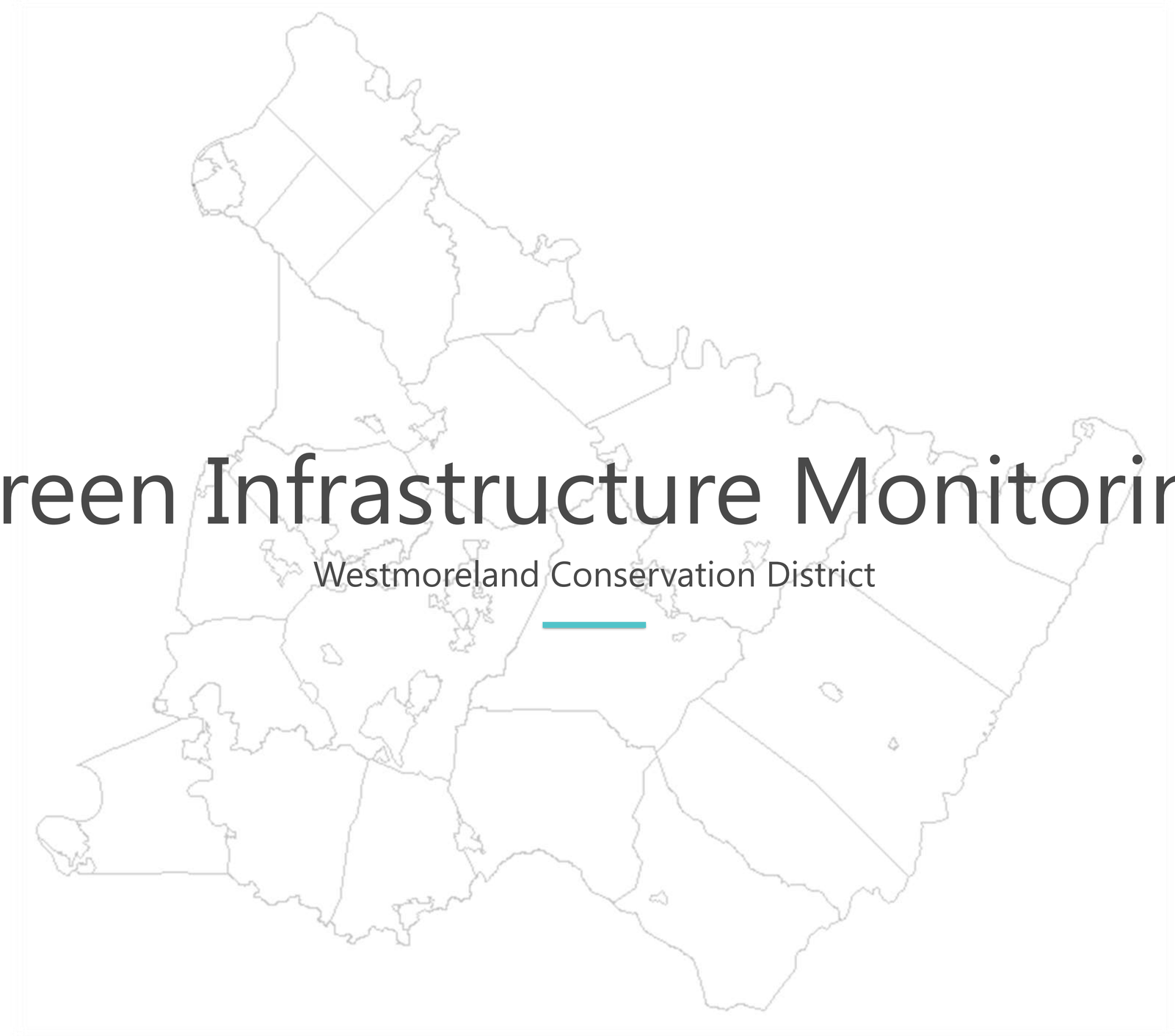


Green Infrastructure Monitoring

Westmoreland Conservation District

Matt Zambelli, PLA

Green Infrastructure Specialist at the Westmoreland Conservation District

Westmoreland Conservation District

Green Infrastructure History at WCD

We have some experience at this.

1989
WCD establishes stormwater management program with Jim Pilsbury, PE

1994
WCD implements first GI demonstration project at Donohoe Center

2002
WCD implements interpretative stormwater trail

2005
WCD establishes a Stormwater Committee and hires Kathy Hamilton, PLA

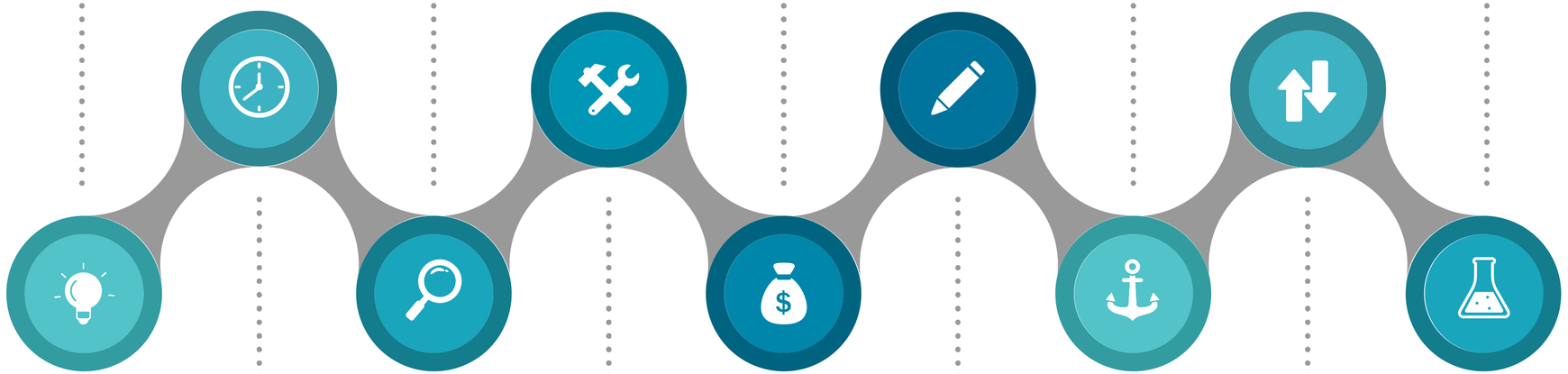
2006
Jim assists with development of PA DEP Stormwater Manual

2011
WCD hires Matt Zambelli, PLA to expand program

2015
WCD installs $2 million in stormwater management projects

2016
WCD receives funding for GI Monitoring project and IWRP

2018
WCD releases GI Monitoring Dashboard and publishes IWRP

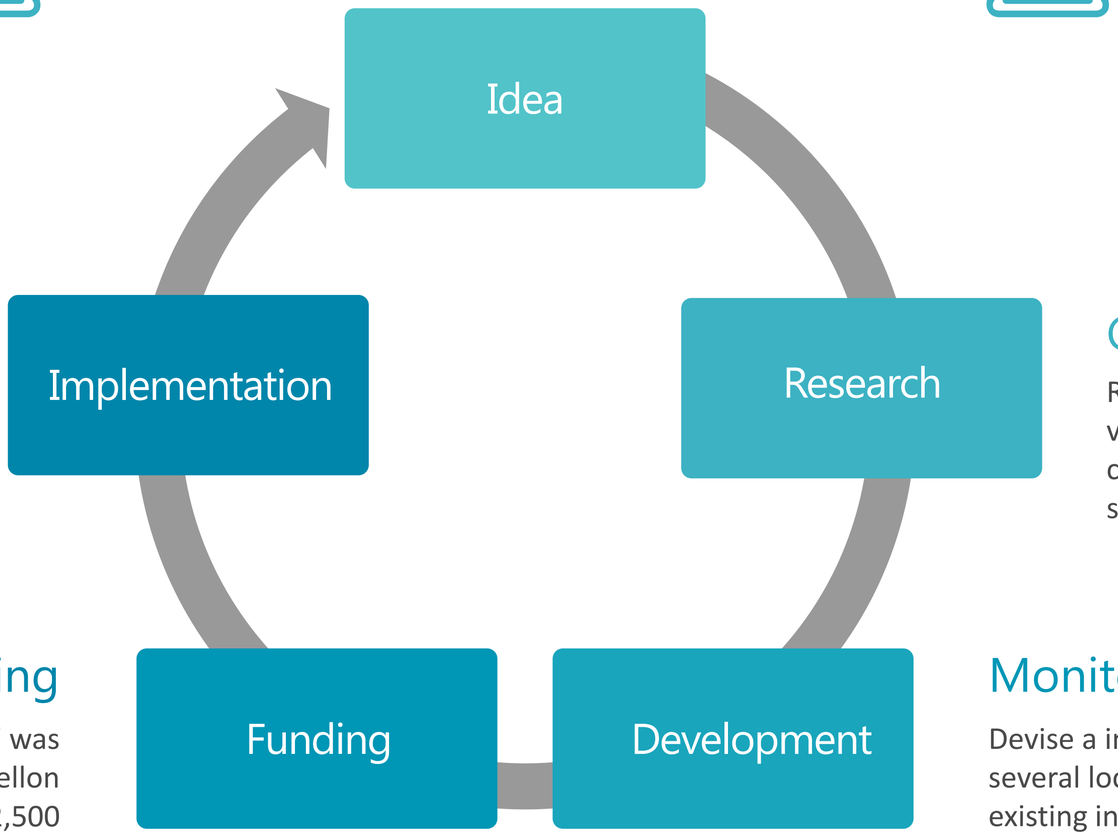


Green Infrastructure Monitoring Program Development

How it all started.

Monitor Local GI Projects

Analyze the function and effectiveness of commonly installed Green Infrastructure BMP's in our local geography.



Implementation

WCD has installed 10 different monitoring installations to date with several more in planning and a partnership with local watersheds.

Funding

The monitoring "pilot project" was funded by the Richard King Mellon Foundation for a total of $92,500

GI Monitoring Research

Research methodologies to monitor various aspects of water flow and chemistry in relation to stormwater and stream flow.

Monitoring Pilot Project

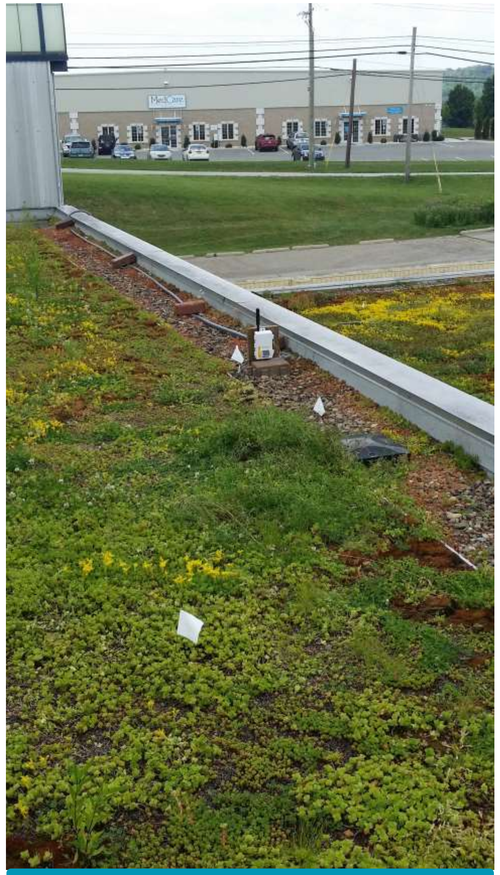
Devise a initial "pilot project" monitor several local stormwater projects, both existing installations and in new construction.

Monitoring Typologies

General types of stormwater BMP's that are monitored throughout Westmoreland County

Porous Pavement

Rain Garden / Bioswale



Green Roof

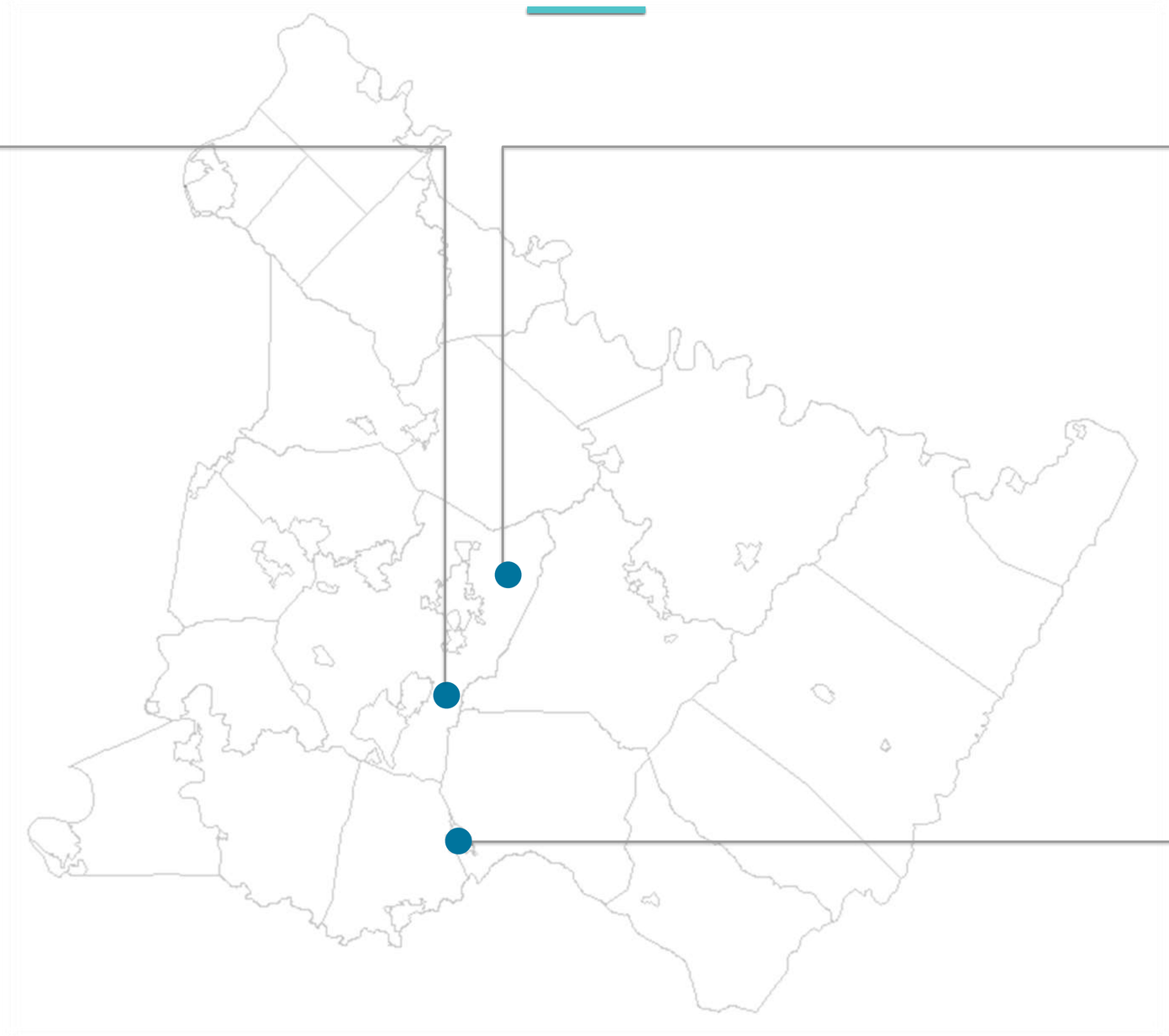
Stream

Monitoring Locations - Pilot

WCCC Campus GI Monitoring

Parking Lot Bioswale

Rain Gauge



WCD Campus GI Monitoring

Visitor Permeable Parking Lot

Staff Permeable Parking Lot

GreenForge Green Roof

GreenForge Rain Garden

Rain Gauges (2)

