

What to Do With All That **Water**

a presentation for the
PA APA Annual Conference



October 18, 2021



Image Source: unsplash.com, Sharon Pittaway



What to Do With All That **Water**

Jim Pillsbury, PE – Hydraulic Engineer

Westmoreland Conservation District

Daniel Carpenter – Deputy Director

*Westmoreland County Department of Planning & Development,
Planning Division*

Why Do We Need Stormwater Management?



Stormwater Runoff Problems

- Impacts to your home and property
- Flooding
- Storm sewer maintenance costs
- Decrease in sportfish population
- Costs of water treatment
- Unsafe water recreation areas



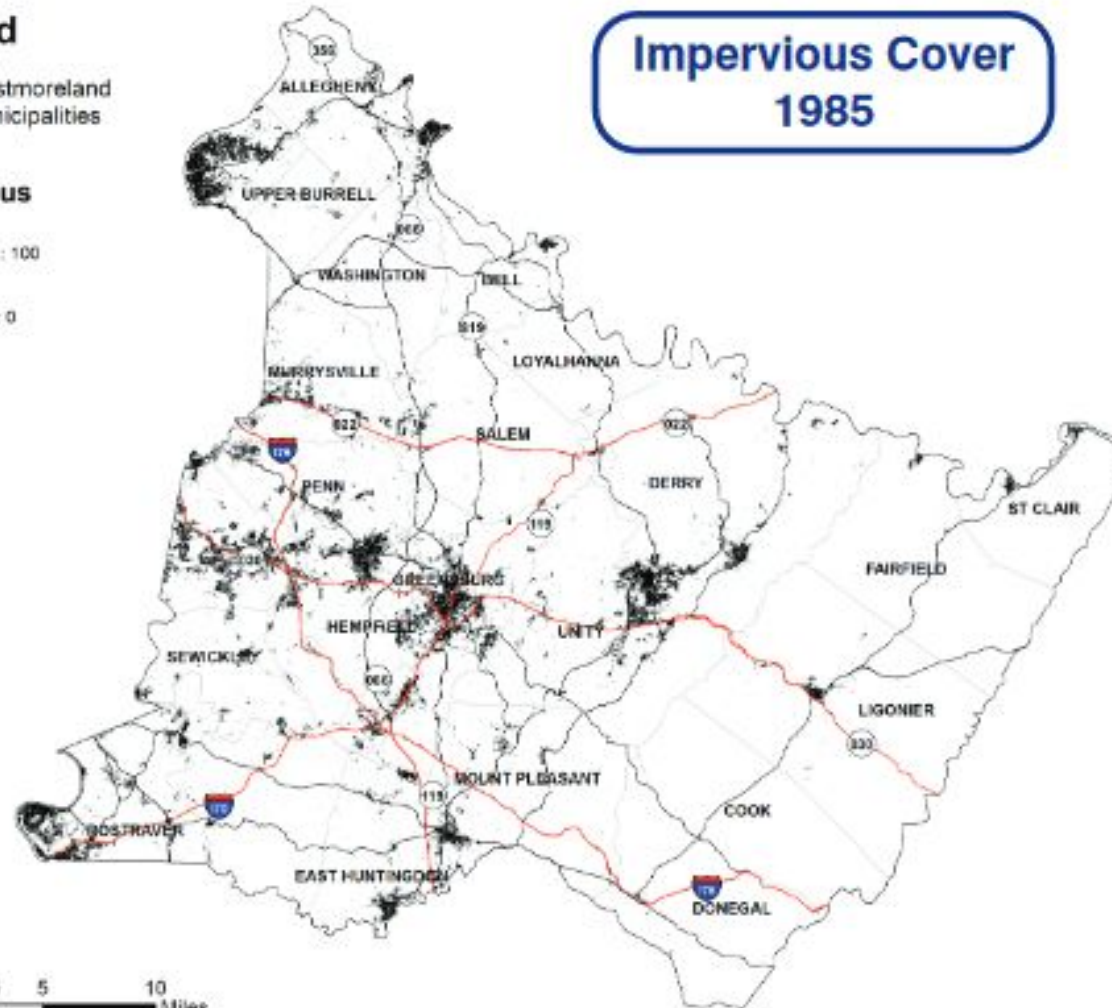
Stormwater Runoff Problems a Result of Sprawl

Legend

Westmoreland Municipalities

1985 Impervious Cover

High : 100
Low : 0

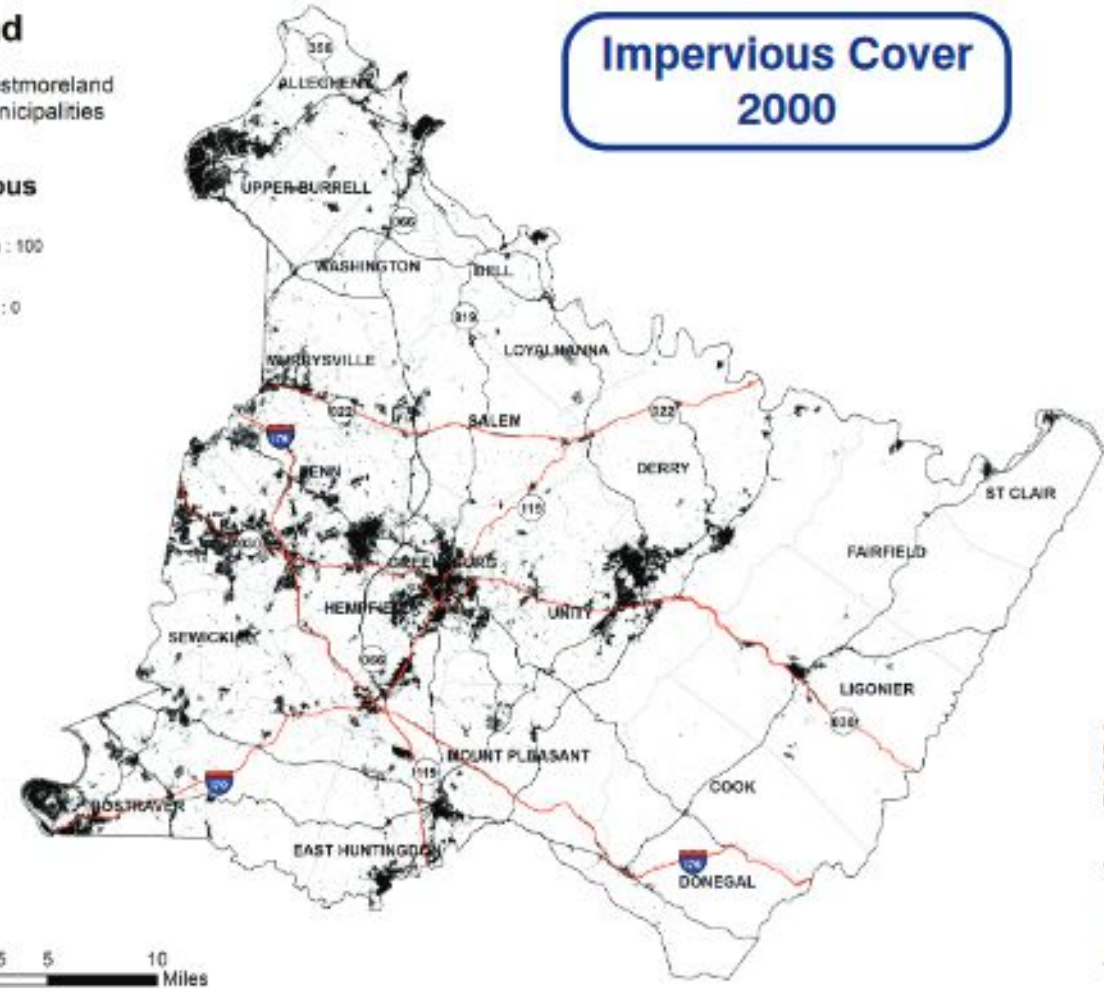


Legend

Westmoreland Municipalities

2000 Impervious Cover

High : 100
Low : 0



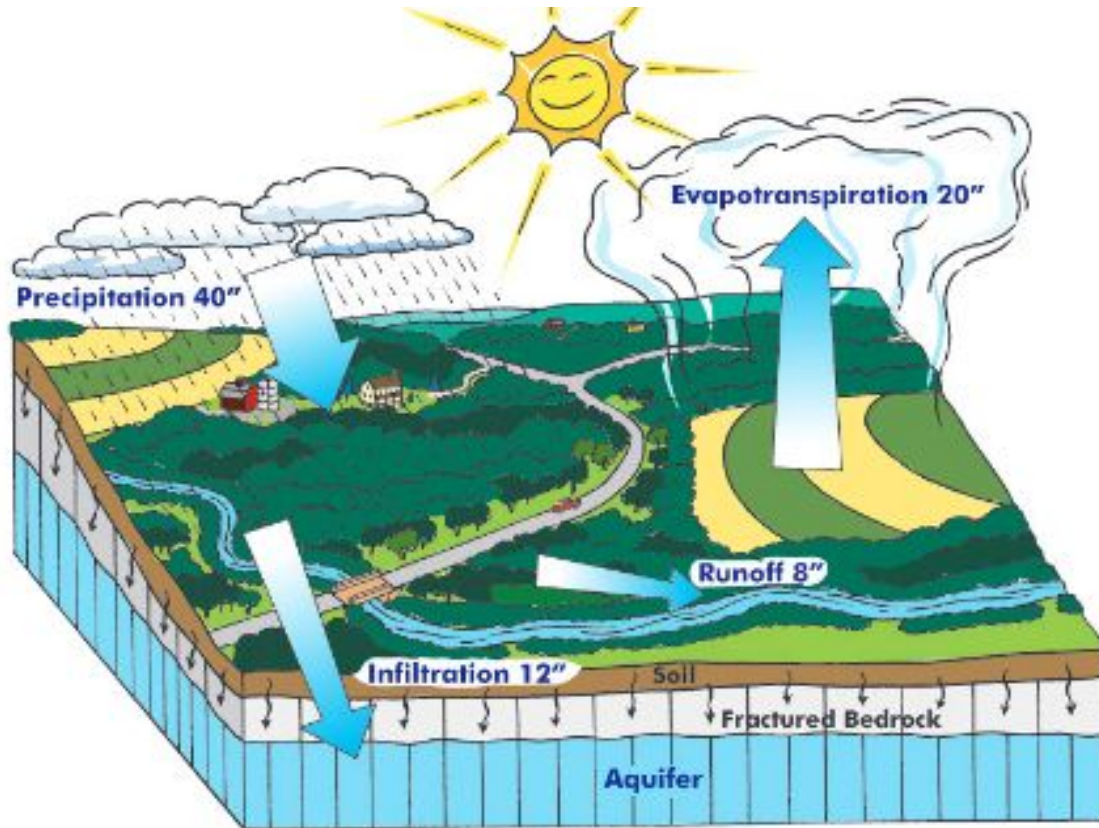
Land Development in the Headwaters of Slate Creek



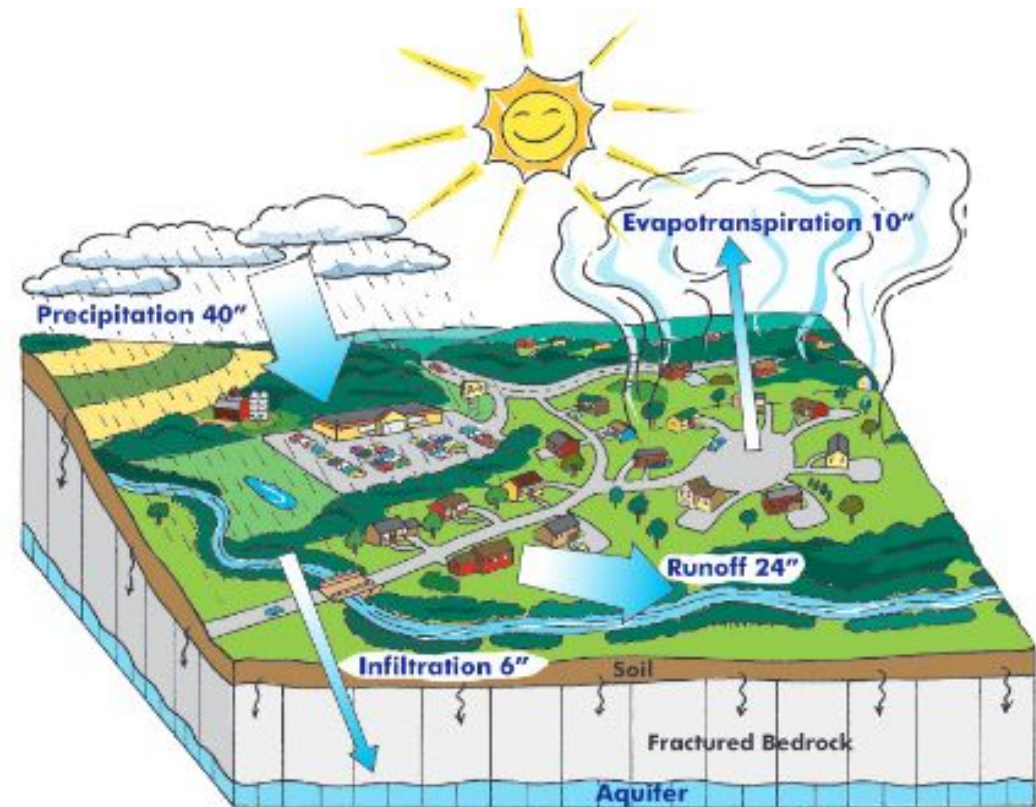
Photo by Westmoreland County

Ann Rudd Saxman Nature Park is a open space in the middle of a highly developed area near Greensburg.

Land Development, the Water Cycle, and Stormwater



Natural water cycle before development



The natural water cycle changes significantly with land development.

