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OF NEW JERSEY

Impervious Cover Assessment, Green Infrastructure Feasibility Study, Green Infrastructure Designs, and Master Plan for West Grove, Pennsylvania

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www.water.rutgers.edu

March 4, 2020

Rutgers Cooperative Extension

Rutgers Cooperative Extension (RCE) helps the diverse population of New Jersey adapt to a rapidly changing society and improves their lives through an educational process that uses science-based knowledge.

Water Resources Program

The Water Resources Program is one of many specialty programs under Rutgers Cooperative Extension.

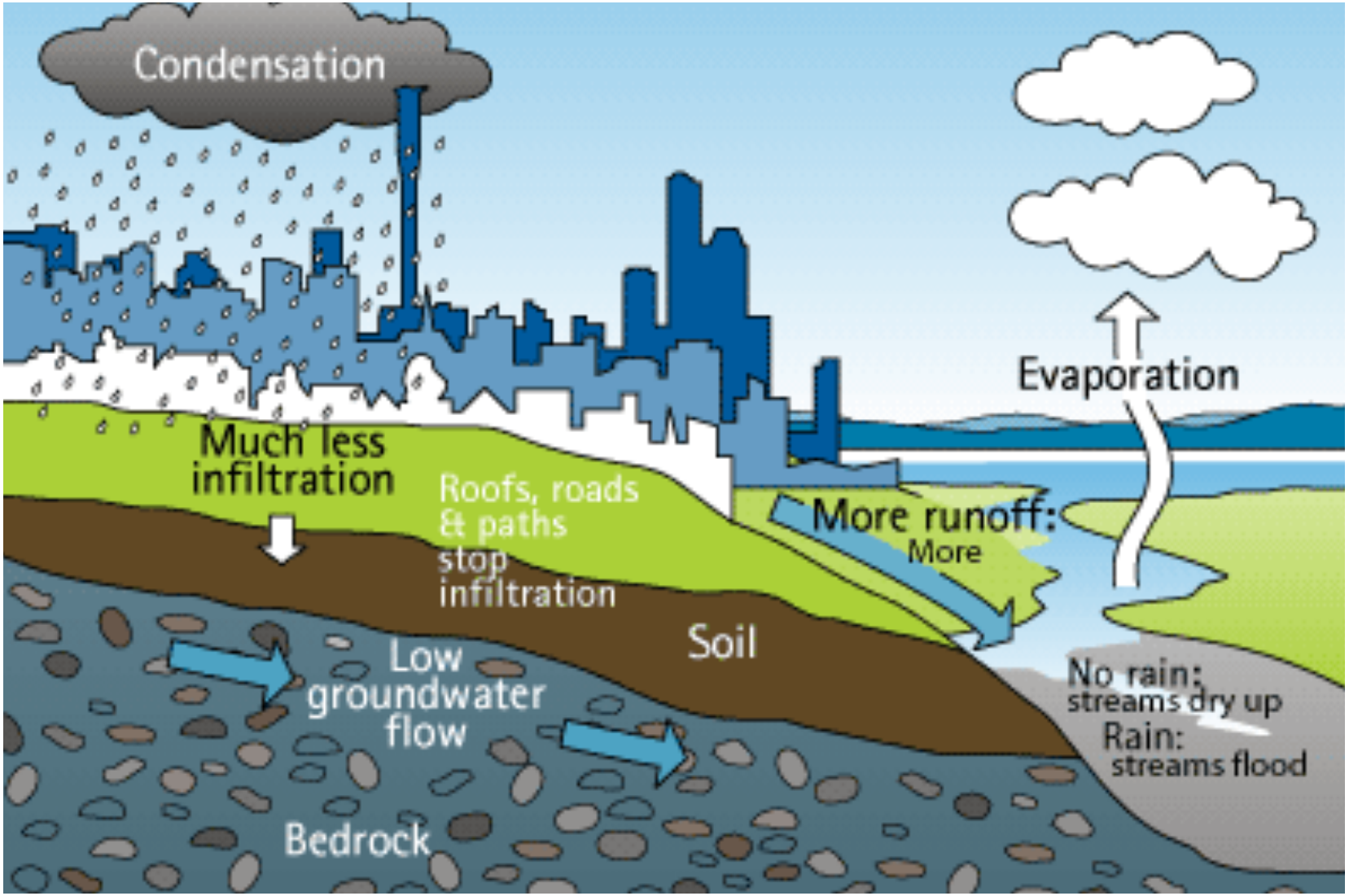
Our Mission is to identify and address community water resources issues using sustainable and practical science-based solutions.

The Water Resources Program serves all of New Jersey, working closely with the County Extension Offices.

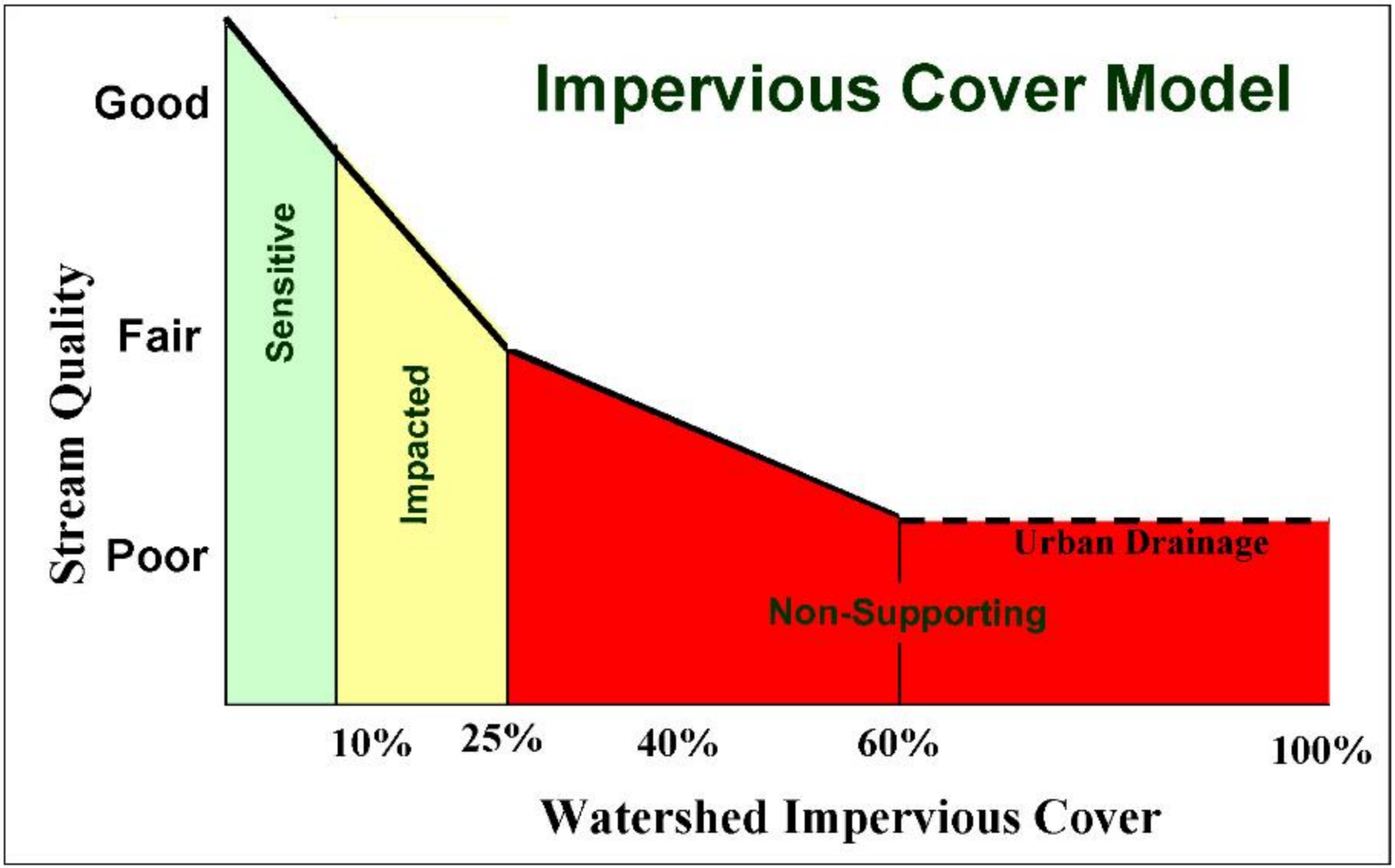
The Impact of Development on Stormwater Runoff