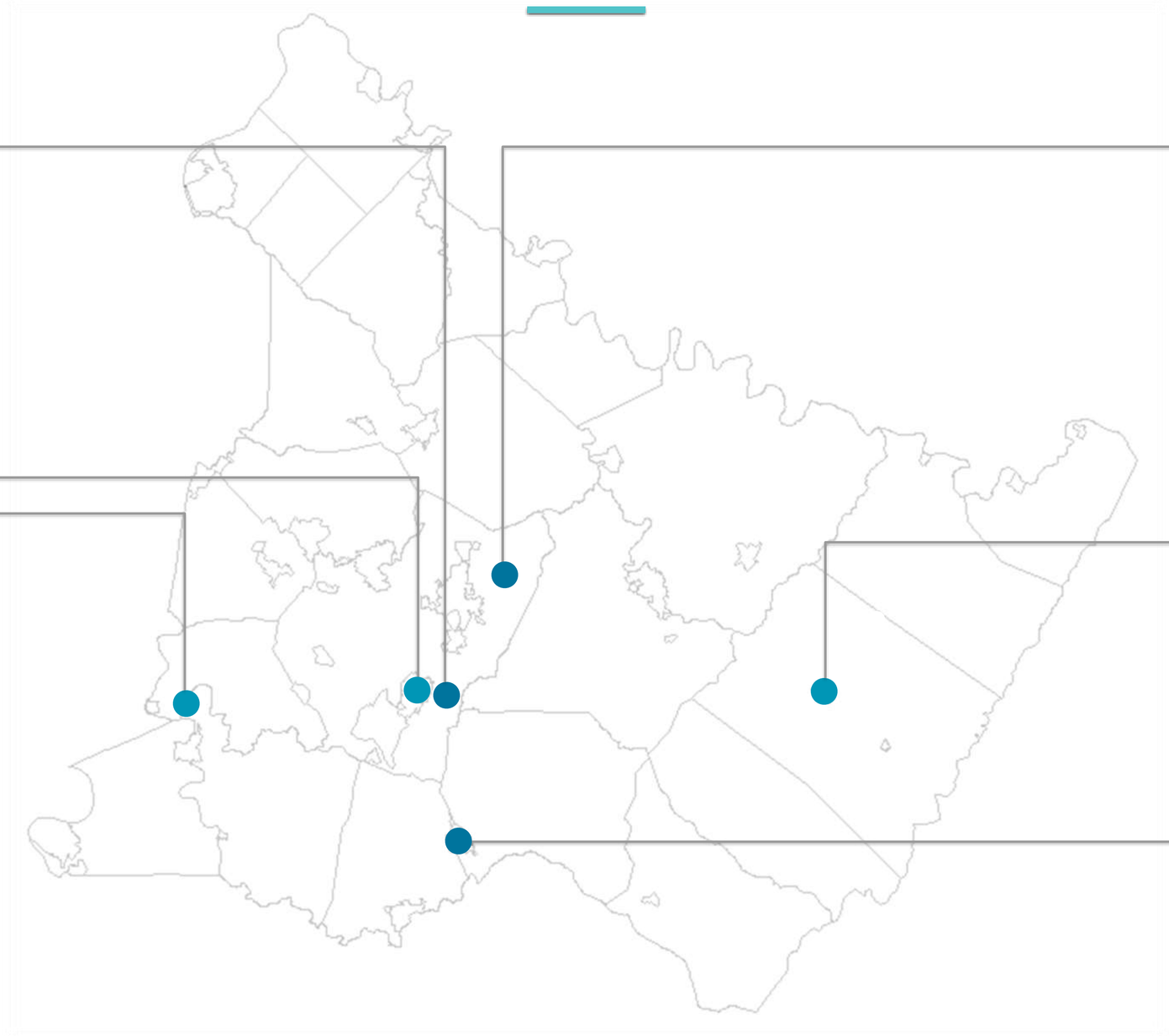
Mt Pleasant GI Monitoring

Borough Building Rain Garden

Monitoring Locations – IWRP Streams

WCCC Campus GI Monitoring
- Parking Lot Bioswale
- Rain Gauge

Stream Monitoring
- Jacks Run
- Sewickley Creek



WCD Campus GI Monitoring
- Visitor Permeable Parking Lot
- Staff Permeable Parking Lot
- GreenForge Green Roof
- GreenForge Rain Garden
- Rain Gauges (2)

Stream Monitoring
- Loyalhanna Creek
- Mill Creek

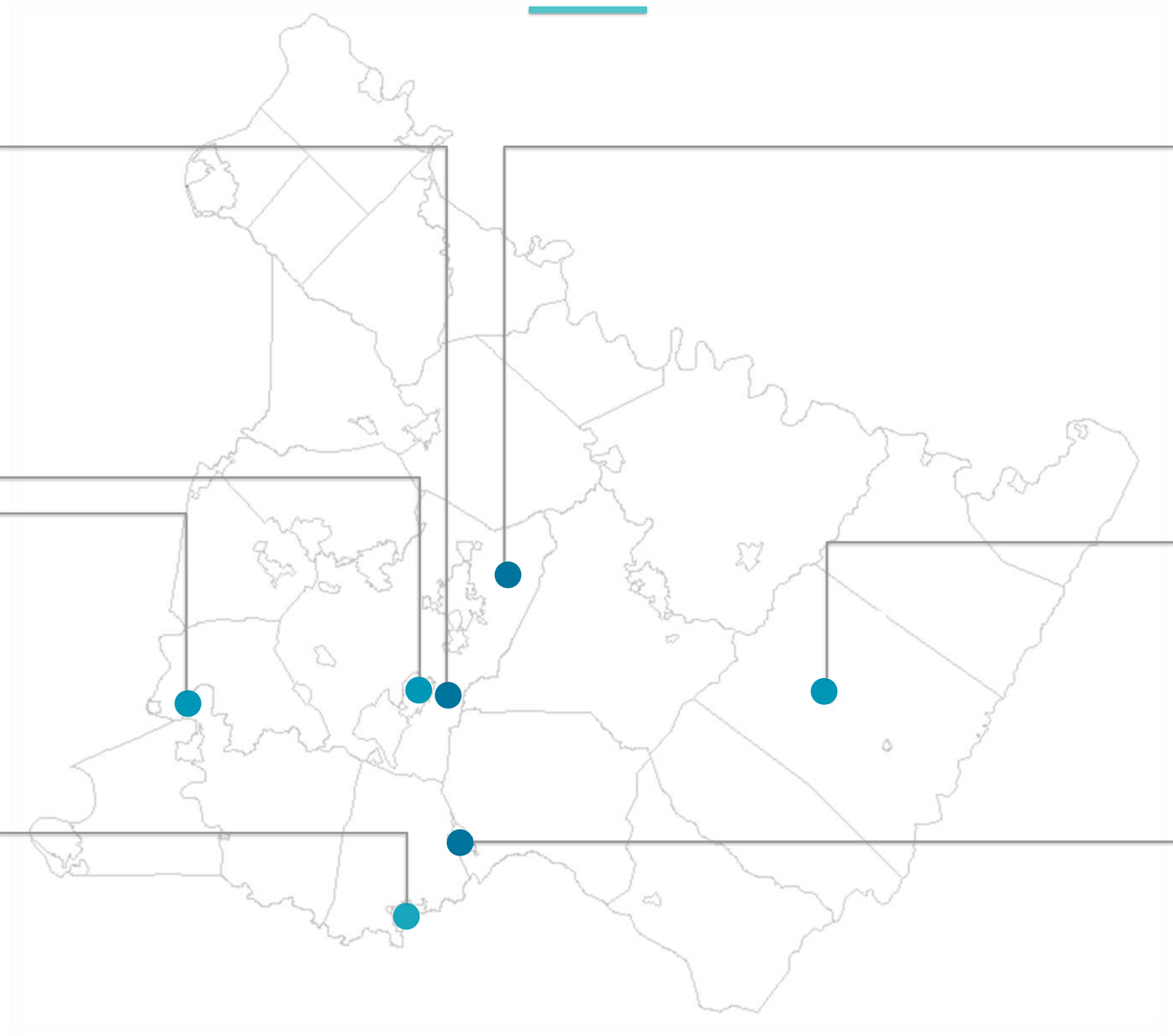
Mt Pleasant GI Monitoring
- Borough Building Rain Garden

Monitoring Locations - Partnerships

WCCC Campus GI Monitoring
Parking Lot Bioswale
Rain Gauge

Stream Monitoring
Jacks Run
Sewickley Creek

Scottdale GI Monitoring
Spring Street Rain Garden
Borough Building Weather Station



WCD Campus GI Monitoring
Visitor Permeable Parking Lot
Staff Permeable Parking Lot
GreenForge Green Roof
GreenForge Rain Garden
Rain Gauges (2)

Stream Monitoring
Loyalhanna Creek
Mill Creek

Mt Pleasant GI Monitoring
Borough Building Rain Garden

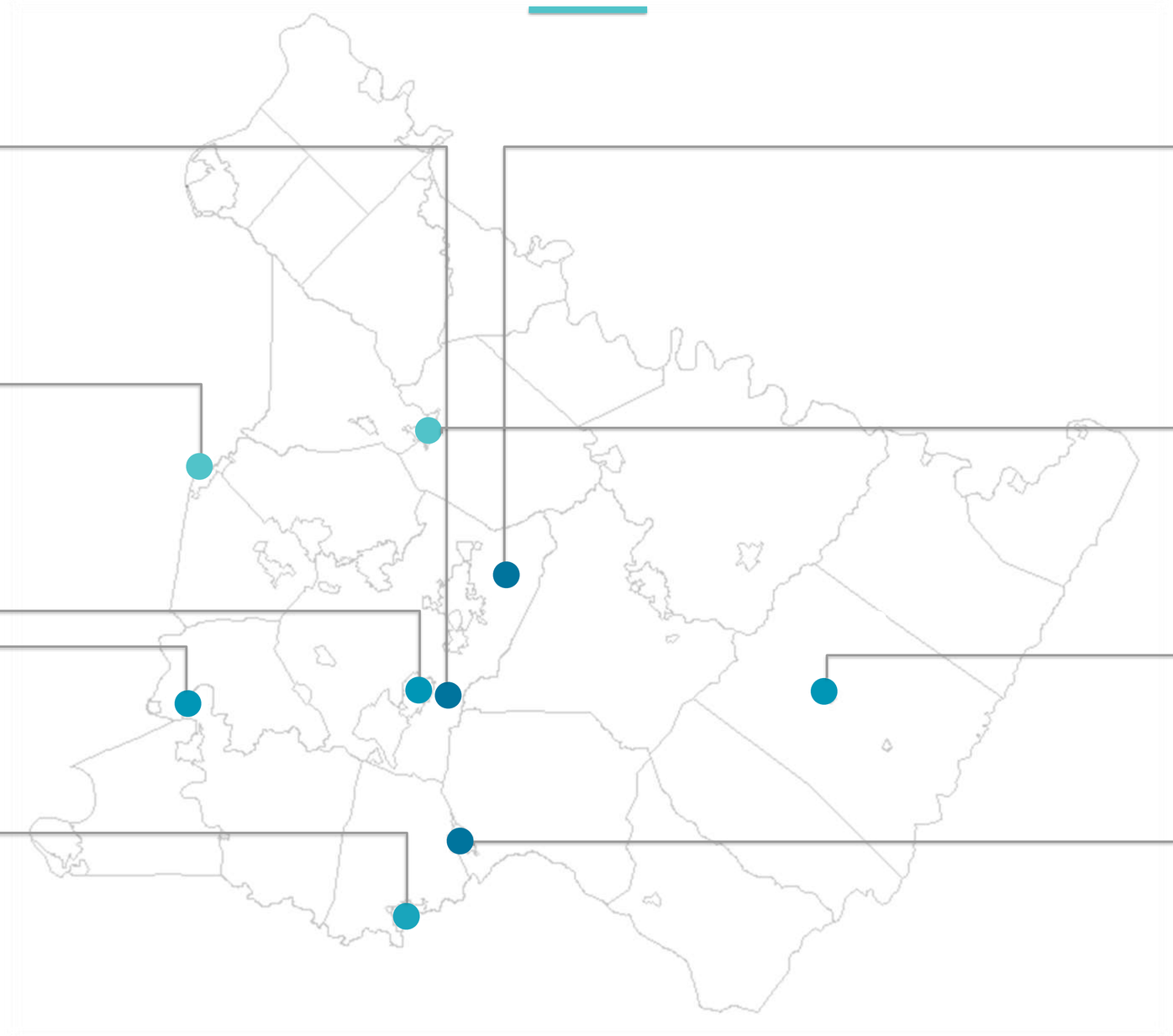
Monitoring Locations – Future Installations