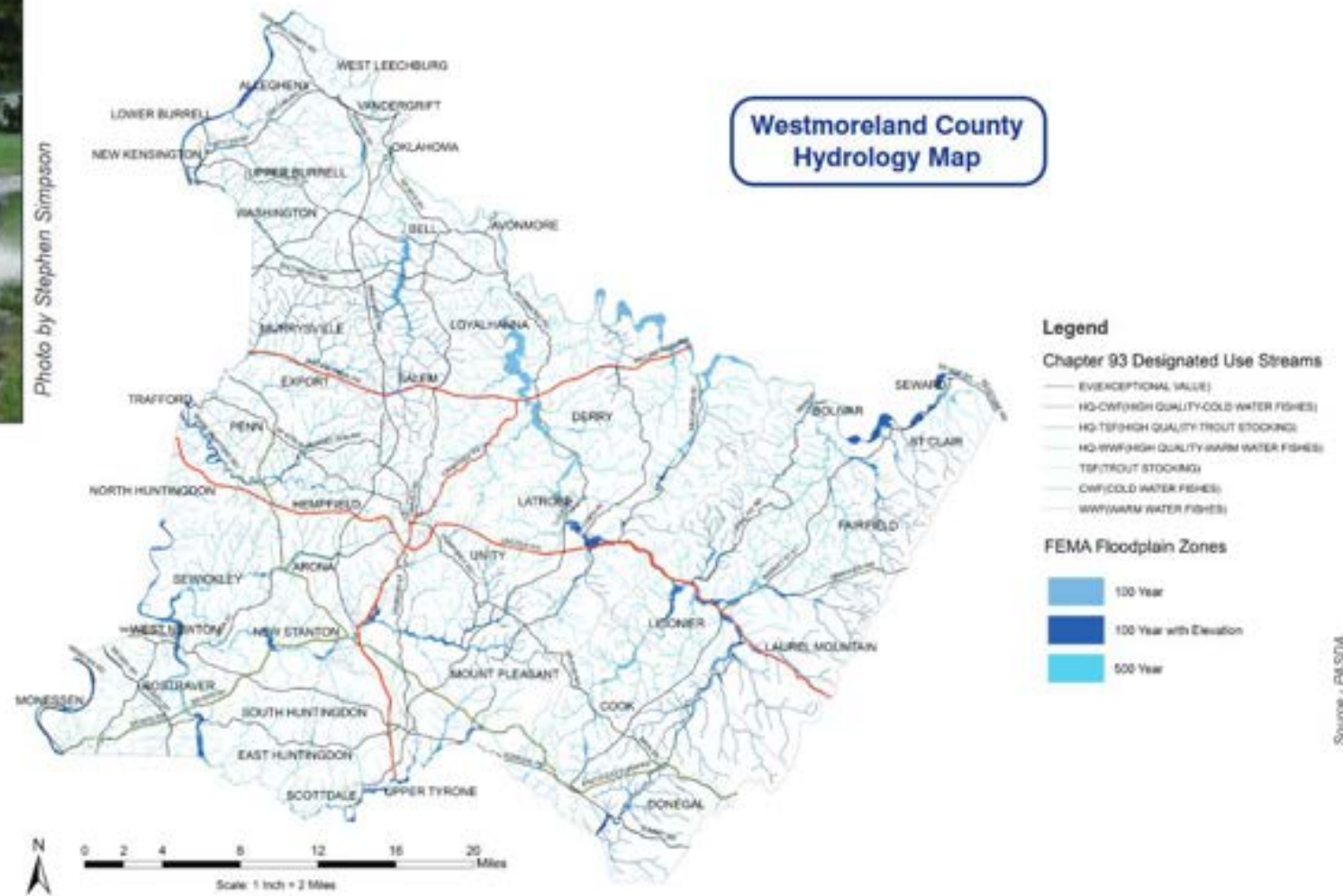
The Intersection of People and Stormwater



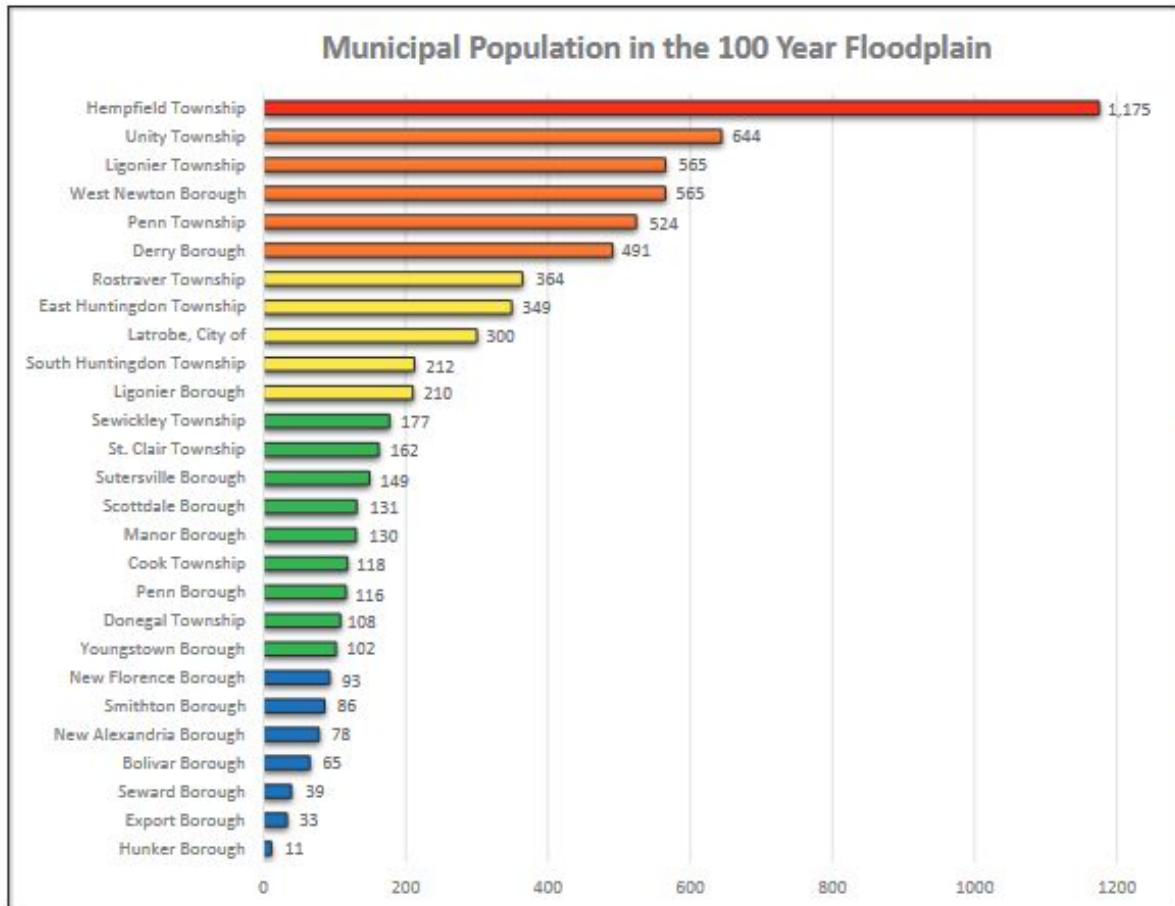
Road flooding near Champion, PA

2,037 miles
of streams

4,713 miles
of roadway

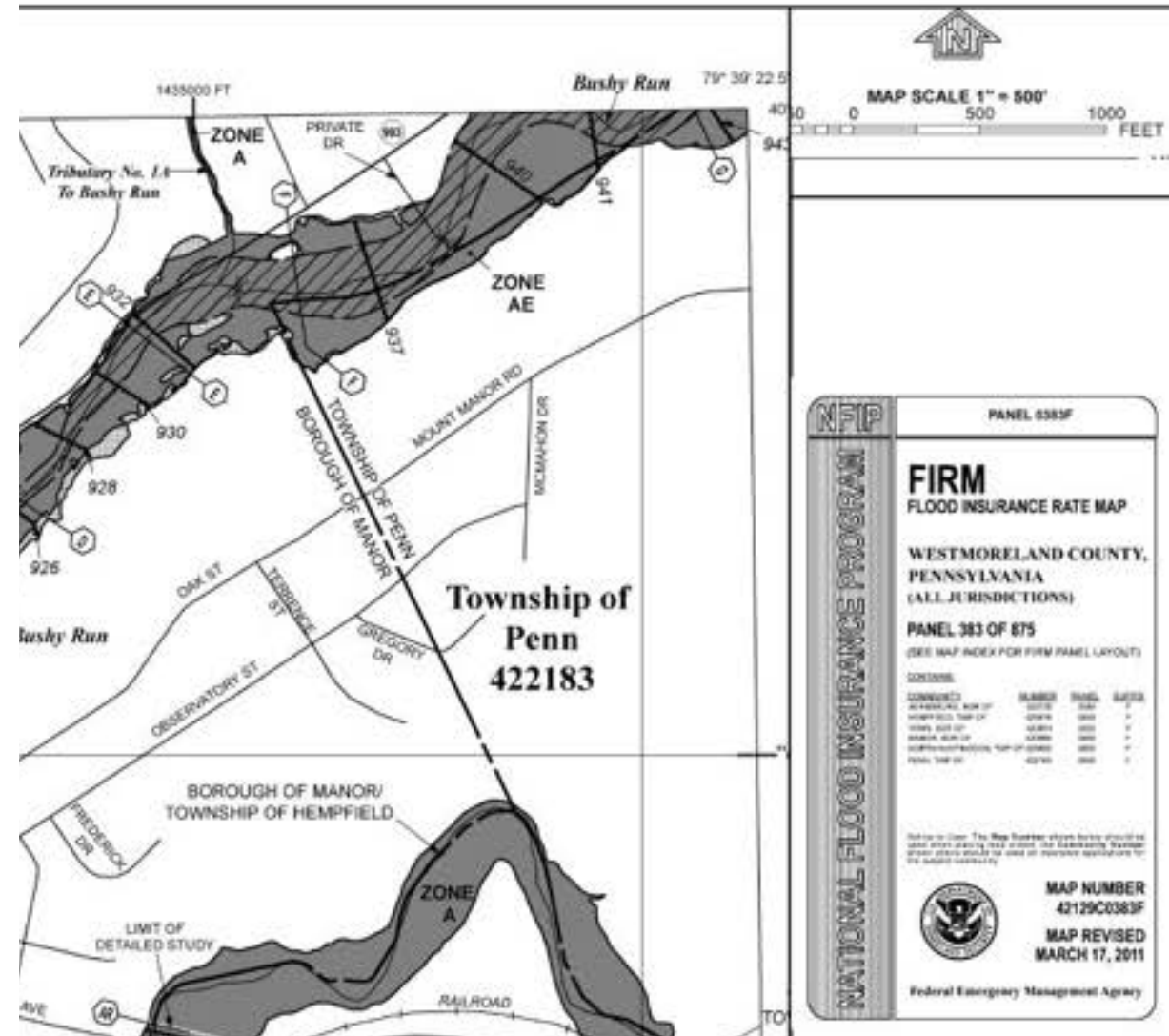


The Intersection of People and Stormwater

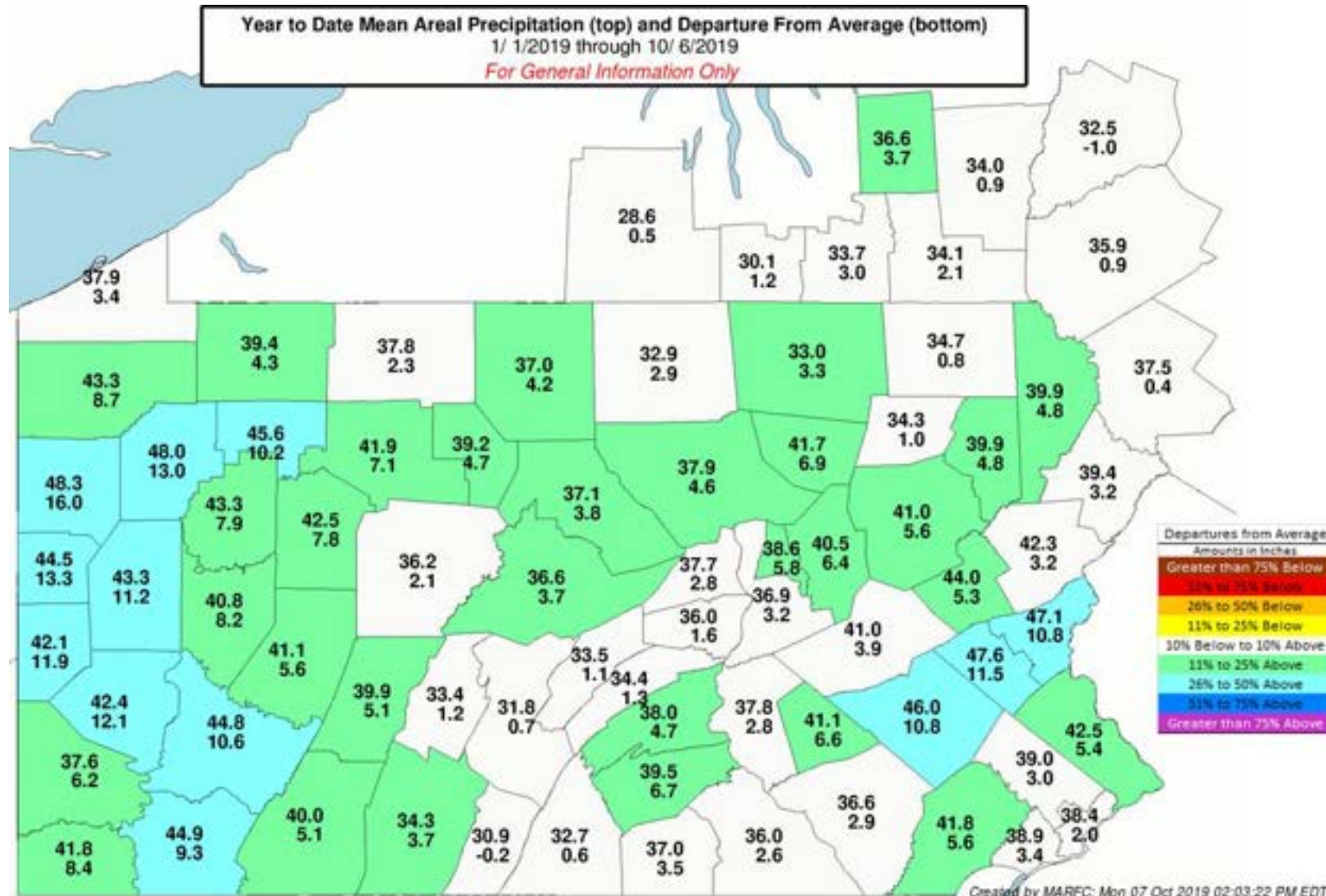


Data from Westmoreland County 911

This chart shows municipalities with significant population living in the 100 year floodplain.