More development → *More impervious surfaces* → *More stormwater runoff*

The *Urban* Hydrologic Cycle



Original ICM developed based on 200+ reports and papers



Reference: Tom Schueler and Lisa Fraley-McNeal, Symposium on Urbanization and Stream Ecology, May 23 and 24, 2008

Green Infrastructure

…an approach to stormwater management that is cost-effective, sustainable, and environmentally friendly

Green Infrastructure projects:

- capture
- filter
- absorb
- reuse

stormwater to maintain or mimic natural systems and treat runoff as a resource

Green Infrastructure includes:

- green roofs
- rainwater harvesting
- tree filter/planter boxes
- rain gardens/bioretention systems
- permeable pavements
- vegetated swales or bioswales
- natural retention basins
- trees & urban forestry
- green streets








Addressing Impervious Cover

Can we eliminate it?

Can we change it?

Can we disconnect it?

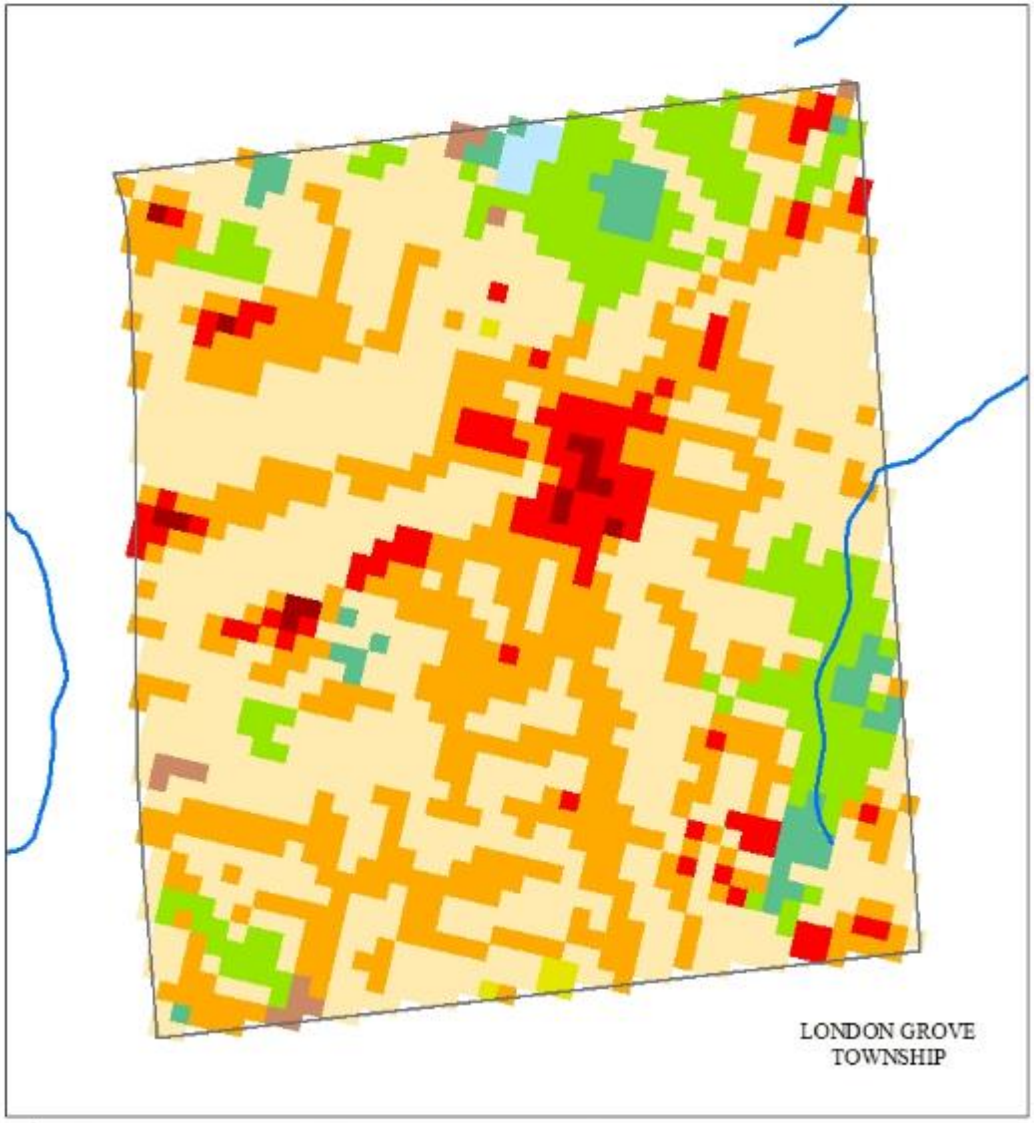
Can we reuse it?

