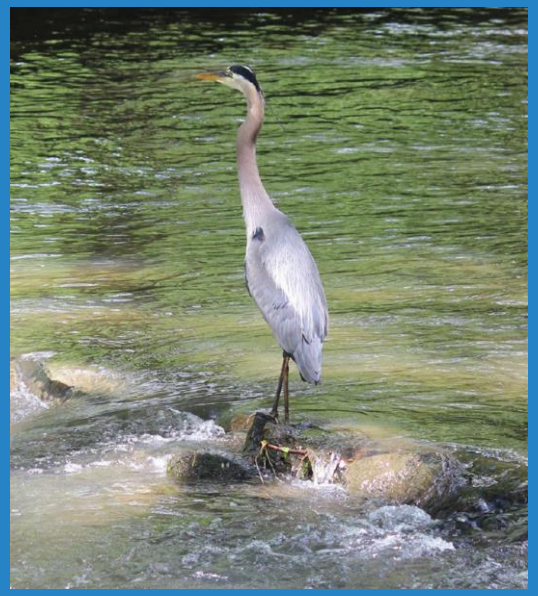
Lehigh Valley Watershed Assessment & Global Act 167 Model Ordinance Update

WorkshopLV – Water Meeting #2
August 15, 2024



WORKSHOPLV
WORKSHOP LEHIGH VALLEY
WATER

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Housekeeping

- Handouts
- Sign in Sheet
- Before leaving, please give parking ticket to Angela for validation
  - You will have 15 minutes to leave the lot after
- Certain expenses may be reimbursed by Pennsylvania Department of Environmental Protection (PA DEP)
  - Municipalities may submit applications for reimbursement of prior year activities
  - Recommend keeping track of your time spent on this effort
  - Contact PA DEP for further details or visit their Act 167 website and scroll down to find information on municipal reimbursement

Municipal reimbursement form

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Agenda

- Welcome and Introductions
- Meeting Objectives
- Re-cap of Meeting #1
- Land Use/Land Cover Changes in the Lehigh Valley
- Review of Watershed Modeling Approaches
- Problem Areas Discussion/Exercise
- Discuss Ordinance Components
- Municipal Survey Introduction
- Meeting Wrap-up, Next Steps and Questions

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MEETING OBJECTIVES

- Increase Understanding of the Stormwater Modeling Process
- Understand Data Needs and critical role of municipalities
- Discuss Possible Ordinance Changes/Update Considerations
- Introduce and Review Municipal Survey Questions and Timeline

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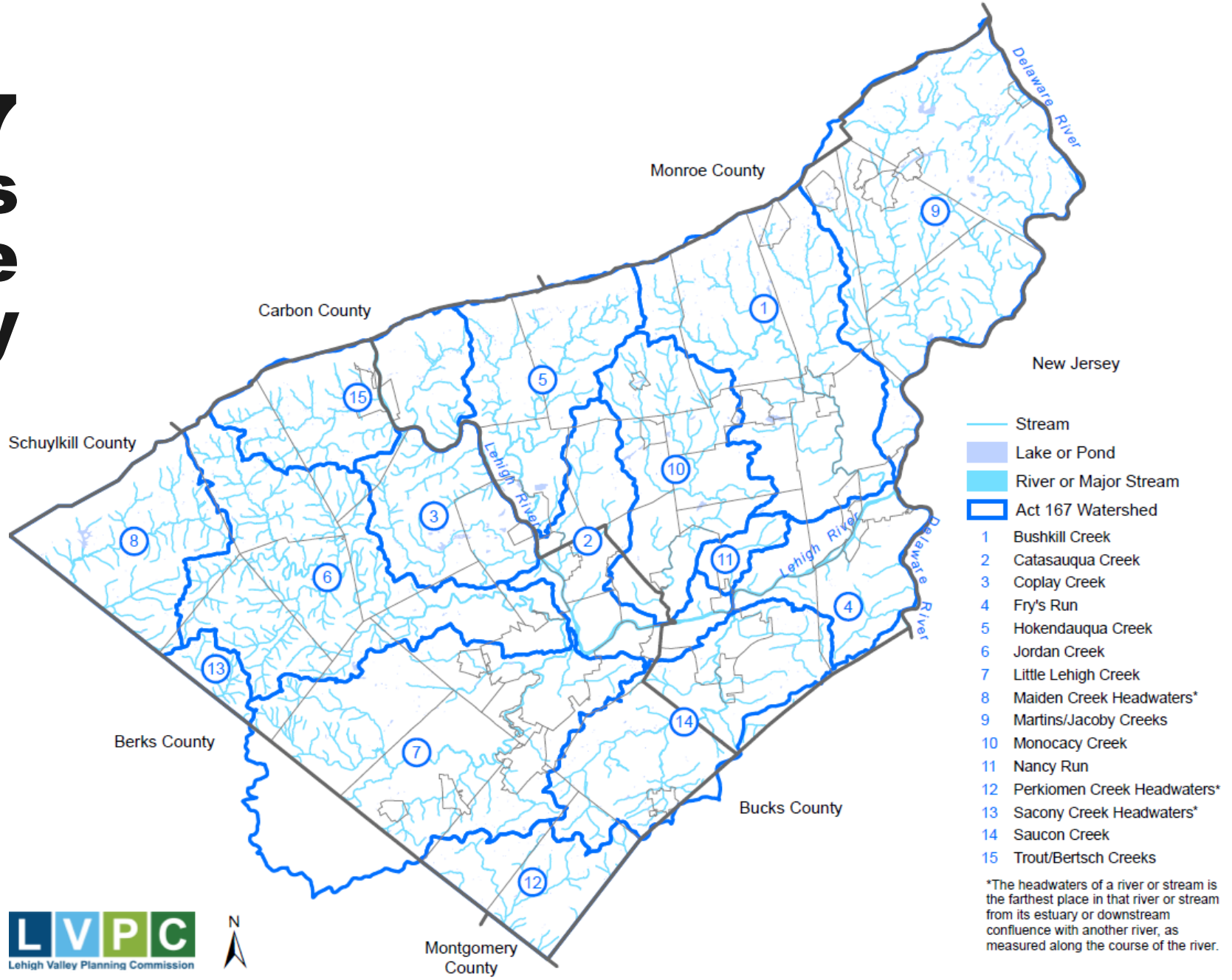
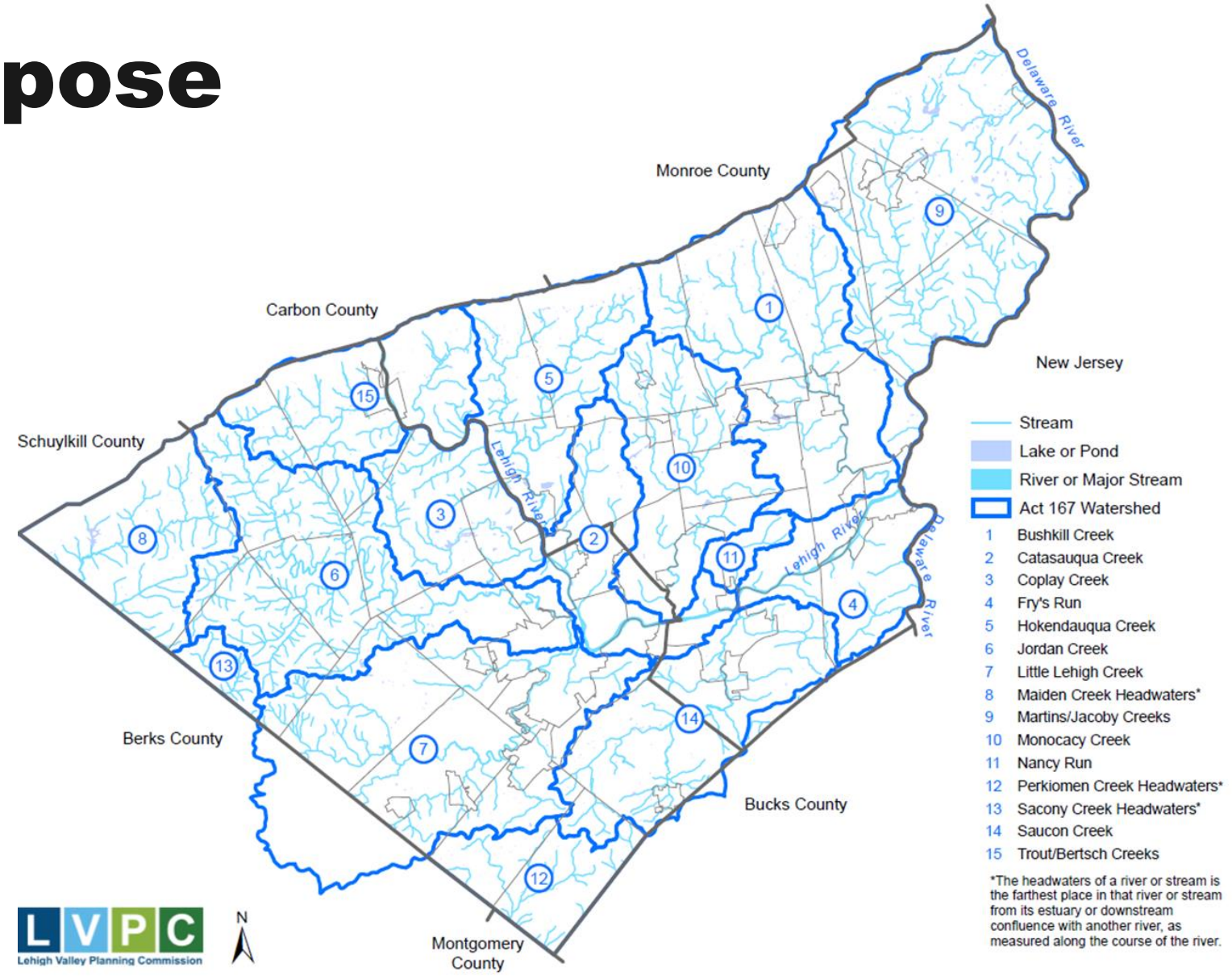
Act 167 Watersheds Of The Lehigh Valley



Re-Cap – Purpose

- Create consistent, up-to-date stormwater ordinance
- Coordinate with all 62 municipalities, county conservation districts, equity communities, interested groups and PA DEP
- Update hydrologic analysis to re-evaluate the runoff control standards
- Establish baseline water quality analysis for all 15 watersheds for MS4 considerations



Re-Cap

Why Now?

