GREEN INFRASTRUCTURE FEASIBILITY STUDY

EAST NEWARK

RUTGERS
New Jersey Agricultural Experiment Station

PASSAIC VALLEY SEWERAGE COMMISSION
"Protecting Public Health and the Environment"

ACKNOWLEDGEMENTS

Designed to highlight green infrastructure opportunities within the Borough of East Newark, this document has been prepared by the Rutgers Cooperative Extension Water Resources Program with funding and direction by the Passaic Valley Sewerage Commission and the New Jersey Agricultural Experiment Station.

We would like to thank the Passaic Valley Sewerage Commission, the New Jersey Agricultural Experiment Station and the Borough of East Newark for their input and support in creating this document.

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New Jersey Agricultural Experiment Station

PASSAIC VALLEY SEWERAGE COMMISSION
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INTRODUCTION

In 2013, the Passaic Valley Sewerage Commission (PVSC) began a new initiative to assist the 48 municipalities within its jurisdiction to manage flooding and eliminate combined sewer overflows. With municipalities spread across five counties, PVSC is dedicated to leading efforts throughout the PVSC Sewerage District by using green infrastructure to intercept stormwater runoff, reduce combined sewer overflows (CSOs), manage existing water infrastructure, and minimize frequent flooding events. To help with this effort, PVSC has entered into a partnership with the Rutgers Cooperative Extension (RCE) Water Resources Program.

East Newark is a community with a combined sewer system which carries both wastewater and stormwater in the same pipes. During heavy rain or snow melt, combined sewer systems often cannot manage all of the water and overflow, causing a combined sewer overflow (CSO) event. When overflows or CSO events occur, stormwater that has been mixed with untreated wastewater is discharged into local waterways, carrying with it many contaminants. By using cost-effective green infrastructure practices, East Newark can begin to reduce the negative impacts of stormwater runoff and pressure on the local infrastructure, while also increasing resiliency to CSO events and protecting the health of our waterways.

This feasibility study is intended to be used as a guide for the community of East Newark to begin implementing green infrastructure practices while demonstrating to residents and local leaders the benefits of and opportunities for better managing stormwater runoff.

Rutgers University professor, Tobiah Horton, reviews a rain garden design with a homeowner.

EAST NEWARK

Located in Hudson County along the Passaic River, the Borough of East Newark covers almost 80 acres with a population of 2,406 as of the 2010 US Census. Across the Passaic River from the City of Newark, the Borough of East Newark shares its southern and eastern border with the municipality of Harrison. To the north, a former industrial rail line separates East Newark from the municipality of Kearny.

East Newark currently holds one combined sewer overflow point within its boundary. This means that in the event of a heavy storm, much of the borough's runoff and wastewater travels into the Passaic River untreated. By evaluating the feasibility of green infrastructure, East Newark can identify cost-effective ways to help mitigate overflow, flooding and water quality in the Passaic River.

WHAT IS STORMWATER?

When rainfall hits the ground, it can soak into the ground or flow across the surface. When rainfall flows across a surface, it is called "stormwater" runoff. Pervious surfaces allow stormwater to readily soak into the soil and recharge groundwater. An impervious surface can be any material that has been placed over soil that prevents water from soaking into the ground. Impervious surfaces include paved roadways, parking lots, sidewalks, and rooftops. As impervious areas increase, so does the amount of stormwater runoff. New Jersey has many problems due to stormwater runoff from impervious surfaces, including:

- POLLUTION: According to the 2010 New Jersey Water Quality Assessment Report, 90% of the assessed waters in New Jersey are impaired. Urban-related stormwater runoff is listed as the most probable source of impairment (USEPA, 2013). As stormwater flows over the ground, it picks up pollutants, including animal waste, excess fertilizers, pesticides and other toxic substances. These pollutants are carried to waterways.
- FLOODING: Over the past decade, the state has seen an increase in flooding. Communities around the state have been affected by these floods. The amount of damage caused also has increased greatly with this trend, costing billions of dollars over this time span.
- EROSION: Increased stormwater runoff causes an increase in stream velocity. The increased velocity after storm events erodes stream banks and shorelines, degrading water quality. This erosion can damage local roads and bridges and cause harm to wildlife.

A local reservoir


Purple Coneflower


Pervious Pavers

To protect and repair our waterways, reduce flooding, and stop erosion, stormwater runoff has to be better managed. Impervious surfaces need to be disconnected with green infrastructure to prevent stormwater runoff from flowing directly into New Jersey's waterways. Disconnection redirects runoff from paving and rooftops to pervious areas in the landscape.

A community garden that harvests and recycles rainwater

Rain barrel workshop participants

A rain garden after planting

WHAT IS GREEN INFRASTRUCTURE?

Green infrastructure is an approach to stormwater management that is cost-effective, sustainable, and environmentally friendly. Green infrastructure projects capture, filter, absorb, and reuse stormwater to maintain or mimic natural systems and to treat runoff as a resource. As a general principle, green infrastructure practices use soil and vegetation to recycle stormwater runoff through infiltration and evapotranspiration. When used as components of a stormwater management system, green infrastructure practices such as bioretention, green roofs, porous pavement, rain gardens, and vegetated swales can produce a variety of environmental benefits. In addition to effectively retaining and infiltrating rainfall, these technologies can simultaneously help filter air pollutants, reduce energy demands, mitigate urban heat islands, and sequester carbon while also providing communities with aesthetic and natural resource benefits (USEPA, 2013).

GLOSSARY OF GREEN INFRASTRUCTURE TERMINOLOGY

A ***DISCONNECTED:***

Disconnected refers to channeling water from gutters and pipes that collect runoff to somewhere other than a sewer drain where it can be filtered.

B ***DEPAVING:***

Depaving is the process of removing hardscape such as asphalt or concrete.

C ***INFILTRATION:***

Infiltration occurs when water on the ground's surface is absorbed into the soil below. Plants promote infiltration.

D ***IMPERVIOUS SURFACE:***

An impervious surface is one that water cannot penetrate.

E ***RUNOFF:***

Runoff is water from precipitation that flows across land and paved surfaces before entering local waterways or sewer systems.