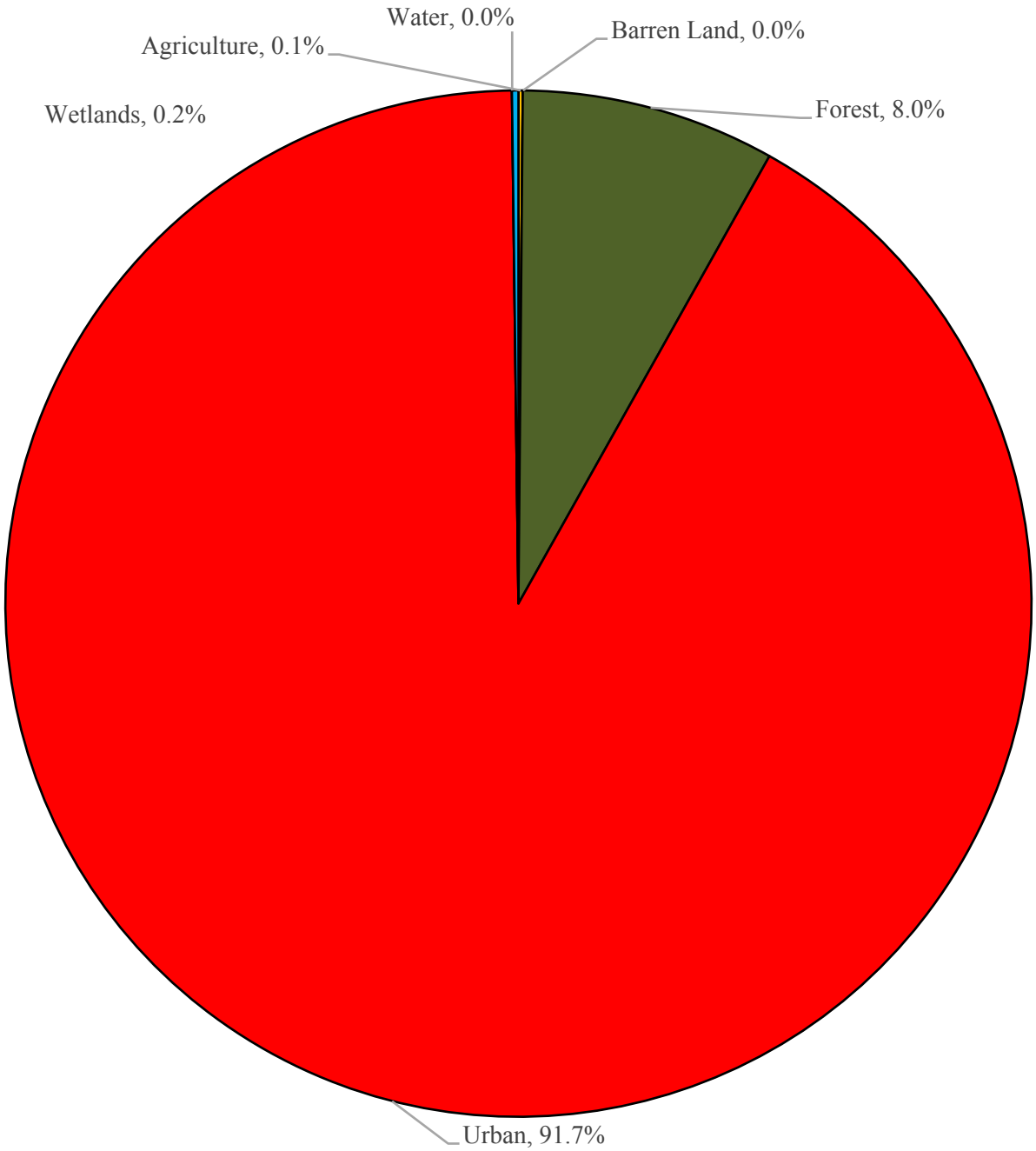
Impervious Cover Assessment

Impervious Cover Assessment

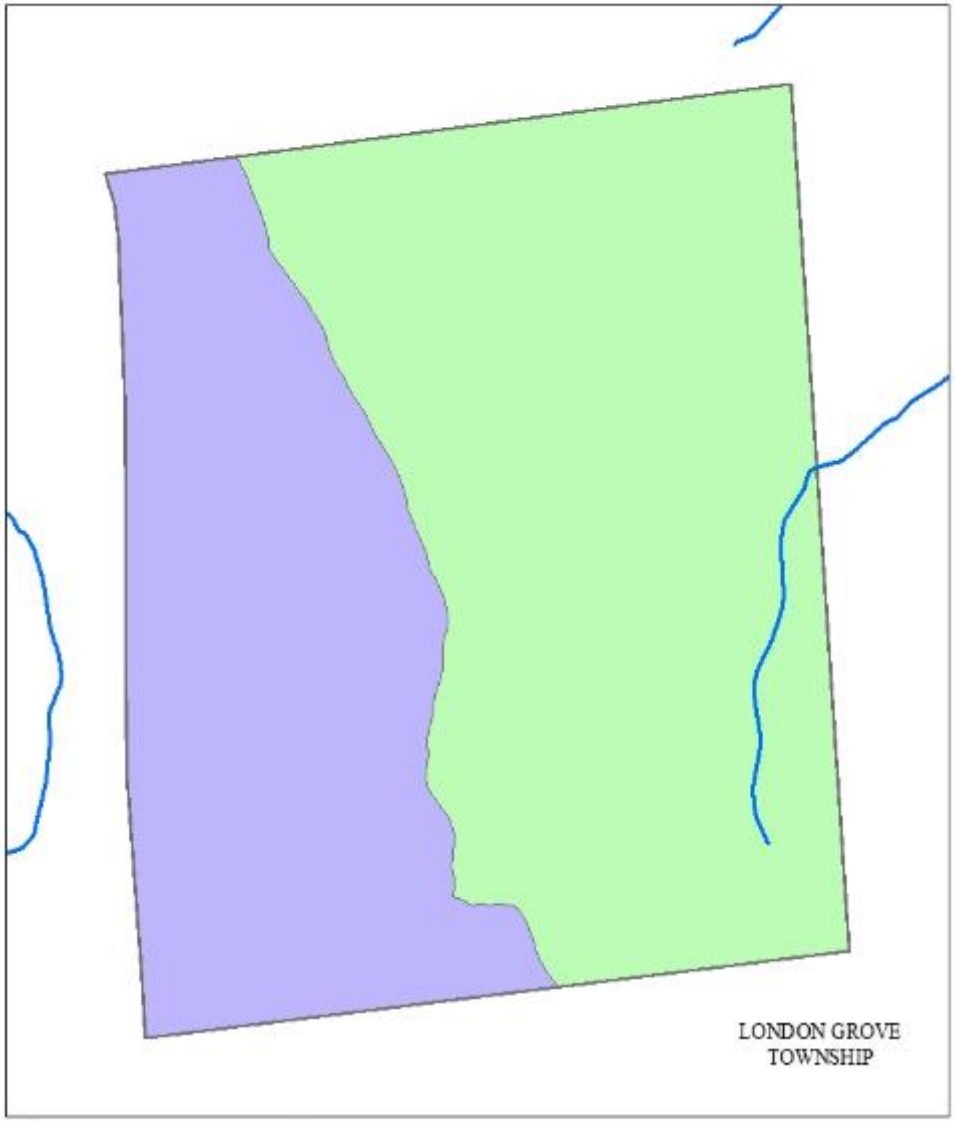
- Analysis completed by watershed and by municipality
- Use 2015 Land Use data to determine impervious cover
- Calculate runoff volumes for water quality, 2, 10 and 100 year design storm and annual rainfall
- Contain three concept designs

Land Use Types for West Grove




Water, 0.0%
Barren Land, 0.0%
Agriculture, 0.1%
Forest, 8.0%
Wetlands, 0.2%
Urban, 91.7%

Subwatersheds of West Grove



Watershed	Total Area (ac)	Impervious Cover (ac)	%
White Clay Creek East Branch	715.0	74.6	10.4%
White Clay Creek Middle Branch	590.3	41.8	7.1%
Total	1,305.4	116.4	8.9%

Subwatershed	NJ Water Quality Storm (MGal)	Annual Rainfall of PA 41" (MGal)	2-Year Design Storm (3.16”) (MGal)	10-Year Design Storm (4.57”) (MGal)	100-Year Design Storm (7.63”) (MGal)
White Clay Creek East Branch	2.5	83.0	6.4	9.3	15.5
White Clay Creek Middle Branch	1.4	46.5	3.6	5.2	8.7
Total	4.0	129.6	10.0	14.4	24.1

*ANNUAL RAINFALL IS FROM THIS 2009 DOCUMENT FROM THE STATE CLIMATOLOGIST: https://web.archive.org/web/20090225124128/http://climate.met.psu.edu/data/ncdc_pa.pdf

*Chapter 7, Appendix A - Field Manual for Pennsylvania Design Rainfall Intensity Charts from NOAA Atlas 14 Version 3 Data (Publication 584, 2010 Edition)

WE LOOK HERE FIRST:

- ✓Schools
- ✓Churches
- ✓Libraries
- ✓Municipal Building
- ✓Public Works
- ✓Firehouses
- ✓Post Offices
- ✓Elks or Moose Lodge
- ✓Parks/ Recreational Fields

- 20 to 40 sites are entered into a PowerPoint
- Site visits are conducted

AVON GROVE LIBRARY

Subwatershed: East Branch White Clay Creek

Site Area: 81,727 sq. ft.

Address: 117 Rosehill Avenue
West Grove, PA 19390

PA UPI: 5-4-198.1-E

Rain gardens can be installed to capture, treat, and infiltrate stormwater runoff from the roof. Parking spaces can be converted to porous pavement to capture and infiltrate stormwater runoff from the parking lot.