ACT 167 Stormwater Management Plan Lehigh and Northampton Counties			
	Watershed	**Last Full Update: Hydrology and Ordinance**	**Ordinance Only Update for Water Quality**
1	Bushkill Creek Watershed	1992	2006
2	Catasauqua Creek Watershed + Lehigh River Subbasin 4	1997	2006
3	Coplay Creek Watershed + Lehigh River Sub-basin 2	1994	2006
4	Fry's Run - Delaware River Sub-basin 2 + Lehigh River Sub-basin 5	1999	2006
5	Hokendauqua Creek Watershed + Lehigh River Sub-basin 3	1997	2006
6	Jordan Creek Watershed	1992	2006
7	Little Lehigh Creek Watershed	1999	2005
8	Maiden Creek Headwaters	2010	
9	Martins/Jacoby Creeks Watershed + Delaware River Subbasin 1	1996	2006
10	Monocacy Creek Watershed	2018	
11	Nancy Run Watershed	1989	2006
12	Perkiomen Creek Headwaters	2009	
13	Sacony Creek Headwaters	2010	
14	Saucon Creek Watershed	1991	2006
15	Trout/Bertsch Creeks Watershed + Lehigh River Subbasin 1	1995	2006

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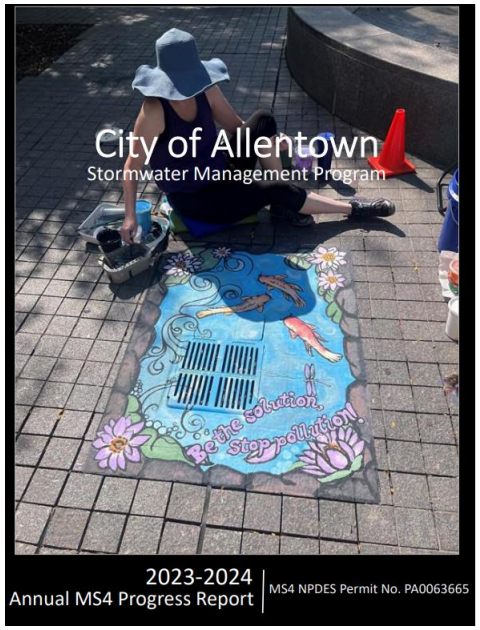
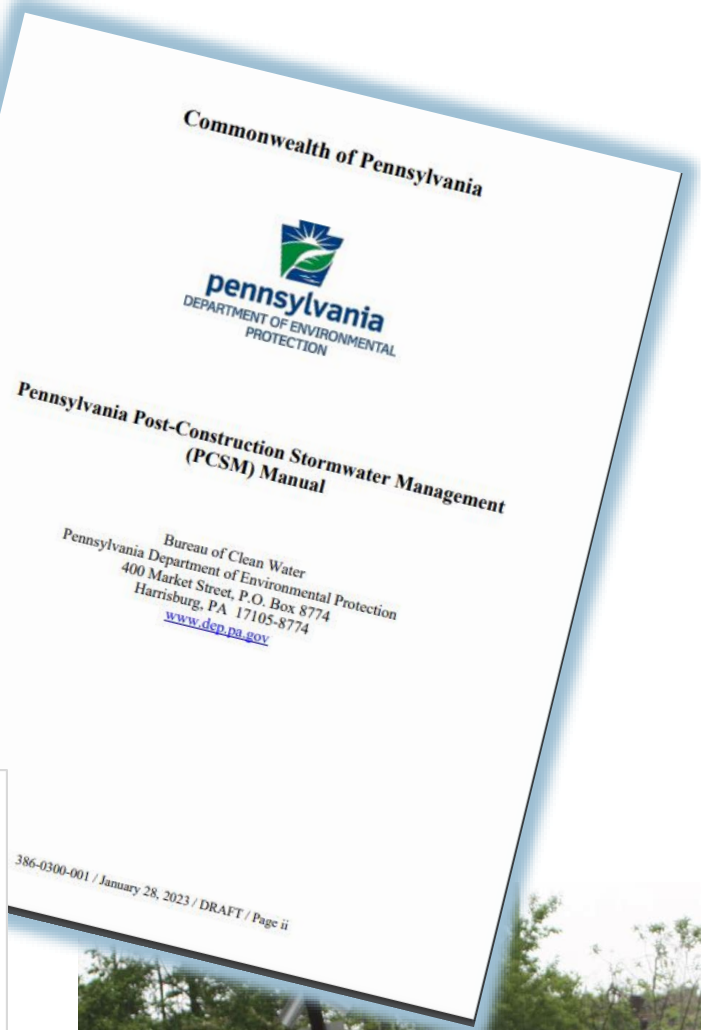
Re-Cap

Why Participate?



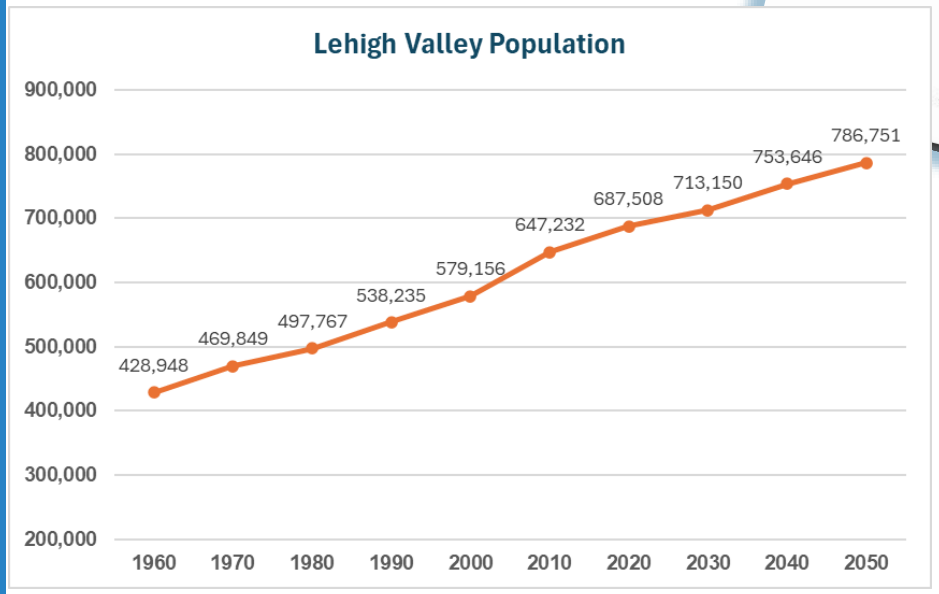

Commonwealth of Pennsylvania

pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION

Pennsylvania Post-Construction Stormwater Management (PCSM) Manual

Bureau of Clean Water
Pennsylvania Department of Environmental Protection
400 Market Street, P.O. Box 8774
Harrisburg, PA 17105-8774
www.dep.pa.gov