A

B

C

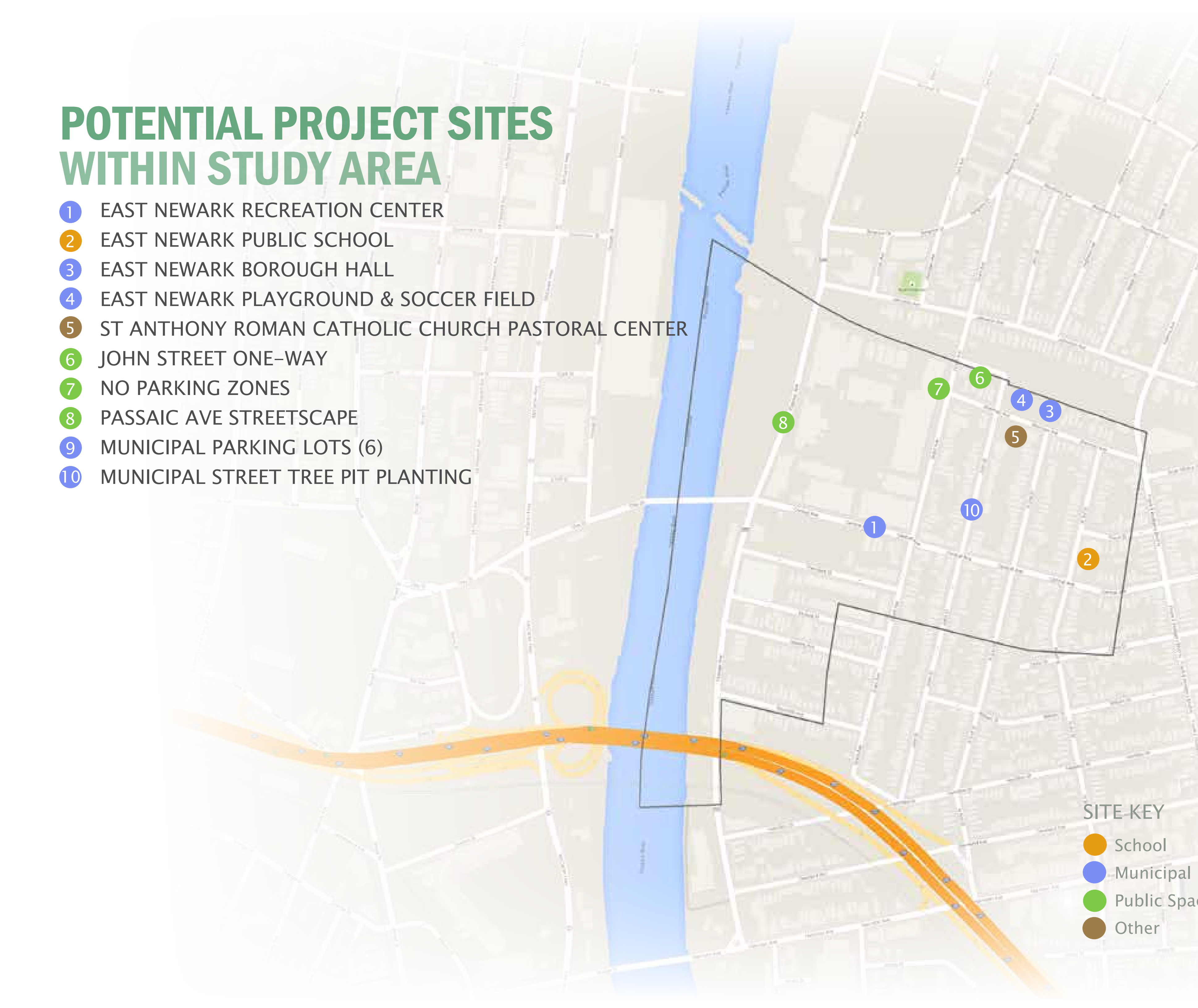
D

E

GREEN INFRASTRUCTURE STRATEGIES

POTENTIAL PROJECT SITES WITHIN STUDY AREA

1. EAST NEWARK RECREATION CENTER
2. EAST NEWARK PUBLIC SCHOOL
3. EAST NEWARK BOROUGH HALL
4. EAST NEWARK PLAYGROUND & SOCCER FIELD
5. ST ANTHONY ROMAN CATHOLIC CHURCH PASTORAL CENTER
6. JOHN STREET ONE-WAY
7. NO PARKING ZONES
8. PASSAIC AVE STREETSCAPE
9. MUNICIPAL PARKING LOTS (6)
10. MUNICIPAL STREET TREE PIT PLANTING

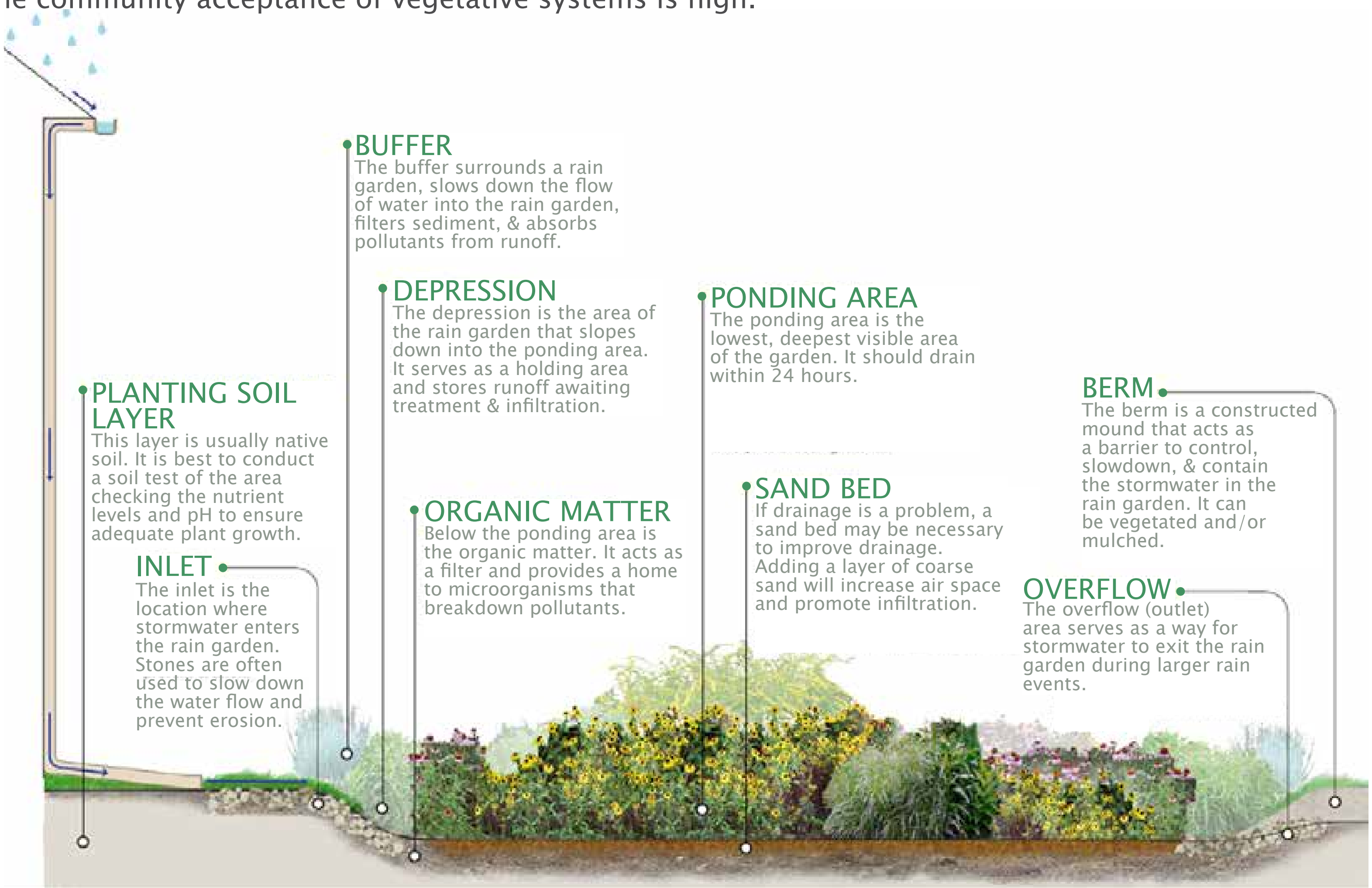



STATE OF
NEW JERSEY
DEPARTMENT OF
ENVIRONMENTAL
PROTECTION

GREEN INFRASTRUCTURE SYSTEMS

VEGETATED SYSTEMS

Vegetative systems primarily focus on reducing water quality impacts and less on reducing flooding. These systems are typically located close to the sources of runoff and can manage the smaller storms of several inches. The main treatment mechanisms are infiltration, filtration, and evapotranspiration. These systems do an excellent job at removing total suspended solids, nutrients and pathogens. Construction costs for vegetated systems are typically low to moderate when compared to other green infrastructure practices. Since these systems often can be incorporated into existing landscapes and enhance aesthetics, the community acceptance of vegetative systems is high.