Stormwater Management and Climate Change



STORMWATER

We

All

Live

Downstream

Westmoreland County - USA Watershed View



Source - Sewickley Creek Watershed

What Did WCD and WCP Do About SWM?



Gina
Cerilli



Ted
Kopas



Charles
Anderson

Westmoreland County ^{previous} Commissioners



Westmoreland County
Integrated Water Resources Plan



Westmoreland County Planning as a Partner

along with

- Westmoreland County Board of Commissioners
- Watershed Plan Advisory Committee (WPAC)
- Ethos Collaborative
- R.K. Mellon Foundation



Image Source: hippostcard.com

Westmoreland County Planning as a Partner



Westmoreland County Planning as a Partner

3,000+

resident
surveys

300+

business
surveys

500+

attendees
at
over

30

workshops

Westmoreland County Planning as a Partner

RESOURCE

ASSET

QUALITY

MAINTAIN

IMPROVE

STORMWATER

FLOODING

ACCESS

QUALITY

Westmoreland County Planning as a Partner

100+

attendees
at

7

strategy
evaluation
workshops

600+

strategy
evaluation
surveys

Westmoreland County Planning as a Partner

Reimagining Our Westmoreland

1. Align Workforce, Education, Employers, and Entrepreneurship
2. Discover Westmoreland
3. Reposition Our Towns
4. Connect With Parks and Nature
5. Build Healthy and Whole Communities
6. Plug Into the New Economy
7. Create Transportation Choices

Westmoreland County Planning as a Partner

Reimagining Our Westmoreland and the IWRP

Water touches all areas of life in Westmoreland County, from drinking water to waste water, to recreational and commercial/industrial use, therefore the study of our water resources must also include stormwater and the water-related issues of water use, flooding, and pollution.

Westmoreland County Planning as a Partner

Reimagining Our Westmoreland

1. Align Workforce, Education, Employers, and Entrepreneurship
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Westmoreland County Planning as a Partner

Connect With Parks and Nature

Strategy 4.3 Preserve Open Space & Protect Natural Assets

Strategy 4.4 Improve & Sustain Water Resources



Westmoreland County Planning as a Partner

Build Healthy and Whole Communities

Strategy 5.3 Go Green

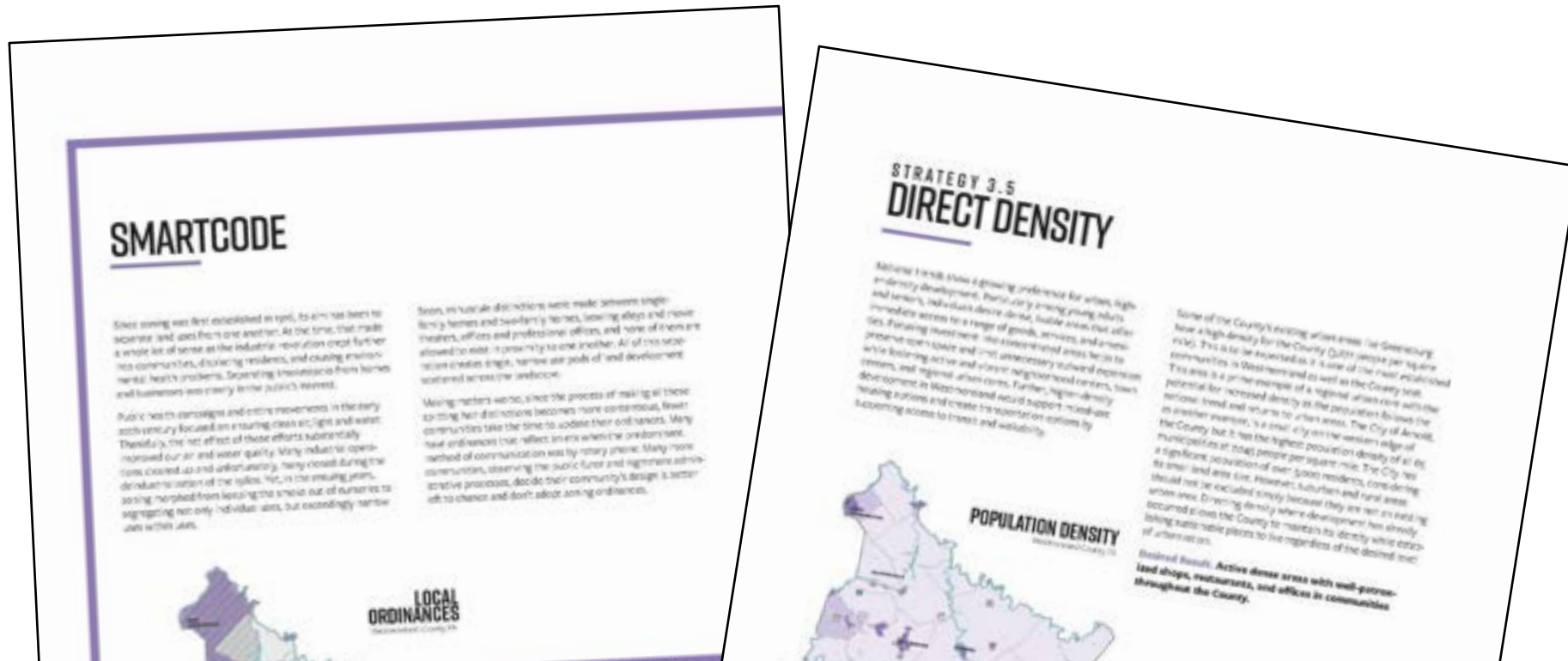


Westmoreland County Planning as a Partner

Reposition Our Towns

Strategy 3.4 Utilize Planning Best Practices

Strategy 3.5 Direct Density



Westmoreland County Planning as a Partner

Why

- Oversee subdivision and land development for **31** of the counties **65** municipalities
- Advise remaining 34 that have their own SALDO
- 41** municipalities have zoning
- Implement the comprehensive plan
- Work with Public Safety on county's Hazard Mitigation Plan

Westmoreland County Planning as a Partner

How

- Helped develop the IWRP
 - Helped develop flowchart tool
 - Helped develop model stormwater ordinance
 - Assisted with local adoption
-
- *Currently developing revisions to our SALDO*

Integrated Water Resources Plan

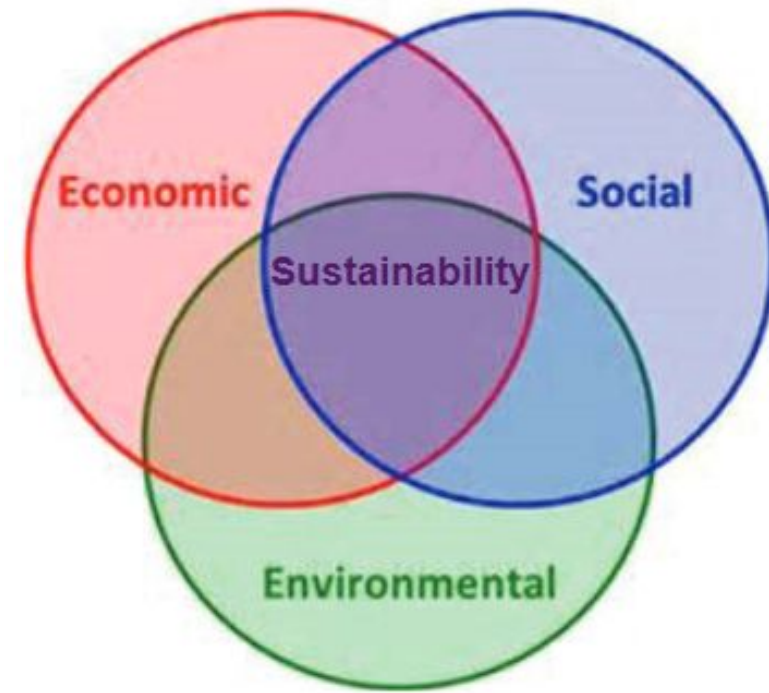
- Studies all types of water
- Addresses water-related issues and problems
- Provides a framework to solve water-related problems
- Useful to all county residents and municipal officials

Integrated Water Resources Plan

- Serves as the countywide Act 167 Plan (Stormwater Management Plan)
- Uses a flowchart tool to give water resource guidance
- Creates a ***model stormwater ordinance***
- Adopted in line with the county Comprehensive Plan

Four Goals of Our Integrated Water Resources Plan

1. Advance sustainable water resources
2. Encourage partnerships
3. Provide accessible information
4. Help meet regulatory mandates for water resources



IWRP First Steps

- Create a Watershed Plan Advisory Committee (WPAC) to guide the plan
- Consultant models selected watersheds where flooding or other water-related problems occur
- Data and information gathered by WCD staff and partners

Watershed Plan Advisory Committee





Westmoreland County

Integrated Water Resources Plan

Watershed Plan Advisory Committee

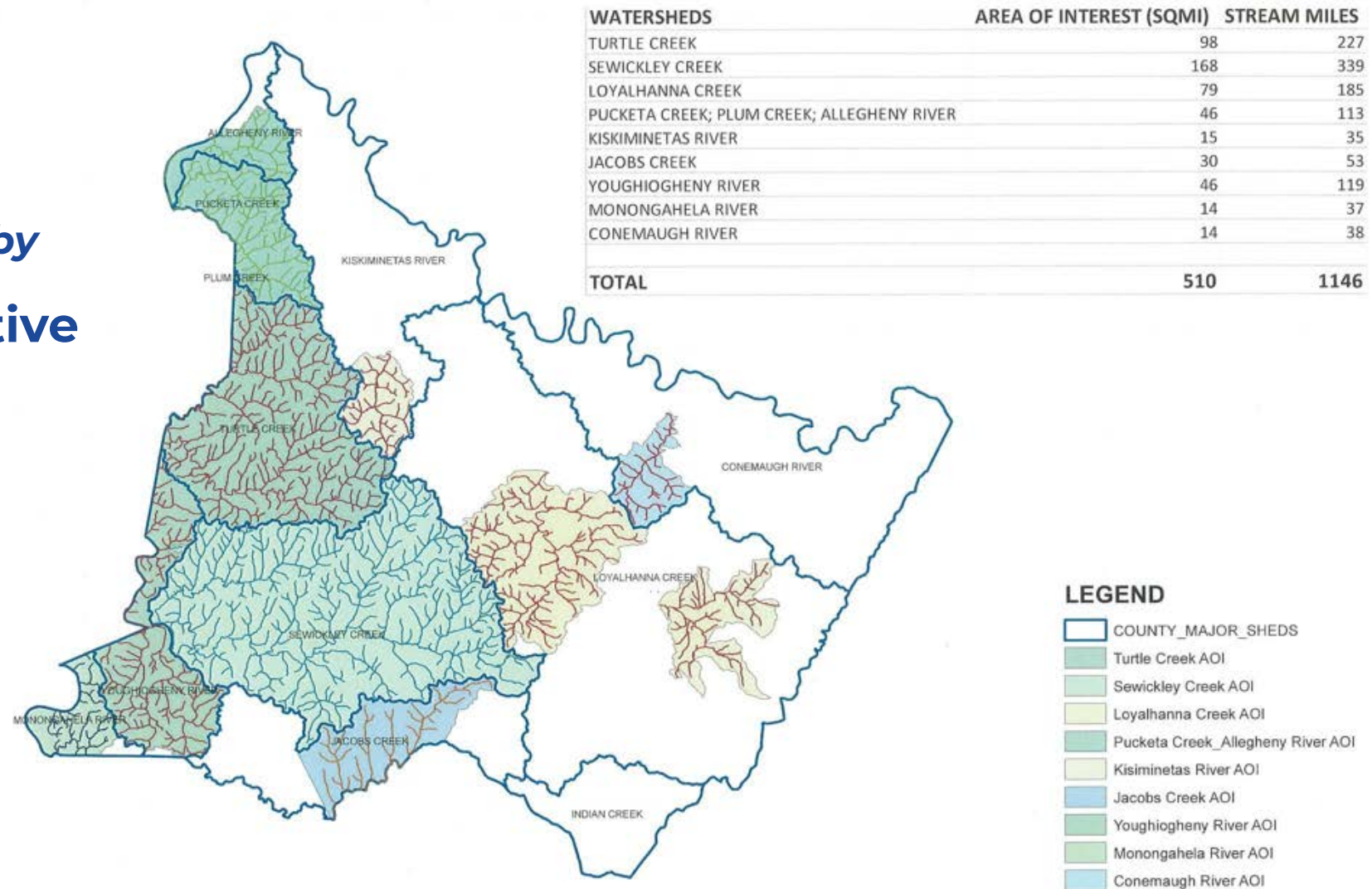


Meeting 1

- April 19, 1:00-3:00 PM
Westmoreland Conservation District
- April 19, 6:30-8:30 PM
Rostraver Township Municipal Building
- April 21, 6:30-8:30 PM
Ligonier Township Municipal Building
- April 28, 6:30-8:30 PM
Allegheny Township Municipal Building

Consultant Models Watersheds

Modeling provided by
**Ethos Collaborative
of Pittsburgh**

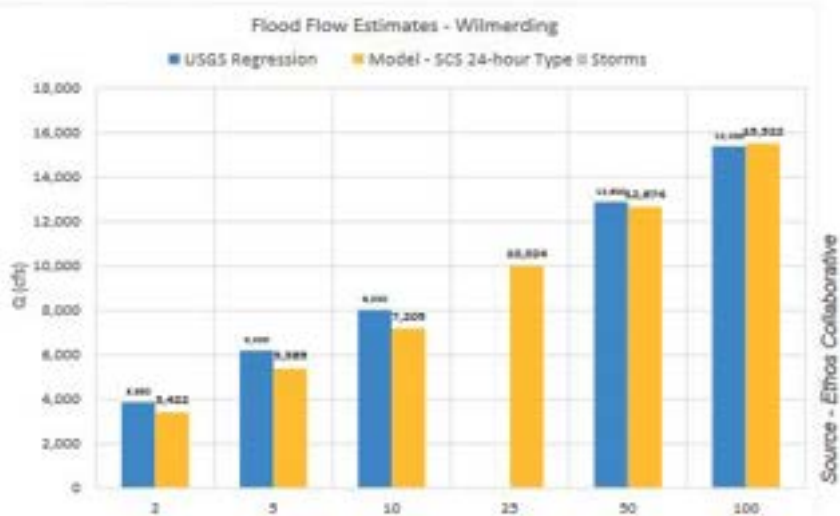


Consultant's work was to accurately model storm flow in streams

CALIBRATION AND VALIDATION:

Comparison between modeled discharge and measured discharge for design storms

The availability of USGS discharge measurements for the Turtle Creek gage at Wilmerding provided solid data to calibrate and validate the HEC-HMS models. Below, modeled versus measured discharge (CFS) for 2, 5, 10, 25, 50, and 100 year storm events provide evidence that the model estimates large flows well, when compared to measured large flows.