386-0300-001 / January 28, 2023 / DRAFT / Page ii



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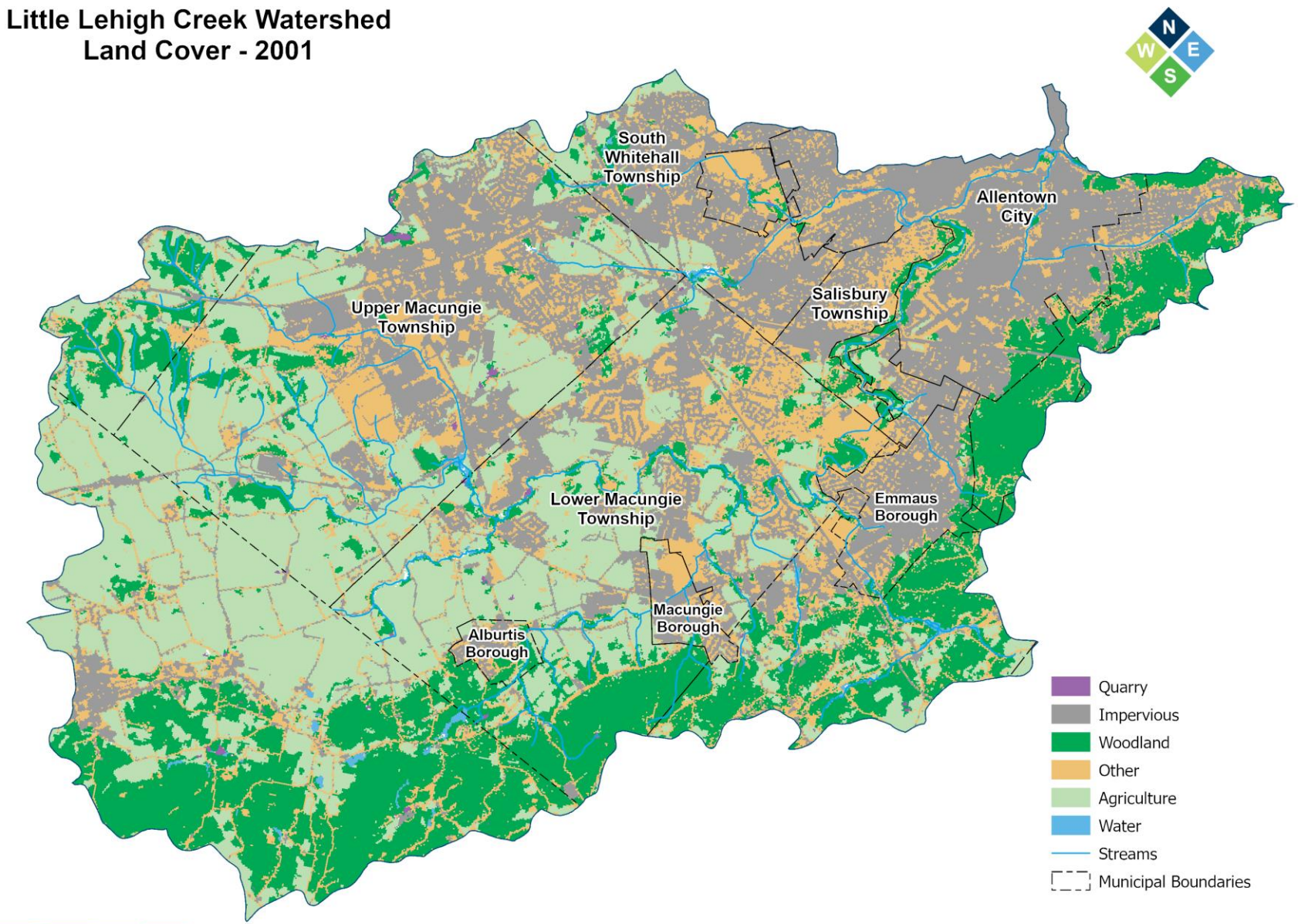
LAND USE/LAND COVER CHANGES OVER TIME



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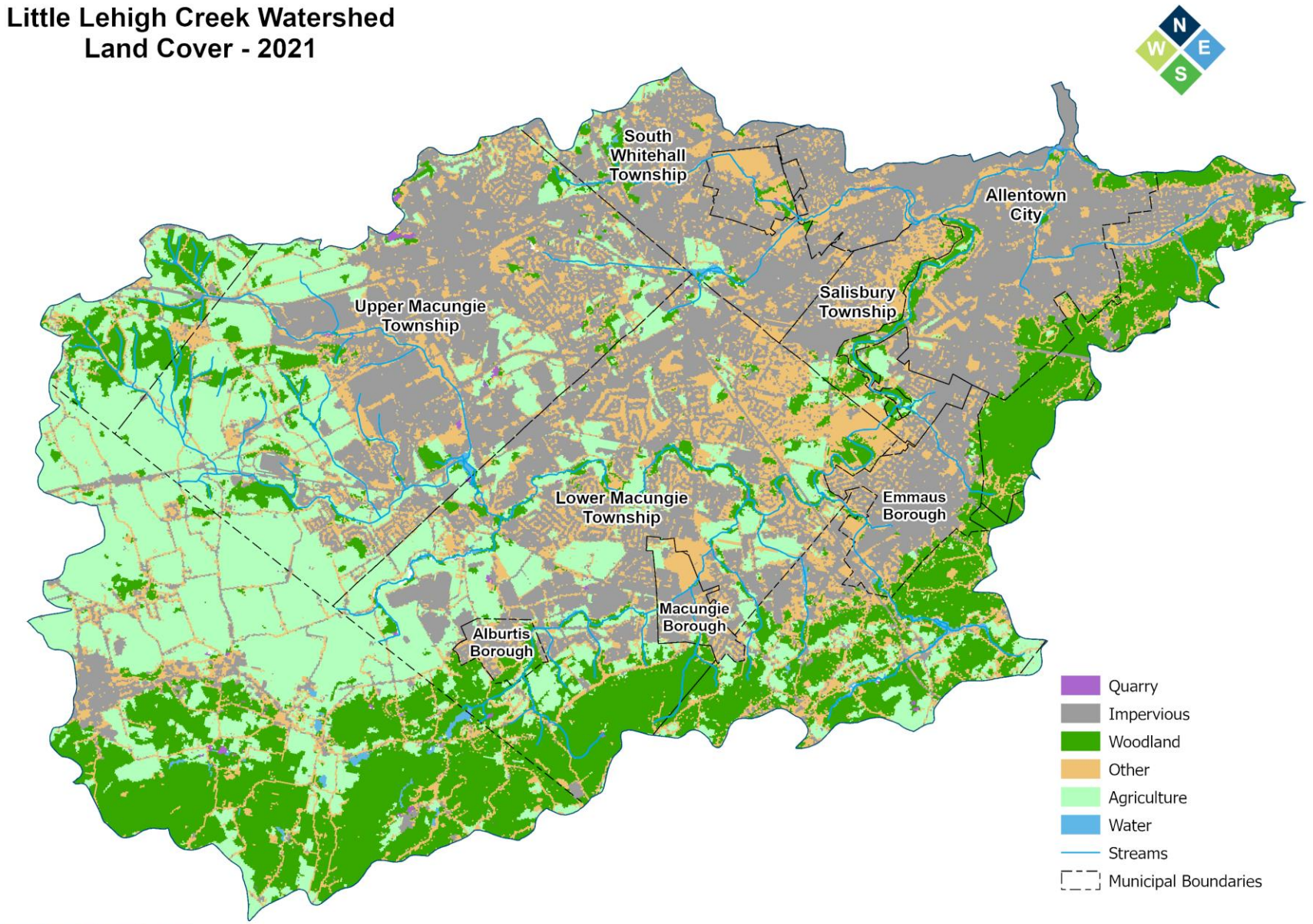
Source: U.S. Geological Survey. National Land Cover Database 2001
https://www.mrlc.gov

LAND USE/LAND COVER CHANGES OVER TIME



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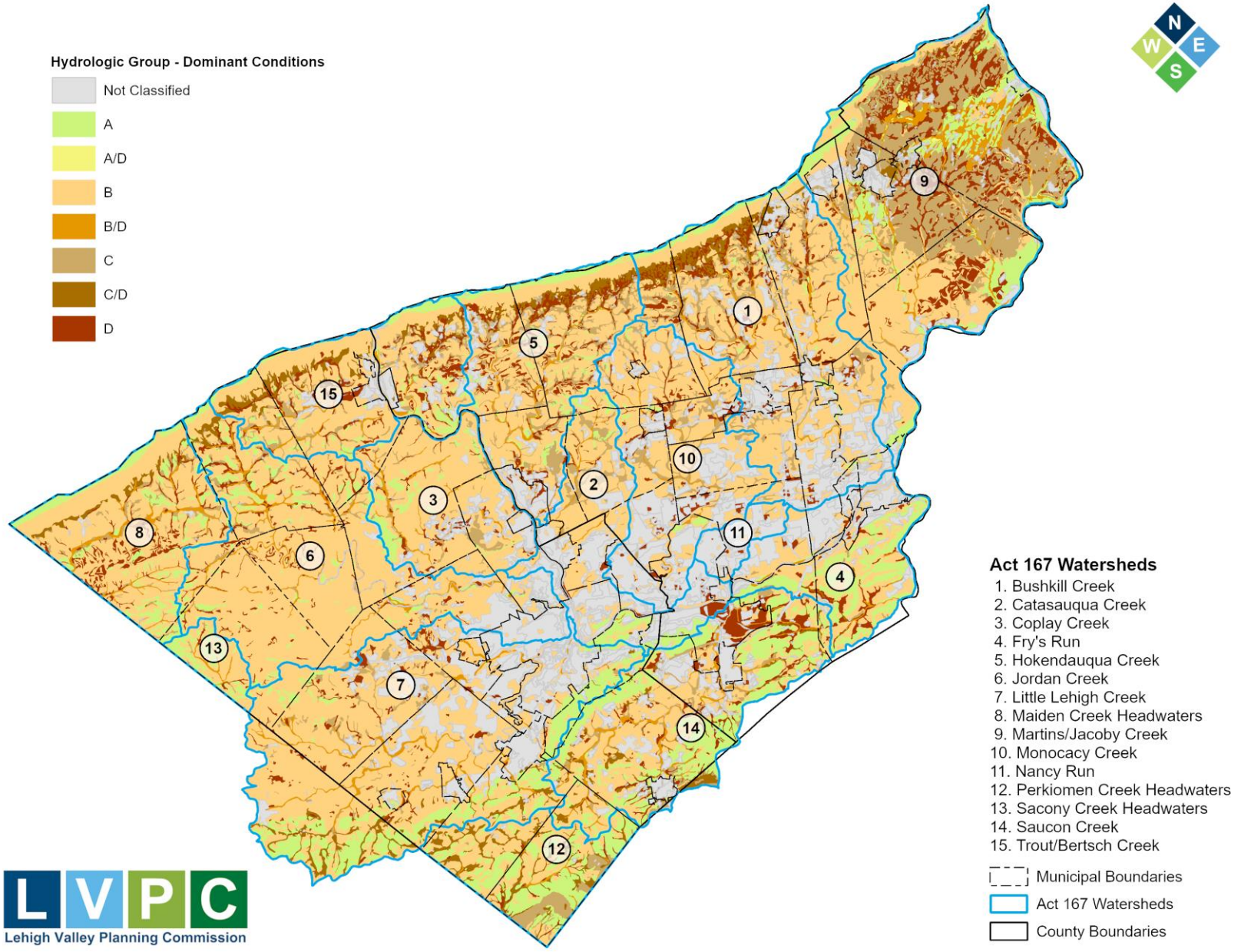
Source: U.S. Geological Survey. National Land Cover Database 2021
https://www.mrlc.gov

HYDROLOGIC SOIL GROUP DESIGNATIONS



Source: Natural Resources Conservation Service Web Soil Survey

Act 167 Overview

Pennsylvania Stormwater Management Act of 1978

Major Components

- Placed responsibility on counties to prepare watershed plans.
- Outlines 13 plan requirements.
- Authorized DEP to prepare guidelines to assist counties.
- Authorized DEP to designate watersheds.
- Authorized grant program to reimburse counties.
- Placed responsibilities on land developers.