RAIN GARDEN DIAGRAM

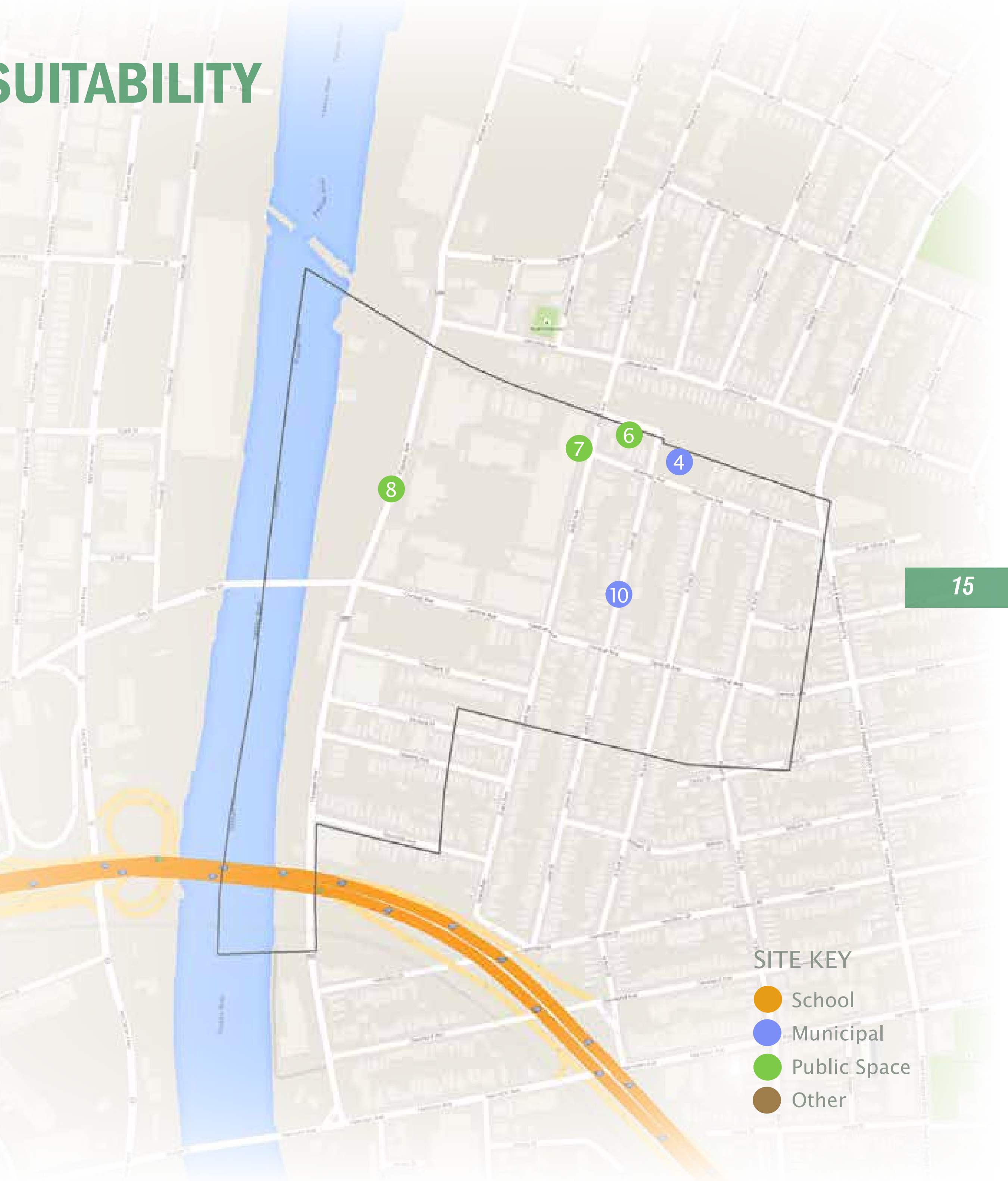
VEGETATED SYSTEM SUITABILITY

Rain gardens are shallow landscaped depressions designed to capture, treat, and infiltrate stormwater runoff. Rain gardens can be readily installed throughout a community to begin re-establishing the natural processes of the landscape. Rain gardens:

- Capture stormwater runoff, reducing soil erosion and sedimentation and the amount of water that flows to our streams and waterways during rain storms
- Protect water quality by filtering out and breaking down pollutants
- Infiltrate runoff and recharge groundwater supplies by providing base flow to nearby streams and waterways
- Enhance and increase green space and vegetated cover

Rain gardens are a simple way communities can begin to reduce stormwater runoff, manage flows to sewer systems, and protect water resources. Rain gardens can be placed in strategic locations to capture runoff from rooftops and paved areas, including:

- Homes
- Schools
- Churches
- Parking areas
- Community gardens



VEGETATED SYSTEM SUITABILITY: EXAMPLE PROJECT SITE

Runoff on many East Newark streets flows towards catch basins that are often located near no parking zones.

VEGETATED SYSTEM SUITABILITY: EXAMPLE PROJECT SITE

Curb cuts and curb bump-out stormwater planters at intersections and near fire hydrants can intercept stormwater runoff, prevent illegal parking, and provide traffic calming for pedestrians.

RAINWATER HARVESTING SYSTEMS

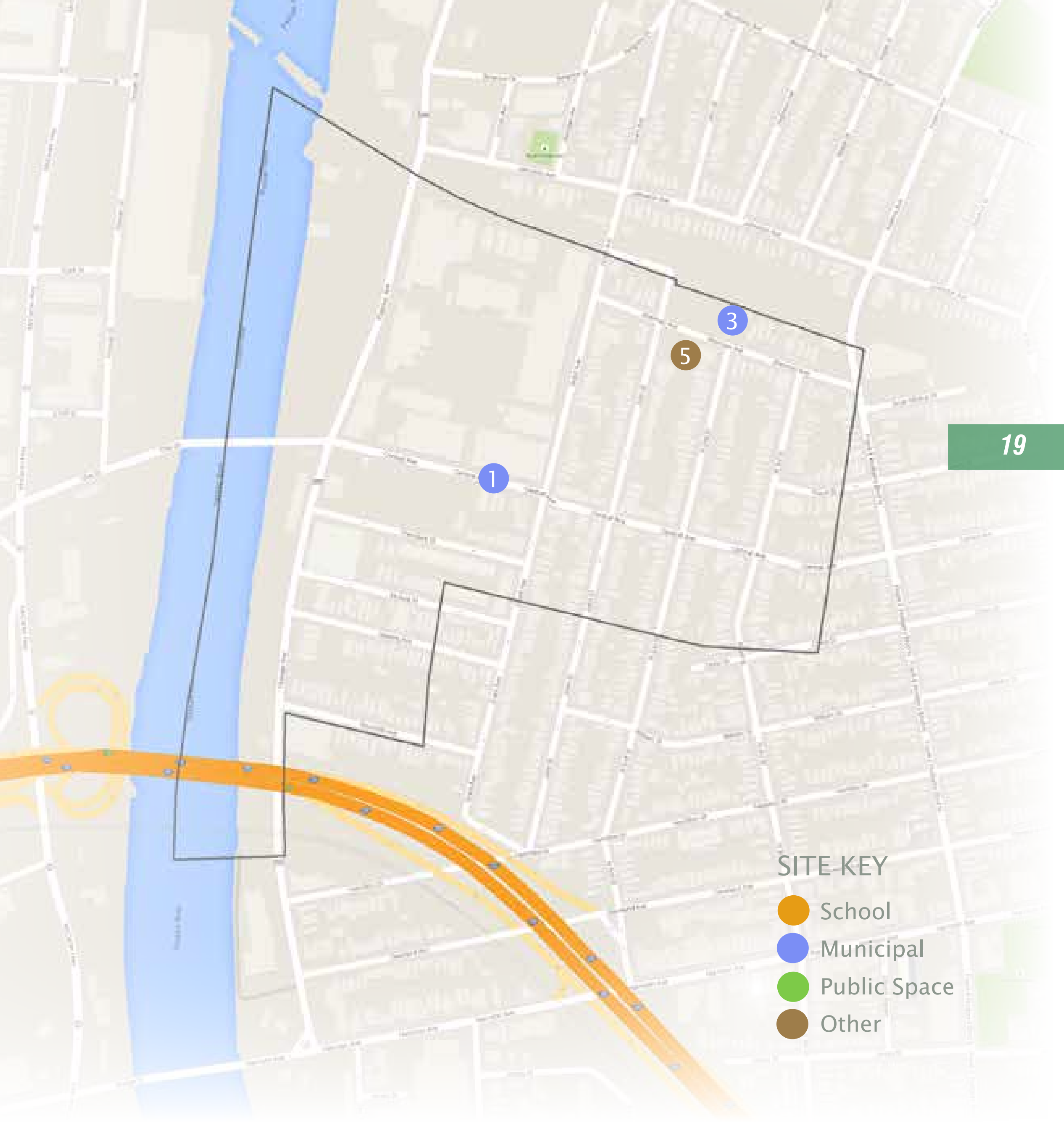
Rainwater harvesting systems focus on the conservation, capture, storage and reuse of rainwater. These systems are located close to residential and commercial buildings. Construction costs are low to moderate, depending on the size of the system, compared to other green infrastructure practices. Since these systems can be easily incorporated into the built landscape, the community acceptance of rainwater harvesting systems is moderate to high. Rainwater harvesting systems include rain barrels and cisterns.