Turtle Creek

STATISTICAL COMPARISON:

Model Results versus Gage Results for Specific Storm Events

Statistical evaluation of individual storms allowed us to quantify the degree of difference between model results and measured data.

- **Pearson's Correlation Coefficient (r)** measures the strength of a relationship between two variables. The "r" values shown below indicate a very strong positive relationship between modeled and measured discharge values.
- **Percent Bias (PBIAS)** calculates the difference between the mean (average) of the model versus the gage data. In general, it provides an estimate of how the model over or under predicts the actual data.
- **Nash-Sutcliffe efficiency (NSE)**, assess model accuracy, where the closer the NSE is to 1, the closer the model is to actual data. In the chart below, the calculated NSE ranges from 0.97 to 0.40.

Event	Pearson's Correlation Coefficient (r)	Percent Bias (PBIAS)	Nash-Sutcliffe efficiency (NSE)
Ivan 2004	0.99	-4%	0.97
June 2013	0.98	0%	0.95
July 2013	0.97	-28%	0.88
Sandy 2012	0.93	8%	0.87
August 2007	0.93	3%	0.85
January 2005	0.99	0%	0.98
January 2013	0.95	-15%	0.88
December 2008	0.95	-10%	0.85
November-December 2010	0.99	59%	0.40
December 2012	0.95	-5%	0.90

Source - Ethos Collaborative

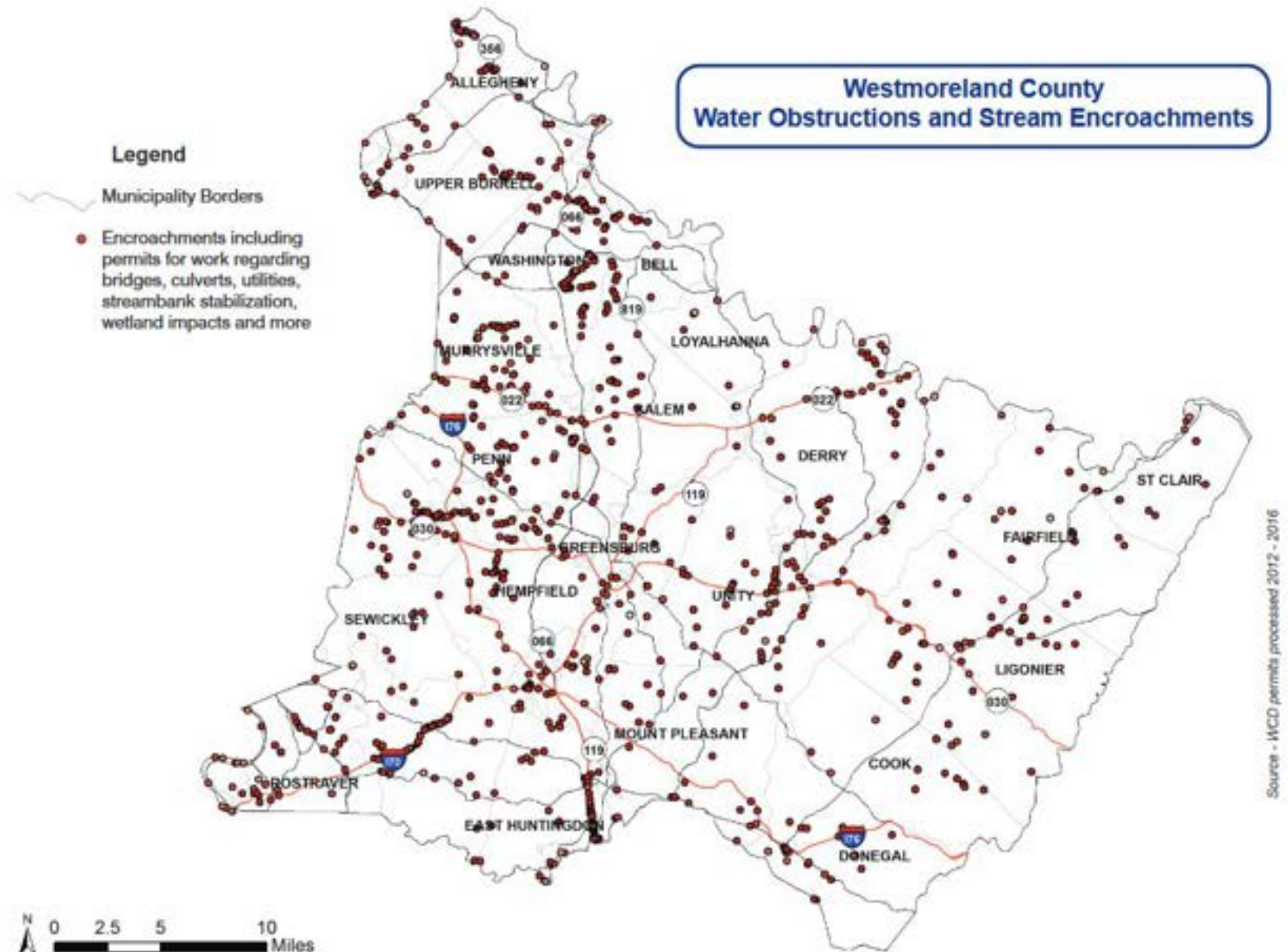
When combined with the actual storm hydrographs (right), these statistical parameters help to define the degree to which HEC-HMS over or under-predicts the data. For example, the hydrograph for the July 2013 storm (right) shows that the blue modeled data line is largely under the red gage line. The "r" value for this storm indicates good correlation between the data. The Percent Bias of -28% indicates that the model is under predicting, and the NSE is 0.88, again suggesting overall that the model achieves a good degree of accuracy.

Obtain Science-Based Data

*Using
our
own
staff*



*Gather
in-house
data
and
information*



*Gather
in-house
data
and
information*

Legend

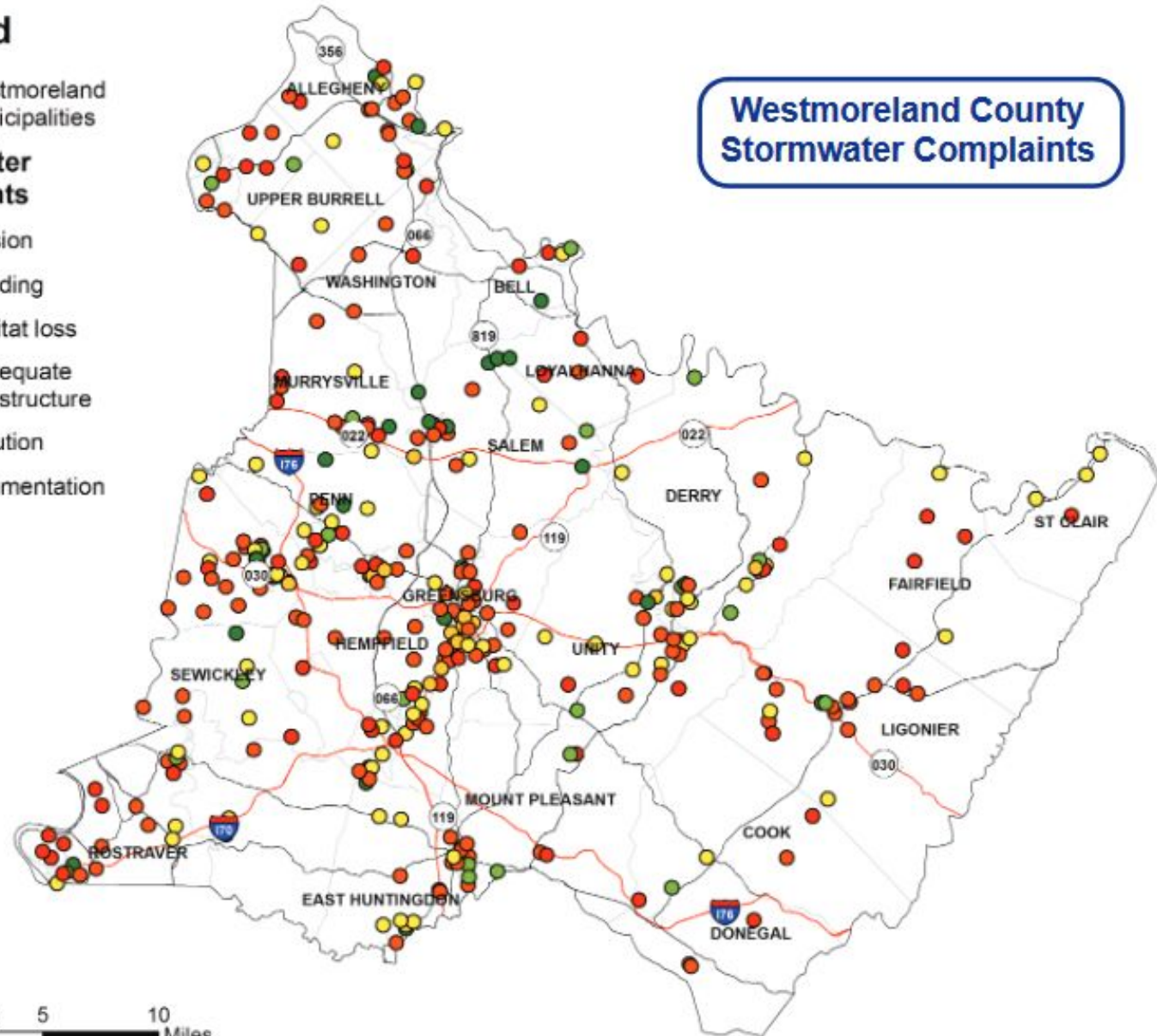
Westmoreland
Municipalities

Stormwater Complaints

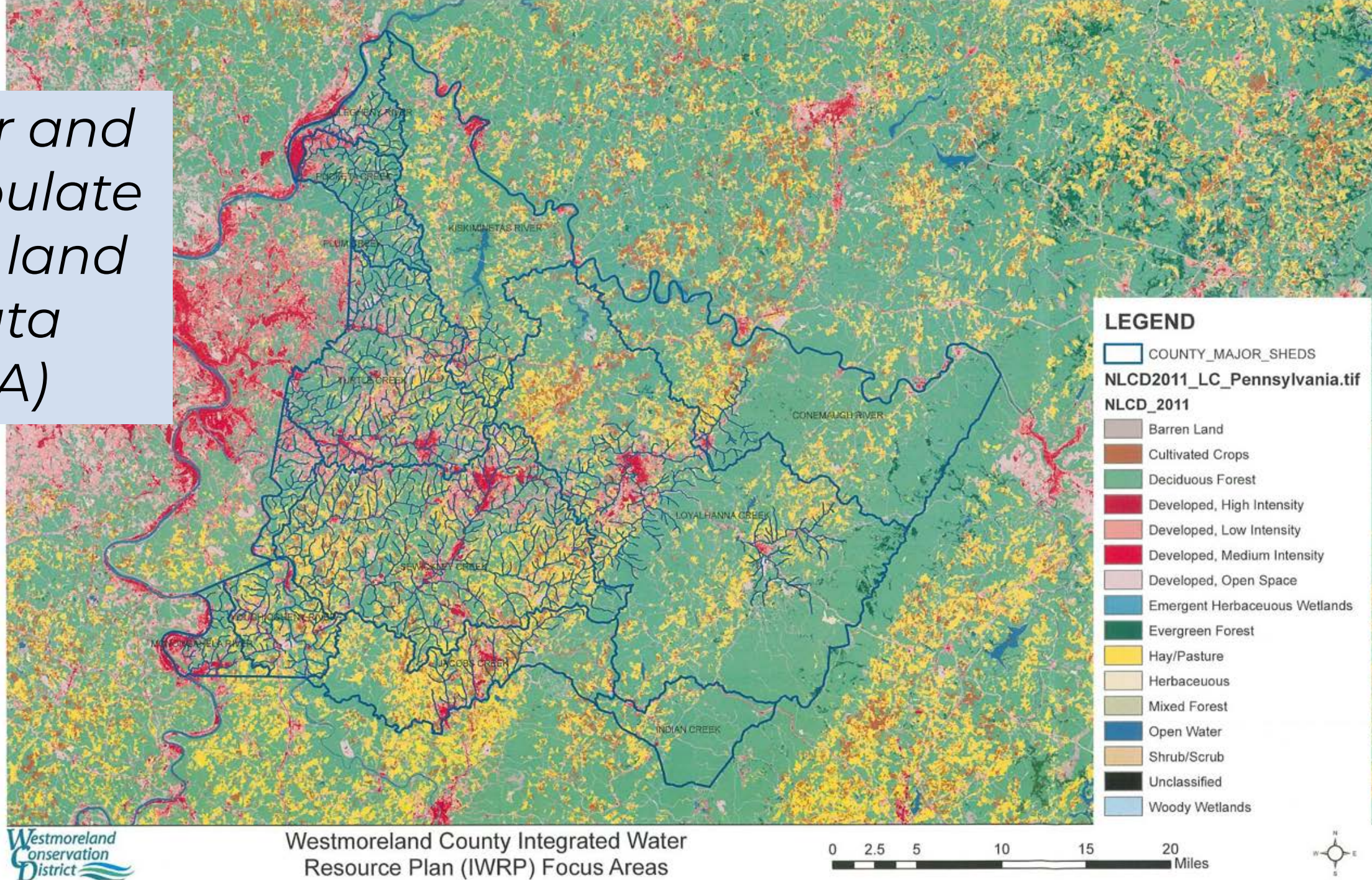
- Erosion
- Flooding
- Habitat loss
- Inadequate infrastructure
- Pollution
- Sedimentation