Purposes

- Encourage the sound planning and management of storm runoff.
- Coordinate the storm runoff management efforts within each watershed.
- Encourage the local administration and management of storm runoff.

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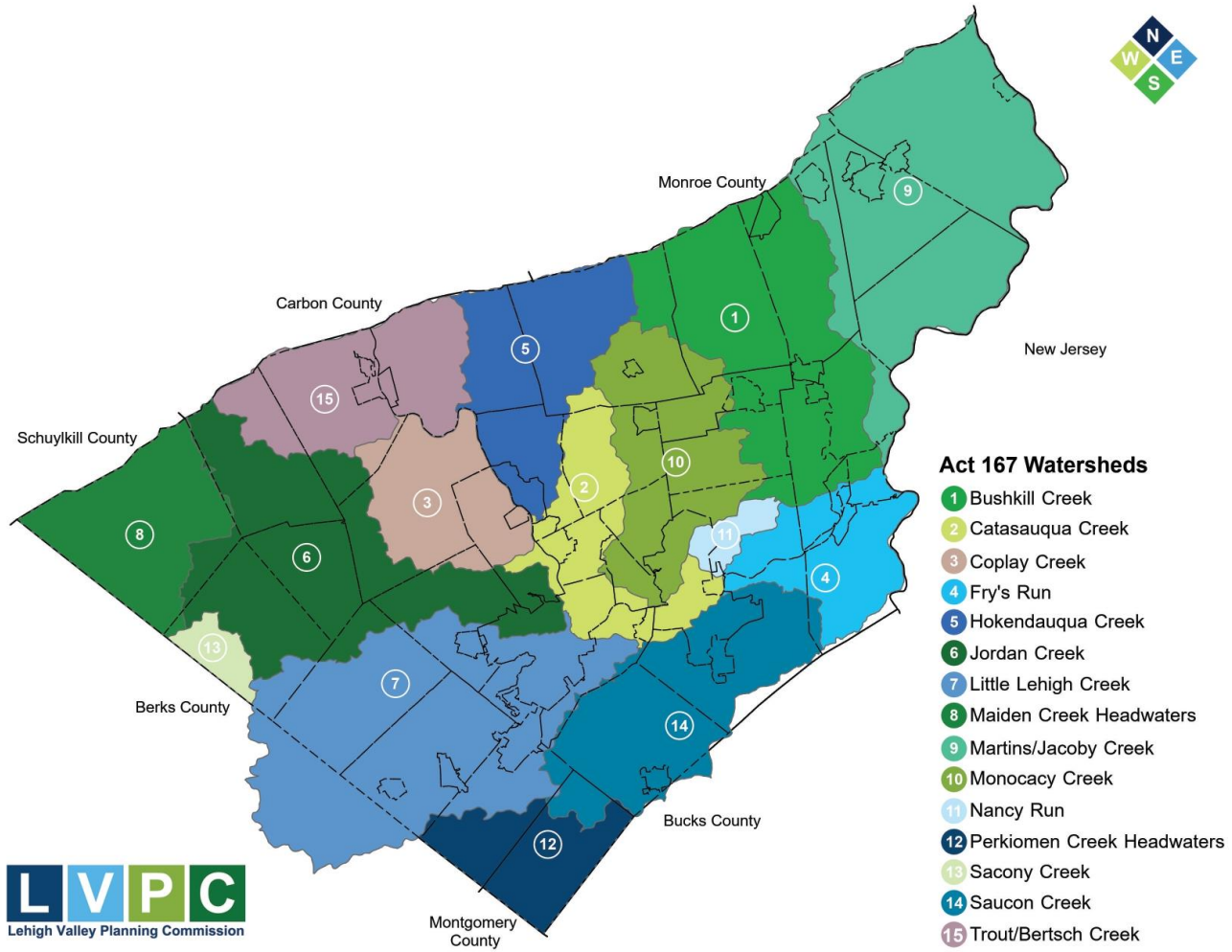
County Responsibilities

- Develop an Act 167 Plan for each watershed within its boundaries.
- Consult with municipalities through the Watershed Plan Advisory Committee.
- Adopt the plan by resolution after holding a public hearing and making the appropriate changes.
- Submit adopted plan to DEP.

Lehigh and Northampton counties have delegated plan preparation to the LVPC



Municipal Responsibilities

- Participate in the plan development
- Review the draft plan and provide comments.
- Adopt the necessary ordinances to control storm runoff after the plan is approved by DEP.
- Implement the plan through the enforcement of the new stormwater ordinance.

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Act 167 Modeling - Examples

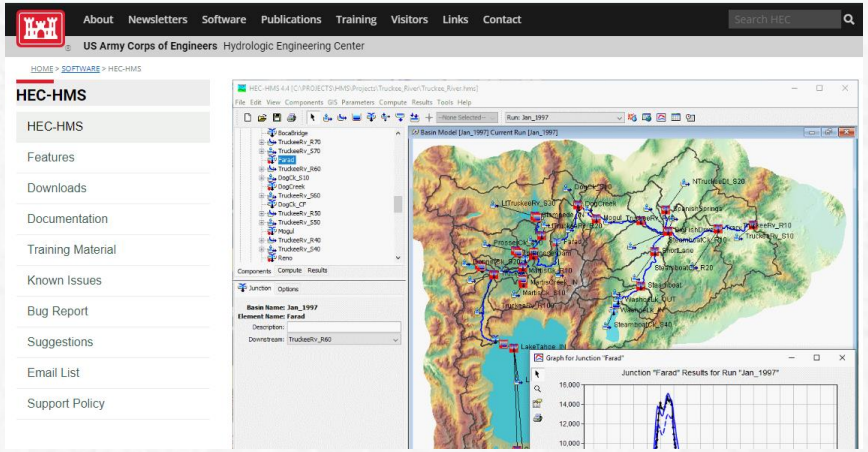
Hydrologic models test proposed control strategies against existing stream flows

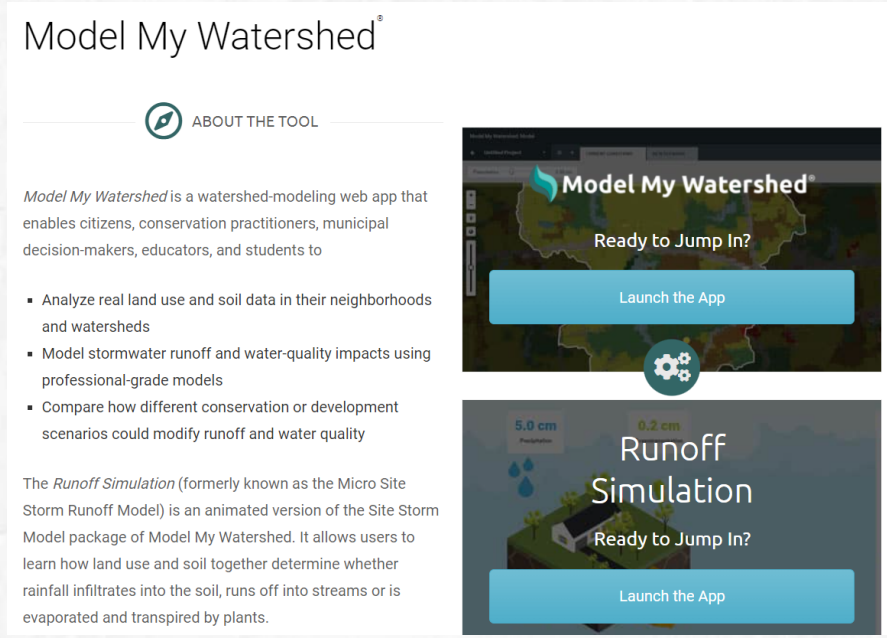
HEC –HMS

(Hydrologic Engineering Center – Hydrologic Modeling System) – US Army Corps of Engineers

Water quality models predict pollutant loading reductions based on proposed stormwater control measures (SCM)

Model My Watershed® - Stroud Water Research Center





DATA COLLECTION

Geology and soils data – On-line sources

Existing land use data – GIS data

Future land use data – Current zoning

Stream channel geometry – Aerial photography and field data

Obstruction documentation – Research – County Flood Insurance Studies

Problem area documentation – Municipal Survey

Flood Control Measures – Research – US Army Corps of Engineers (federal) data

– Flood Protection Pennsylvania DEP (State) data

– PA flood protection projects (PA.Gov-State)

