning media lower than the street and sidewalk elevations. Benefits associated with the use of green gutters include: (1) reduced impervious area and stormwater runoff; (2) increased temporary stormwater storage volume; (3) safe physical buffer between pedestrians and vehicular traffic; and (4) enhanced streetscaping opportunities with a green space for native grasses, shrubs or perennials. An example green gutter from Kansas City, Missouri's Green Stormwater Infrastructure Manual is shown in **Figure 3-2.** Green gutters are typically not recommended in areas with steep topography, e.g. the area between Oak Street and Burlin Street, but can be used with proper design of check dams and weirs to slow stormwater flows through other practices.

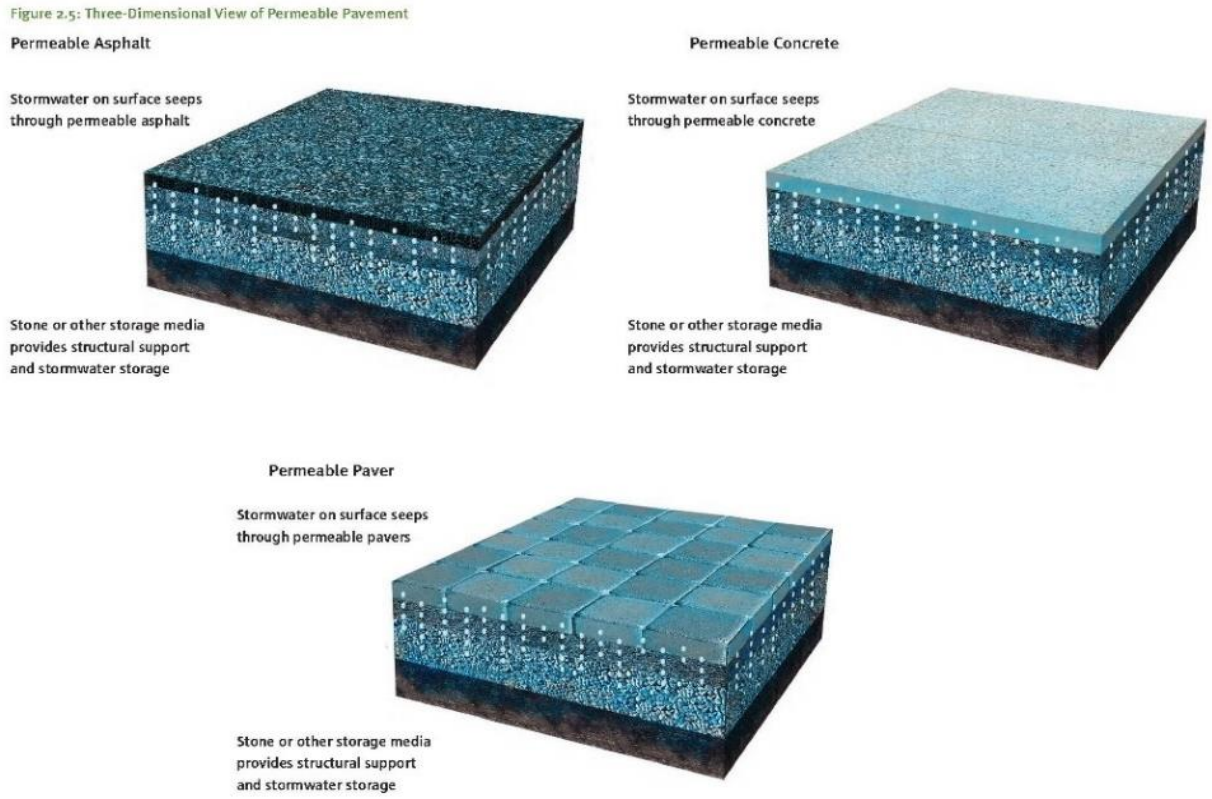
Figure Error! No text of specified style in document.**3-2: Green Gutter Rendering**



Rendering Source*: Kansas City, Missouri Green Stormwater Infrastructure Manual*.

Permeable pavement materials are recommended to construct the new sidewalks in select locations. Permeable pavements consist of materials that allow water to pass freely through the surface, serving to reduce stormwater runoff as compared to traditional impervious paving materials. Stone media below the pavements provide structural pavement support as well as temporary storage of stormwater. Permeable pavements are recommended in the same sections of Commercial Street where green gutters are suggested; i.e. from Washington to Oak Street and from Burlin to Randall Avenue. Renderings of different permeable pavement types from Philadelphia's *Green Streets Design Manual* are shown in **Figure 3-3**. Additionally, an example photo displaying permeable paver shoulders on an asphalt street is shown in **Figure 3-4.**

Figure 3-3 Error! No text of specified style in document.**: Permeable Pavements**



Rendering Source*: City of Philadelphia Green Streets Design Manual*.