Westmoreland County Stormwater Complaints

N 0 2.5 5 10 Miles

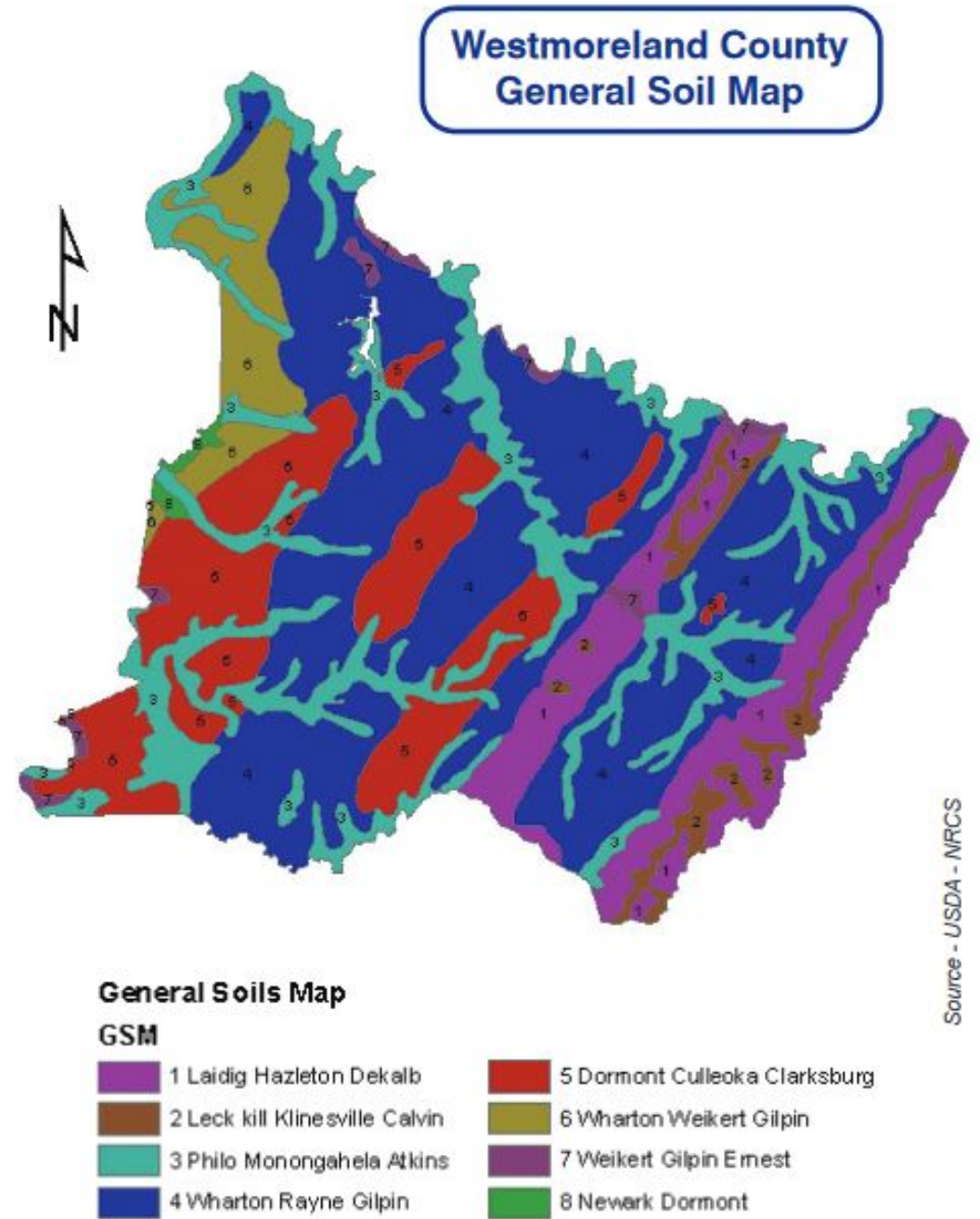


*Gather and
manipulate
public land
use data
(PASDA)*



WCD Staff, Consultant, and WPAC

- Meetings
- Data gathering
- **Meetings**
- Calculations
- ***Meetings***
- Writing
- **Meetings**



So What Did We Come Up With?

A
Comprehensive
Plan
for Water
Resources



WESTMORELAND COUNTY'S **Integrated Water Resources Plan**



For more information contact:



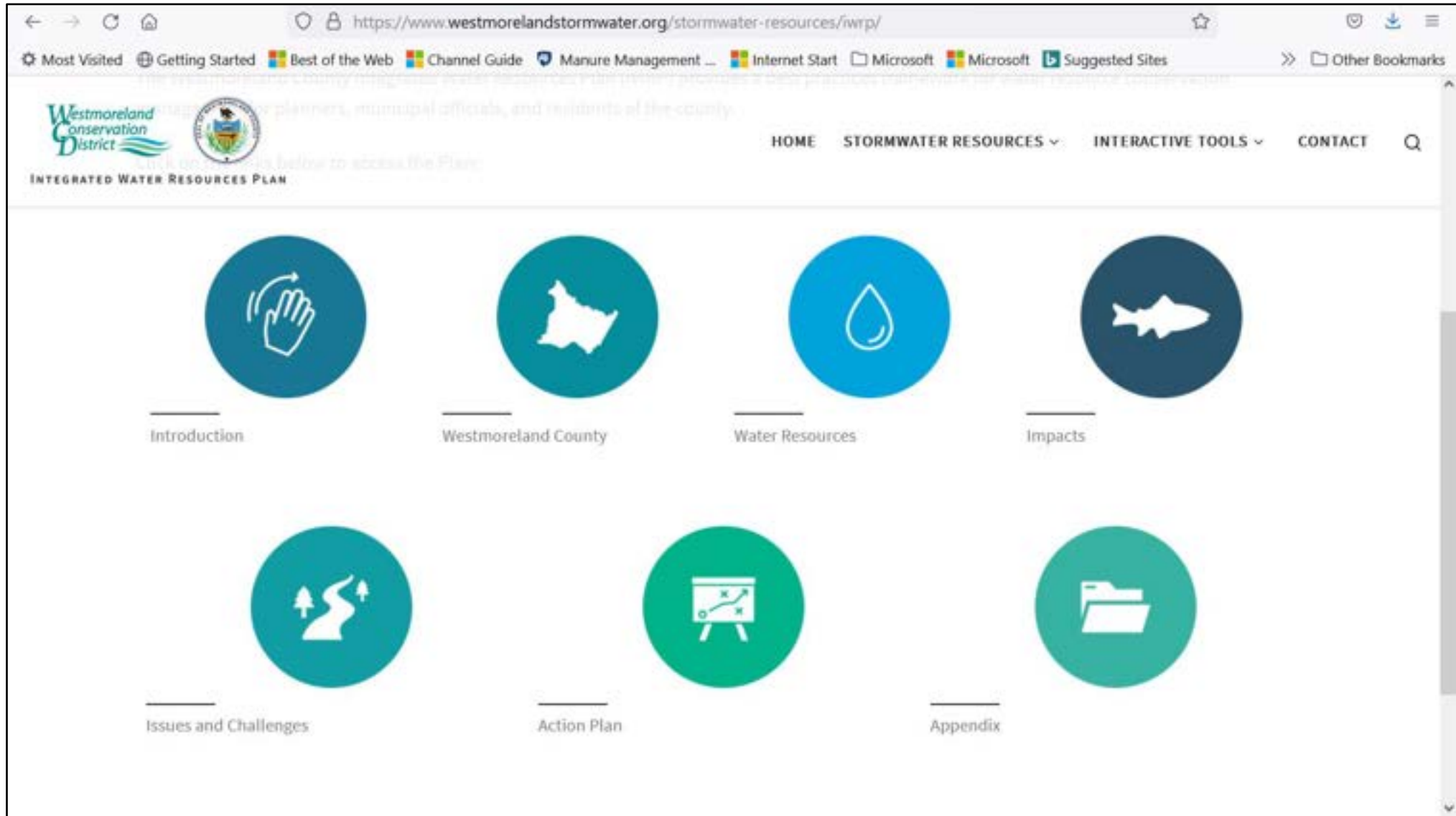
218 Donohoe Road • Greensburg, PA 15601 • 724-837-5271
www.westmorelandstormwater.org email: waterplan@wcdpa.com

What's in the IWRP

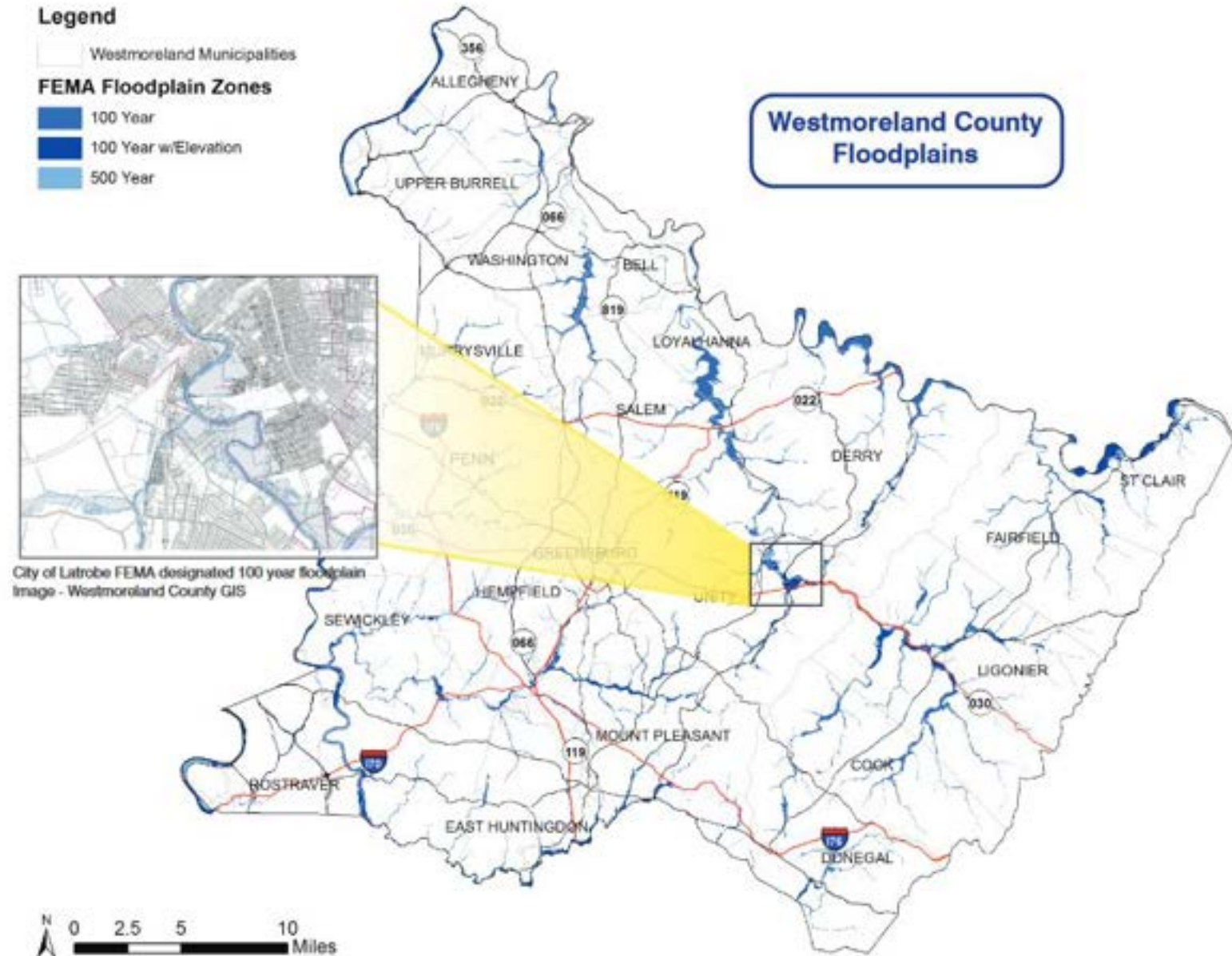
- Resources for municipalities, citizens, farmers, developers, and others who interact with our county's water
- Model ordinances for municipal adoption
- Identification and prioritization of project areas
- Promotion of green infrastructure as a way of solving stormwater problems

www.westmorelandstormwater.org

Westmoreland County Integrated Water Resources Plan



IWRP
contains
maps, data,
information,
e-library,
links, etc.