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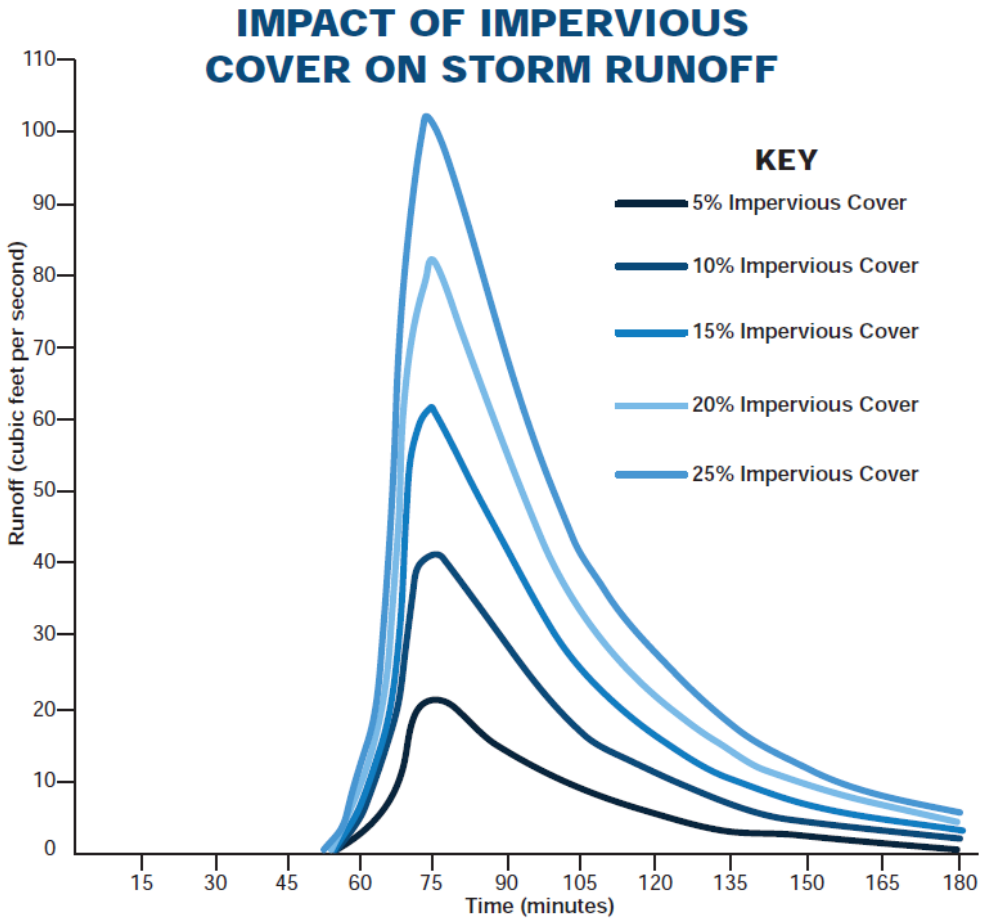
IMPACTS OF LAND DEVELOPMENT



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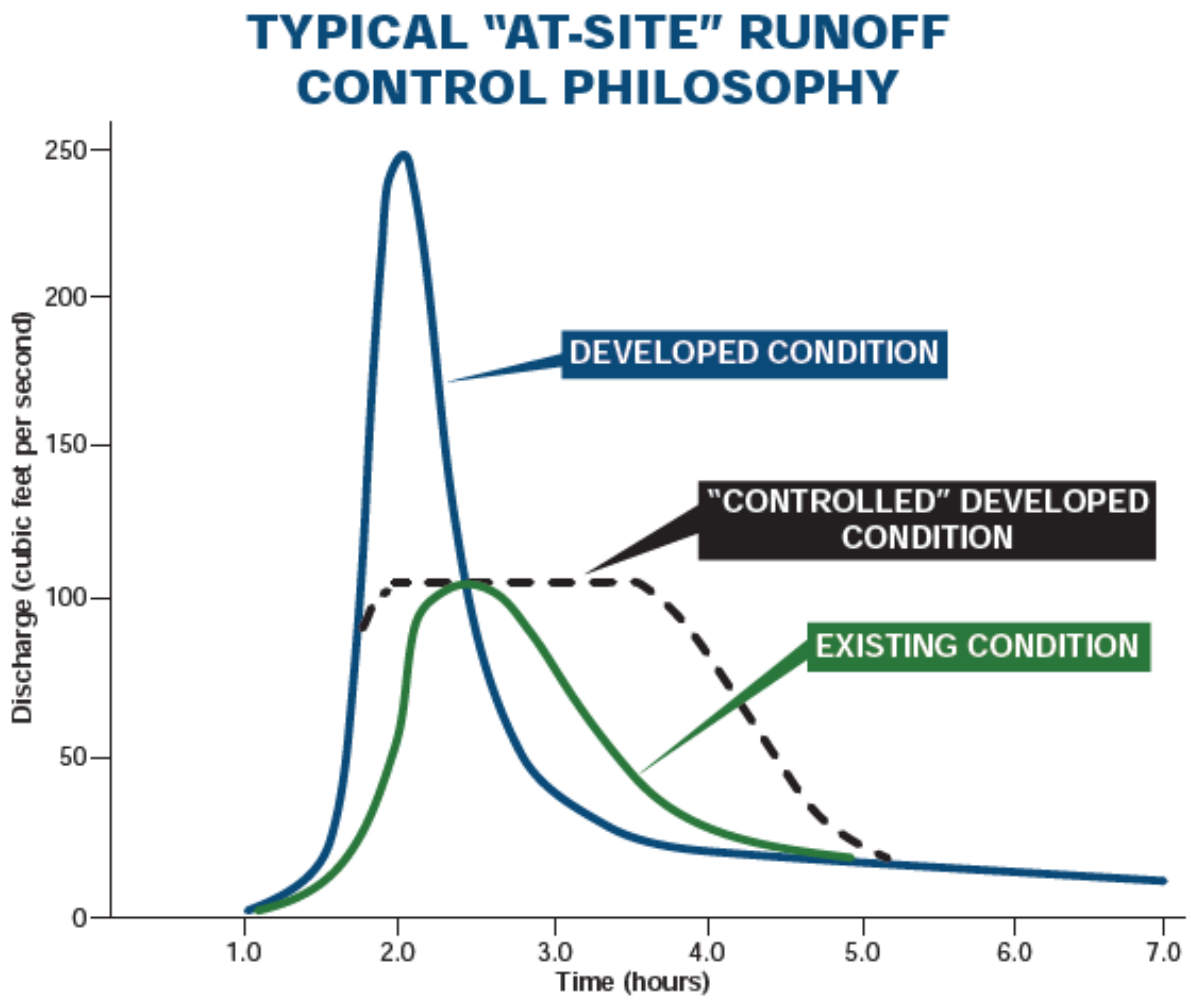
IMPACTS OF LAND DEVELOPMENT

- New impervious cover increases the rate and volume of runoff
- Detention basins control the rate, but not volume
- Increased volume can cause increased flows downstream in the watershed



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Geology for Lehigh and Northampton Counties