Impervious Cover		Existing Loads from Impervious Cover (lbs/yr)			Runoff Volume from Impervious Cover (Mgal)	
%	sq. ft.	TP	TN	TSS	For the 1.25" Water Quality Storm	For an Annual Rainfall of 44"
63	51,399	0.8	7.4	270.0	0.040	1.41

GREEN INFRASTRUCTURE RECOMMENDATIONS

Avon Grove Library

- bioretention system
- pervious pavement
- drainage area
- property line
- 2015 Aerial: NJOIT, OGIS

0 20' 40'

RUFFINI BARBER SHOP

Subwatershed: East Branch White Clay Creek

Site Area: 1,298 sq. ft.

Address: 104 Rosehill Avenue
West Grove, PA 19390

PA UPI: 5-4-199.1

A rain garden can be installed in the turfgrass area west of the building, and a nearby connected downspout can be disconnected and led into the garden to capture, treat, and infiltrate stormwater runoff from the roof.

Impervious Cover		Existing Loads from Impervious Cover (lbs/yr)			Runoff Volume from Impervious Cover (Mgal)	
%	sq. ft.	TP	TN	TSS	For the 1.25" Water Quality Storm	For an Annual Rainfall of 44"
97	1,263	0.0	0.2	6.6	0.001	0.03

GREEN INFRASTRUCTURE RECOMMENDATIONS

Ruffini Barber Shop

- bioretention system
- drainage area
- property line
- 2015 Aerial: NJOIT, OGIS

0 10' 20'

HARMONY PARK

Subwatershed: Middle Branch White Clay Creek

Site Area: 398,349 sq. ft.

Address: 280 West Harmony Road
West Grove, PA 19390

PA UPI: 5-3-8-E

A rain garden can be installed on the turfgrass southwest of the parking lot to capture, treat, and infiltrate runoff. Another rain garden can be installed on the turfgrass area near the corner of the building to capture, treat, and infiltrate rooftop runoff. Parking spaces can be converted to porous pavement to capture and infiltrate stormwater runoff from the parking lot. A cistern can be installed at the another building to capture rooftop runoff for reuse.

Impervious Cover		Existing Loads from Impervious Cover (lbs/yr)			Runoff Volume from Impervious Cover (Mgal)	
%	sq. ft.	TP	TN	TSS	For the 1.25" Water Quality Storm	For an Annual Rainfall of 44"
12	48,949	0.8	7.0	257.2	0.038	1.34

GREEN INFRASTRUCTURE RECOMMENDATIONS

Harmony Park

- bioretention system
- porous pavement
- rainwater harvesting
- drainage area
- property line
- 2015 Aerial: NJOIT, OGIS

0 50' 100'

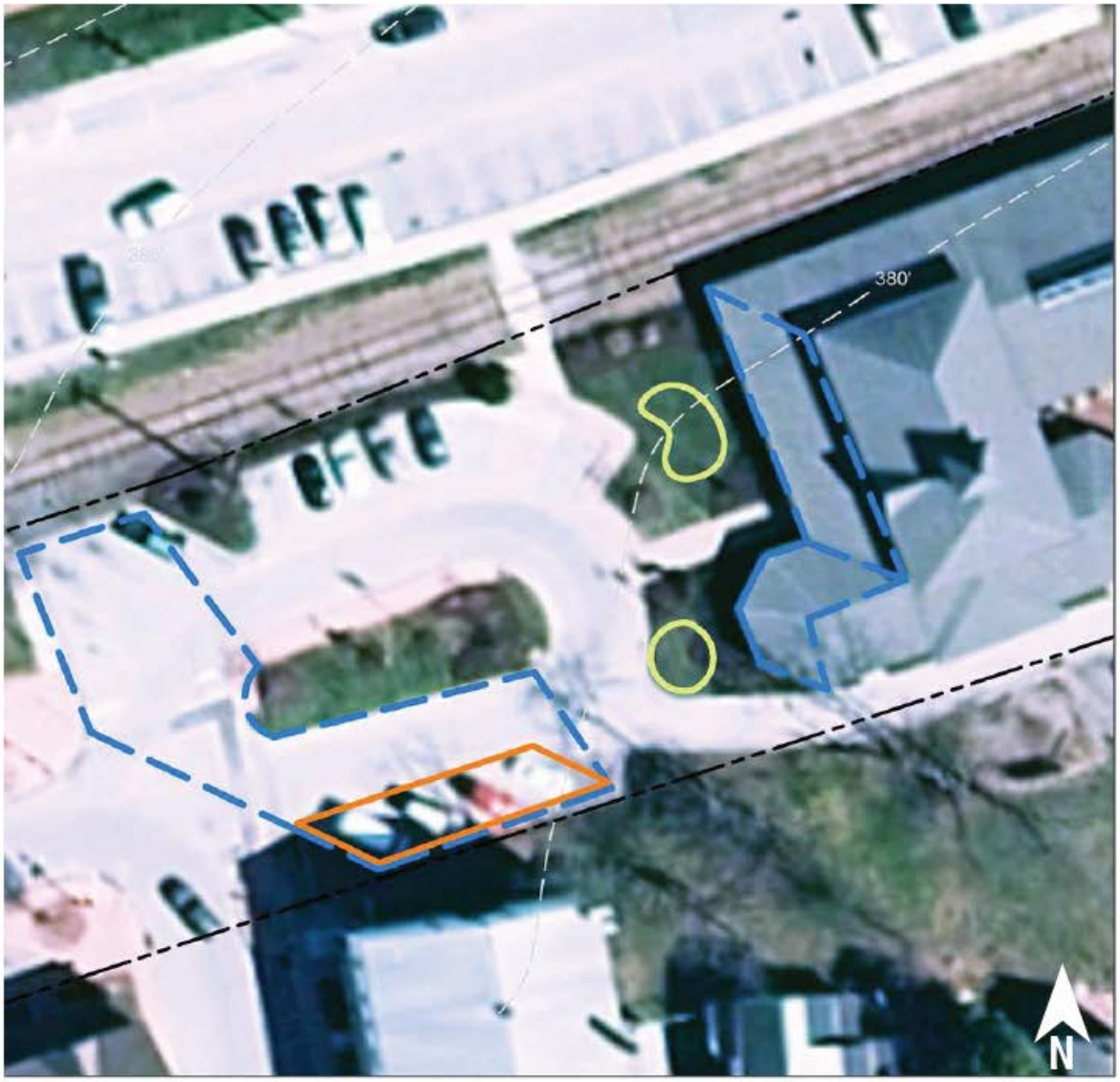
Green Infrastructure Feasibility Study

POTENTIAL PROJECT SITES WITHIN STUDY AREA

Site	Name	Address	Page #
1	Avon Grove Library*	117 Rosehill Avenue, West Grove, PA 19390	40
2	Citizens Bank	106 West Evergreen Street, West Grove, PA 19390	44
3	National Food Sales Inc.	233 East Evergreen Street, West Grove, PA 19390	46
4	Ruffini Barber Shop	104 Rosehill Avenue, West Grove, PA 19390	48
5	The Station Ice-Cream	100 Railroad Avenue, West Grove, PA 19390	50
6	United States Postal Service	5 Prospect Avenue, West Grove, PA 19390	52
7	West Grove Family Dentistry	20 Prospect Avenue, West Grove, PA 19390	54
8	West Grove Fire Company Station 22*	101 Walnut Street, West Grove, PA 19390	56
9	West Grove Memorial Park	40 Parkway Avenue, West Grove, PA 19390	60
10	West Grove Presbyterian Church	139 W Evergreen Street, West Grove, PA 19390	62
11	Enon Missionary Baptist Church	297 Willow Street, West Grove, PA 19390	64
12	Harmony Park*	280 West Harmony Road, West Grove, PA 19390	66
13	Star of Bethlehem U.A.M.E Church	215 West Summit Avenue, West Grove, PA 19390	70
14	West Grove United Methodist Church	300 North Guernsey Road, West Grove, PA 19390	72