RAIN BARREL DIAGRAM

RAINWATER HARVESTING SYSTEMS SUITABILITY

Typical rainwater harvesting systems can store up to 5,000 gallons of water. Harvesting during the rainy months of spring and summer provides a source of water during hot and dry periods between rain storms. Instead of using potable water, residents can save money using the rainwater stored in a rain barrel or cistern. This also reduces the demand on drinking water supplies and related infrastructure.

Rain barrels and cisterns are an effective rainwater harvesting tool and can be an important element in a community-wide green infrastructure program. For every inch of rain that falls on an eight hundred square foot roof (20' x 40'), nearly 500 gallons of water can be collected. Over an entire year, water draining from this rooftop will total over 20,000 gallons. This sustainable practice reduces the impact a building has on the environment by harvesting stormwater runoff from rooftops and decreasing flow to sewer systems. Rain barrels and cisterns provide an alternative source of water for gardens, lawns, and landscaping by reducing the use of potable water supplies.



RAINWATER HARVESTING SYSTEM SUITABILITY: EXAMPLE PROJECT SITE

Located on Sherman Avenue, the East Newark Borough Hall & Police Department complex has downspouts that discharge onto the asphalt parking lot.

RAINWATER HARVESTING SYSTEM SUITABILITY: EXAMPLE PROJECT SITE

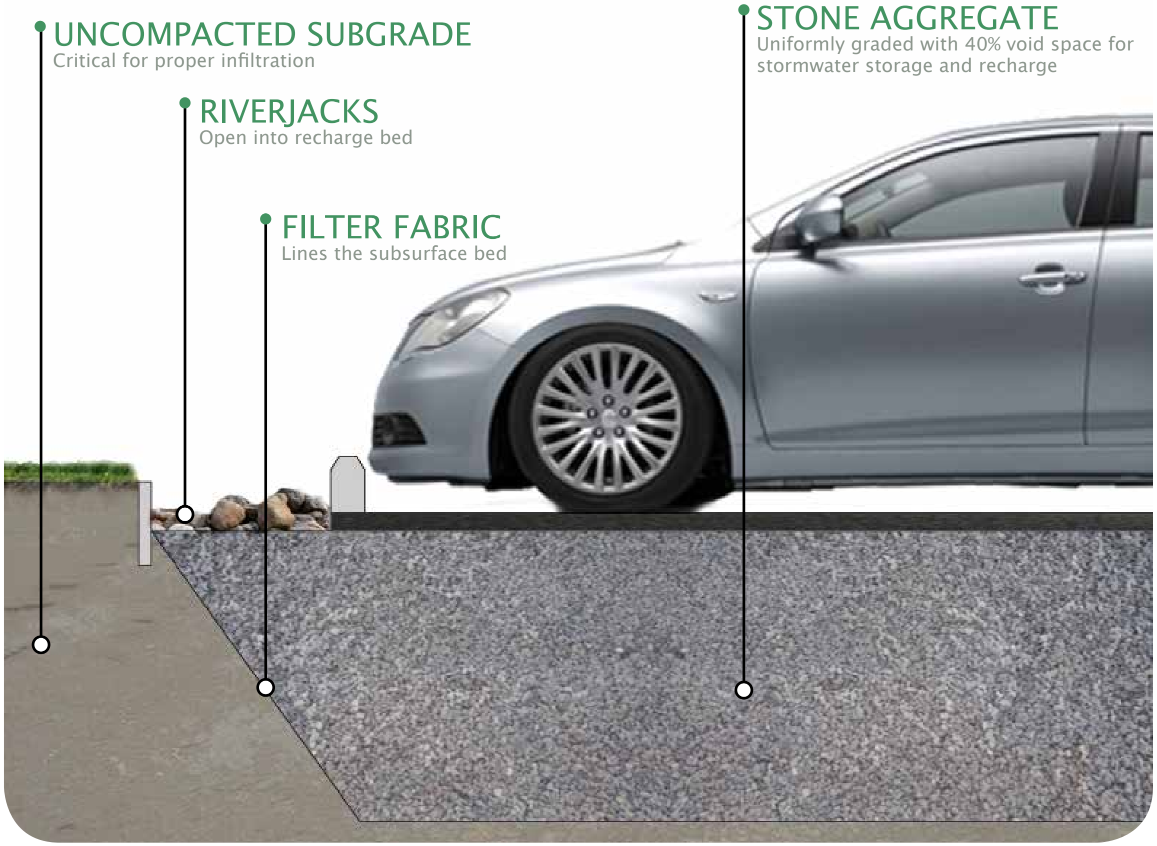
Roof runoff from these downspouts can be stored in rain barrels and infiltrated through porous asphalt.

STORAGE, QUANTITY & INFILTRATION SYSTEMS

Storage, quantity, and infiltration systems primarily focus on storage. These systems are typically located close to runoff sources within residential, commercial, and industrial landscapes. The main treatment mechanism is reducing peak flows of stormwater by storing it before it becomes runoff. Construction costs for storage, quantity, and infiltration are moderate to high when compared to other green infrastructure practices because they require more space and infrastructure and are more laborious to install. Since these systems can be seamlessly incorporated into the built environment and can manage a large quantity of water, the community acceptance of storage, quantity, and infiltration systems is high.