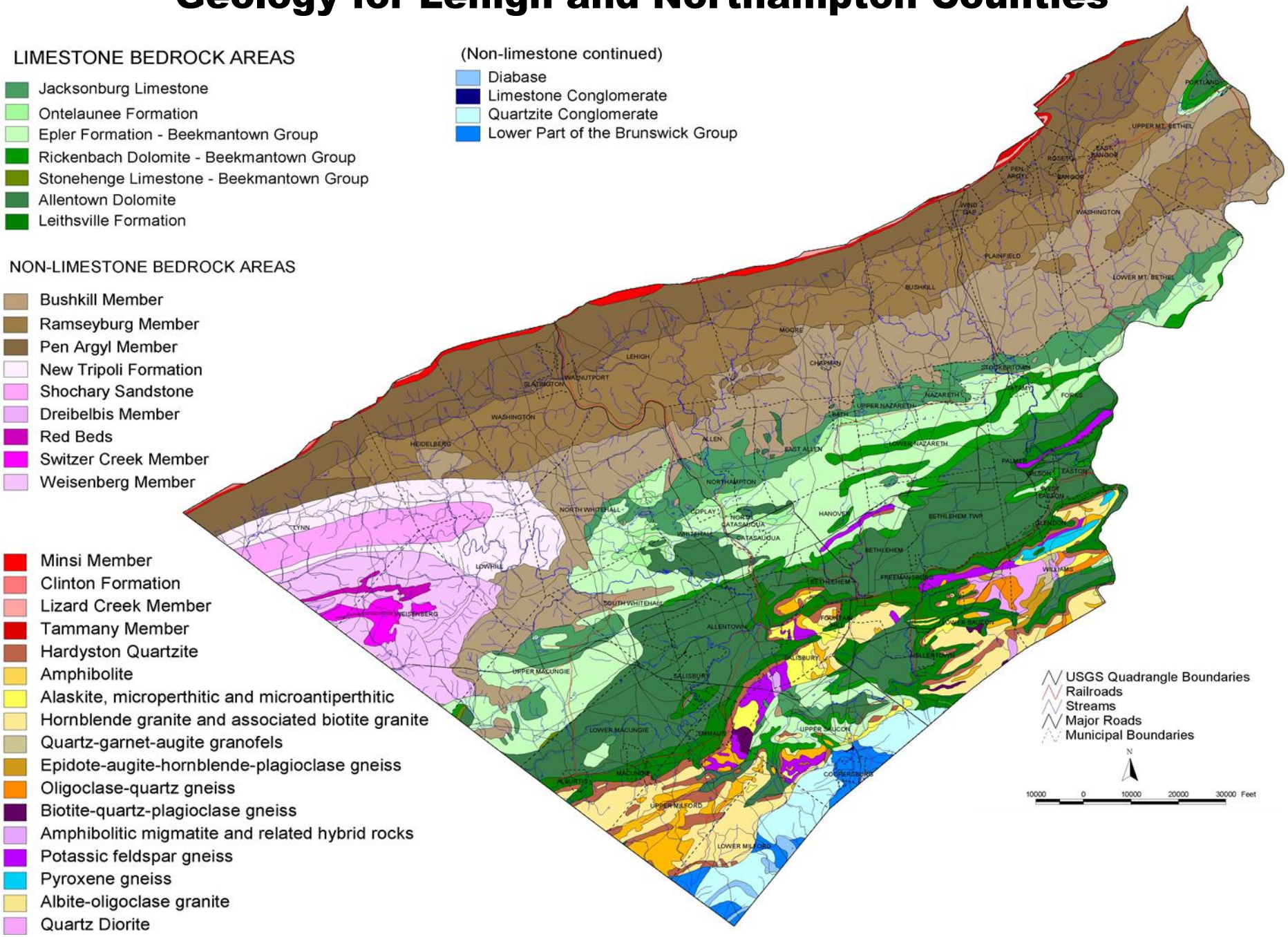

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Photo from : Morning Call July 11,2023

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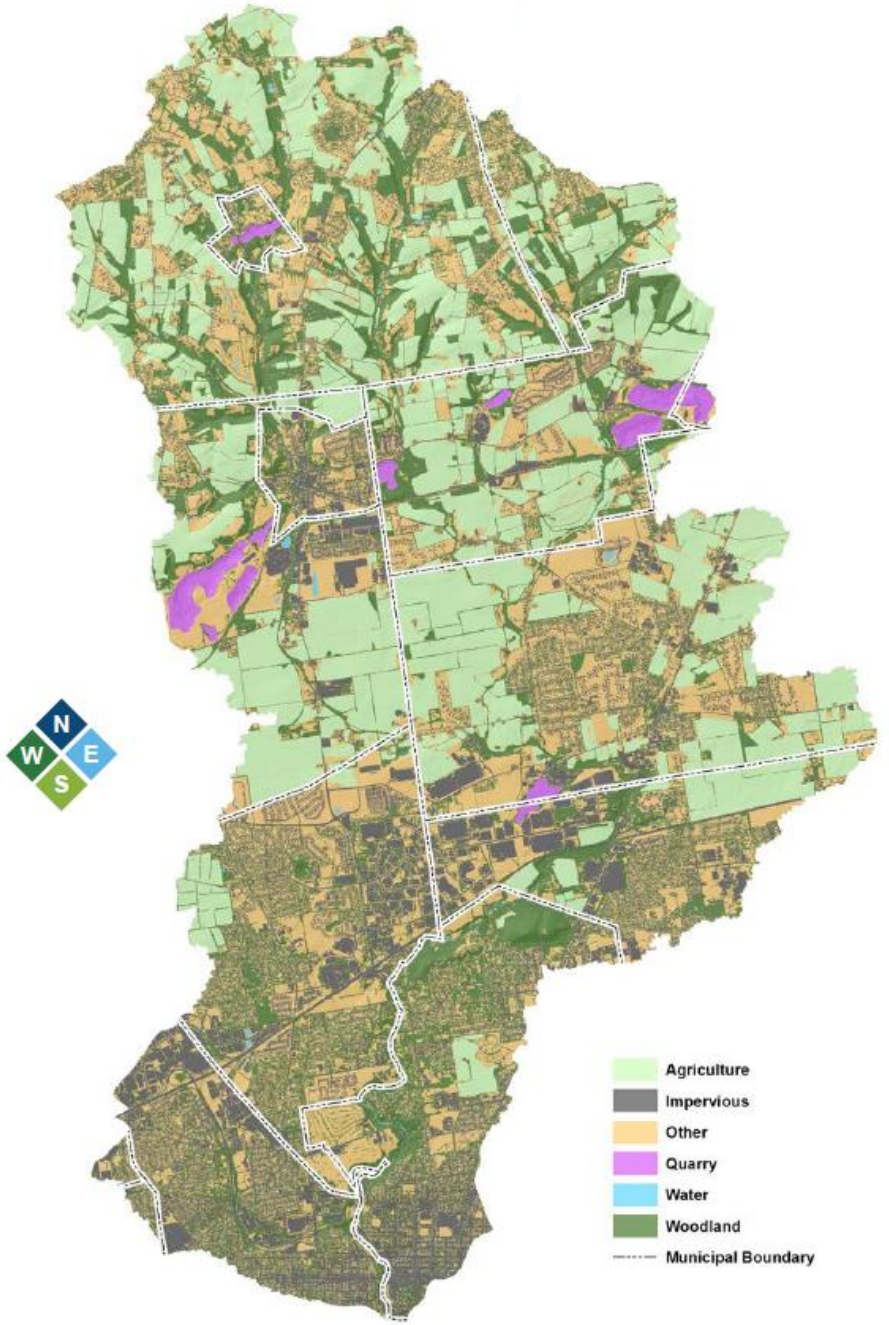
Monocacy Creek Watershed 2015 Existing Land Cover



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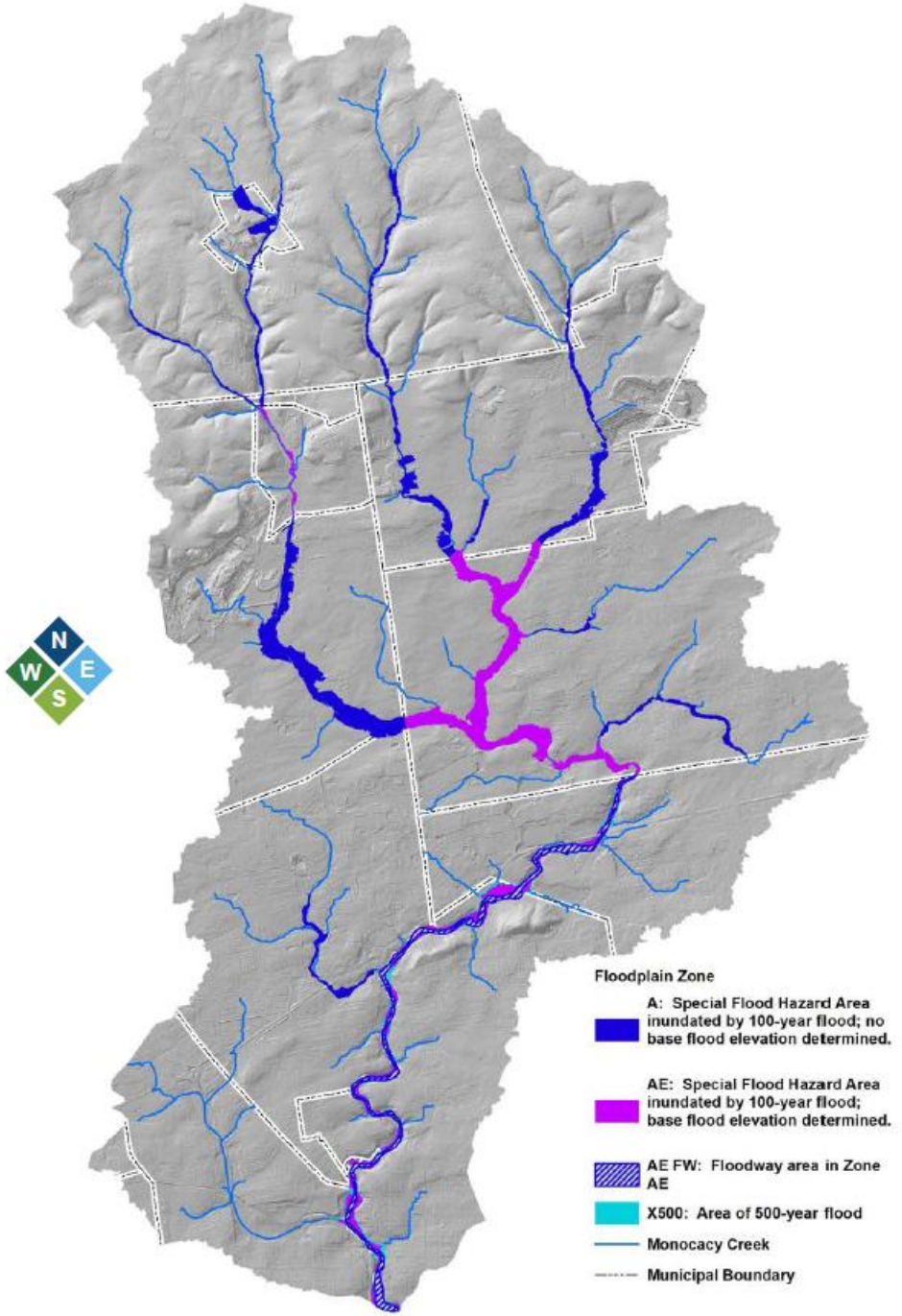
Monocacy Creek Watershed – Floodplains