* Contains a concept design


14
3
12
10
2
6
5
1
7
4
8
9
13
11
Legend
Project Sites
West Grove Township
Waterbodies



bioretention system

pervious pavement

drainage area

property line

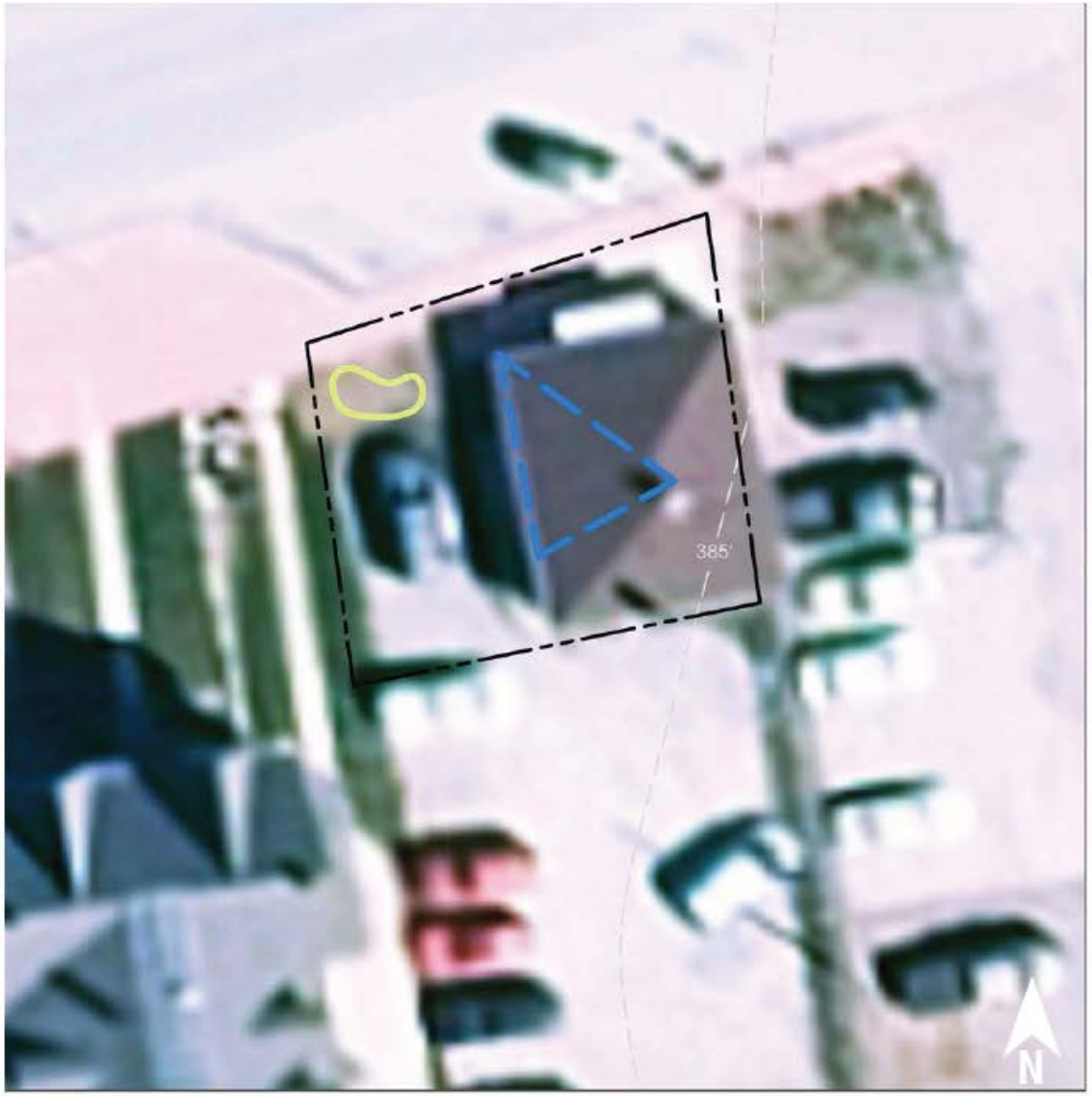
2015 Aerial: NJOIT, OGIS

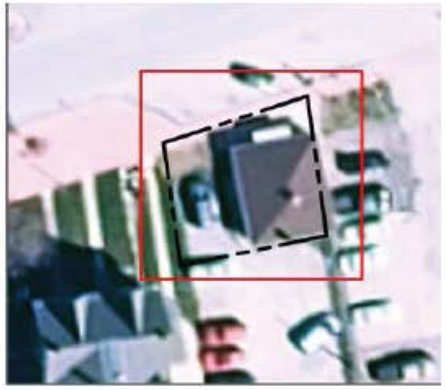
0' 20' 40'

Rain gardens can be installed to capture, treat, and infiltrate stormwater runoff from the roof. Parking spaces can be converted to porous pavement to capture and infiltrate stormwater runoff from the parking lot. A preliminary soil assessment suggests that the soils have suitable drainage characteristics for green infrastructure.

Impervious Cover		Existing Loads from Impervious Cover (lbs/yr)			Runoff Volume from Impervious Cover (Mgal)	
%	sq. ft.	TP	TN	TSS	From the 1.25" Water Quality Storm	For an Annual Rainfall of 44"
63	51,399	0.8	7.4	270.0	0.040	1.41

Recommended Infrastructure Practices	Recharge Potential (Mgal/yr)	TSS Removal Potential (lbs/yr)	Maximum Volume Reduction Potential (gal/storm)	Peak Discharge Reduction Potential (cu. ft./second)	Estimated Size (sq. ft.)	Estimated Cost
Bioretention systems	0.047	8	3,450	0.13	450	$2,250
Pervious pavement	0.129	22	9,470	0.36	885	$22,125