WCCC Campus GI Monitoring
Parking Lot Bioswale
Rain Gauge

Monroeville GI Monitoring
Library Porous Pavement
Elementary Rain Garden

Stream Monitoring
Jacks Run
Sewickley Creek

Scottdale GI Monitoring
Spring Street Rain Garden
Borough Building Weather Station



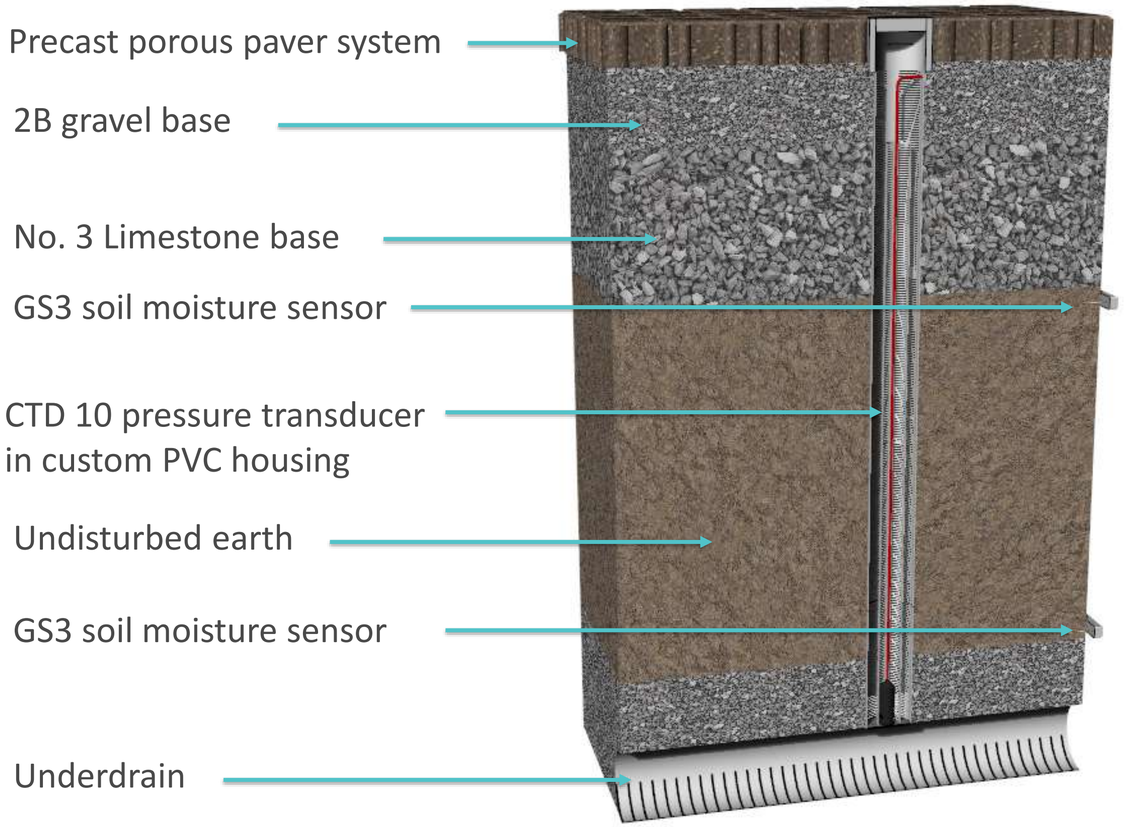
WCD Campus GI Monitoring
Visitor Permeable Parking Lot
Staff Permeable Parking Lot
GreenForge Green Roof
GreenForge Rain Garden
Rain Gauges (2)

Stormwater Basin Monitoring
TBD

Stream Monitoring
Loyalhanna Creek
Mill Creek

Mt Pleasant GI Monitoring
Borough Building Rain Garden

WCD Permeable Pavement Monitoring – Visitor Parking



Monitoring Breakdown:

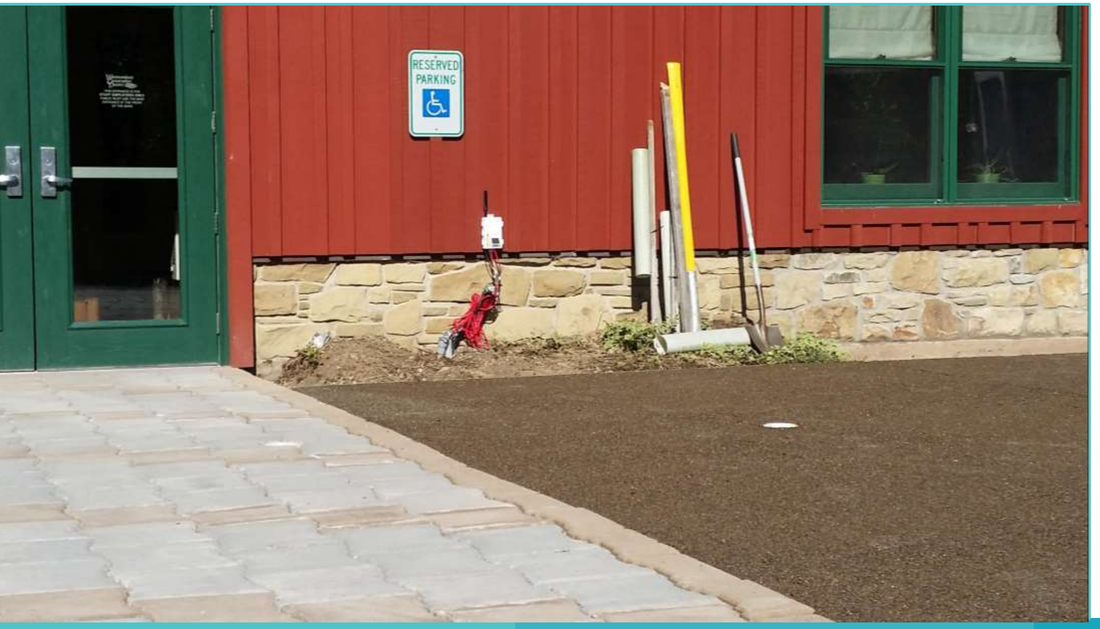
Unilock Eco-Optiloc Permeable Pavement System:

- ~ CTD Standpipe 48” – Water level, electrical conductivity, temperature
- ~ GS3 6” Subgrade – Soil moisture, electrical conductivity, temperature
- ~ GS3 18” Subgrade – Soil moisture, electrical conductivity, temperature

FelxiPave Permeable Sidewalk System:

- ~ GS3 @ 10” Subgrade – Soil moisture, electrical conductivity, temperature
- ~ GS3 @ 20” Subgrade – Soil moisture, electrical conductivity, temperature

WCD Permeable Pavement Monitoring – Staff Parking



Precast porous paver system

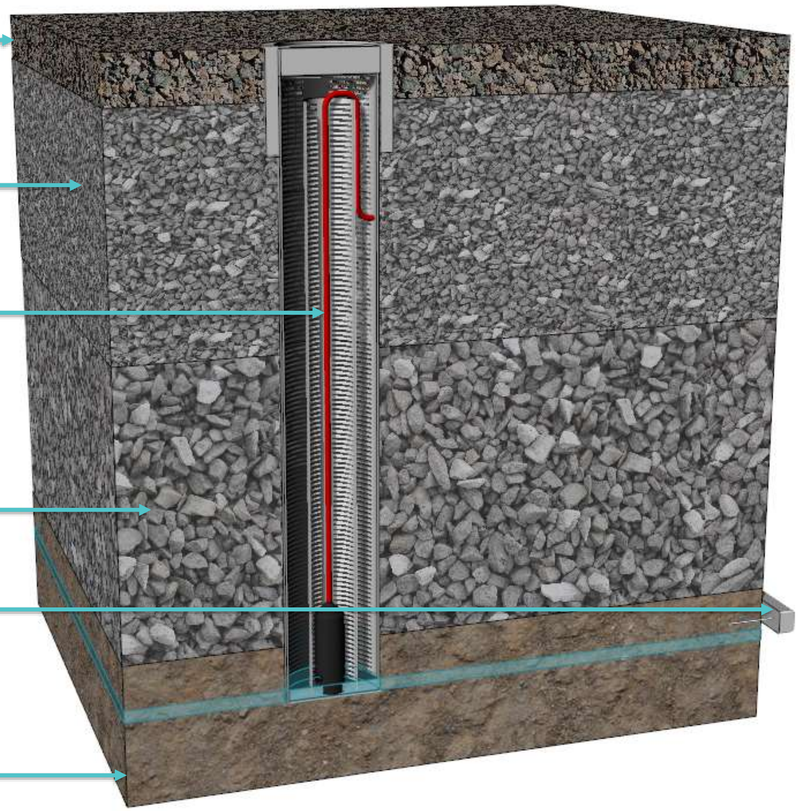
2B gravel base

CTD 10 pressure transducer in custom PVC housing

No. 3 Limestone base

GS3 soil moisture sensor

Undisturbed earth



Monitoring Breakdown:

Pave Drain Permeable Pavement System:

~ CTD Standpipe 24” – Water level, electrical conductivity, temperature

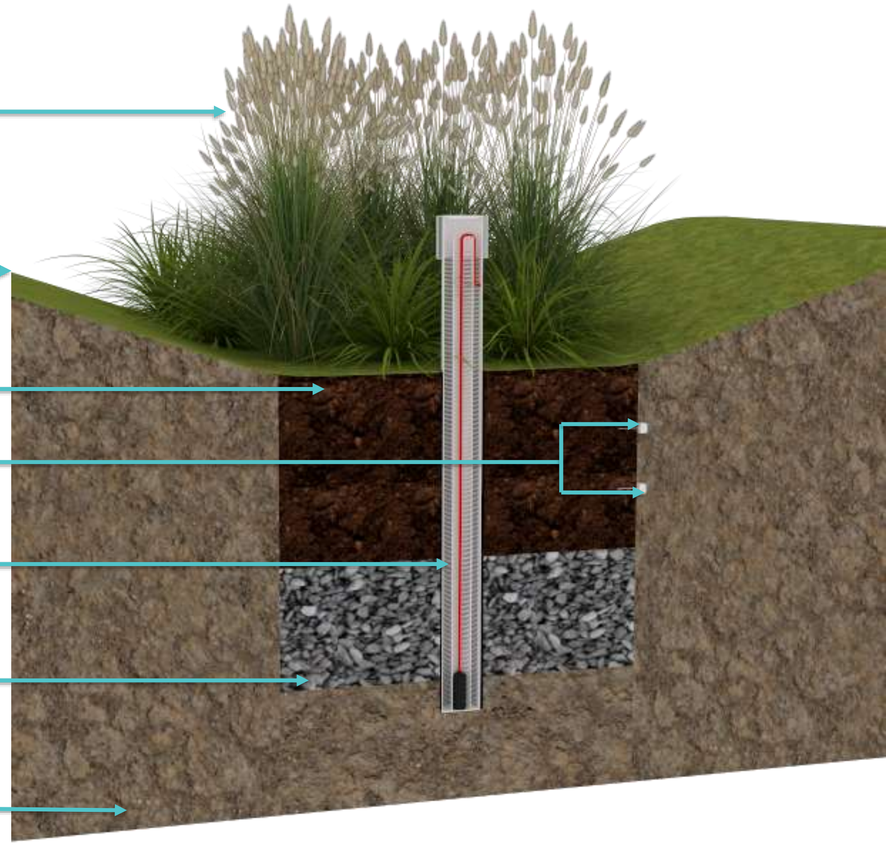
~ GS3 1” Subgrade – Soil moisture, electrical conductivity, temperature

Pave Drain Permeable Pavement System:

~ CTD Standpipe 24” – Water level, electrical conductivity, temperature

~ GS3 1” Subgrade – Soil moisture, electrical conductivity, temperature

GreenForge Rain Garden Monitoring



Monitoring Breakdown:

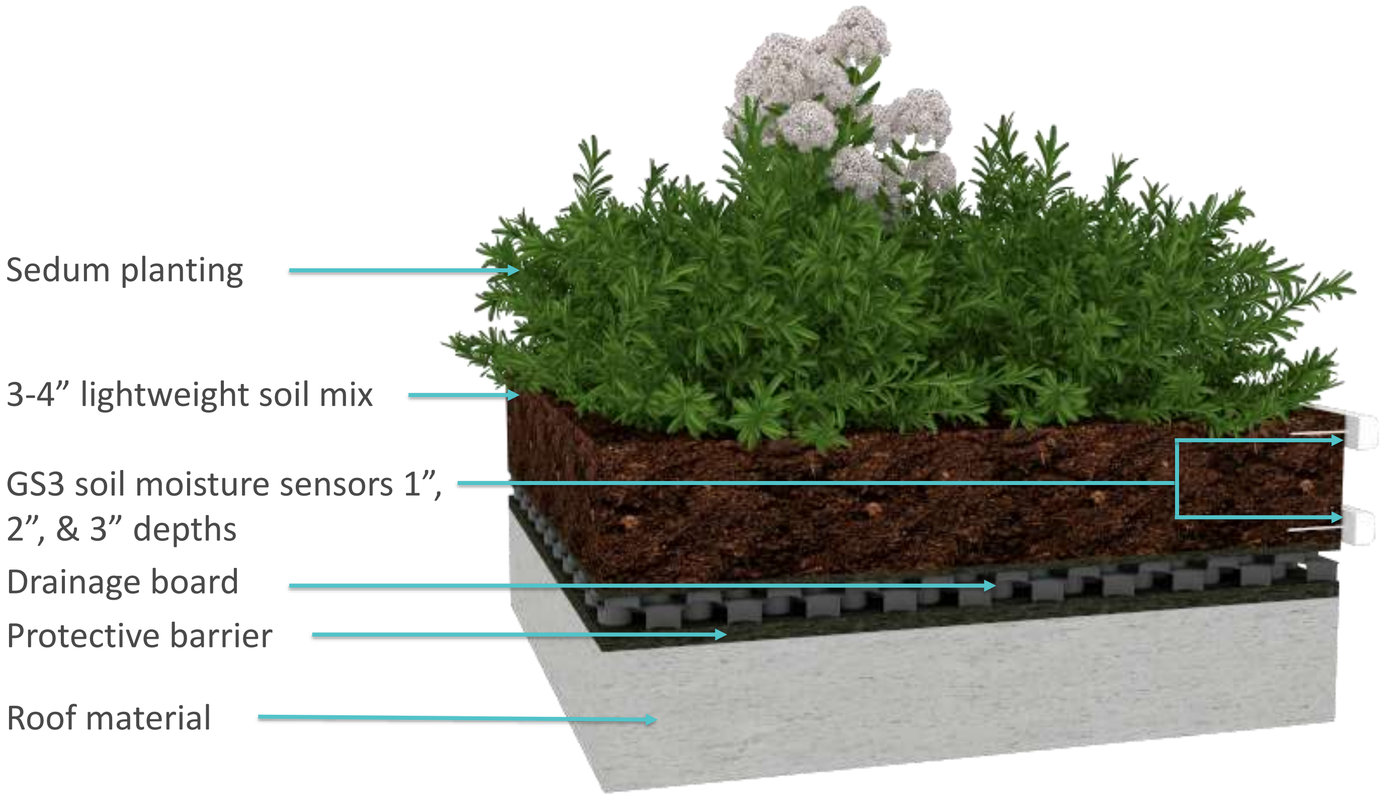
WCD Rain Garden System:

~ CTD Standpipe 42” – Water level, electrical conductivity, temperature

~ GS3 4” Grow Media – Soil moisture, electrical conductivity, temperature

~ GS3 10” Grow Media – Soil moisture, electrical conductivity, temperature

GreenForge Green Roof Monitoring



Monitoring Breakdown:

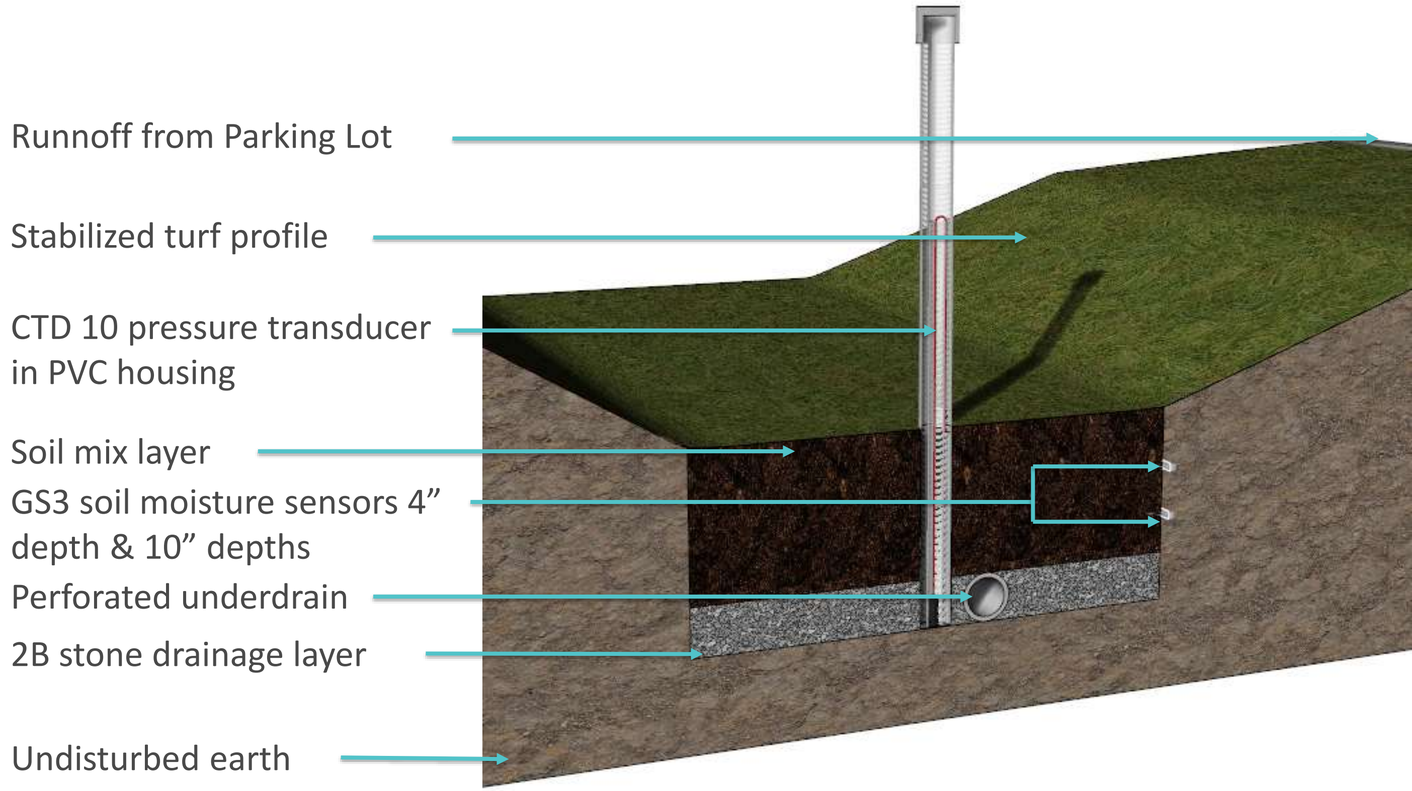
WCD Green Roof System:

- ~ ECRN 100 – .2 mm high resolution Rain Gauge
- ~ GS3 1” Grow Media – Soil moisture, electrical conductivity, temperature
- ~ GS3 2” Grow Media – Soil moisture, electrical conductivity, temperature
- ~ GS3 3” Grow Media – Soil moisture, electrical conductivity, temperature
- ~ GS3 1.5” Lower Roof – Soil moisture, electrical conductivity, temperature

WCD Green Roof Outlet System:

- ~ CTD Overflow Weir – Water level, electrical conductivity, temperature

Westmoreland County Community College Grass Swale Monitoring

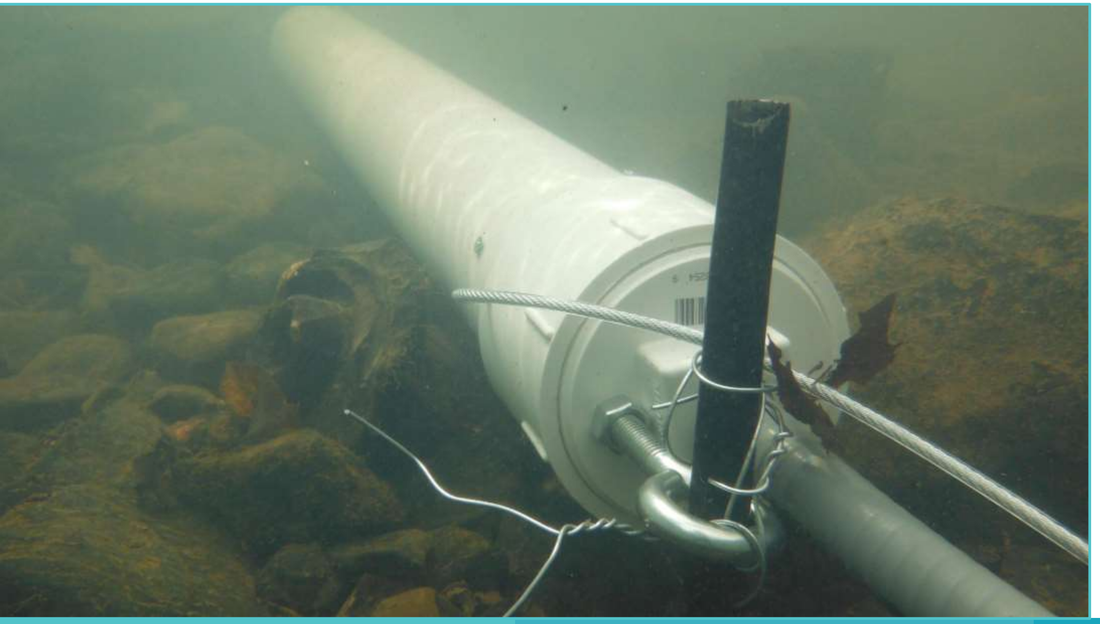


Monitoring Breakdown:

WCCC BioSwale System:

- ~ ECRN 100 - .2 mm high resolution Rain Gauge
- ~ CTD Standpipe 60” – Water level, electrical conductivity, temperature
- ~ GS3 4” Grow Media – Soil moisture, electrical conductivity, temperature
- ~ GS3 18” Grow Media – Soil moisture, electrical conductivity, temperature

Sewickley Creek Stream Monitoring



EM50G solar wireless logger

Sturdy tree

Protective housing for cables, secured in several locations

Stream bank

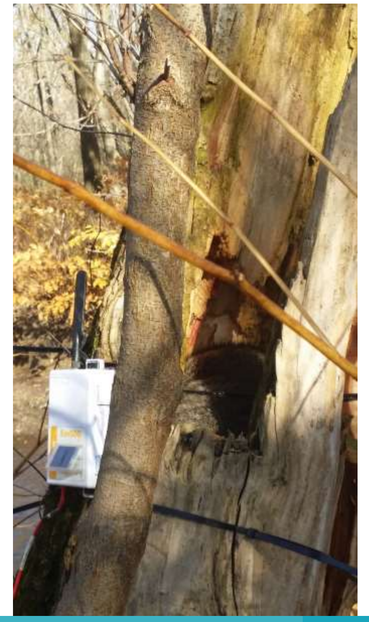
CTD 10 pressure transducer in PVC housing, secured in line with stream flow

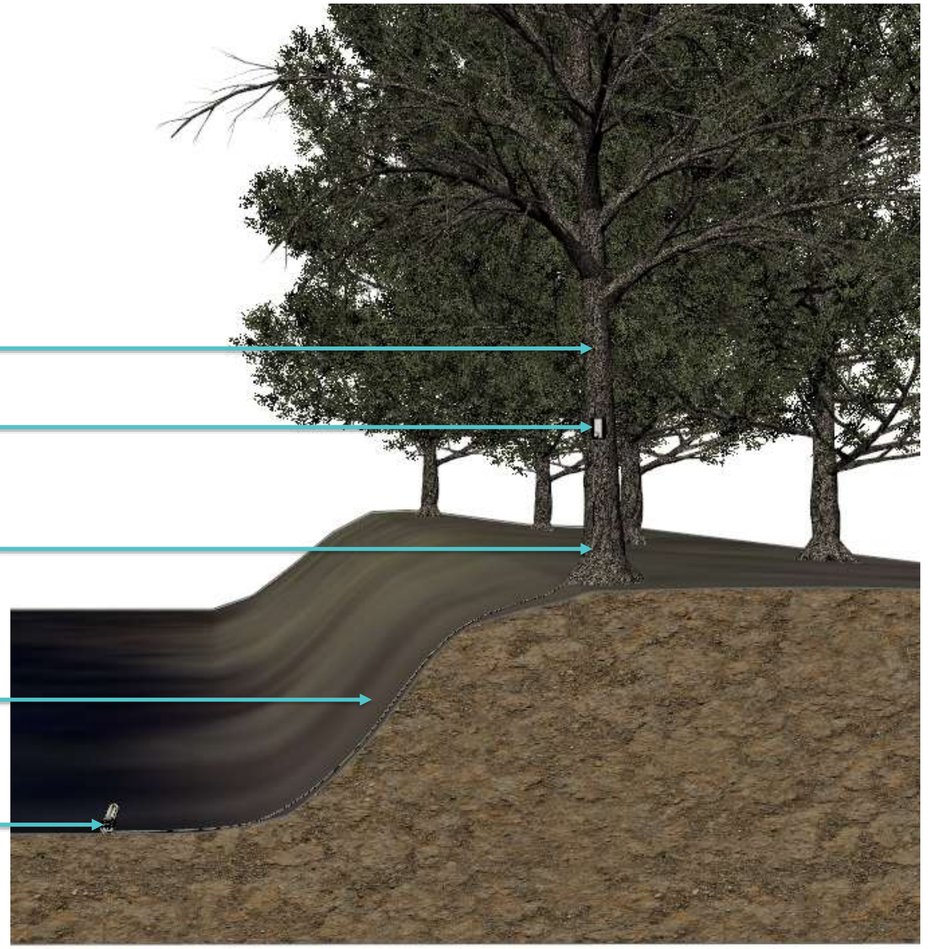
Monitoring Breakdown:

Sewickley Creek Monitoring System:

~ CTD Inline Pipe 36” – Water level, electrical conductivity, temperature

Jacks Run Stream Monitoring



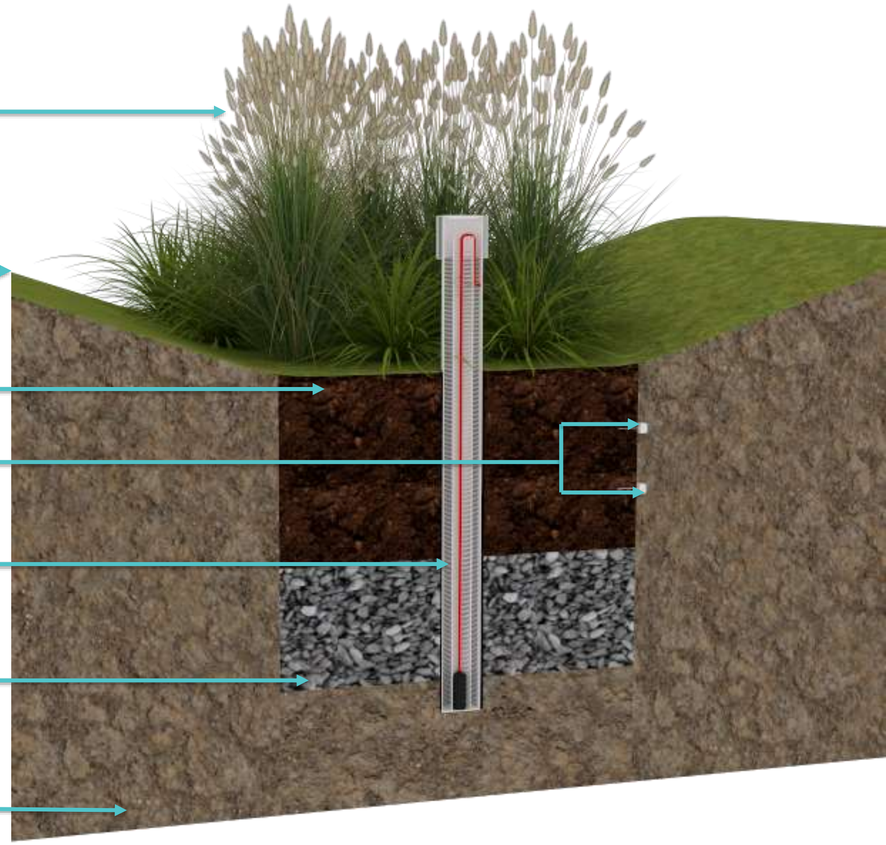


Monitoring Breakdown:

Sewickley Creek Monitoring System:

~ CTD Inline Pipe 36” – Water level, electrical conductivity, temperature

Mount Pleasant Municipal Rain Garden Monitoring

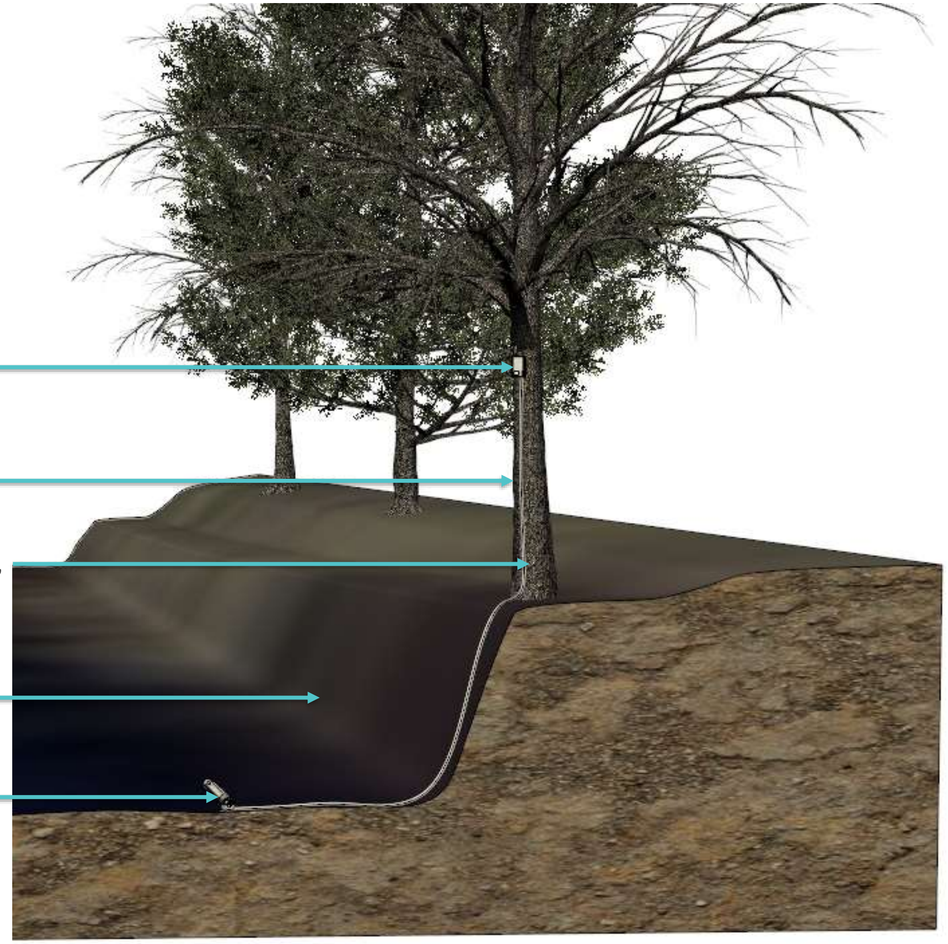


Monitoring Breakdown:

WCD Rain Garden System:

- ~ CTD Standpipe 42” – Water level, electrical conductivity, temperature
- ~ GS3 4” Grow Media – Soil moisture, electrical conductivity, temperature
- ~ GS3 10” Grow Media – Soil moisture, electrical conductivity, temperature

Loyalhanna Creek Stream Monitoring



EM50G solar wireless logger

Sturdy tree

Protective housing for cables, secured in several locations

Stream bank

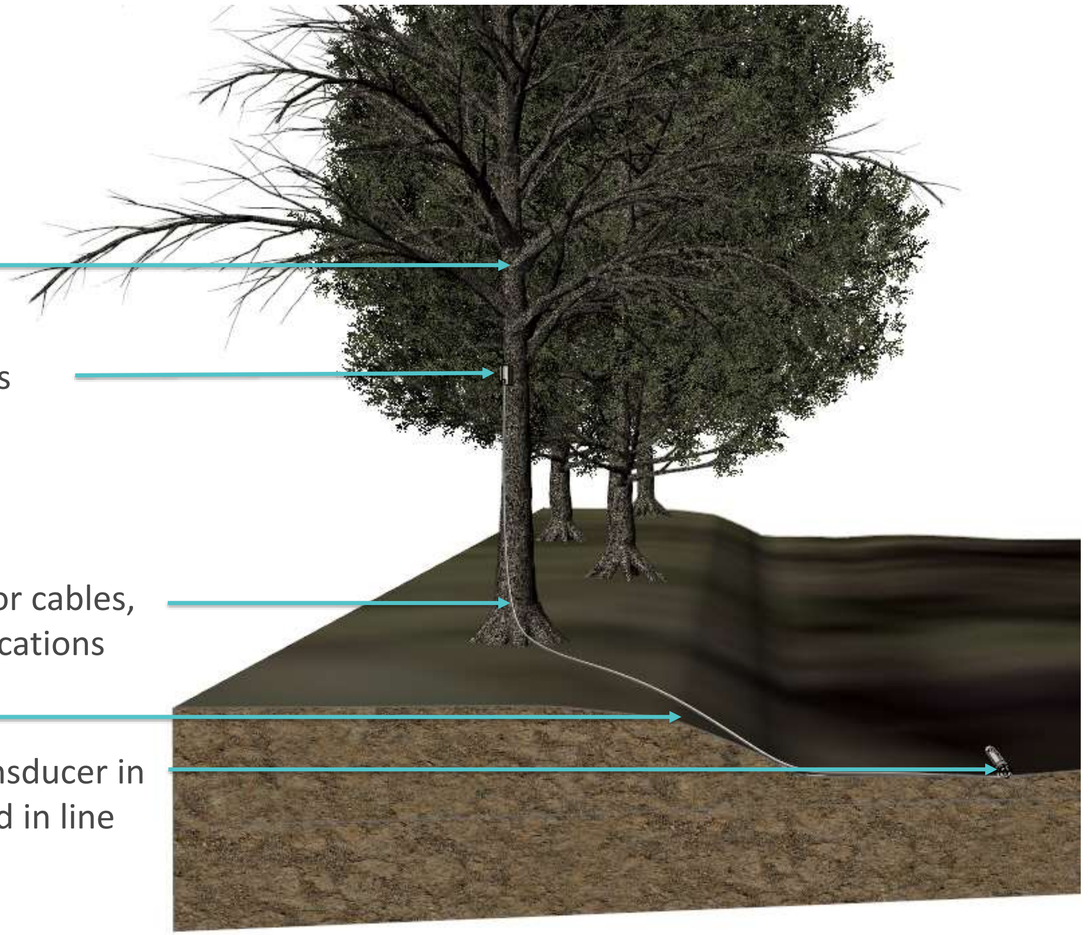
CTD 10 pressure transducer in PVC housing, secured in line with stream flow

Monitoring Breakdown:

Loyalhanna Creek Monitoring System:

~ CTD Inline Pipe 36” – Water level, electrical conductivity, temperature

Mill Creek Stream Monitoring



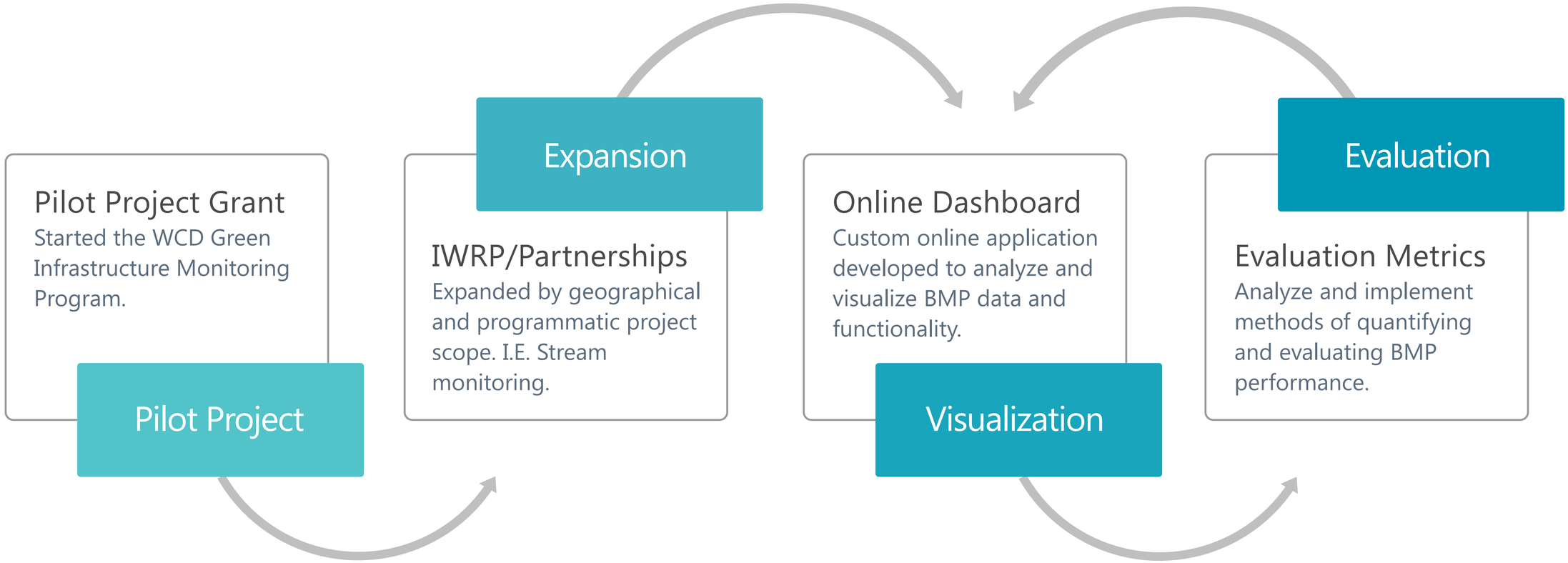
Monitoring Breakdown:

Sewickley Creek Monitoring System:

~ CTD Inline Pipe 36” – Water level, electrical conductivity, temperature

Program Development

The evolving process



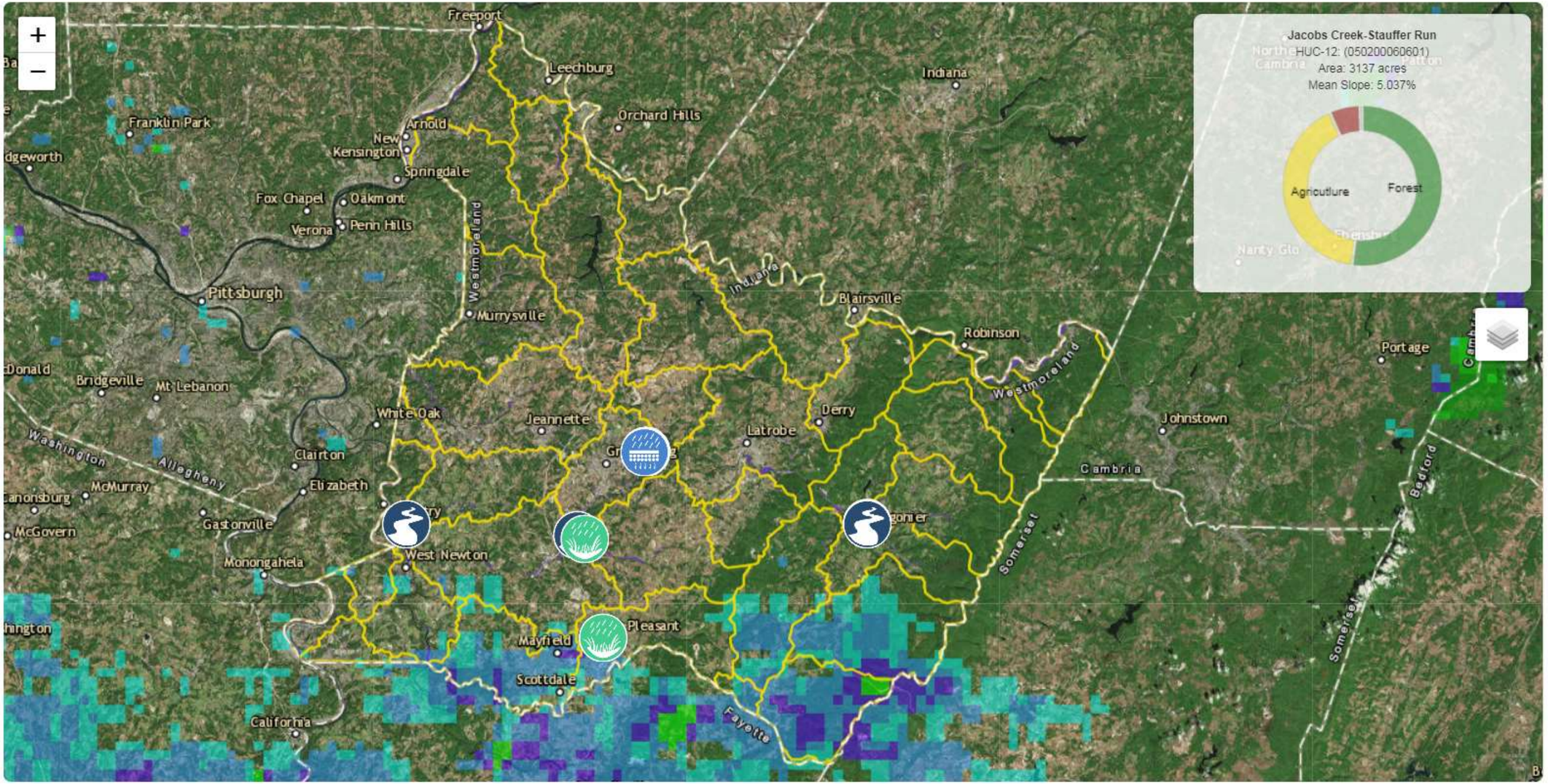
Monitoring Dashboard

County View

Home | About | Contact

Available Loggers

- **Sewickely Creek Stream at Lober** *WCD.STREAM.001*
- **Precipitation** *WCD.PRECIP.001*
- **WCD Green Roof Outlet** *WCD.ROOF.002*
- **Loyalhanna Creek Stream at Ligonier** *WCD.STREAM.003*
- **Jacks Run Stream at Youngwood** *WCD.STREAM.002*
- **Mill Creek Stream at Ligonier** *WCD.STREAM.004*
- **WCD Rear Porous Parking Lot** *WCD.PAVER.002*
- **WCD Green Roof** *WCD.ROOF.001*
- **GreenForge Rain Garden** *WCD.RG.001*
- **WCD Upper Porous Parking Lot** *WCD.PAVER.001*
- **Westmoreland Community College Grass Biowale** *WCD.RG.002*
- **Mt Pleasant Rain Garden** *WCD.RG.003*



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Monitoring Dashboard

Watershed View

Westmoreland Conservation District

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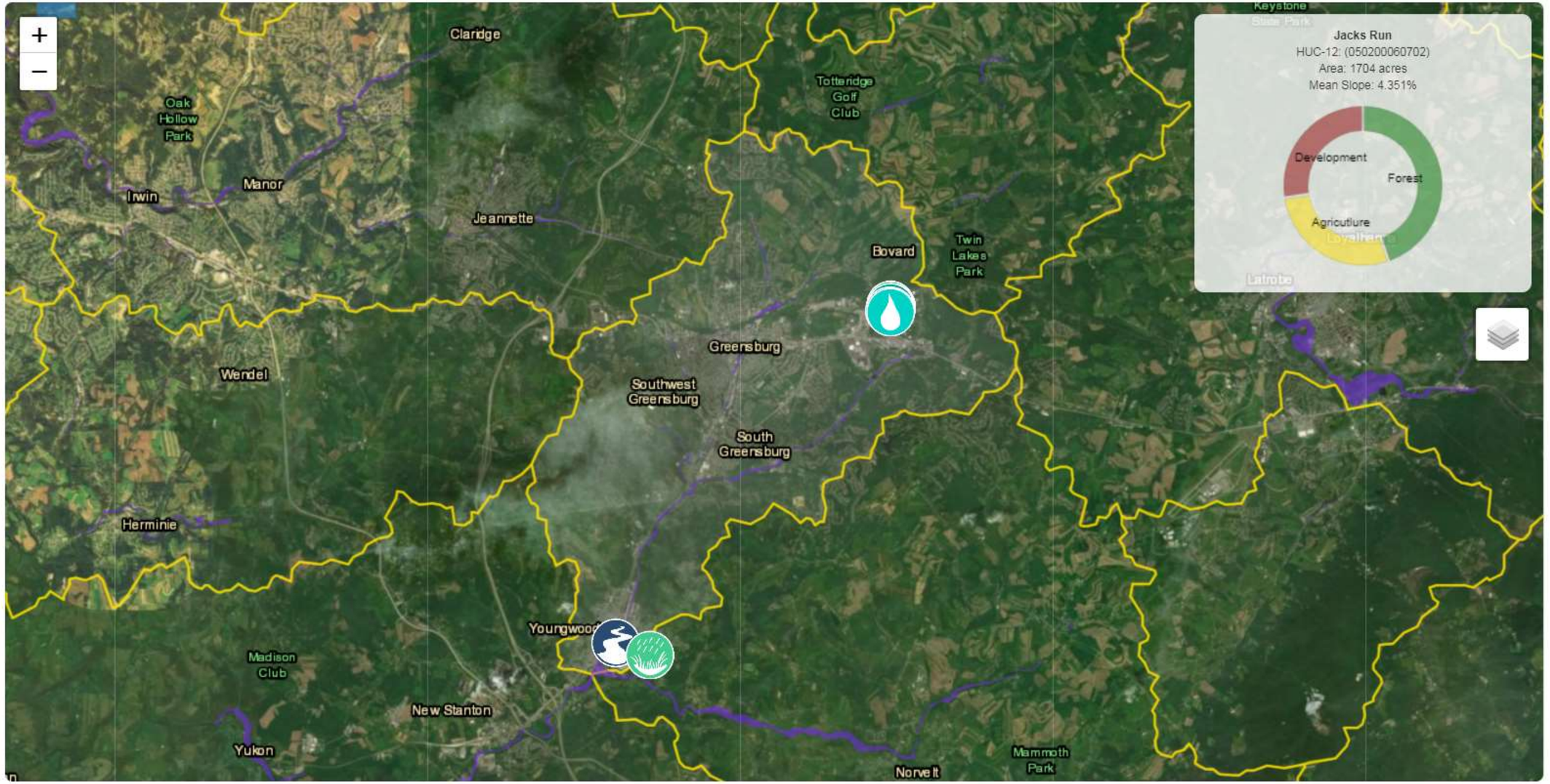
Available Loggers

- **Sewickely Creek Stream at Lober**
  WCD.STREAM.001
- **Precipitation**
  WCD.PRECIP.001
- **WCD Green Roof Outlet**
  WCD.ROOF.002
- **Loyalhanna Creek Stream at Ligonier**
  WCD.STREAM.003
- **Jacks Run Stream at Youngwood**
  WCD.STREAM.002
- **Mill Creek Stream at Ligonier**
  WCD.STREAM.004
- **WCD Rear Porous Parking Lot**
  WCD.PAVER.002
- **WCD Green Roof**
  WCD.ROOF.001
- **GreenForge Rain Garden**
  WCD.RG.001
- **WCD Upper Porous Parking Lot**
  WCD.PAVER.001
- **Westmoreland Community College Grass Biowale**
  WCD.RG.002
- **Mt Pleasant Rain Garden**
  WCD.RG.003



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Monitoring Dashboard

Site View

Westmoreland Conservation District

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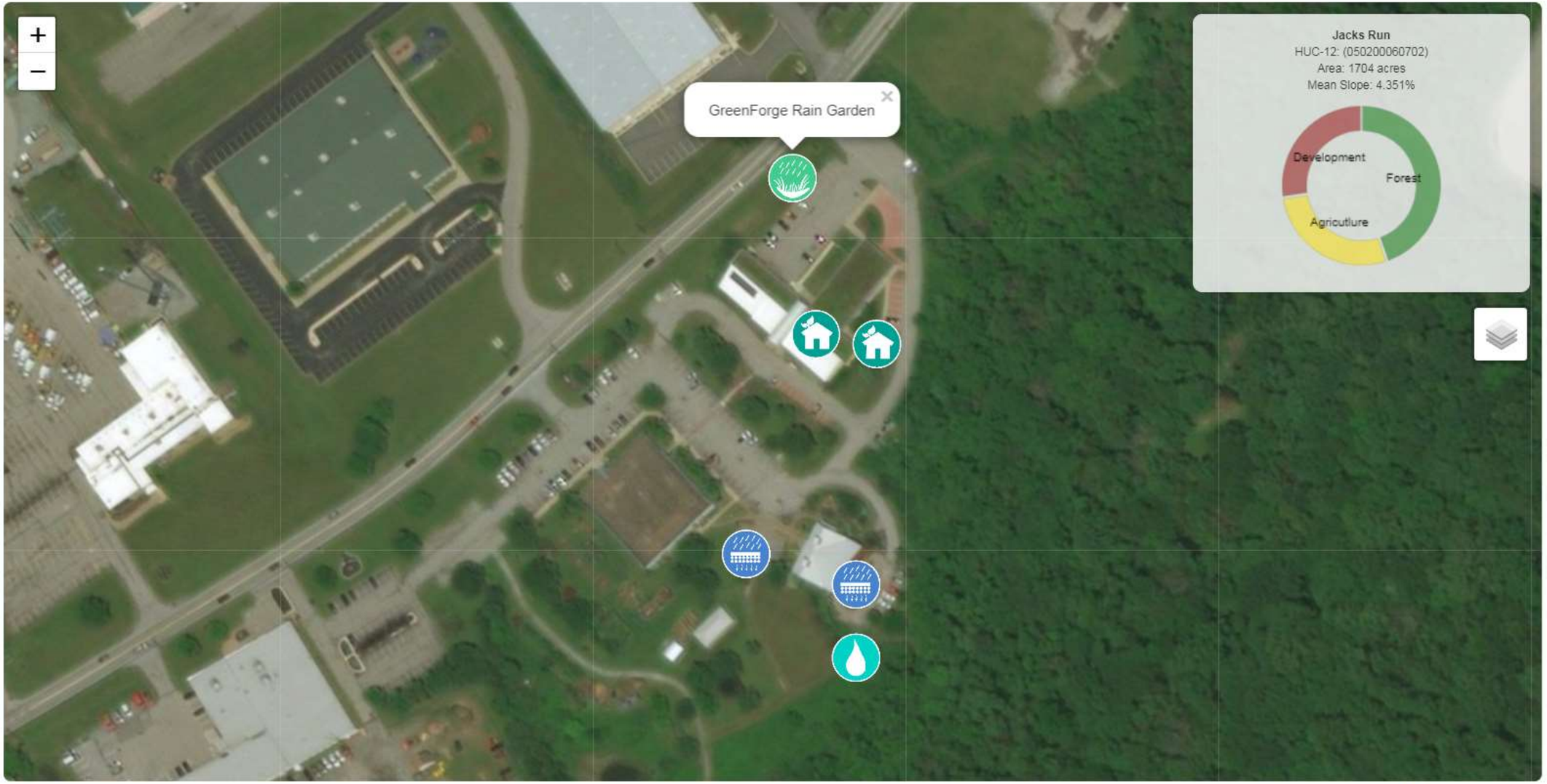
Available Loggers

- **Sewickely Creek Stream at Lober** *WCD.STREAM.001*
- **Precipitation** *WCD.PRECIP.001*
- **WCD Green Roof Outlet** *WCD.ROOF.002*
- **Loyalhanna Creek Stream at Ligonier** *WCD.STREAM.003*
- **Jacks Run Stream at Youngwood** *WCD.STREAM.002*
- **Mill Creek Stream at Ligonier** *WCD.STREAM.004*
- **WCD Rear Porous Parking Lot** *WCD.PAVER.002*
- **WCD Green Roof** *WCD.ROOF.001*
- **GreenForge Rain Garden** *WCD.RG.001*
- **WCD Upper Porous Parking Lot** *WCD.PAVER.001*
- **Westmoreland Community College Grass Biowale** *WCD.RG.002*
- **Mt Pleasant Rain Garden** *WCD.RG.003*



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Monitoring Dashboard

BMP Performance View

Home | About | Contact

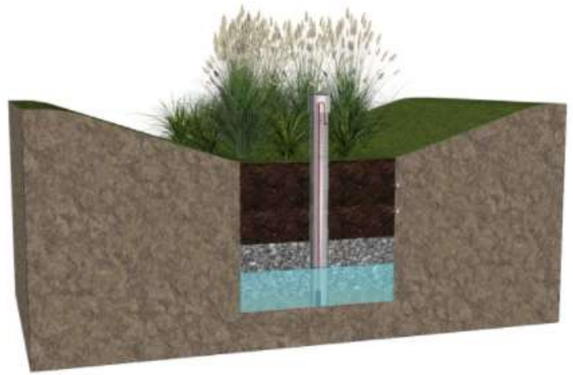
Go Back

WCD.RG.002
Westmoreland Community College Grass Biowale

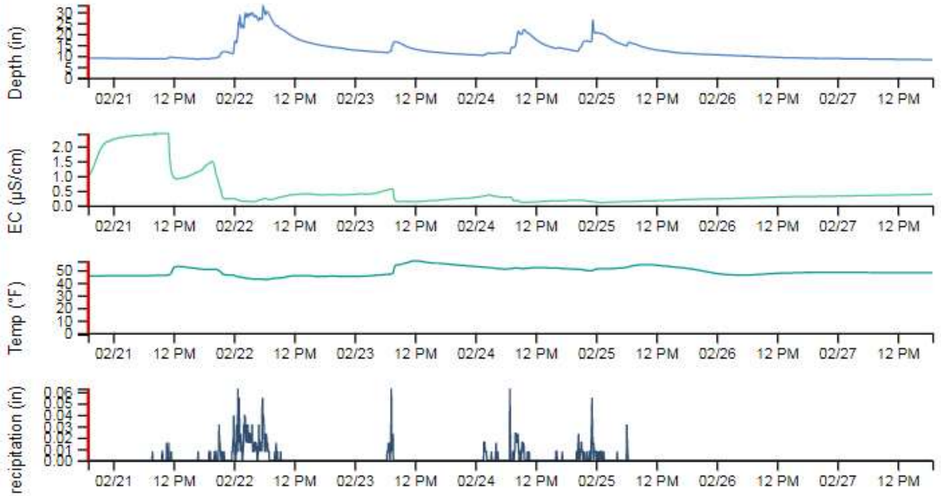
Watershed: Not Provided
HUC-12: Not Provided

Logger Details
Decagon Data Service 1.20
Device: 5G106911
Sensor:
Lat/Lon: 40.234976, -79.566547

Time: Tue Feb 20 2018 19:00:00 GMT-0500 (Eastern Standard Time)
Water Depth: 9.06 in.