PERMEABLE PAVEMENT

- Underlying stone reservoir
- Porous asphalt and pervious concrete are manufactured without "fine" materials to allow infiltration
- Grass pavers are concrete interlocking blocks with open areas to allow grass to grow
- Ideal application for porous pavement is to treat a low traffic or overflow parking area



PERMEABLE PAVEMENT DIAGRAM

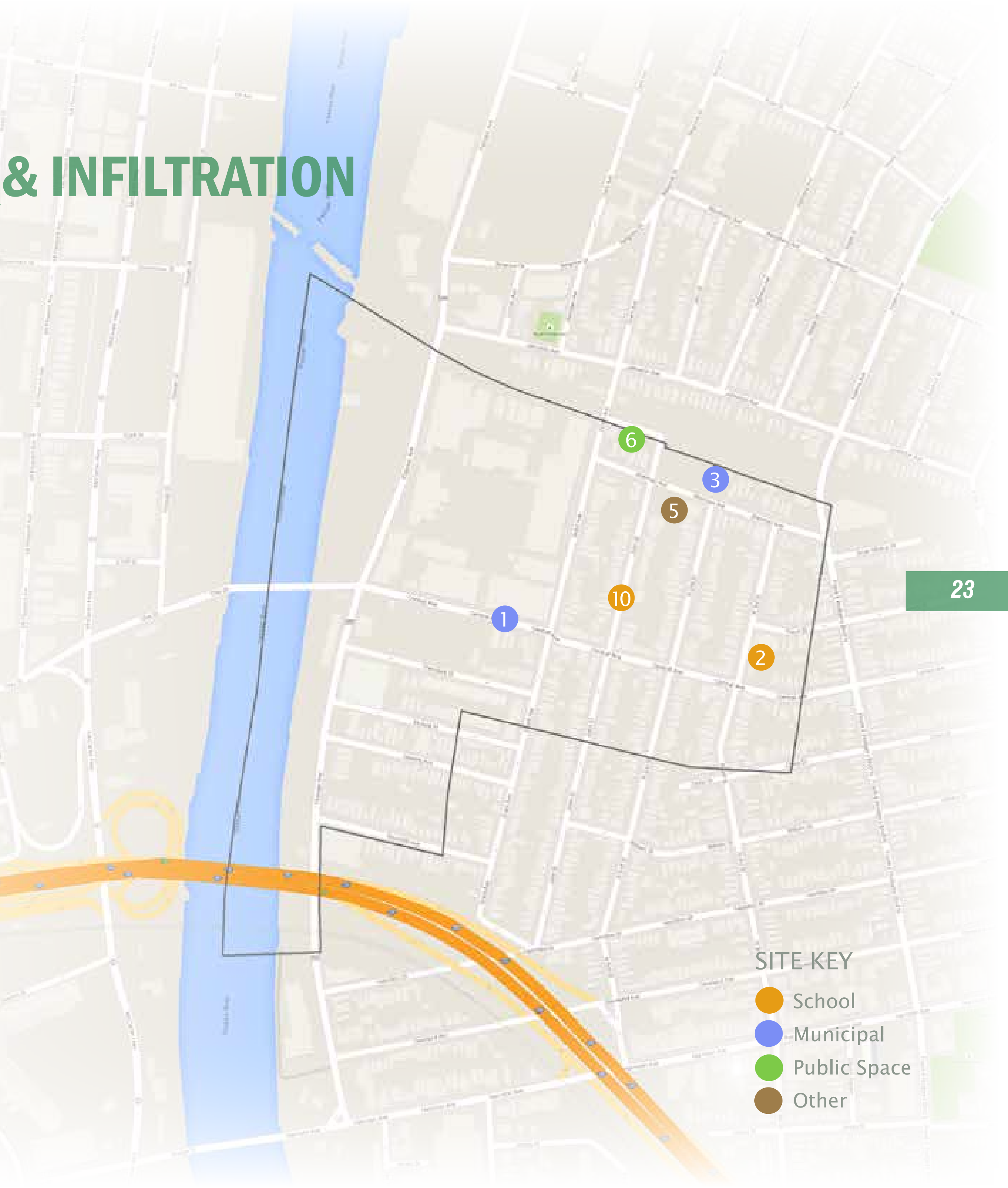
STORAGE, QUANTITY & INFILTRATION SYSTEM SUITABILITY

Pervious paving systems are paved areas that produce less stormwater runoff than areas paved with conventional paving. These systems include:

- Permeable pavers
- Porous asphalt
- Pervious concrete

The paving material is placed over a bed of uniformly graded stone. The paving materials allow water to pass through and then infiltrate into the pore spaces of the underlying stone bed. The stored runoff then infiltrates over time into the uncompacted subgrade soils.

Stormwater planters are small, contained vegetated systems that collect and treat stormwater using a prepared soil media and mulch. These systems serve as small bioretention facilities filtering stormwater through layers of mulch, soil, and plant root systems. Treated stormwater can then be infiltrated into existing surrounding soils as groundwater (infiltration planter), or if infiltration is not appropriate, drainage pipes can discharge filtered stormwater into traditional storm sewer infrastructure (flow-through planter).



STORAGE, QUANTITY & INFILTRATION SYSTEM SUITABILITY: EXAMPLE PROJECT SITE

The terminus of John Street is a limited traffic, one-way street with angled parking.

STORAGE, QUANTITY & INFILTRATION SYSTEM SUITABILITY: EXAMPLE PROJECT SITE

Runoff from the road and adjacent park can be intercepted in permeable pavement and a series of stormwater planters in the sidewalk with curb cuts.


TREE
PLANTING

COMMUNITY ENGAGEMENT & EDUCATION

BUILD A RAIN BARREL WORKSHOP

With the Build a Rain Barrel Workshop, community members participate in a short presentation on stormwater management and water conservation and then learn how to build their own rain barrel. Workshop participants work with trained experts to convert 55 gallon plastic food-grade drums into rain barrels. They are quickly able to take an active role in recycling rainwater by installing a rain barrel at their house! Harvesting rainwater has many benefits including saving water, saving money, and preventing basement flooding. By collecting rainwater, homeowners are helping to reduce flooding and pollution in local waterways. When rainwater flows across hard surfaces like rooftops, driveways, roadways, parking lots, and compacted lawns, it carries pollution to our local waterways. Harvesting the rainwater in a rain barrel is just one of the ways homeowners can reduce the amount of rainwater draining from their property and help reduce neighborhood flooding problems.

STORMWATER MANAGEMENT IN YOUR SCHOOLYARD

The *Stormwater Management in Your Schoolyard* program provides educational lectures, hands-on activities, and community-level outreach for students on the topics of water quality issues and stormwater management practices such as rain gardens and rain barrels. Program objectives include the exploration of various aspects of the natural environment on school grounds, the detailed documentation of findings related to these explorations, and the communication of these findings to the school community. As part of this program, several New Jersey State Core Curriculum Content Standards for science (5.1, 5.3, and 5.4), twenty-first century life and careers (9.1, 9.3, and 9.4), and social studies (6.3) are addressed. Every school is unique in its need for stormwater management, so each school's *Stormwater Management in Your Schoolyard* program can be delivered in a variety of ways. This program can be tailored for grades K-8 or 9-12 and can be offered to meet a variety of schedules.

MAINTENANCE PROCEDURES

MAINTAINING EAST NEWARK'S GREEN INFRASTRUCTURE SYSTEMS

1. VEGETATED SYSTEMS
    - Rain Garden
    - Stormwater Planter
    - Bioswale

2. RAINWATER HARVESTING
    - Rain Barrel
    - Cistern

3. STORAGE, QUANTITY, AND INFILTRATION
    - Porous Asphalt & Concrete
    - Underground Detention

VEGETATED SYSTEM MAINTENANCE

RAIN GARDEN:

Weekly

- Water
- Weed
- Inspect for invasive plants, plant health, excessive sediment, and movement of sediment within the rain garden
- Observe the rain garden during rain events and note any successes (Example of success: stormwater runoff picks up oil and grease from the parking lot, flows through a curb cut, and into a rain garden; the rain garden traps the nonpoint source pollutants before they reach the nearby waterway)

Annually

- Mulch in the spring to retain a 3-inch mulch layer in the garden
- Prune during dormant season to improve plant health
- Remove sediment
- Plant
- Test the soil (every 3 years)
- Harvest plants to use in other parts of the landscape
- Clean debris from gutters connected to rain garden
- Replace materials (such as river rock and landscape fabric) where needed

STORMWATER PLANTER

- Very similar maintenance regime to rain gardens

BIOSWALE

- Very similar maintenance regime to rain gardens

RAINWATER HARVESTING SYSTEM MAINTENANCE

RAIN BARREL:

- Keep screen on top and a garden hose attached to the overflow to prevent mosquitoes; change screen every two years
- Remove debris from screen after storms
- Disconnect the barrel in winter; store inside or outside with a cover
- Clean out with long brush and water/dilute bleach solution (~3%)

CISTERN:

- In the fall, prepare your cistern for the winter by diverting flow so that no water can enter and freeze within the tank
- Weekly check: Check for leaks, clogs, obstructions, holes, and vent openings where animals, insects, and rodents may enter; repair leaks with sealant; drain the first flush diverter/ roof washer after every rainfall event
- Monthly check: Check roof and roof catchments to make sure no debris is entering the gutter and downspout directed into the cistern; keep the roof, gutters, and leader inlets clear of leaves; inspect the first flush filter and all of its attachments, making any necessary replacements; inspect cistern cover, screen, overflow pipe, sediment trap, and other accessories while making any necessary replacements

STORAGE, QUANTITY & INFILTRATION SYSTEM MAINTENANCE

POROUS ASPHALT & CONCRETE:

- Materials cost is ~20-25% more than traditional asphalt or concrete
- Long-term maintenance is required by routine quarterly vacuum sweeping
- Sweeping cost may be off-set by reduced deicing costs
- Asphalt repairs can be made with standard asphalt not to exceed 10% of surface area
- Concrete repairs can be made with standard concrete not to exceed 10% of the surface area

UNDERGROUND DETENTION:

- Periodic inspections of the inlet and outlet areas to ensure correct operation of system
- Clean materials trapped on grates protecting catch basins and inlet area monthly
- Primary maintenance concerns are removal of floatables that become trapped and removal of accumulating sediments within the system; this should be done at least on an annual basis
- Proprietary traps and filters associated with stormwater storage units should be maintained as recommended by the manufacturer
- Any structural repairs required to inlet and outlet areas should be addressed in a timely manner on an as needed basis
- Local authorities may require annual inspection or require that they carry out inspections and maintenance




POTENTIAL PROJECT SITES

EAST NEWARK RECREATION CENTER & PRESCHOOL

44 Central Avenue
East Newark, NJ 07029

Located on Central Avenue, East Newark Recreation Center & Preschool facility has several downspouts and an asphalt parking lot. Downspouts can be diverted into curbside stormwater planters or raised planter boxes to capture roof runoff. Stormwater ponding on the adjacent parking lot can be captured and infiltrated through pervious pavement.

SUITABLE GREEN INFRASTRUCTURE STRATEGIES:

- [ ] rain gardens
- [ ] curb cuts
- [x] stormwater planters
- [ ] rain barrels
- [ ] buffers
- [ ] cisterns
- [x] pervious pavement
- [ ] bioswales
- [ ] depaving

EAST NEWARK RECREATION CENTER & PRESCHOOL

44 Central Avenue
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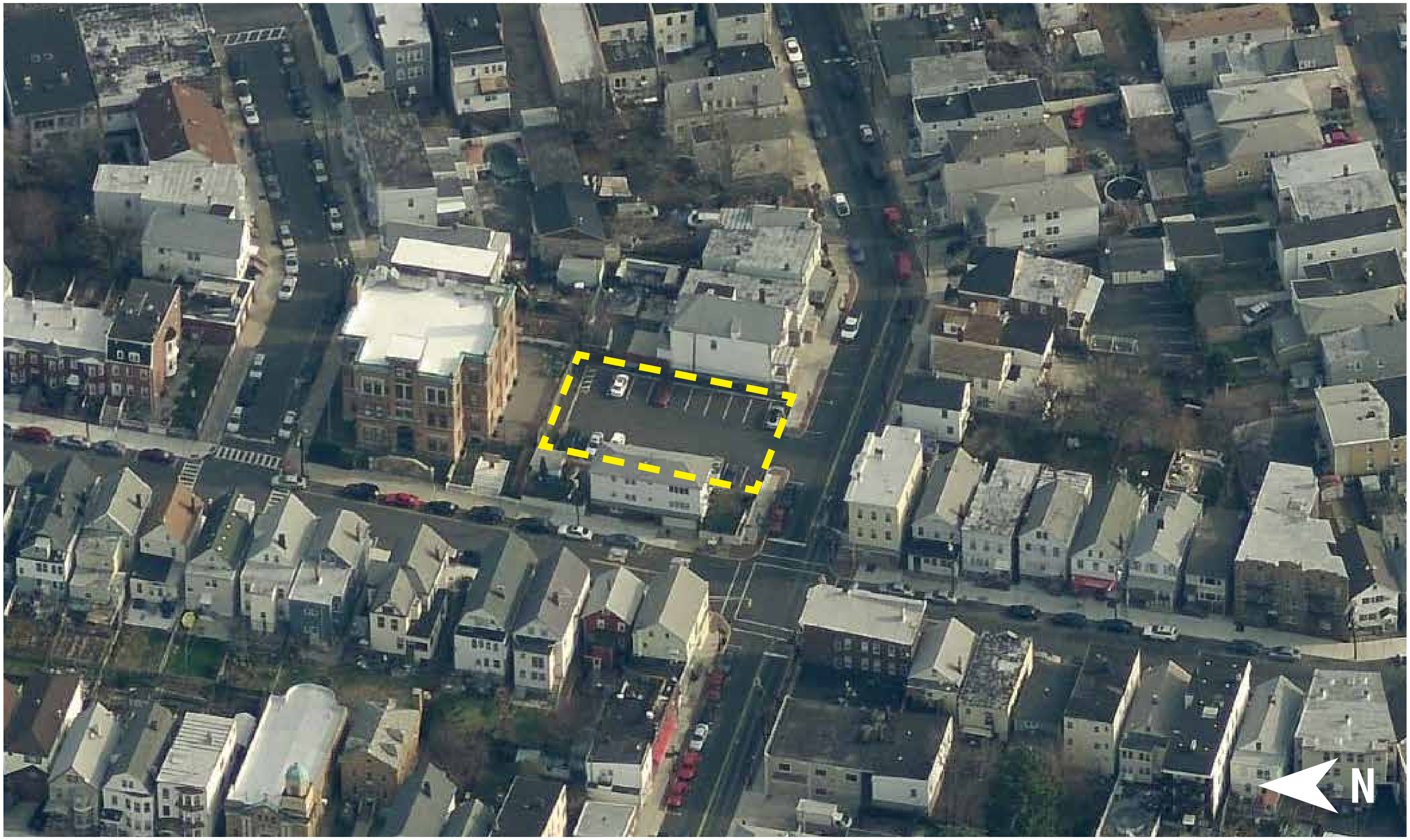
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Located on North 3rd Street, the East Newark Public School building has internally fed drainage. Permeable pavement can be used to manage stormwater runoff in the adjacent asphalt parking lot.

SUITABLE GREEN INFRASTRUCTURE STRATEGIES:

- [ ] rain gardens
- [ ] tree pits
- [ ] stormwater planters
- [ ] rain barrels
- [ ] buffers
- [ ] cisterns
- [x] pervious pavement
- [ ] bioswales
- [ ] depaving

EAST NEWARK BOROUGH HALL & POLICE DEPARTMENT

34 Sherman Avenue
East Newark, NJ 07029



Located on Sherman Avenue, the East Newark Borough Hall & Police Department complex has downspouts that discharge onto the asphalt parking lot. Roof runoff from these downspouts can be stored in rain barrels and infiltrated through porous asphalt. Runoff from the road can be intercepted in a stormwater planter in the no-parking zone and sidewalk.

SUITABLE GREEN INFRASTRUCTURE STRATEGIES:

- [ ] rain gardens
- [x] rain barrels
- [x] pervious pavement
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EAST NEWARK BOROUGH HALL & POLICE DEPARTMENT

34 Sherman Avenue
East Newark, NJ 07029

EAST NEWARK PLAYGROUND AND SOCCER FIELD

28 Sherman Avenue
East Newark, NJ 07029

Located on Sherman Avenue down the street from Borough Hall, this park contains a synthetic turf soccer field and a playground. Surface runoff can be intercepted around the outer edges of the park through permeable pavement.