Figure 3-4: Permeable Paver Shoulder Example Photo (PaveDrain Product)

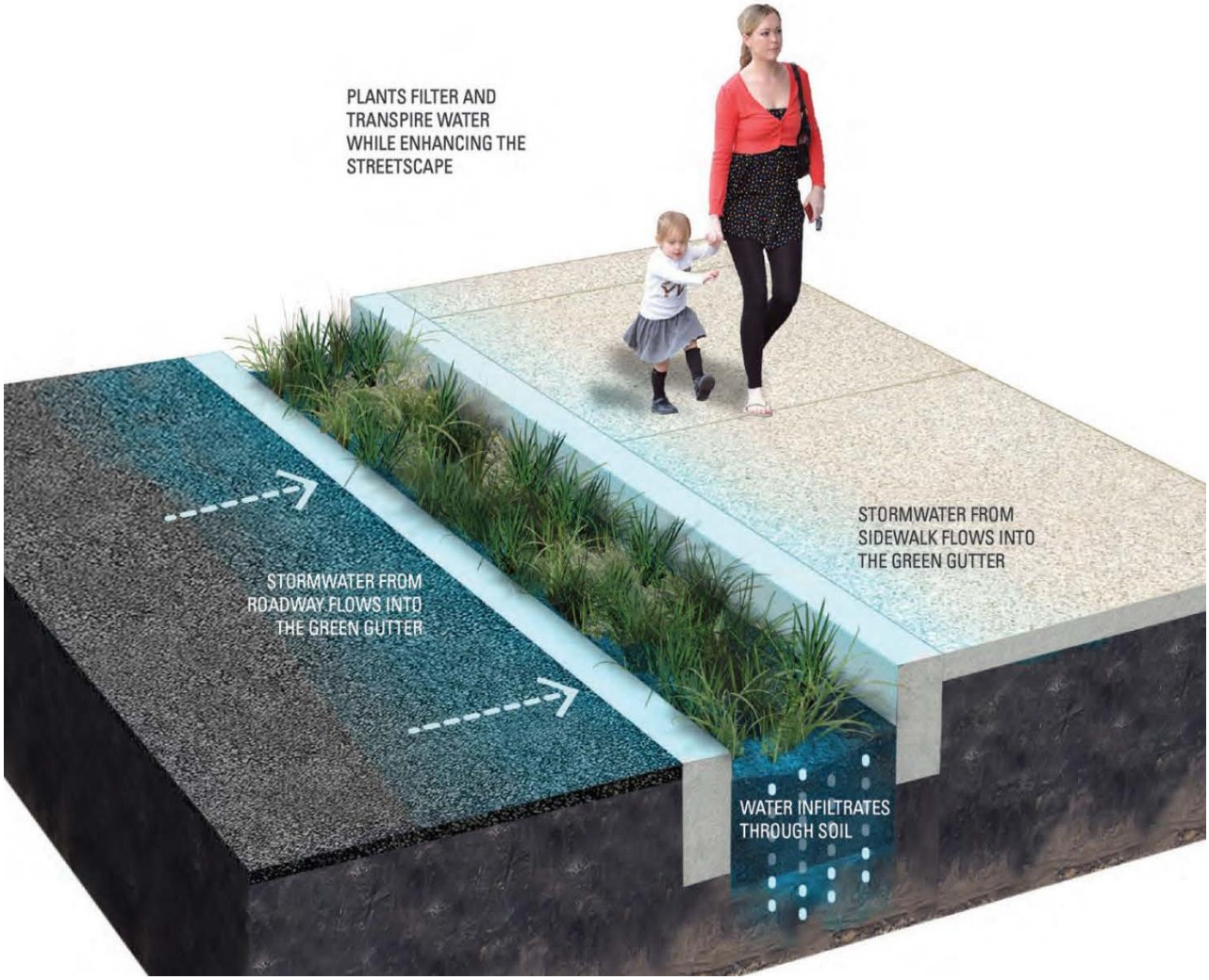
The properties outlined in red on **Figure 3-5** were recently donated to the City of Warsaw. The City also has the opportunity to purchase the property designated with a star, providing a continuous connection between these properties and Town Branch Creek. These three properties provide the opportunity to implement a larger scale green stormwater infrastructure practice, such as an extended detention wetland, to alleviate existing flooding issues along the creek. Wetlands provide significant water quality benefits including suspended solid and nutrient removal from urban runoff, as well as channel stability and reduced erosion by slowing flows through the existing bend in Town Branch Creek. Wetlands with a detention component can also alleviate larger scale flooding concerns by providing temporary storage of stormwater and slow release back into the creek. This location provides further water quality benefit as it is situated just 1,300 feet upstream of the Town Branch Creek confluence with the Osage River, providing water quality pretreatment to the majority of stormwater runoff that Warsaw contributes to the river.