bioretention system

drainage area

property line

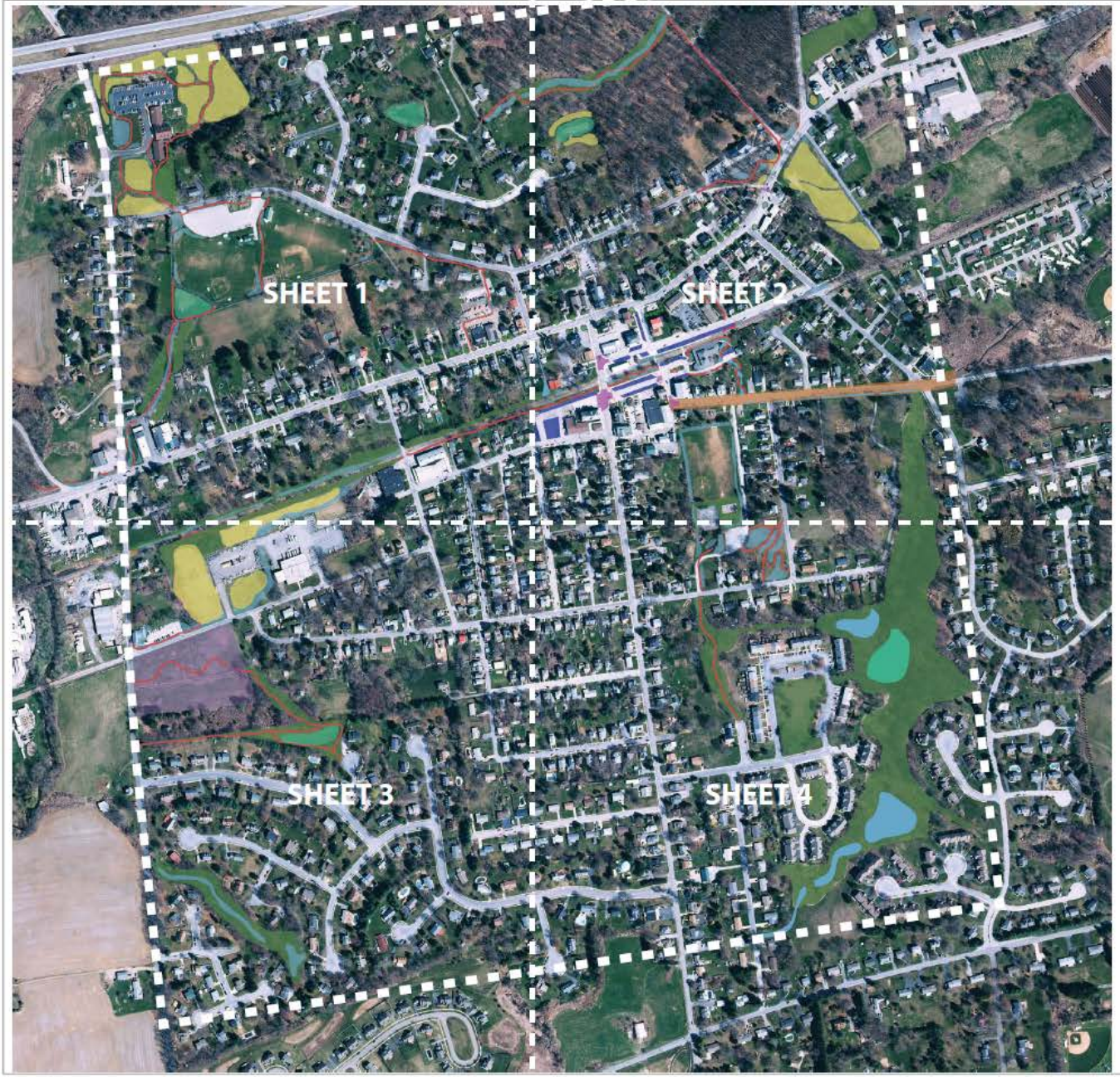
2015 Aerial: NJOIT, OGIS

0' 10' 20'

A rain garden can be installed in the turfgrass area west of the building, and a nearby connected downspout can be disconnected and led into the garden to capture, treat, and infiltrate stormwater runoff from the roof. A preliminary soil assessment suggests that more soil testing would be required before determining the soil's suitability for green infrastructure.

Impervious Cover		Existing Loads from Impervious Cover (lbs/yr)			Runoff Volume from Impervious Cover (Mgal)	
%	sq. ft.	TP	TN	TSS	From the 1.25" Water Quality Storm	For an Annual Rainfall of 44"
97	1,263	0.0	0.2	6.6	0.001	0.03

Recommended Infrastructure Practices	Recharge Potential (Mgal/yr)	TSS Removal Potential (lbs/yr)	Maximum Volume Reduction Potential (gal/storm)	Peak Discharge Reduction Potential (cu. ft./second)	Estimated Size (sq. ft.)	Estimated Cost
Bioretention system	0.005	1	380	0.01	50	$250



WEST GROVE, PENNSYLVANIA GREEN INFRASTRUCTURE CONCEPT MASTERPLAN

Green Stormwater Infrastructure (GSI):

- Rain Garden
- Bioswale
- Detention Basin Naturalization
- Porous Paving
- Cisterns

Environmental Enhancements:

- Streambank Stabilization
- Riparian Zone Restoration
- Meadow Creation, Restoration
- Upland Woodland Restoration
- Street Tree in Expanded Stormwater Pit

Human Health and Wellbeing:

- Nature Trails
- Pathway Connections
- Raised Intersections
- "Green" or "Complete" Street

DRAFT

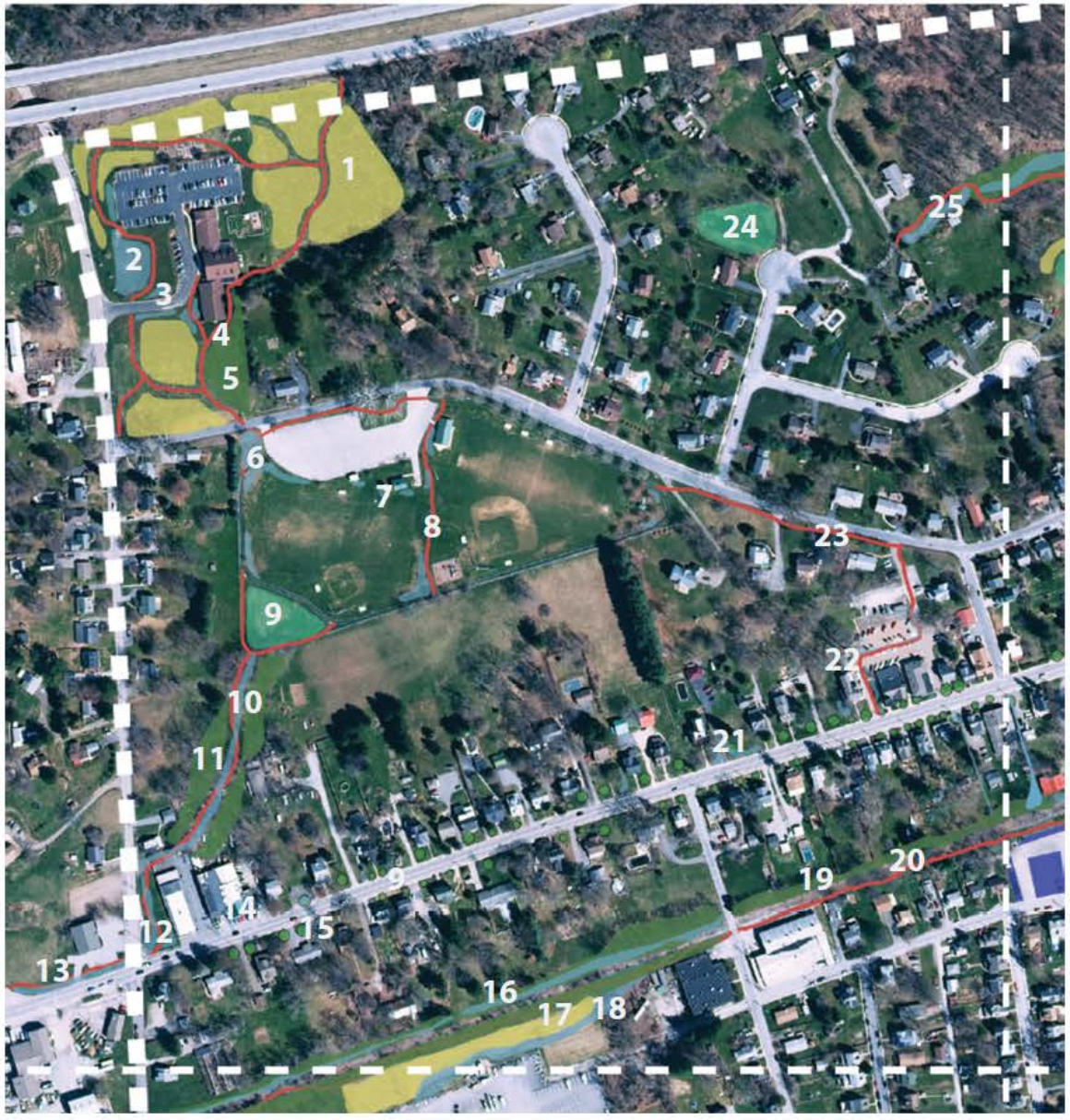
CHRISTOPHER C. OBROPTA, Ph.D., P.E.
PROFESSIONAL ENGINEER - NJ LICENSE # 37532

REVISIONS
No. | DATE | DESCRIPTION

West Grove Borough
Green Infrastructure Concept Masterplan
West Grove, Chester County, PA
COVER SHEET