Last Week | Next Week



Precipitation Change

- Precipitation: Not Raining
- 24-Hour Cumulative Rainfal (in): 0.00

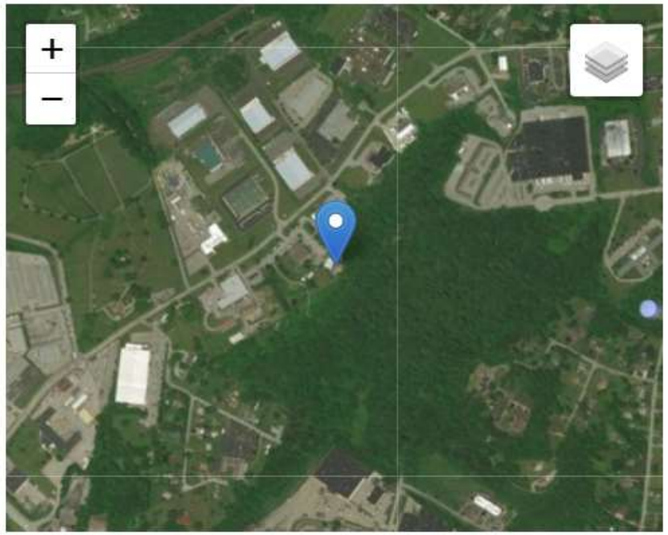
Performance Change

- Water Level: Rising

Plant Health Change

- Growing Season: Dormant
- Heat Stress: Low
- Frost Risk: Low

Trends & Statistics Change



Activity Feed for the Entire Time Period

- Tue Feb 20 2018 19:00:00 - Precip Alert — It has started to rain.
- Tue Feb 20 2018 19:00:00 - Precip Alert — The rain is slowing or stopping.
- Tue Feb 20 2018 19:00:00 - Precip Alert — It has started to rain.
- Tue Feb 20 2018 19:00:00 - Precip Alert — The rain is slowing or stopping.
- Tue Feb 20 2018 19:00:00 - Precip Alert

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Monitoring Dashboard

BMP Performance View

Home | About | Contact

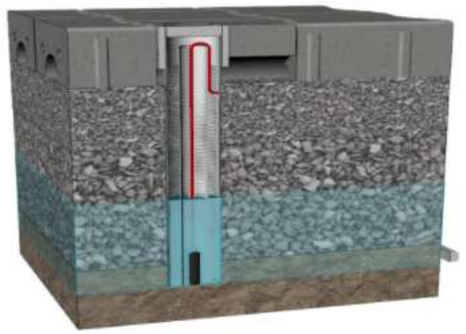
Go Back

WCD.PAVER.002
WCD Rear Porous Parking Lot

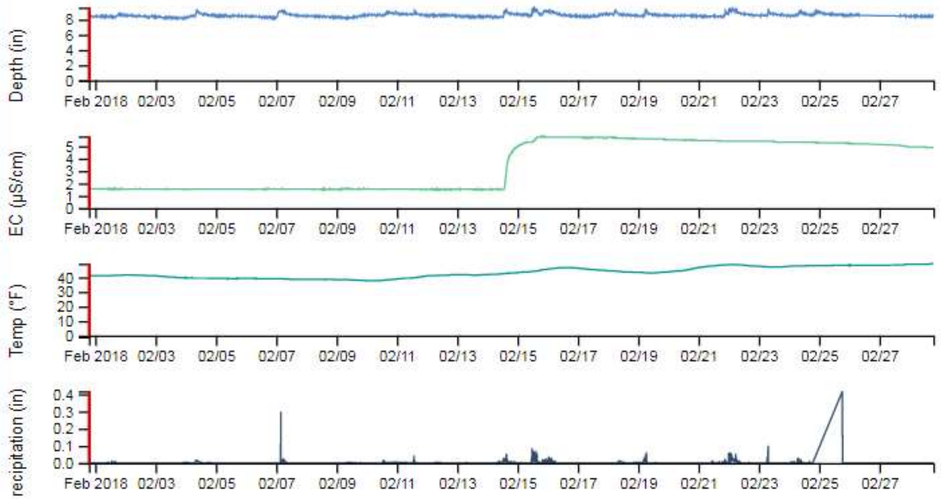
Watershed: Not Provided
HUC-12: Not Provided

Logger Details
Decagon Data Service 1.20
Device: 5G106710
Sensor:
Lat/Lon: 40.308739, -79.498666

Time: Wed Jan 31 2018 19:00:00 GMT-0500 (Eastern Standard Time)
Water Depth: 8.46 in.



Jan 2018 | Last Week | Next Week | Feb 2018



Precipitation Change

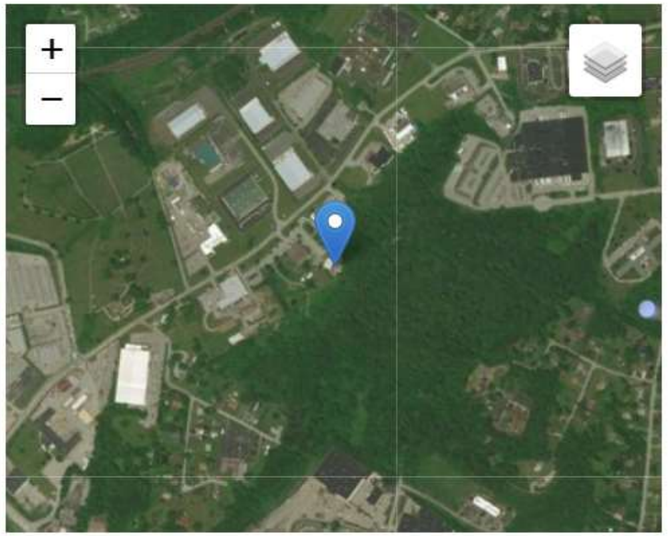
Precipitation:
Not Raining

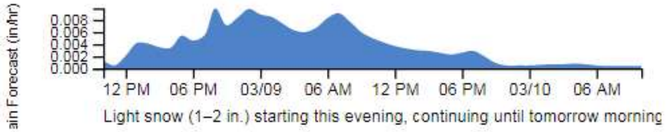
24-Hour Cumulative Rainfal (in):
0

Performance Change

Trends & Statistics Change

Miscellaneous Change





Activity Feed for the Entire Time Period

No Activity to Report. Try another date range.

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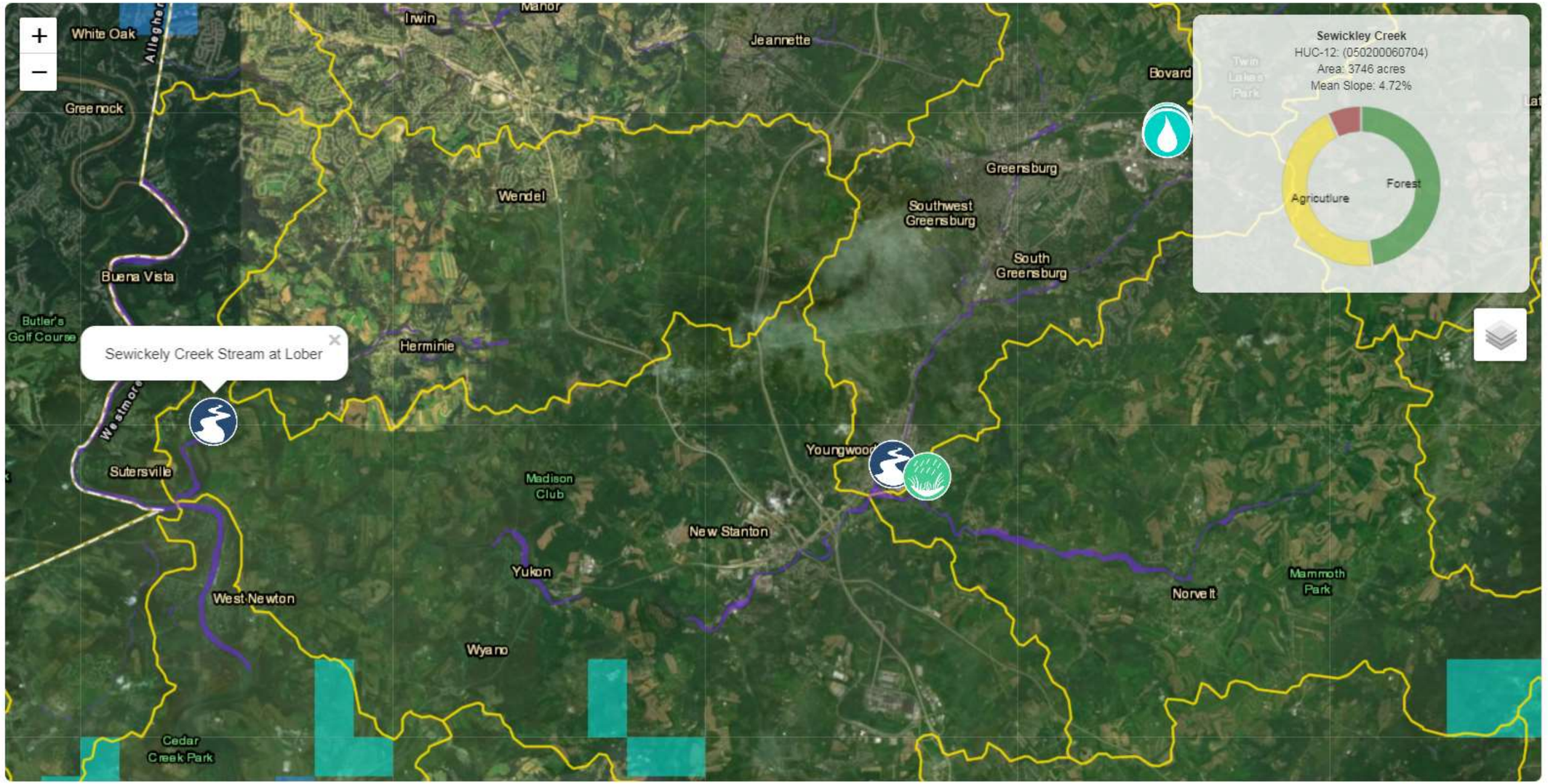
Monitoring Dashboard

Watershed View

Home | About | Contact

Available Loggers

- **Sewickely Creek Stream at Lober** *WCD.STREAM.001*
- **Precipitation** *WCD.PRECIP.001*
- **WCD Green Roof Outlet** *WCD.ROOF.002*
- **Loyalhanna Creek Stream at Ligonier** *WCD.STREAM.003*
- **Jacks Run Stream at Youngwood** *WCD.STREAM.002*
- **Mill Creek Stream at Ligonier** *WCD.STREAM.004*
- **WCD Rear Porous Parking Lot** *WCD.PAVER.002*
- **WCD Green Roof** *WCD.ROOF.001*
- **GreenForge Rain Garden** *WCD.RG.001*
- **WCD Upper Porous Parking Lot** *WCD.PAVER.001*
- **Westmoreland Community College Grass Biowale** *WCD.RG.002*
- **Mt Pleasant Rain Garden** *WCD.RG.003*



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Monitoring Dashboard

GI Performance View

Westmoreland Conservation District

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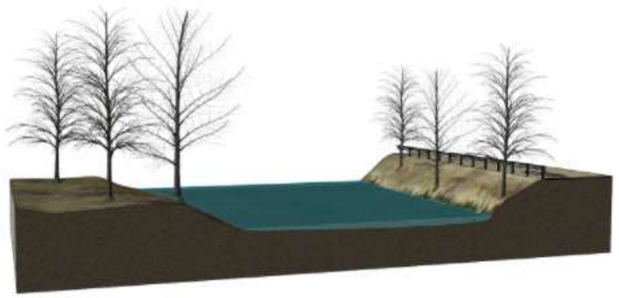
WCD.STREAM.001
Sewickely Creek Stream at Lober

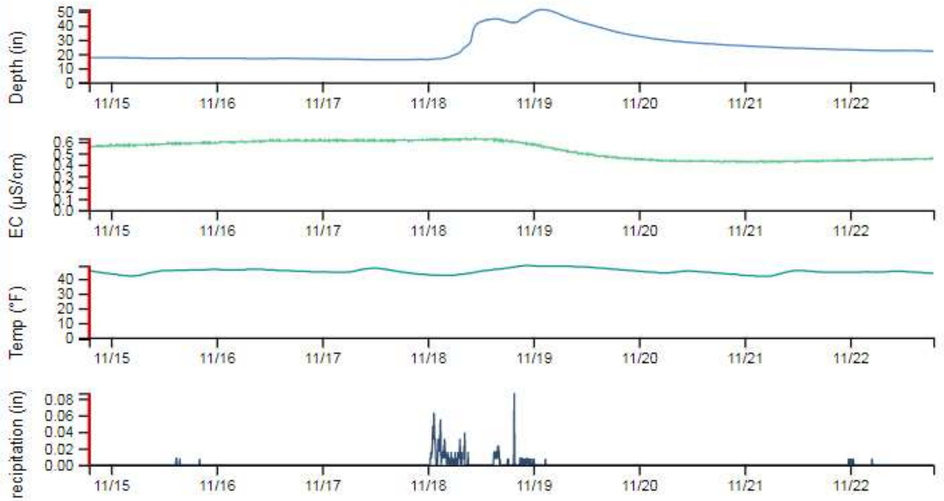
Watershed: Not Provided
HUC-12: Not Provided

Logger Details
Decagon Data Service 1.20
Device: 5G106452
Sensor:
Lat/Lon: 40.246873, -79.767304

Time: Tue Nov 14 2017 19:00:00 GMT-0500 (Eastern Standard Time)
Water Depth: 17.32 in.