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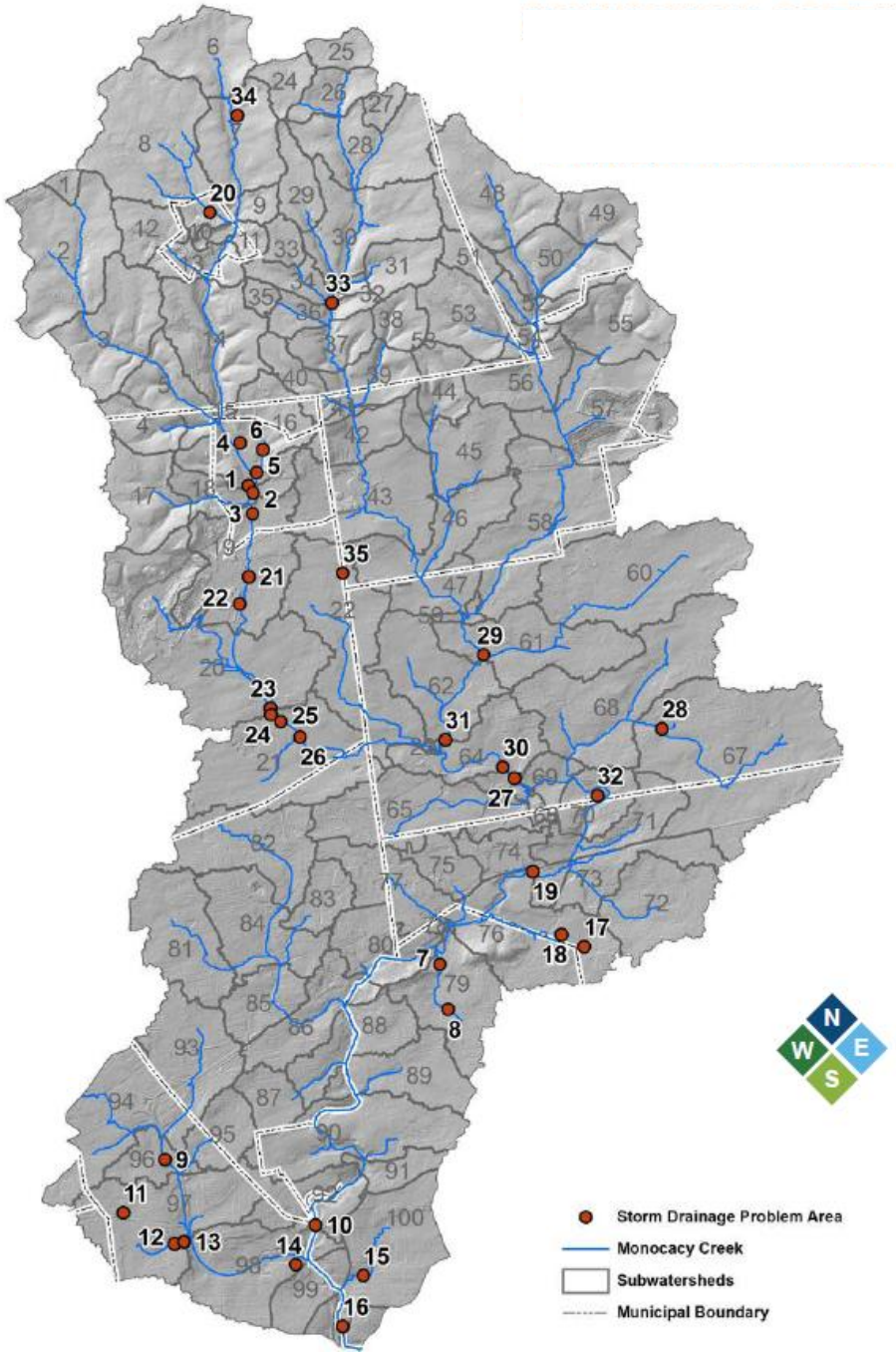
Monocacy Creek Watershed – Problem Areas



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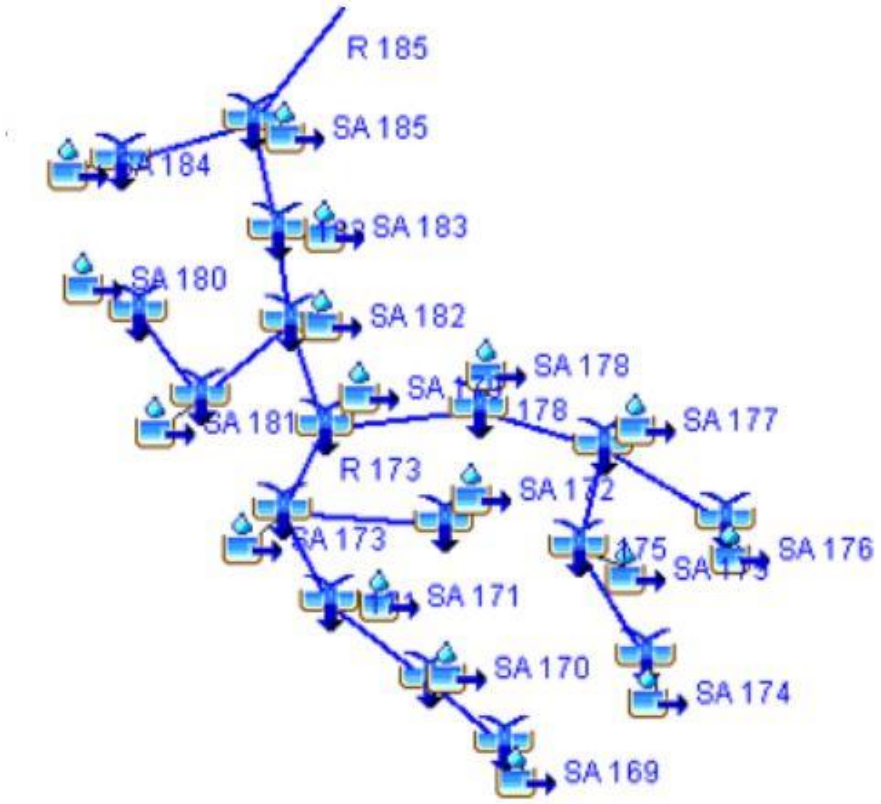
EXAMPLE- HYDROLOGIC MODEL

- Computer model of the watershed created using collected data
- Existing flows are calculated to evaluate obstructions, etc.
- Future flows are calculated and used to determine what “Release Rates” are required to maintain peak flows throughout the watershed



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NOAA Atlas 14, Volume 2, Version 3 ALLENTOWN
BETHLEHEM EA
Station ID: 36-0106
Location name: Allentown, Pennsylvania, USA*
Latitude: 40.6508°, Longitude: -75.4492°
Elevation:
Elevation (station metadata): 390 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