RUTGERS New Jersey Agricultural Experiment Station

SHEET NAME
COVER



Projects

1	Meadow creation/restoration on the property of the West Grove United Methodist Church
2	Stormwater detention basin naturalization
3	Rain gardens and bioswales
4	Fitness and nature pathways through the church property connecting to Harmony Park
5	Woodland and/or scrub/shrub landscape
6,7	Rain gardens and bioswales at Harmony Park
8	Expansion and connection of existing fitness loop
9	Stormwater detention basin naturalization
10,11,12	Stream daylighting and riparian restoration, work with property owner with easements, and/or MOU to facilitate restoration and access
13	Bioswale and path connection to natural area
14	Rain gardens, downspout planters and storm-water planters at business front
15	Street trees in expanded stormwater filtration tree pits along Evergreen
16	Enhance existing surface drainage with bioswale practices and native plantings
17, 18	Meadow, bioswale and native woodland or shrubland on Philadelphia Electric Company and Robertson Manufacturing properties
19, 20	Pathway along tracks and enhanced property edges
21	Tree plantings and rain gardens in the right of way, and on private property
22	West Grove Presbyterian bioswales, rain gardens and pathway linkage
23	Enhanced streetscape connection with sidewalk, bioswales and tree planting
24	Detention basin naturalization
25	Path, stream and woodland restoration

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DATE XX/XX/XX

REVISIONS
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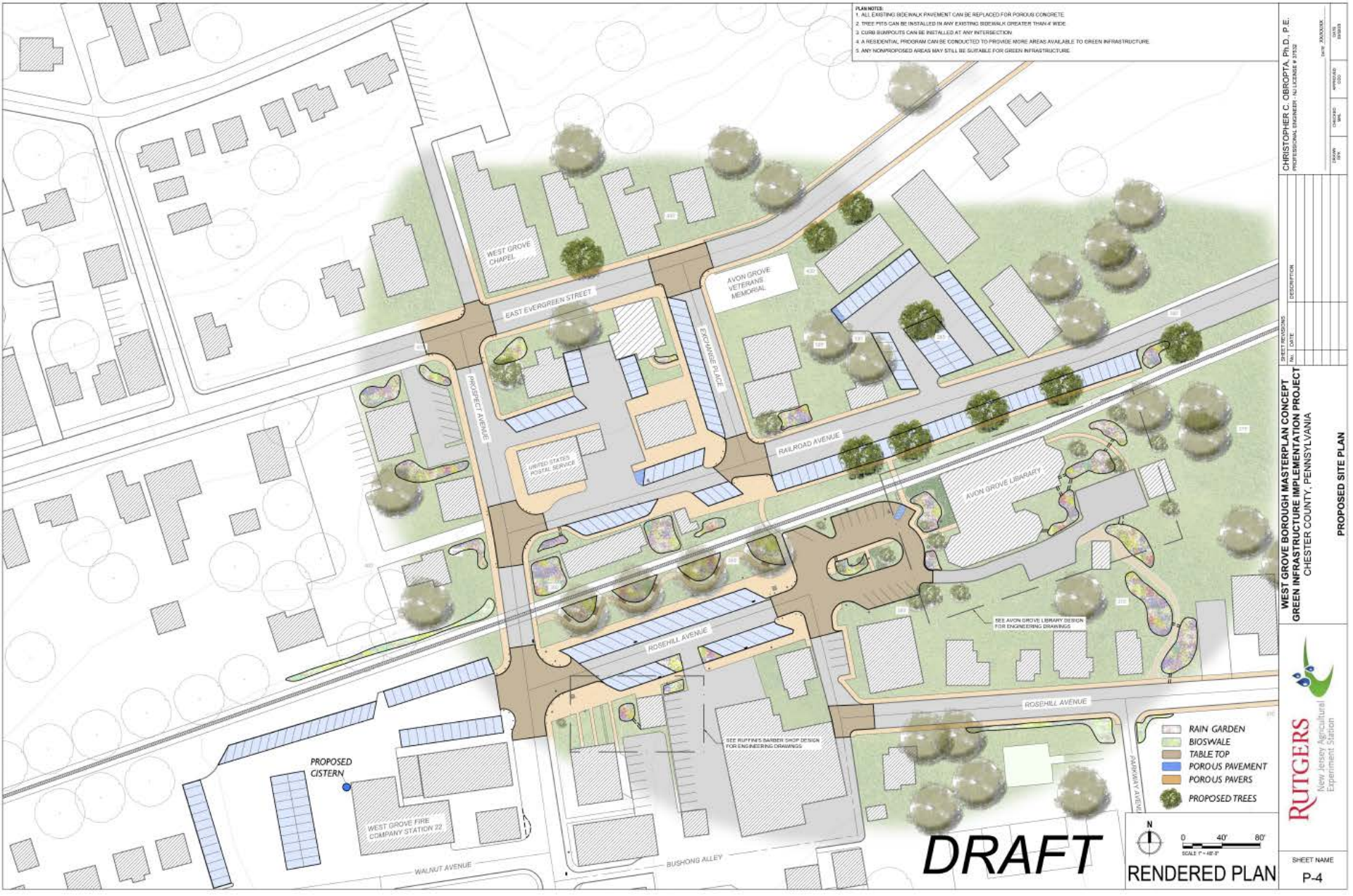
West Grove Borough
Green Infrastructure Concept Masterplan
West Grove, Chester County, PA
COVER SHEET

RUTGERS New Jersey Agricultural Experiment Station

SHEET NAME
Sheet 1, NW


PLAN NOTES:
1. ALL EXISTING SIDEWALK PAVEMENT CAN BE REPLACED FOR POROUS CONCRETE
2. TREE PITS CAN BE INSTALLED IN ANY EXISTING SIDEWALK GREATER THAN 4' WIDE
3. CURB BUMPOUTS CAN BE INSTALLED AT ANY INTERSECTION
4. A RESIDENTIAL PROGRAM CAN BE CONDUCTED TO PROVIDE MORE AREAS AVAILABLE TO GREEN INFRASTRUCTURE
5. ANY NON-PROPOSED AREAS MAY STILL BE SUITABLE FOR GREEN INFRASTRUCTURE
WEST GROVE CHAPEL
EAST EVERGREEN STREET
AVON GROVE VETERANS MEMORIAL
EXCHANGE PLACE
PROSPECT AVENUE
UNITED STATES POSTAL SERVICE
RAILROAD AVENUE
AVON GROVE LIBRARY
SEE AVON GROVE LIBRARY DESIGN FOR ENGINEERING DRAWINGS
ROSEHILL AVENUE
SEE RUFFIN'S BARBER SHOP DESIGN FOR ENGINEERING DRAWINGS
PROPOSED CISTERN
WEST GROVE FIRE COMPANY STATION 22
WALNUT AVENUE
BUSHONG ALLEY
RAIN GARDEN
BIOSWALE
TABLE TOP
POROUS PAVEMENT
POROUS PAVERS
PROPOSED TREES
DRAFT
N
0 40' 80'
RENDERED PLAN
CHRISTOPHER C. OBROPTA, Ph.D., P.E.
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WEST GROVE BOROUGH MASTERPLAN CONCEPT
GREEN INFRASTRUCTURE IMPLEMENTATION PROJECT
CHESTER COUNTY, PENNSYLVANIA
PROPOSED SITE PLAN
RUTGERS New Jersey Agricultural Experiment Station
SHEET NAME
P-4

WEST GROVE MUNICIPAL MASTERPLAN

Perspective A

Perspective B

AVON GROVE LIBRARY

RAIN GARDEN IMPLEMENTATION PROJECT
117 ROSEHILL AVENUE, WEST GROVE BOROUGH
CHESTER COUNTY, PENNSYLVANIA

PA UPI: 5-4-198.1-E

PROJECT DESCRIPTION:

A RAIN GARDEN (845 S.F.) IS TO BE IMPLEMENTED ON THE LAWN IN FRONT OF THE WEST ENTRANCE OF THE LIBRARY TO CAPTURE, TREAT, AND INFILTRATE STORMWATER RUNOFF FROM THE ROOF (4,215 S.F.).