Figure 3-5: Potential Extended Detention Wetland

3.4 Roadway Typical Sections

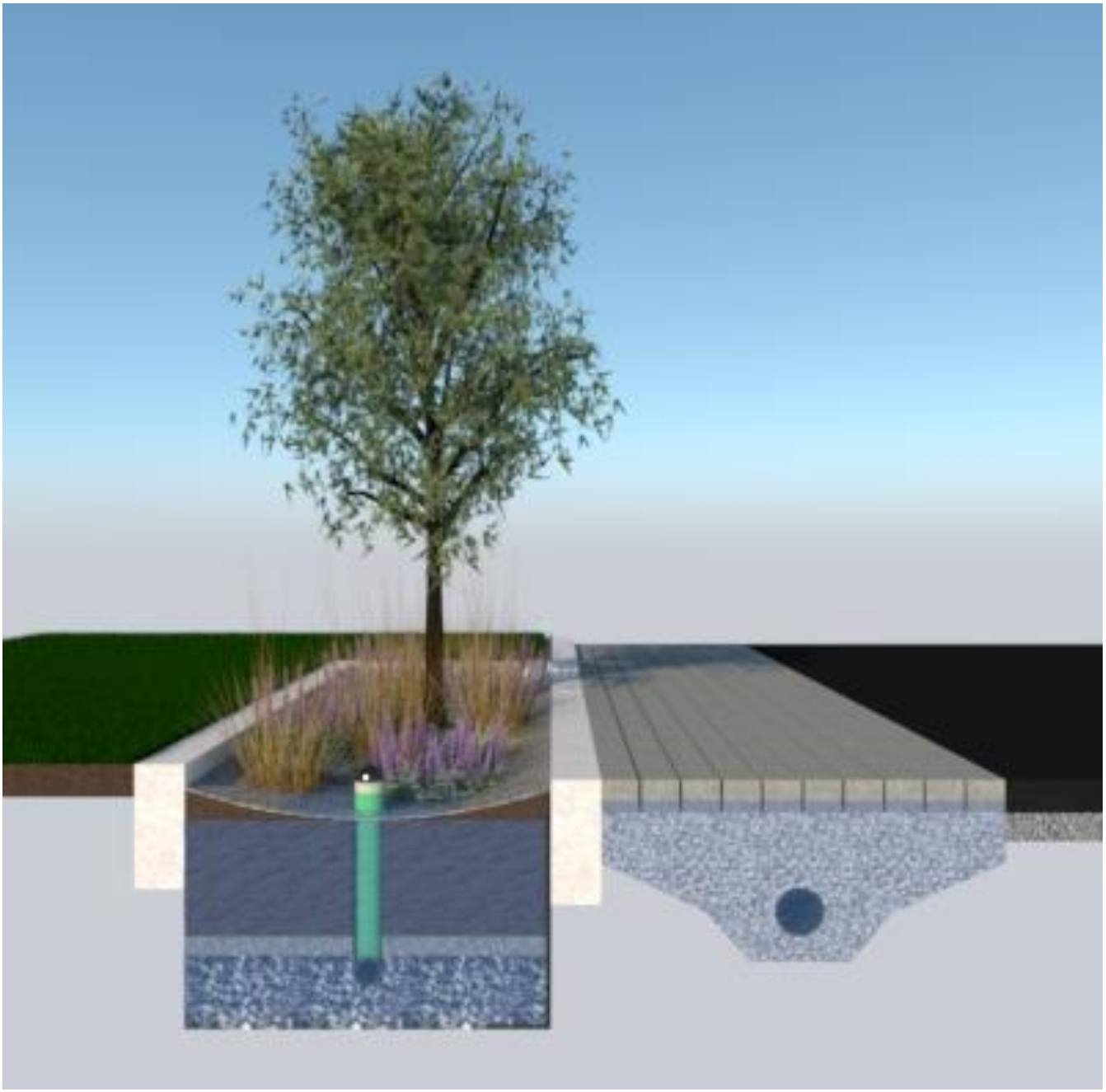
Roadway typical sections that incorporate the bike lanes, pedestrian accommodations, and green stormwater infrastructure described in previous sections are illustrated on **Attachment C** in the back of this report. **Figure 3-6,** below is a rendering from Philadelphia's *Green Streets Design Manual* further demonstrating the green gutter section proposed through most of the corridor. **Figure 3-7**, shows a rendering of a permeable paver shoulder applied with a bioretention practice, similar to the green gutter and permeable pavement combination proposed for Commercial Street.