IWRP
describes
water-related
problems in
both **practical**
and **technical**
terms

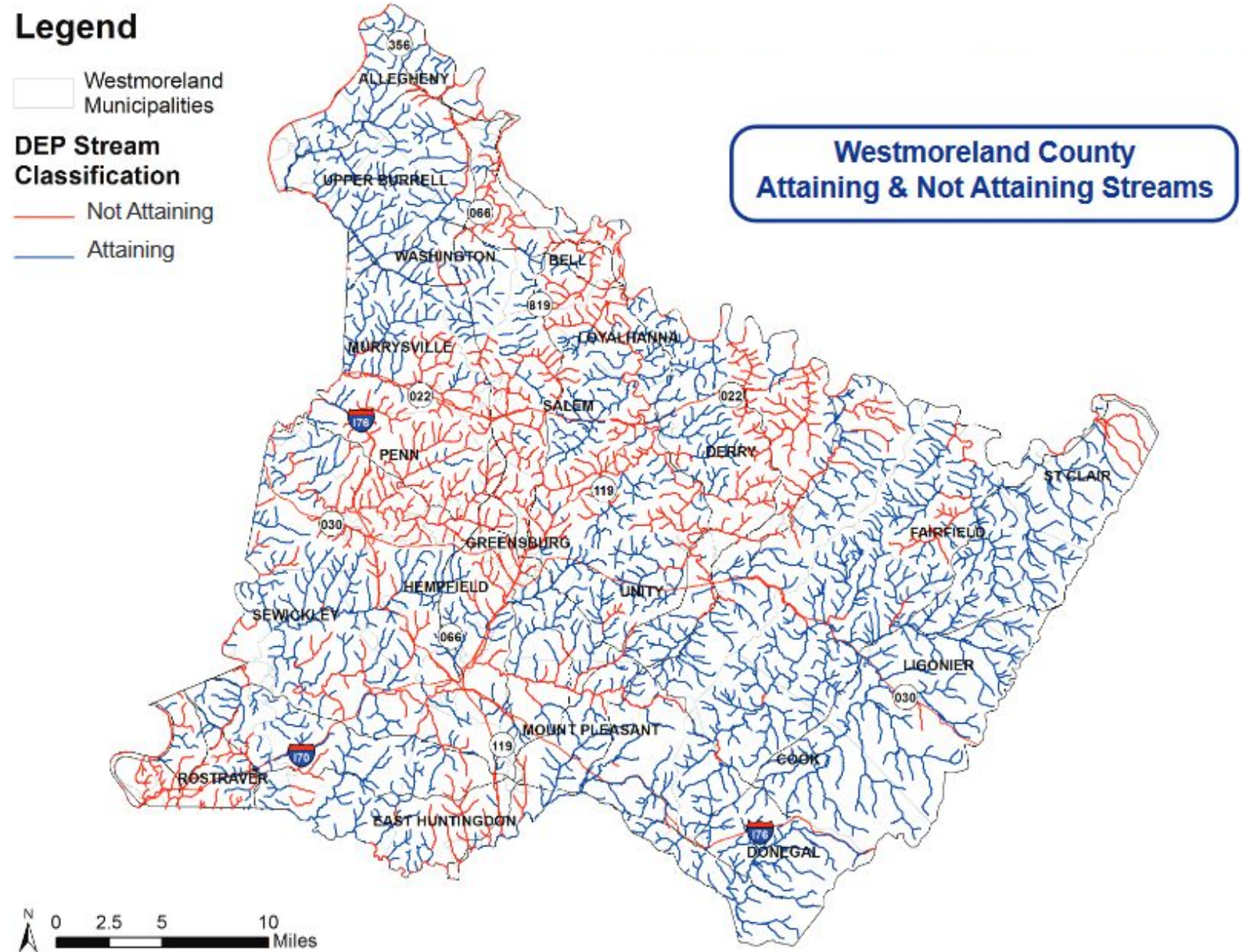
Legend

Westmoreland
Municipalities

DEP Stream Classification

Not Attaining

Attaining



Hydromodification – A Common Water Problem in Westmoreland County



Source - North Huntingdon Township

North Huntingdon Township hydromodification map

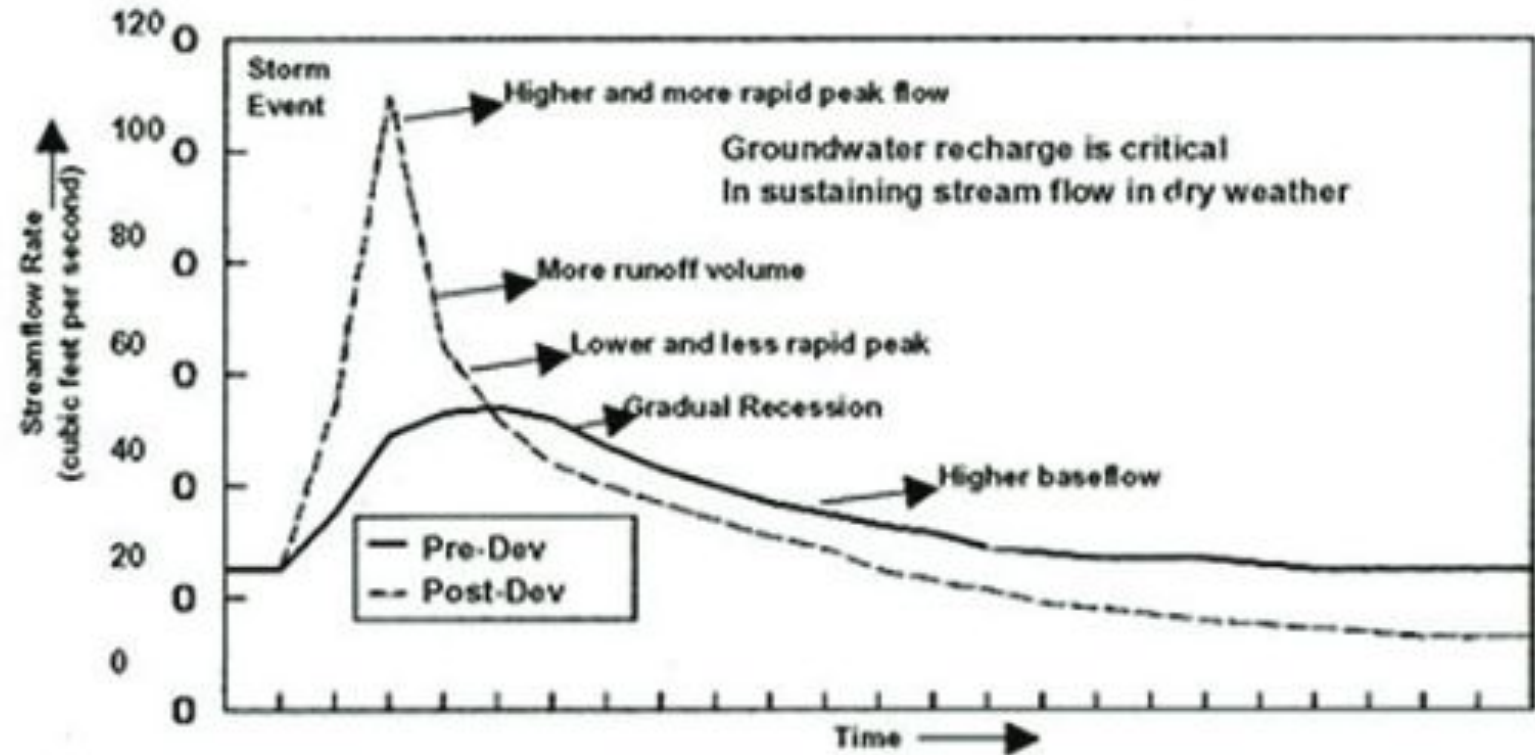


Photo by Alyssa Harden

Hydromodification: What's natural about this stream? Jack's Run in Southwest Greensburg

Land development increases the peak flow rate and decreases baseflow

Pre- and Post-Development Hydrographs



Increases in impervious surface often decrease the amount of infiltration. Without infiltration, groundwater recharge rates will be reduced, and the stream base-flows will not be sustained at natural levels.

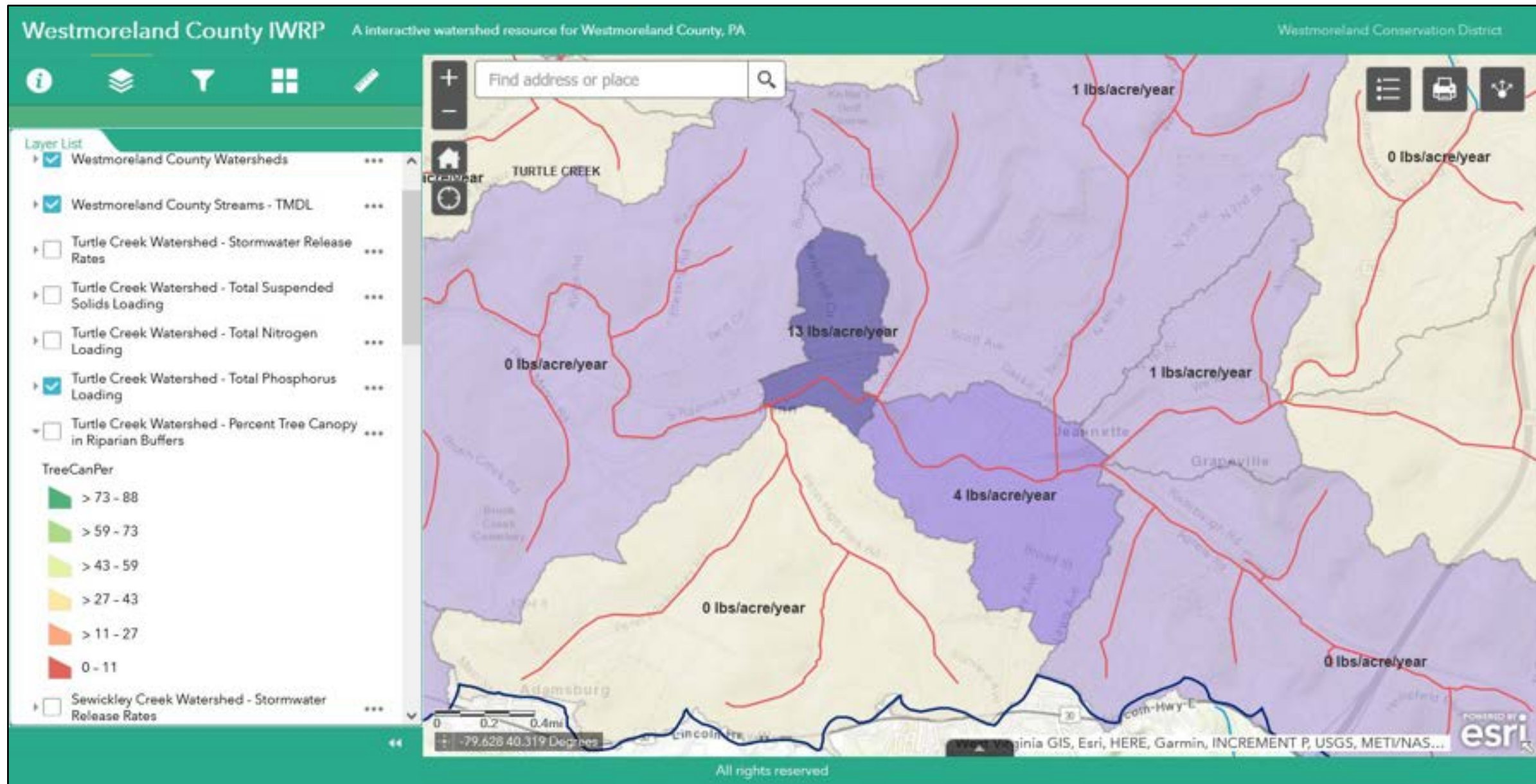
Loss of
baseflow
in an
urbanized
stream



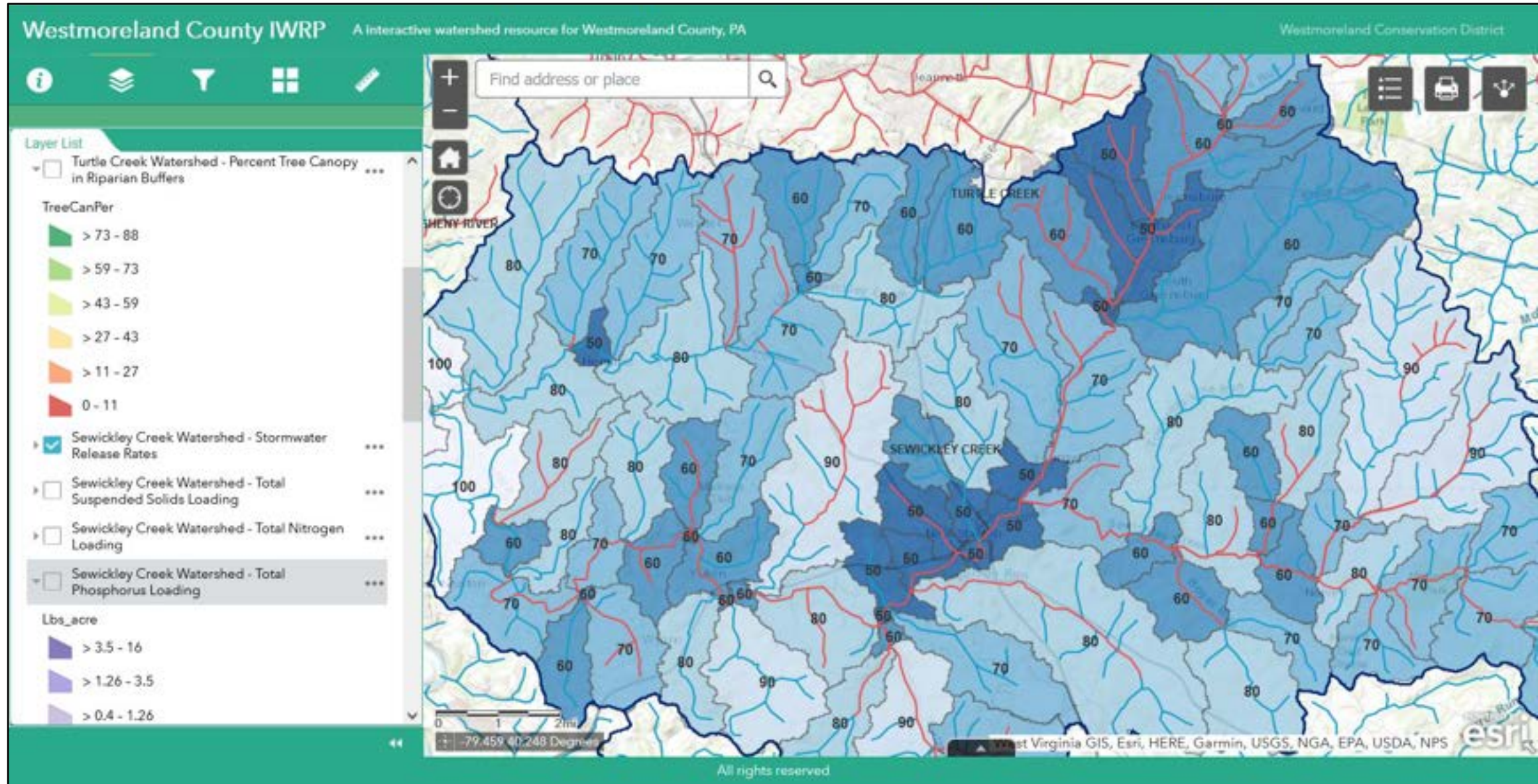
IWRP provides technical design information for engineers and developers



Interactive maps provide technical design information for engineers and developers