SUITABLE GREEN INFRASTRUCTURE STRATEGIES:

- [ ] rain gardens
- [ ] tree pits
- [ ] stormwater planters
- [ ] rain barrels
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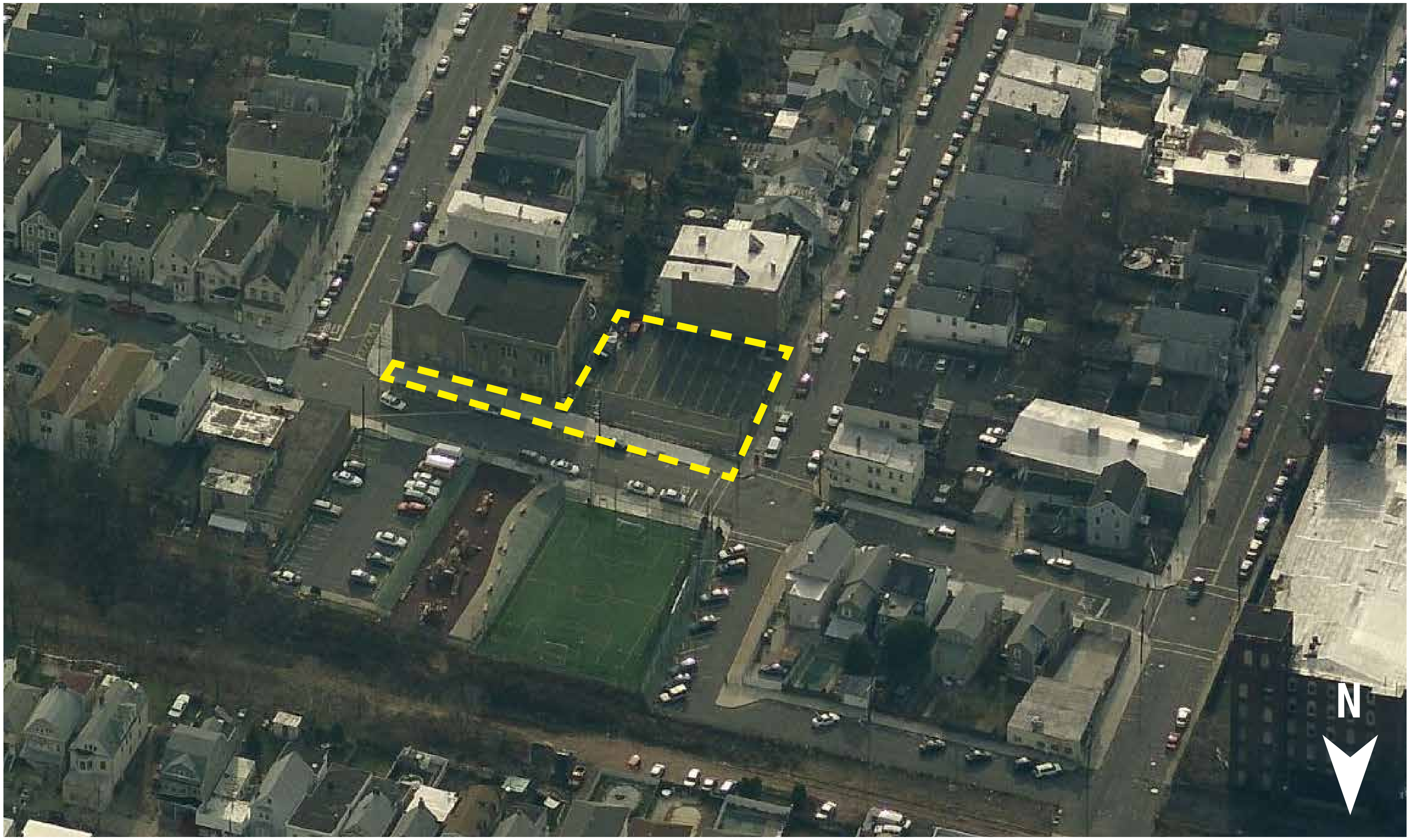
EAST NEWARK PLAYGROUND AND SOCCER FIELD

28 Sherman Avenue
East Newark, NJ 07029



ST. ANTHONY ROMAN CATHOLIC CHURCH PASTORAL CENTER

446 North 2nd Street
East Newark, NJ 07029


The St. Anthony Roman Catholic Church Pastoral Center building is located at the intersection of North 2nd Street and Sherman Avenue near the municipal complex. Concrete sidewalks can be retrofitted to intercept runoff through downspout disconnection or through curb cuts, and stormwater planters. The adjacent asphalt parking area is in fair condition with visible cracks and potholes. The parking lot can be repaved with porous asphalt to manage stormwater runoff that otherwise ponds on site or drains to the adjacent roadway and sewer system.

SUITABLE GREEN INFRASTRUCTURE STRATEGIES:

- [ ] rain gardens
- [ ] tree pits
- [x] stormwater planters
- [ ] rain barrels
- [ ] buffers
- [ ] cisterns
- [x] pervious pavement
- [ ] bioswales
- [ ] depaving

ST. ANTHONY ROMAN CATHOLIC CHURCH PASTORAL CENTER

446 North 2nd Street
East Newark, NJ 07029

JOHN STREET ONE-WAY

Sherman Avenue/John Street
East Newark, NJ 07029

The terminus of John Street is a limited traffic, one-way street with angled parking. Runoff from the road and adjacent park can be intercepted in permeable pavement and a series of stormwater planters in the sidewalk with curb cuts.

SUITABLE GREEN INFRASTRUCTURE STRATEGIES:

- [ ] rain gardens
- [ ] tree pits
- [x] stormwater planters
- [ ] rain barrels
- [ ] buffers
- [ ] cisterns
- [x] pervious pavement
- [ ] bioswales
- [ ] depaving

NO PARKING ZONES

Sherman Avenue and Grant Avenue
East Newark, NJ 07029


Runoff on many East Newark streets flows towards catch basins that are often located near no parking zones. Curb cuts and curb bump-out stormwater planters at intersections and near fire hydrants can intercept stormwater runoff, prevent illegal parking, and provide traffic calming for pedestrians.

SUITABLE GREEN INFRASTRUCTURE STRATEGIES:

- [ ] rain gardens
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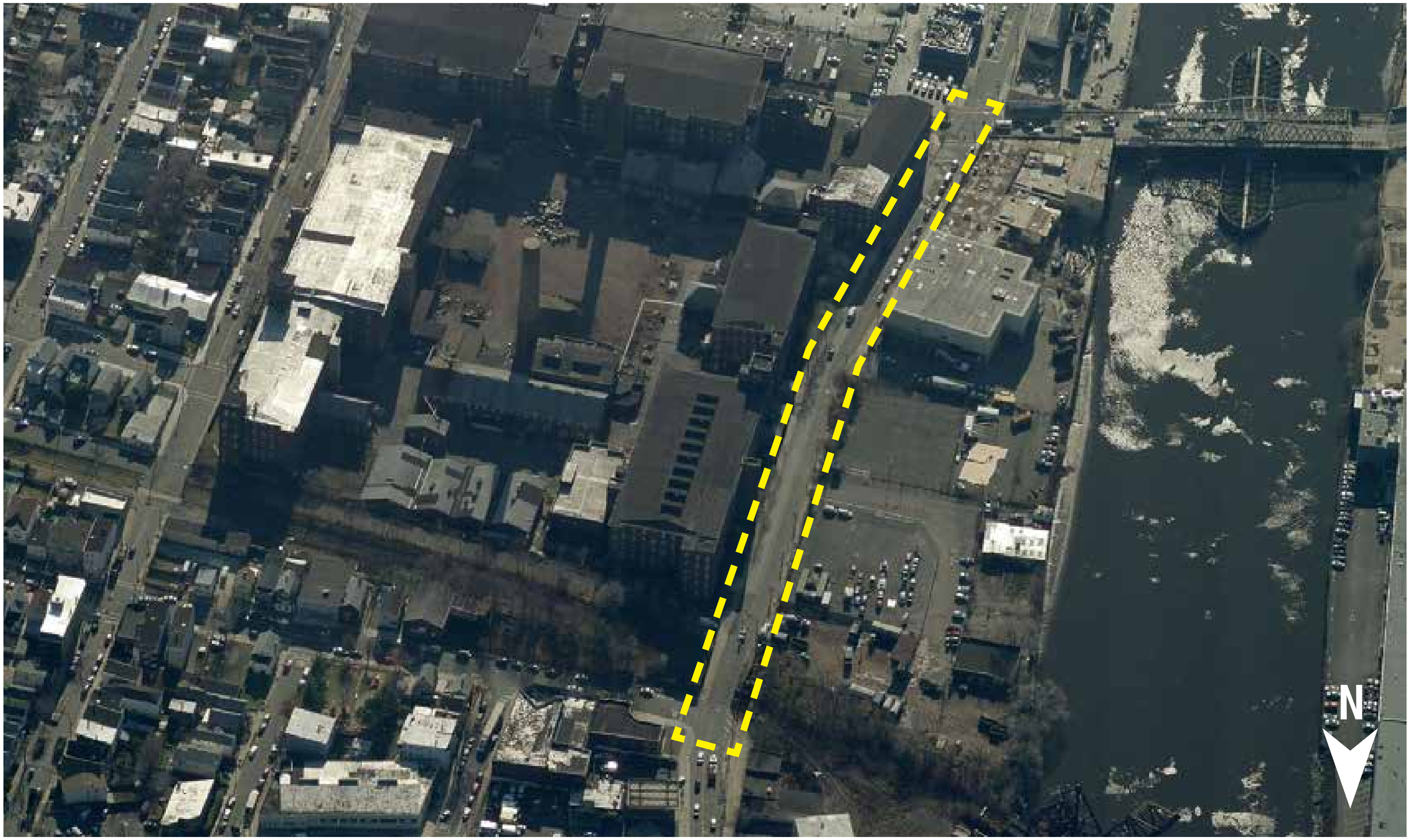

PASSAIC AVENUE/COUNTY ROAD 599 STREETSCAPE

Passaic Avenue and Johnston Avenue
East Newark, NJ 07029

  

Passaic Avenue/County Road 599 is a riverfront artery with wide sidewalks and several adjacent industrial properties. Stormwater runoff can be intercepted along the road with curb cuts, stormwater planters, tree pits, and permeable pavement.

SUITABLE GREEN INFRASTRUCTURE STRATEGIES:

- [ ] rain gardens
- [x] tree pits
- [x] stormwater planters
- [ ] rain barrels
- [ ] buffers
- [ ] cisterns
- [x] pervious pavement
- [ ] bioswales
- [ ] depaving

PASSAIC AVENUE/COUNTY ROAD 599 STREETSCAPE

Passaic Avenue and Johnston Avenue
East Newark, NJ 07029


N

Six municipal parking lots, located throughout East Newark, can be repaved with porous asphalt to capture and infiltrate stormwater.

SUITABLE GREEN INFRASTRUCTURE STRATEGIES:

- [ ] rain gardens
- [ ] tree pits
- [ ] stormwater planters
- [ ] rain barrels
- [ ] buffers
- [ ] cisterns
- [x] pervious pavement
- [ ] bioswales
- [ ] depaving



Over the years, many street trees have been taken down due to sidewalk lifting and space constraints. A mass tree planting program can be integrated with curb cuts and curb bump-out stormwater planters to infiltrate and treat stormwater.

SUITABLE GREEN INFRASTRUCTURE STRATEGIES:

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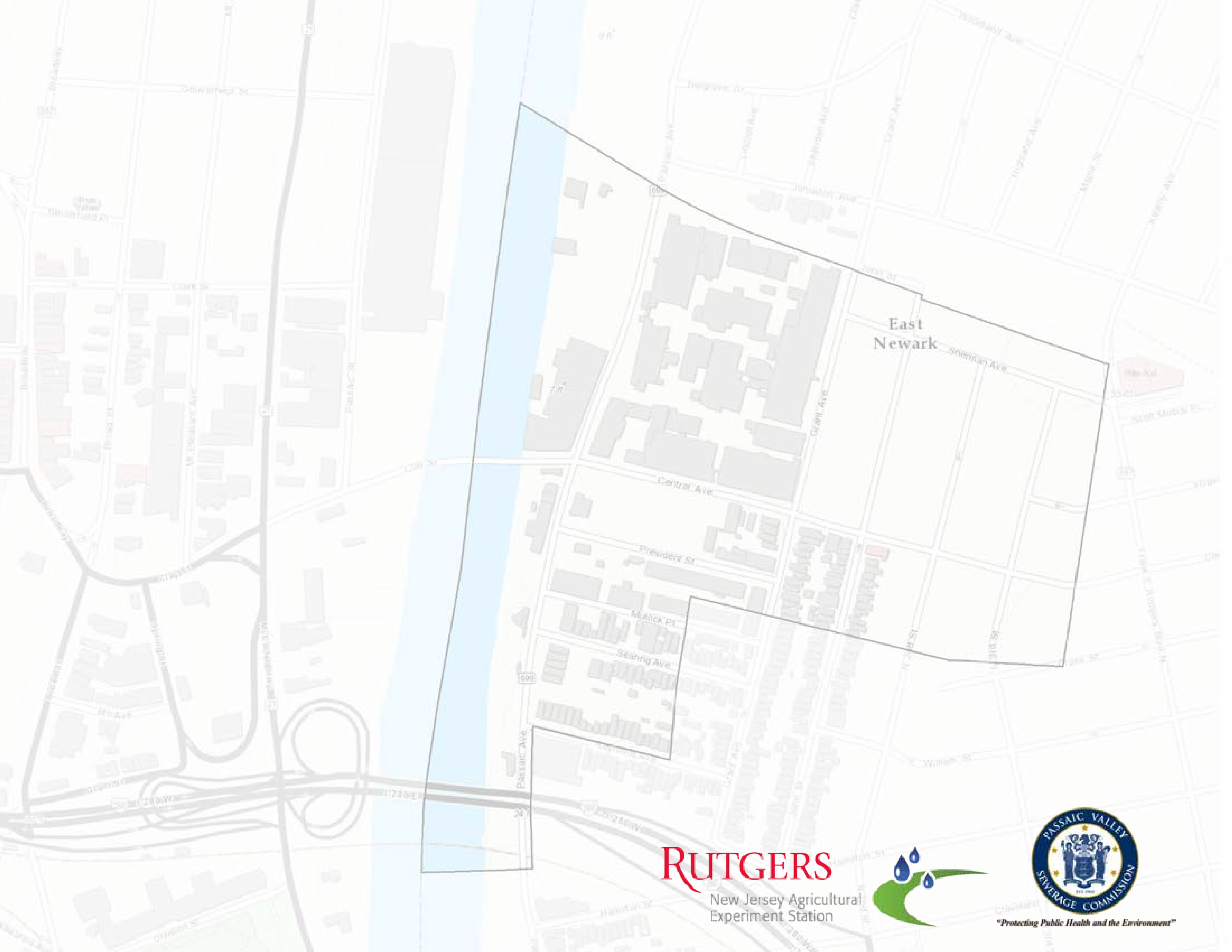

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