Figure3-6: Roadway Section with Green Gutter



Source*: City of Philadelphia Green Streets Design Manual*.

Figure 3-7: Roadway Section with Permeable Paver Shoulder and Bioretention Planter



3.5 Right-of-Way and Cost Considerations

Acquisition of additional right-of-way or permanent easements and temporary easements will be required in several locations to accommodate roadway improvements described in this study.

The budget-level cost estimate for the recommended Commercial Street improvements from Harrison Street to Randall Avenue is $4.6 million, as summarized in **Table 3-1.** This estimate includes costs for surveys, engineering design, easements, utility relocations and construction. Topographic surveys and additional engineering design are needed to better define the cost of the project as well as right-of-way

and/or easement limits. Actual project costs are significantly dependent upon the funding source(s) to be used, subsequent engineering and environmental studies, and fluctuations in the economy.

Table Error! No text of specified style in document.**-1: Budget-Level Cost Estimate**

ITEM	QTY	UNIT	UNIT COST	COST
Removal of Pavement, etc.	1	L SUM	$65,000.00	$65,000
Common Excavation	300	CY	$12.00	$4,000
Rock Excavation	1000	CY	$35.00	$35,000
Embankment in Place	8360	CY	$30.00	$251,000
Subgrade Compaction (6 Inch Depth)	40	STA	$400.00	$16,000
Compacting Embankment	300	CY	$10.00	$3,000
4" Type 1 Aggregate Base	2780	SY	$8.00	$22,000
Asphalt Pavement	3300	TON	$72.00	$238,000
Driveways	2231	SY	$70.00	$156,000
6" Gravel	533	SY	$8.00	$4,000
Concrete Curb, Type "S"	12650	LF	$45.00	$569,000
Green Gutter, not incl 2 curbs	1260	SY	$100.00	$126,000
Storm Sewer Inlets	54	EACH	$2,500.00	$135,000
Storm Sewer Pipe	7420	LF	$50.00	$371,000
End Sections	8	EACH	$725.00	$6,000
Retaining Wall	2700	SF	$50.00	$135,000
Hand Rail	540	LF	$50.00	$27,000
Sidewalk	920	SY	$45.00	$41,000
Permeable Conc Sidewalk, not incl 2 curbs	2240	SY	$54.00	$121,000
Concrete Sidewalk, Curb Ramp	42	EACH	$2,300.00	$97,000
RCB Extension	70	CY	$700.00	$49,000
Pavement Marking	37000	LF	$1.20	$44,000
Erosion Control	1	L SUM	$25,000.00	$25,000
Traffic Control	1	L SUM	$25,000.00	$25,000
Lighting (incl cable, etc.)	21	EACH	$5,000.00	$105,000
Seed, mulch, etc.	2	ACRE	$8,000.00	$16,000
Relocating Mailboxes	30	EACH	$200.00	$6,000
Signing and Overhead Flashing Beacon	1	L SUM	$12,000.00	$12,000
Guardrail	500	LF	$60.00	$30,000
Subtotal				$2,734,000
Contractor Construction Staking (2%)	1	L SUM	$54,680.00	$55,000
Mobilization (5%)	1	L SUM	$136,700.00	$137,000
Subtotal				$2,926,000
Contingency (15%)				$439,000
Sub-Total Construction				$3,365,000
Engineering & Surveying costs (15%)				$505,000
Construction Administration Costs (10%)				$337,000
Easement Costs				$30,000
Utility Adjustment & Relocations				$200,000
Escalation (2% per year for 3 years)				$202,000
Grand Total				**$4,639,000**

The stormwater management study will better define the recommended runoff collection and needed drainage system as well as associated costs. While green stormwater infrastructure practices decrease the

needs for curb and gutter, stormwater inlets, and large diameter stormwater pipe, green practices are still typically more expensive than a standard storm sewer system and traditional pavement materials. However, implementation of these green street infrastructure elements in strategic locations rather than along the entire street could minimize costs variation. The stormwater study will also evaluate the potential need for larger scale stormwater storage along Commercial street to alleviate flooding issues at the Town Branch creek. Utilizing green stormwater infrastructure elements such as green gutters and permeable pavements would reduce runoff thereby reducing the potential volume and costs of larger scale stormwater storage.