Numerical standards provide for regulatory and design use



IWRP provides information on potential projects



Westmoreland County IWRP

A interactive watershed resource for Westmoreland County, PA

Westmoreland Conservation District



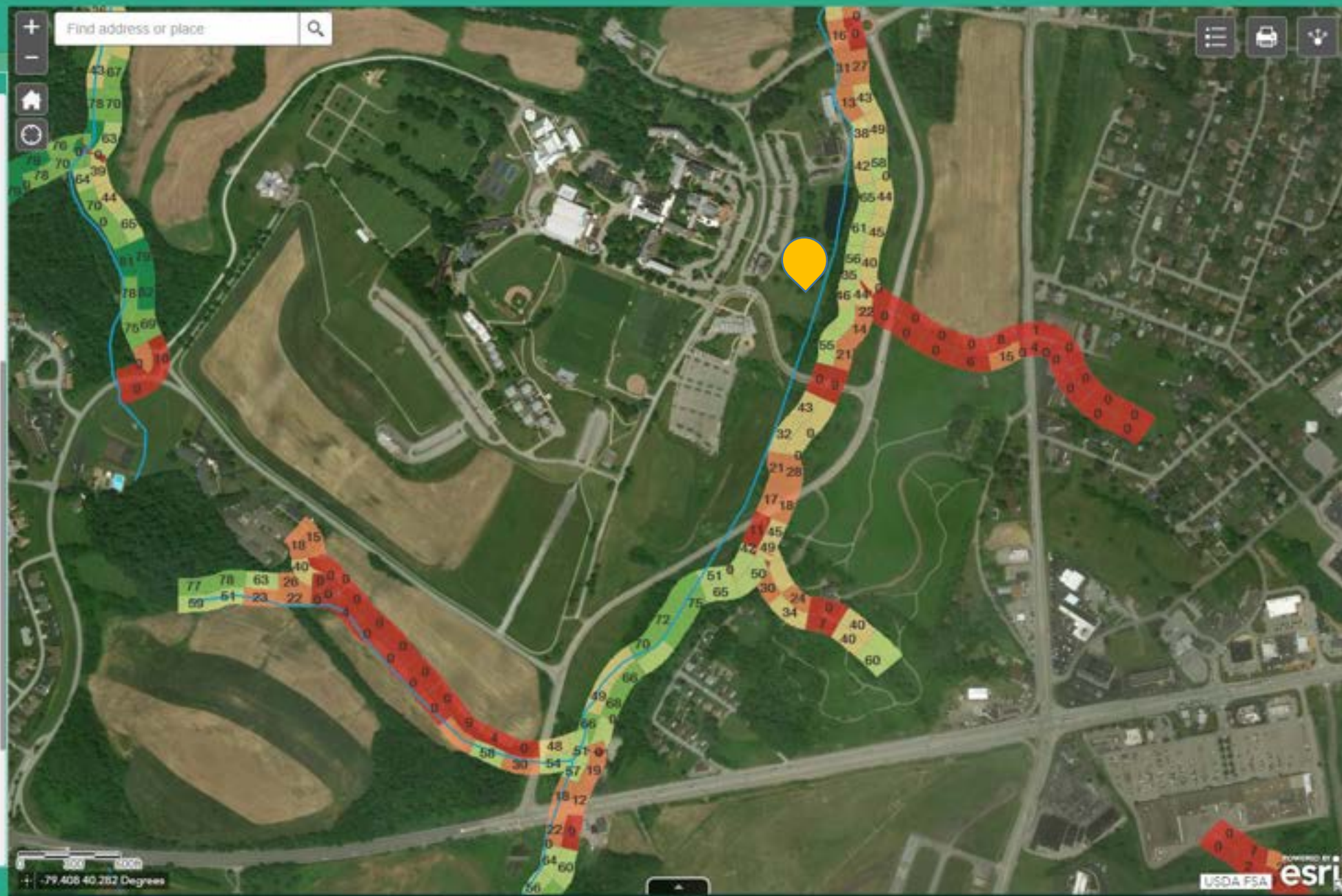
Layer List

- ☐ Loyalhenna Creek Watershed - Total Suspended Solids Loading ...
- ☐ Loyalhenna Creek Watershed - Total Nitrogen Loading ...
- ☐ Loyalhenna Creek Watershed - Total Phosphorus Loading ...
- ☒ Loyalhenna Creek Watershed - Percent Tree Canopy in Riparian Buffers ...

TreeCanPer

- > 78 - 91
- > 65 - 78
- > 49 - 65
- > 31 - 49
- > 11 - 31
- 0 - 11

- ☐ Kiskiminetas Watershed - Stormwater Release Rates ...
- ☐ Kiskiminetas River Watershed - Total Suspended Solids Loading ...
- ☐ Kiskiminetas River Watershed - Total Nitrogen Loading ...
- ☐ Kiskiminetas River Watershed - Total Phosphorus Loading ...
- ☐ Kiskiminetas River Watershed - Percent Tree Canopy in Riparian Buffers ...
- ☐ Conemaugh River Watershed - Stormwater Release Rates ...
- ☐ Conemaugh River Watershed - Total Suspended Solids Loading ...
- ☐ Conemaugh River Watershed - Total Nitrogen Loading ...
- ☐ Conemaugh River Watershed - Total Phosphorus Loading ...
- ☐ Conemaugh River Watershed - Percent Tree Canopy in Riparian Buffers ...

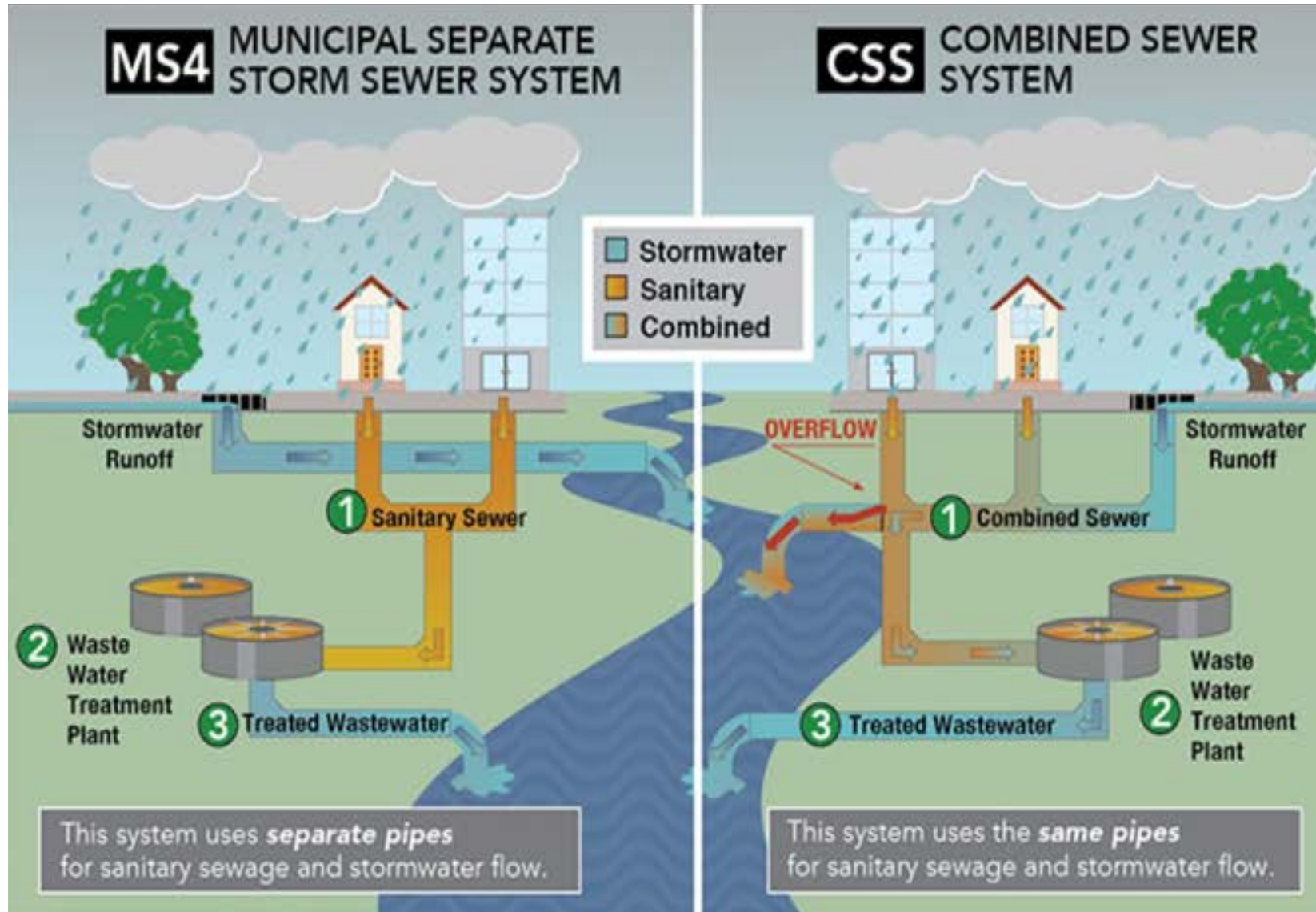


Statutory Authority for Municipal Regulation of Stormwater

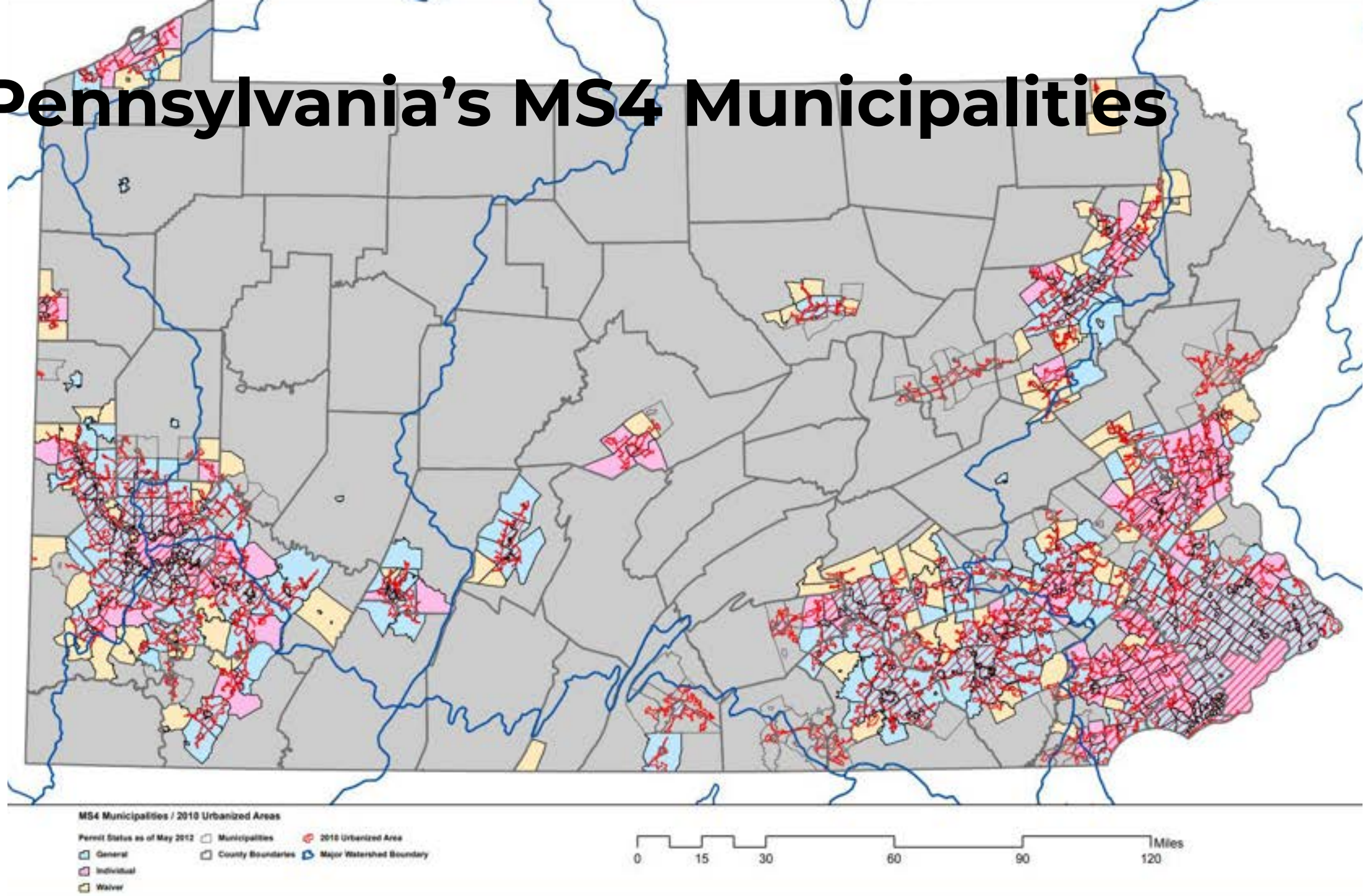
- The [Municipality] is empowered to regulate land use activities that affect stormwater runoff by the authority of
 - the Stormwater Management Act of October 4, 1978, P.L. 864 (Act 167), 32 P.S. Section 680.1, et seq., as amended,
 - and the Act of July 31, 1968, P.L. 805, No. 247, The Pennsylvania **Municipalities Planning Code**, as amended.
 - Other regulations such as MS4

**Westmoreland County has 65 municipalities!
And 65 different ways of managing
(or not managing) stormwater**

How Are Municipalities Involved in Stormwater Management?



Pennsylvania's MS4 Municipalities



Stormwater Management Ordinance

- Required by PA Act 167 of 1978, the Stormwater Management Act
- *County must create and adopt a **stormwater plan***
- *Municipalities must adopt a **stormwater ordinance***



Patriot-News, Governor Milton Shapp

Source of the New SWM Ordinance

- DEP's model ordinance (2022)
- Other DEP model ordinances
- Allegheny County's Act 167 Plan & ordinance
- Salisbury Township, Lancaster County
- Input from WCD Technical Advisory Committee
- Input from attorneys Les Mlakar and John Campfield

WESTMORELAND COUNTY MODEL STORMWATER MANAGEMENT ORDINANCE

Implementing the Requirements of the Westmoreland County Stormwater Management / Integrated Water Resources Plan

The following Model Ordinance is based on the PA DEP 2022 MODEL STORMWATER MANAGEMENT ORDINANCE (5/2016), and was created as part of the Westmoreland County Integrated Water Resources Plan 2020. Its creation was guided by the Watershed Planning Advisory Committee, the Westmoreland Conservation District, the Westmoreland County Department of Planning and Development; approved by the PA DEP February 4, 2020; and formally adopted by the Westmoreland County Commissioners by Resolution June 4, 2020.