Last Week | Next Week



Precipitation Change

Precipitation:
Not Raining

24-Hour Cumulative Rainfal (in):
0

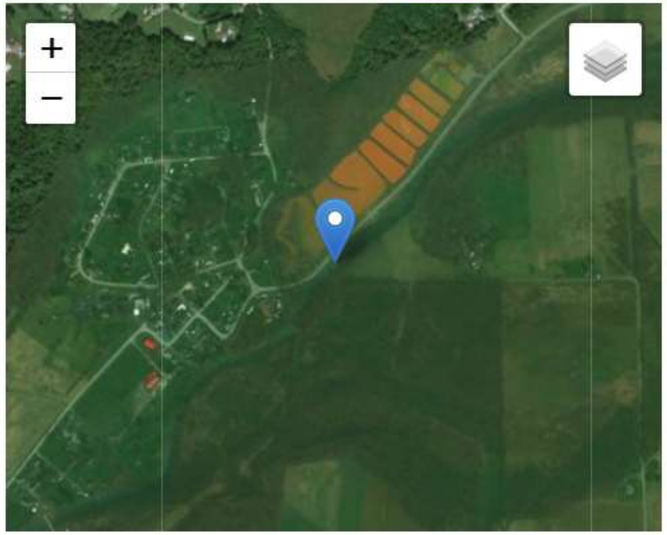
Hydraulic Conditions Change

Brook Trout Health Change

Growth and Survivability:
Below Ideal Temperature

Spawning Conditions:
Spawning Season - Ideal Conditions

Trends & Statistics Change



Mostly cloudy throughout the day.

Activity Feed for the Entire Time Period

Tue Nov 14 2017 20:10:00 - Brook Trout Health Alert
Great news if you love fishing. Water temperatures have risen to ideal spawning temperatures.

Wed Nov 15 2017 10:40:00 - Brook Trout Health Alert
Brrrr... Water temperatures have swung below the ideal range for spawning.

Thu Nov 16 2017 20:25:00 - Brook Trout Health Alert
Great news if you love fishing. Water temperatures have risen to ideal spawning temperatures.

Fri Nov 17 2017 07:00:00 - Brook Trout Health Alert
Brrrr... Water temperatures have swung below the

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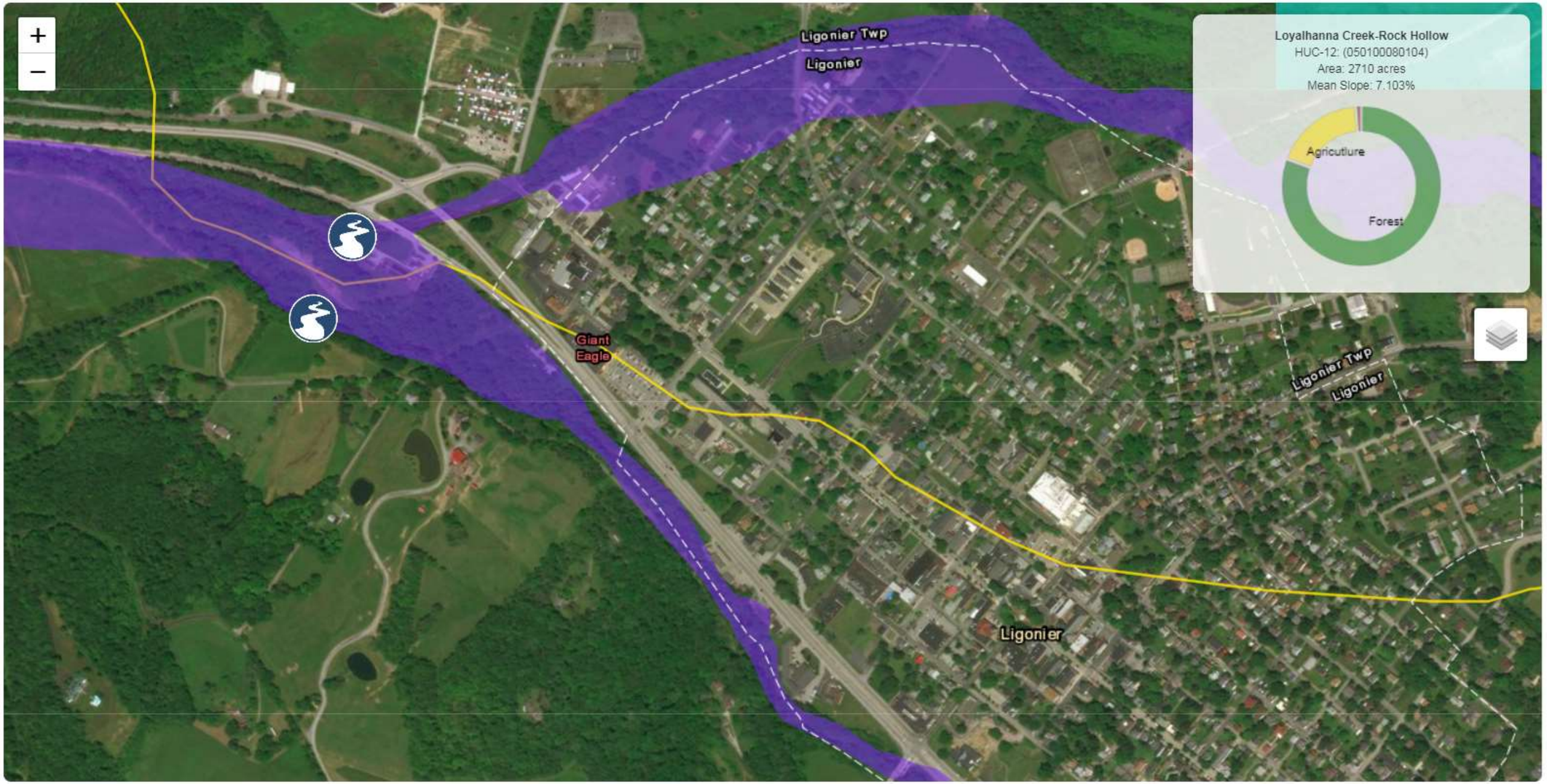
Monitoring Dashboard

Site View

Westmoreland Conservation District

Available Loggers

- **Sewickely Creek Stream at Lober**
  WCD.STREAM.001
- **Precipitation**
  WCD.PRECIP.001
- **WCD Green Roof Outlet**
  WCD.ROOF.002
- **Loyalhanna Creek Stream at Ligonier**
  WCD.STREAM.003
- **Jacks Run Stream at Youngwood**
  WCD.STREAM.002
- **Mill Creek Stream at Ligonier**
  WCD.STREAM.004
- **WCD Rear Porous Parking Lot**
  WCD.PAVER.002
- **WCD Green Roof**
  WCD.ROOF.001
- **GreenForge Rain Garden**
  WCD.RG.001
- **WCD Upper Porous Parking Lot**
  WCD.PAVER.001
- **Westmoreland Community College Grass Biowale**
  WCD.RG.002
- **Mt Pleasant Rain Garden**
  WCD.RG.003



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Monitoring Dashboard

GI Performance View

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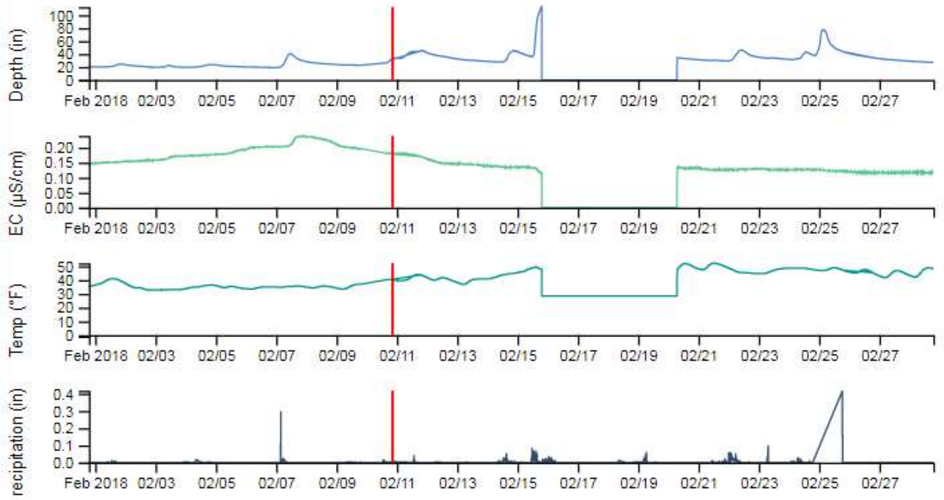
WCD.STREAM.003
Loyalhanna Creek Stream at Ligonier

Watershed: Not Provided
HUC-12: Not Provided

Logger Details
Decagon Data Service 1.20
Device: 5G106909
Sensor:
Lat/Lon: 40.247103, -79.250316

Time: Sun Feb 11 2018 16:00:00 GMT-0500 (Eastern Standard Time)
Water Depth: 43.78 in.

Jan 2018 | Last Week | Next Week | Feb 2018



Precipitation Change

Precipitation:
Not Raining

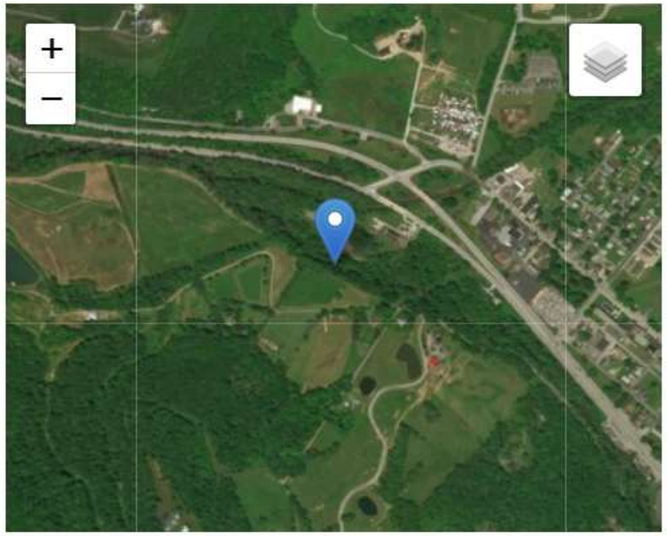
Hydraulic Conditions Change

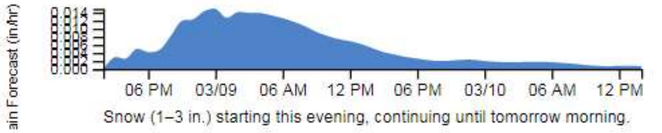
Brook Trout Health Change

Growth and Survivability:
Below Ideal Temperature

Spawning Conditions:
Not currenly spawning season

Trends & Statistics Change





Snow (1–3 in.) starting this evening, continuing until tomorrow morning.

Activity Feed for the Entire Time Period

No Activity to Report. Try another date range.

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westmorelandstormwater.org

www.westmorelandstormwater.org

Westmoreland Conservation District

Home of the Westmoreland County Integrated Water Resource Plan

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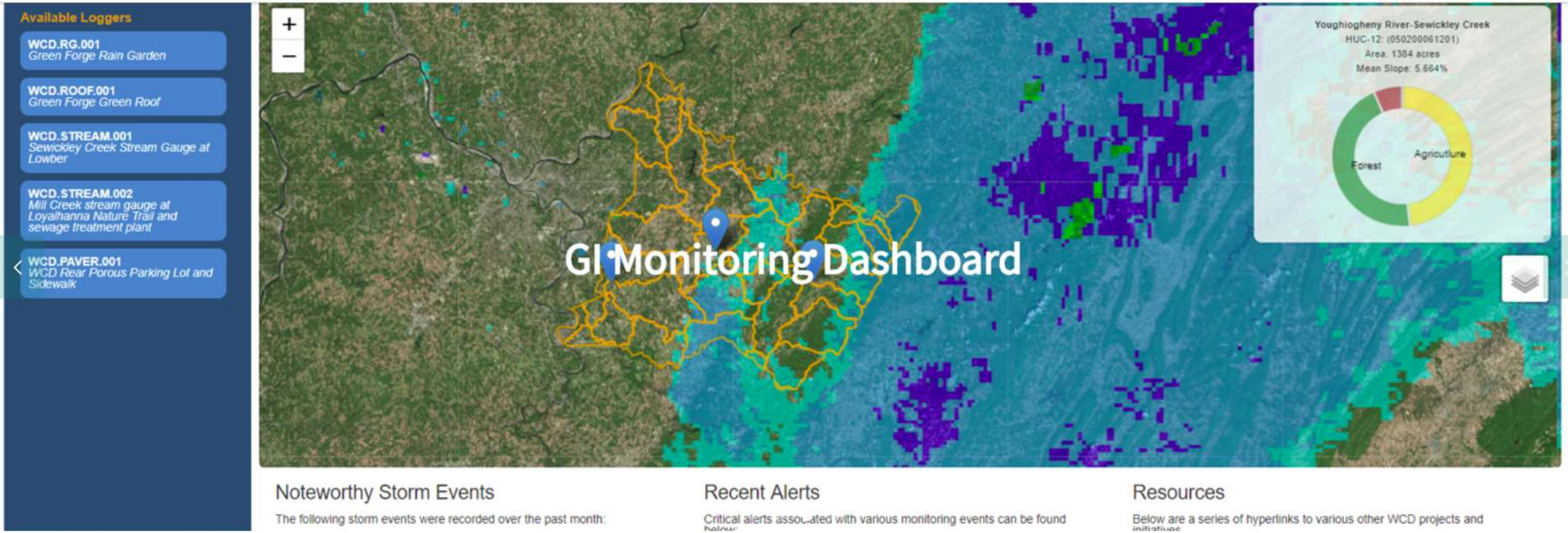

Noteworthy Storm Events

The following storm events were recorded over the past month:

Recent Alerts

Critical alerts associated with various monitoring events can be found

Resources

Below are a series of hyperlinks to various other WCD projects and