LOCATION MAP:

LEGEND:

- EXISTING DRAINAGE AREA
- EDGE OF PAVEMENT
- EXISTING CENTERLINE
- EXISTING FENCE
- EXISTING TREELINE
- EXISTING TREE/SHRUB
- EXISTING BUILDING
- EXISTING UTILITY POLE
- EXISTING CATCH BASIN
- EXISTING CONTOURS
- LIMIT OF WORK
- PROPOSED GREEN INFRASTRUCTURE
- PROPOSED TOP OF BERM

LIST OF DRAWINGS:

SHEET NAME	TITLE
COVER	COVER SHEET
P-1	EXISTING CONDITIONS AND DEMOLITION PLAN
P-2	PROPOSED SITE PLAN
P-3	PLANTING PLAN
DT-1	RAIN GARDEN DETAILS
DT-2	RENDERING

GENERAL NOTES:

1. ELEVATION DATA OBTAINED FROM NOAA DIGITAL COASTAL LIDAR. ELEVATIONS ARE HEIGHT ABOVE MEAN SEA LEVEL SET BY NAVD 1988.
2. EXISTING SOILS ARE CHANNERY SILT LOAM WHICH ARE CLASSIFIED AS HYDROLOGIC SOIL GROUP B WHICH HAVE MODERATE INFILTRATION RATES BASED ON THE NRCS WEB SOIL SURVEY (websoilsurvey.sc.egov.usda.gov).
3. ANY OVERHEAD AND UNDERGROUND UTILITIES SHOWN ARE FROM FIELD OBSERVATIONS AND ARE NOT A COMPLETE REPRESENTATION. A UTILITY MARKOUT NEEDS TO BE CONDUCTED PRIOR TO MOBILIZATION.

DRAFT

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DATE 03/03/20

REVISIONS
NO. | DATE | DESCRIPTION

AVON GROVE LIBRARY
RAIN GARDEN IMPLEMENTATION PROJECT
117 ROSEHILL AVENUE, WEST GROVE BOROUGH
CHESTER COUNTY, PA
COVER SHEET

RUTGERS New Jersey Agricultural Experiment Station

SHEET NAME
COVER

Before:

After:

HARMONY PARK

GREEN INFRASTRUCTURE IMPLEMENTATION PROJECT
280 WEST HARMONY ROAD, WEST GROVE BOROUGH
CHESTER COUNTY, PENNSYLVANIA

PA UPI: 5-3-8-E

PROJECT DESCRIPTION:

A RAIN GARDEN (845 S.F.) IS TO BE IMPLEMENTED ALONG THE SOUTHWEST CORNER OF THE PARKING LOT AND WILL CAPTURE, TREAT, AND INFILTRATE STORMWATER RUNOFF FROM THE WEST SIDE OF THE PARKING LOT (3,120 S.F.).

LOCATION MAP:

LEGEND:

- EXISTING DRAINAGE AREA
- EDGE OF PAVEMENT
- EXISTING CENTERLINE
- EXISTING FENCE
- EXISTING TREELINE
- EXISTING TREE/SHRUB
- EXISTING BUILDING
- EXISTING UTILITY POLE
- EXISTING CATCH BASIN
- EXISTING CONTOURS
- LIMIT OF WORK
- PROPOSED TOP OF BERM

LIST OF DRAWINGS:

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P-1	EXISTING CONDITIONS PLAN
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P-3	PLANTING PLAN
DT-1	RAIN GARDEN DETAILS
DT-2	RENDERING

GENERAL NOTES:

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3. ANY OVERHEAD AND UNDERGROUND UTILITIES SHOWN ARE FROM FIELD OBSERVATIONS AND ARE NOT A COMPLETE REPRESENTATION. A UTILITY MARKOUT NEEDS TO BE CONDUCTED PRIOR TO MOBILIZATION. NJ ONE CALL: 811 OR 800-272-1000

DRAFT

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REVISIONS
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GREEN INFRASTRUCTURE IMPLEMENTATION PROJECT
HARMONY PARK
280 HARMONY ROAD, WEST GROVE BOROUGH
CHESTER COUNTY, PA
COVER SHEET

RUTGERS New Jersey Agricultural Experiment Station

SHEET NAME
COVER

Before:

After:

RUFFINI'S BARBER SHOP

RAIN GARDEN IMPLEMENTATION PROJECT
104 ROSEHILL AVENUE, WEST GROVE BOROUGH
CHESTER COUNTY, PENNSYLVANIA
PA UPI: 5-4-199.1

PROJECT DESCRIPTION:

A RAIN GARDEN IS TO BE IMPLEMENTED TO THE WEST OF RUFFINI'S BARBER SHOP TO CAPTURE, TREAT, AND INFILRATE STORMWATER RUNOFF FROM THE ROOF VIA THE DISCONNECTED DOWNSPOUT LOCATED AT THE SOUTHWEST CORNER OF THE BUILDING. TWO DESIGNS ARE PRESENTED; BOTH CAPTURE RUNOFF FROM RUFFINI'S BARBER SHOP (465 S.F.), BUT DESIGN B ALSO CAPTURES RUNOFF FROM THE RESIDENTAL BUILDING TO THE SOUTH WEST (530 S.F.). THE TWO DESIGNS ARE TWO DIFFERENT SIZES, 185 S.F. AND 290 S.F. RESPECTIVALY.

LOCATION MAP:

LEGEND:

- EXISTING DRAINAGE AREA
- EDGE OF PAVEMENT
- EXISTING CENTERLINE
- EXISTING FENCE
- EXISTING TREELINE
- EXISTING TREE/SHRUB
- EXISTING BUILDING
- EXISTING UTILITY POLE
- EXISTING FIRE HYDRANT
- EXISTING LIGHT POST
- EXISTING CATCH BASIN
- EXISTING CATCH BASIN
- EXISTING CONTOURS
- LIMIT OF WORK
- PROPOSED GREEN INFRASTRUCTURE
- PROPOSED TOP OF BERM

LIST OF DRAWINGS:

SHEET NAME	TITLE
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P-1	EXISTING CONDITIONS
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RUFFINI'S BARBER SHOP
RAIN GARDEN IMPLEMENTATION PROJECT
104 ROSEHILL AVENUE, WEST GROVE BOROUGH
CHESTER COUNTY, PA
COVER SHEET

RUTGERS New Jersey Agricultural Experiment Station

SHEET NAME
COVER

Before:

After:

Final Thoughts

- Plans promote action
- Plans are a conduit for funding
- Impervious cover reduction action plan provide sites for developers to offset impacts
- Wide range in cost of projects (Eagle Scout projects to economic stimulus money projects)
- Foundation for stormwater utilities, watershed restoration plans, stormwater mitigation plan, and/or integrated water quality plans

Next Steps

- Funding is available to implement some of the concept plans or other projects identifies in the action plan
- Decide who will take ownership of the assessment and action plan
  - Township Committee
  - Township Engineer and Business Administrator
  - Environmental Commission
  - Sustainable Jersey Green Team
  - Local Watershed Association
- Form a Municipal Action Team
- E-Learning Tool entitled: *Impervious Cover Assessment (ICA) and Impervious Cover Reduction Action Plan: The Answer to All Your Problems* http://water.rutgers.edu/E-learning.html

RUTGERS
THE STATE UNIVERSITY
OF NEW JERSEY

Questions?

Christopher C. Obropta, Ph.D., P.E.
Tobiah Horton
www.water.rutgers.edu