The Pennsylvania Storm Water Management Act (Act 167 of 1978) requires municipalities to “adopt or amend, and shall implement such ordinances and regulations, including zoning, subdivision and development, building code, and erosion and sedimentation ordinances, as are necessary to regulate development within the Municipality in a manner consistent with the applicable watershed stormwater plan and the provisions of this act”. **It is expected that by December 31, 2020, each of Westmoreland County's municipalities will adopt a stormwater management ordinance consistent with the principles and standards contained in this Model Stormwater Ordinance.**

Federal regulations at 40 CFR § 122.34 require the use of ordinances by small MS4s to address 1) the prohibition of unauthorized non-stormwater discharges (MCM #3), 2) erosion and sediment controls for construction activities involving earth disturbances of one acre or more (or disturbances less than one acre if the construction activity is part of a larger common plan of development or sale that would disturb one acre or more) (MCM #4), and 3) post-construction stormwater management for new development and redevelopment projects (MCM #5). It is expected that MS4 municipalities will update existing ordinances to comply with the requirements of the MS4 program or, at a minimum, enact the DEP 2022 model ordinance by September 30, 2022.

DEP is directed under Act 167 to develop a model stormwater ordinance. DEP's intention in publishing the 2022 Model Stormwater Management Ordinance is that its use will satisfy both Act 167 requirements, and MS4 regulatory requirements.

- Model SWM Ordinance based on DEP models and other SWM ordinances found statewide
- Adopted by Westmoreland County Commissioners
- Accepted by PA DEP

§107.	Severability
§108.	Compatibility with Other Requirements.
§109.	Erroneous Permit
§110.	Prohibitions
§111.	Liability Disclaimer.

ARTICLE II Definitions.

§201.	Interpretations and word usage
§202.	Definitions of terms.

ARTICLE III Stormwater Management Performance Standards.

§301.	Stormwater Management Performance Districts.
§302.	General Requirements
§303.	Exemption from performance standards.
§304.	No-Harm Option
§305.	Waivers / Modifications / Demonstrated Equivalency
§306.	Small Project
§307.	General Standards
§308.	Watershed Standards
§309.	Design Criteria for Stormwater Management Facilities and BMPs
§310.	Erosion and Sedimentation Controls.
§311.	Water Obstructions and Encroachments

ARTICLE IV Stormwater Management Plan Requirements.

§401.	General Requirements.
§402.	Stormwater Management Plan Contents.
§403.	Other Permits/Approvals.
§404.	Operation and Maintenance Program
§405.	[Financial Guarantees]

Unique aspects of the Model Ordinance

- Flexible standards according to municipal needs
- Allows off-site mitigation for difficult sites
- WCD review for watershed-wide consistency

Stormwater Performance Districts

- Establish standards for design professionals
- Release Rate, Water Quality Standards
- For purposes of stormwater management, the [Municipality] is located in the following [Creek / River] Watershed(s), which includes the Stormwater Management Performance District(s) shown on the map entitled “_____”. The location and boundaries of the watershed(s) and performance district(s) are shown on a map entitled “_____”, which is hereby adopted as a portion of the Ordinance. For areas not covered by a stormwater performance district, the release rate shall be [“__”%] of the pre-development peak flow as set by the municipality.

Regulated Development Activity Table

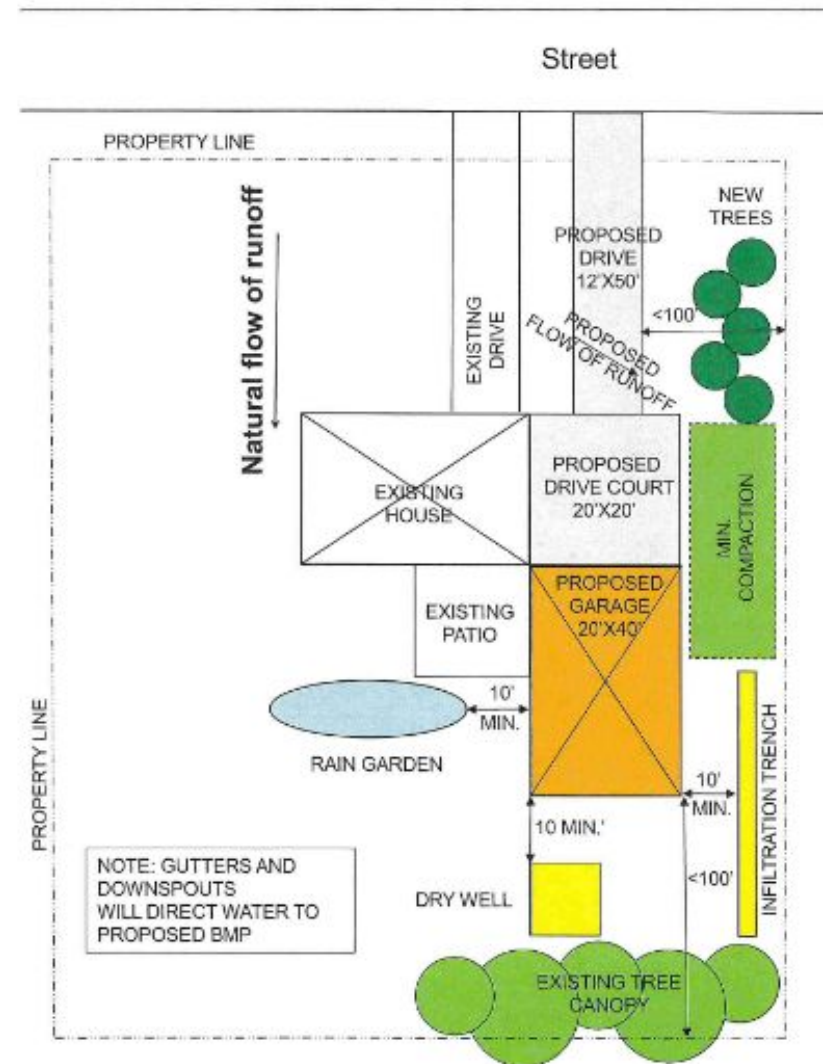
*Which projects
require
stormwater
management?*

SWM Plan Requirement	New Impervious Area for New and Redevelopment	Disturbed Area*	Next Steps
Exempt	0	Less than 1 acre	Comply with Exemption section of this ordinance
No-Harm	Up to [1,000] sf for urban [3,000] square feet for suburban/rural areas	Less than [3,000] sf urban [5,000] square feet for suburban / rural areas	Comply with No-Harm section of this ordinance
Waiver / Modification / Demonstrated Equivalency	Less than 1 acre, subject to municipal approval	Less than 1 acre	Comply with Waiver / Modification / Demonstrated Equivalency section of this ordinance
Small Project (per definition), refer to Appendix C	[1,000] [3,000] square feet to [10,000] square feet	[3,000] [5,000] square feet to [20,000] square feet	Submit Small Project Site Plan complete with all attachments
Stormwater Management Plan meeting the Ordinance requirements	Greater than [10,000] square feet if Exempt and Small Project criteria are not met, or if improvements do not meet No-Harm criteria	Greater than [20,000] square feet	Consult a qualified professional

Small Project provisions in the Model Ordinance to make it more friendly to a small site or residential renovation project

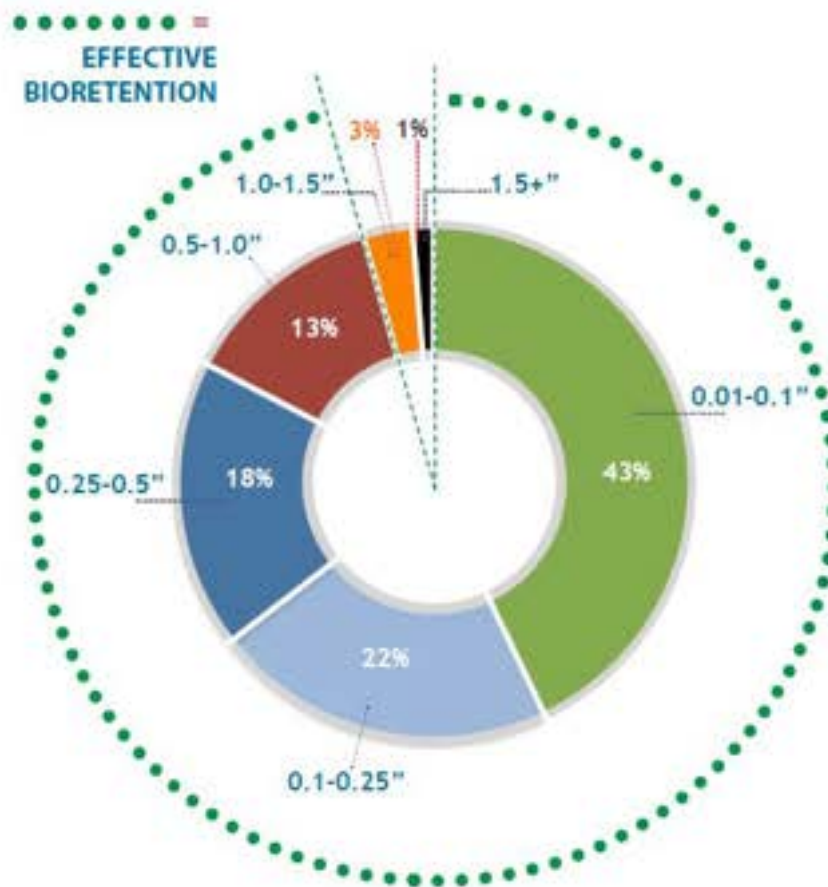
Small Project Sketch Plan: *Example*

Project Name: _____ Date: _____
Location: _____





PRECIPITATION: Rain Days in a Year



RAIN DAYS in an AVERAGE YEAR

The graphic to the left illustrates that the vast majority of annual precipitation we receive in Southwest Pennsylvania (39.5" average) is well below 1". In fact, 83% of all annual precipitation is 1/2" per day or less.

96% of all precipitation days fall into the design criteria for bioretention cells to manage 1" of stormwater in a 24-hour period—as specified in this Primer. Well-designed and well-maintained rain gardens with underdrains can readily manage inflows from larger, far more infrequent storms.

Precipitation Ranges (inches)	Average # Days per Year	Percent of RAIN Days per Year	Percent of Annual Precipitation
0.01 - 0.1	61	43%	7%
0.1 - 0.25	31	22%	13%
0.25 - 0.50	26	18%	24%
0.50 - 1.0	18	13%	31%
1.0 - 1.5	5	3%	13%
1.50+	2	1%	12%
	143	100%	100%

IF we control runoff from the small rain events less than 1/2", then we can control most of the runoff most of the time. Most non-point source pollution would be reduced most of the time too! By capturing and retaining the first 1/4" of runoff, we would solve many of the combined sewer overflows in the region.

Ordinance
focuses on green
stormwater
management







Projects That Illustrate Our Principles

- Vandergrift streetscape project
- Jeannette stream daylighting project
- Partners: Borough of Vandergrift, City of Jeannette
- Funders: PA DEP Growing Greener, Westmoreland IDC

Vandergrift's curving, tree-lined streets were designed by famed landscape architect Frederick Law Olmsted*



**but they had
no storm
sewers*

Vandergrift Streetscape Project



Photo by Kathy Hamilton

Street trees planted in a soil containment system beneath a permeable concrete sidewalk in Vandergrift, funded by PA DEP Growing Greener, 2010 .

Filling the cells with soil mix (sand, compost, topsoil)



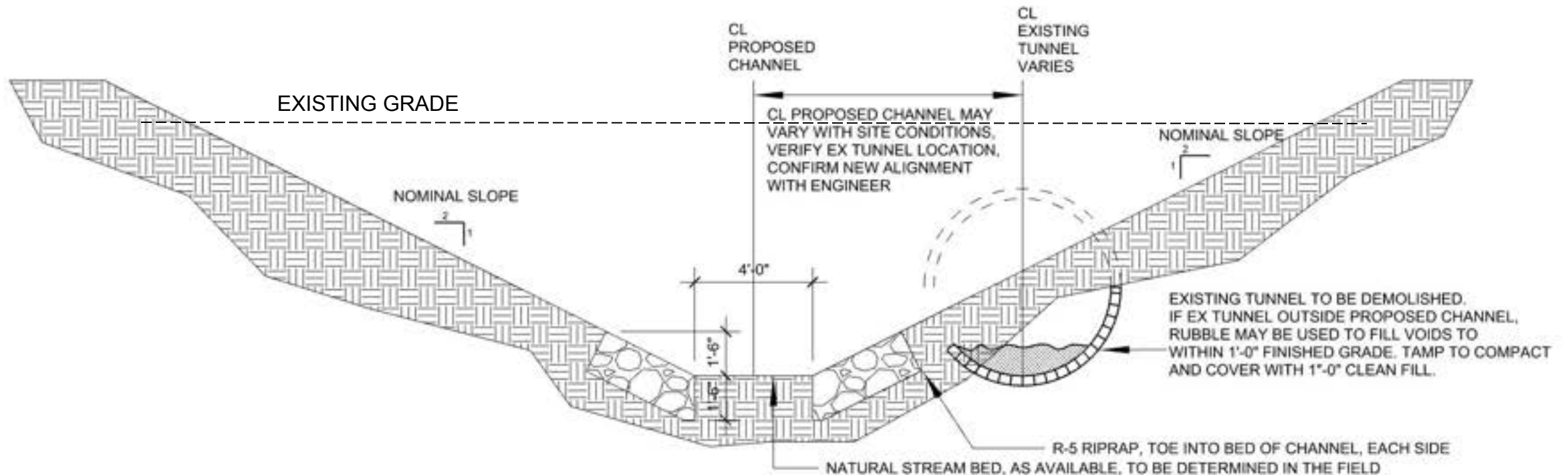
Workers placed permeable concrete on top of the crushed stone





What Is Daylighting?

Exposing (and restoring) some or all of a previously covered waterway



BROWNFIELD
SITE

APPROXIMATE LOCATION
OF EXISTING TUNNEL

EXISTING FLOOD CONTROL CHANNEL

Jeannette Stream Daylighting Project
EXISTING CONDITIONS



OPENING HEAD OF TUNNEL



SOIL AMENDMENTS / SLOPE STABILIZATION

July 8, 2020



Many Thanks to Our Project Partners



Stormwater Management Is Your Friend



Jim Pillsbury, PE

jim@wcdpa.com

Daniel Carpenter

dcarpen1@co.westmoreland.pa.us

www.westmorelandstormwater.org
www.westmorelandconservation.org