G.M. Bonnin, D. Martin, B. Lin, T. Parzybok, M.Yekta, and D. Riley

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.321 (0.288-0.355)	0.381 (0.343-0.423)	0.448 (0.403-0.496)	0.499 (0.448-0.552)	0.563 (0.502-0.622)	0.610 (0.540-0.673)	0.657 (0.579-0.726)	0.704 (0.615-0.780)	0.766 (0.661-0.851)	0.815 (0.697-0.909)
10-min	0.511 (0.459-0.566)	0.610 (0.548-0.676)	0.718 (0.645-0.794)	0.798 (0.716-0.882)	0.894 (0.797-0.987)	0.966 (0.856-1.07)	1.04 (0.916-1.15)	1.11 (0.970-1.23)	1.20 (1.04-1.34)	1.28 (1.09-1.42)
15-min	0.638 (0.573-0.707)	0.764 (0.687-0.848)	0.905 (0.814-1.00)	1.00 (0.902-1.11)	1.13 (1.01-1.25)	1.22 (1.08-1.35)	1.31 (1.16-1.45)	1.40 (1.22-1.55)	1.51 (1.31-1.68)	1.60 (1.37-1.78)
30-min	0.873 (0.785-0.968)	1.05 (0.947-1.17)	1.28 (1.15-1.42)	1.45 (1.30-1.61)	1.67 (1.49-1.84)	1.83 (1.62-2.02)	2.00 (1.76-2.21)	2.17 (1.90-2.40)	2.40 (2.07-2.67)	2.58 (2.21-2.88)
60-min	1.09 (0.977-1.20)	1.32 (1.19-1.46)	1.64 (1.48-1.82)	1.89 (1.70-2.09)	2.22 (1.98-2.45)	2.48 (2.20-2.74)	2.75 (2.42-3.04)	3.04 (2.65-3.36)	3.43 (2.96-3.81)	3.76 (3.21-4.19)
2-hr	1.30 (1.17-1.45)	1.57 (1.41-1.75)	1.97 (1.76-2.19)	2.28 (2.04-2.53)	2.72 (2.42-3.01)	3.09 (2.73-3.42)	3.48 (3.06-3.85)	3.91 (3.40-4.34)	4.53 (3.89-5.05)	5.06 (4.29-5.66)
3-hr	1.43 (1.28-1.59)	1.73 (1.55-1.92)	2.15 (1.93-2.40)	2.49 (2.23-2.76)	2.97 (2.64-3.29)	3.36 (2.97-3.72)	3.79 (3.32-4.19)	4.25 (3.70-4.71)	4.92 (4.23-5.48)	5.48 (4.65-6.14)
6-hr	1.82 (1.64-2.02)	2.18 (1.98-2.42)	2.70 (2.44-3.00)	3.13 (2.82-3.46)	3.75 (3.35-4.15)	4.28 (3.80-4.72)	4.86 (4.27-5.37)	5.51 (4.78-6.08)	6.46 (5.52-7.15)	7.28 (6.13-8.07)
12-hr	2.24 (2.03-2.50)	2.70 (2.44-3.00)	3.35 (3.03-3.72)	3.91 (3.52-4.34)	4.74 (4.23-5.23)	5.46 (4.82-6.02)	6.26 (5.47-6.90)	7.15 (6.18-7.88)	8.52 (7.22-9.41)	9.70 (8.09-10.7)
24-hr	2.62 (2.43-2.83)	3.14 (2.92-3.40)	3.93 (3.65-4.24)	4.59 (4.25-4.94)	5.56 (5.12-5.98)	6.39 (5.86-6.86)	7.30 (6.64-7.83)	8.30 (7.49-8.89)	9.79 (8.73-10.5)	11.1 (9.75-11.8)
2-day	3.07 (2.84-3.32)	3.69 (3.42-4.00)	4.62 (4.27-5.00)	5.38 (4.97-5.82)	6.48 (5.96-6.99)	7.41 (6.77-7.98)	8.42 (7.66-9.06)	9.52 (8.60-10.2)	11.1 (9.97-12.0)	12.5 (11.1-13.4)
3-day	3.23 (2.99-3.50)	3.89 (3.60-4.21)	4.85 (4.48-5.25)	5.64 (5.20-6.09)	6.78 (6.23-7.31)	7.74 (7.08-8.34)	8.78 (7.99-9.44)	9.92 (8.96-10.7)	11.6 (10.4-12.4)	13.0 (11.5-13.9)
4-day	3.39 (3.14-3.67)	4.08 (3.78-4.42)	5.08 (4.70-5.50)	5.90 (5.44-6.37)	7.08 (6.50-7.63)	8.07 (7.38-8.69)	9.15 (8.32-9.83)	10.3 (9.31-11.1)	12.0 (10.7-12.9)	13.4 (11.9-14.4)
7-day	4.00 (3.71-4.34)	4.79 (4.44-5.20)	5.90 (5.46-6.39)	6.82 (6.30-7.39)	8.16 (7.50-8.83)	9.28 (8.50-10.0)	10.5 (9.56-11.3)	11.8 (10.7-12.8)	13.7 (12.3-14.8)	15.3 (13.6-16.6)
10-day	4.61 (4.29-4.97)	5.50 (5.12-5.92)	6.68 (6.22-7.18)	7.64 (7.10-8.22)	9.01 (8.35-9.68)	10.1 (9.35-10.9)	11.3 (10.4-12.1)	12.6 (11.5-13.5)	14.4 (13.0-15.4)	15.8 (14.2-17.0)
20-day	6.20 (5.83-6.60)	7.35 (6.91-7.82)	8.73 (8.20-9.28)	9.84 (9.22-10.5)	11.4 (10.6-12.1)	12.6 (11.7-13.3)	13.8 (12.8-14.7)	15.1 (14.0-16.0)	16.9 (15.5-17.9)	18.3 (16.7-19.5)
30-day	7.75 (7.32-8.18)	9.13 (8.62-9.64)	10.6 (10.0-11.2)	11.8 (11.1-12.4)	13.3 (12.6-14.1)	14.6 (13.7-15.4)	15.8 (14.8-16.7)	17.0 (15.9-18.0)	18.7 (17.3-19.7)	19.9 (18.4-21.1)
45-day	9.81 (9.32-10.3)	11.5 (10.9-12.1)	13.2 (12.5-13.9)	14.5 (13.7-15.2)	16.1 (15.3-17.0)	17.4 (16.5-18.3)	18.6 (17.6-19.6)	19.8 (18.7-20.9)	21.4 (20.1-22.5)	22.5 (21.1-23.8)
60-day	11.8 (11.2-12.4)	13.8 (13.1-14.5)	15.7 (14.9-16.5)	17.1 (16.2-18.0)	19.0 (18.0-19.9)	20.3 (19.3-21.4)	21.7 (20.5-22.8)	22.9 (21.6-24.1)	24.6 (23.1-25.9)	25.8 (24.2-27.2)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

What is the rainfall amount for a 100-year storm?

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MODEL CALIBRATION

Raw data in the model not generally representative of actual stream flows

Model must be calibrated to reflect actual flood events

- Involves adjusting input parameters to get output to match known/approximated values

USGS stream gage data is ideal

- Does not exist in all watersheds

In un-gaged watersheds, flood peaks can be estimated by several methods:

- Penn State University-IV (PSU-IV) – Short Cut Method
- Correlation

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SAUCON CREEK MODEL CALIBRATION

T_r	PSU-IV	1989 Model (PSRM)	2009 Model (HEC)
2	2,344	1,337	2,284
10	4,690	3,220	4,880
25	6,675	4,804	6,786
100	10,266	8,719	10,959

*All flow values are expressed as cubic feet per second (cfs).

Model results based on 1989 land use data.

PSRM – Penn State Runoff Model
Tr – Return Period

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MONOCACY CREEK

CALIBRATED HYDROLOGIC ENGINEERING CENTER HYDROLOGIC MODELING SYSTEM MODEL VERSUS MONOCACY CREEK GAGING STATION DATA AT MONOCACY PARK GAGE

Peak Flow (cubic feet per second)

Return Period	Gage Data	Model Data	Deviation
2	650	732	12.5%
10	2,052	2,238	9.0%
25	3,332	3,584	7.6%
100	6,342	6,913	9.0%

*All flow values are expressed as cubic feet per second (cfs).

Model results based on 2015 land use data.

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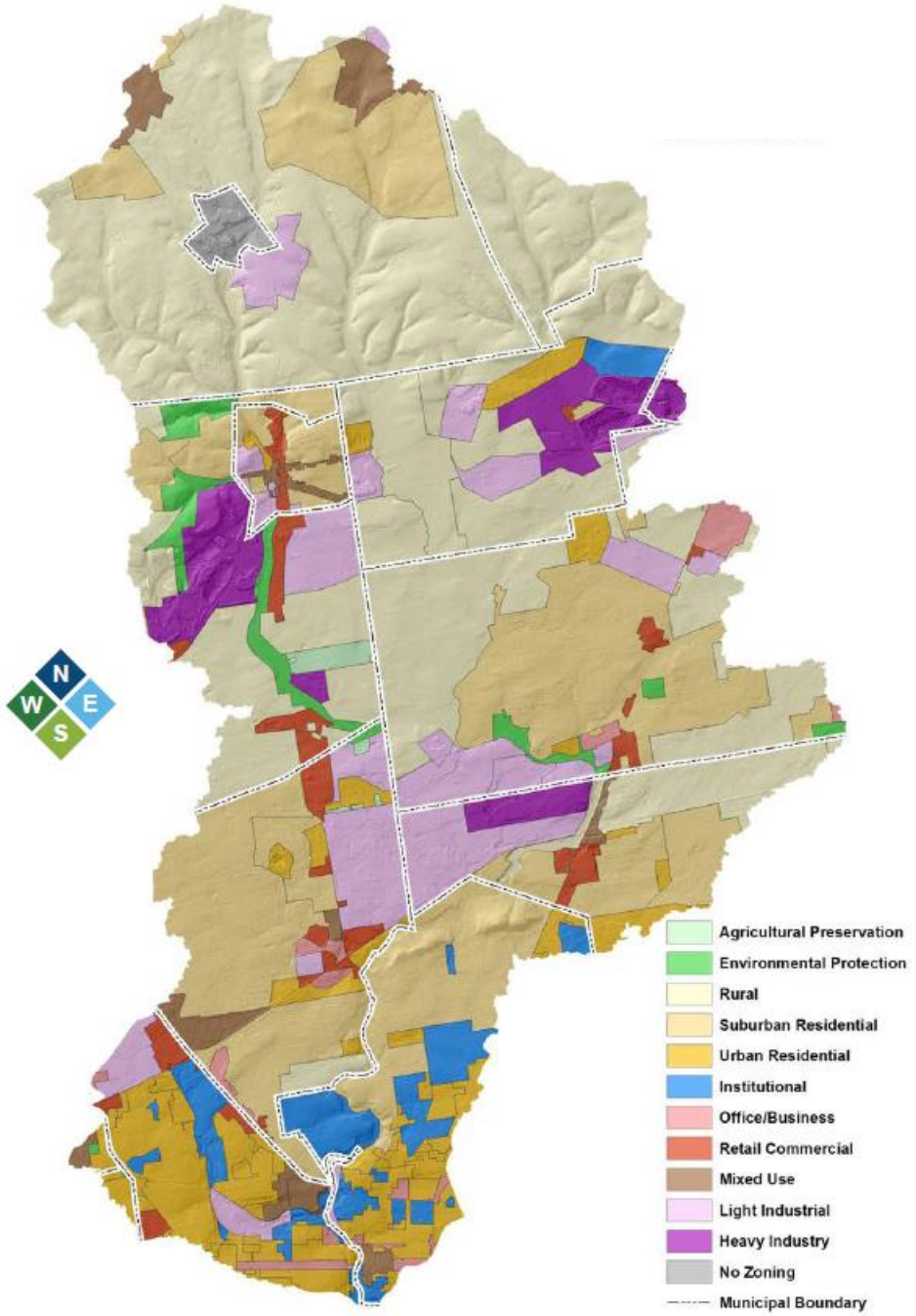
Monocacy Creek Watershed – Future Condition



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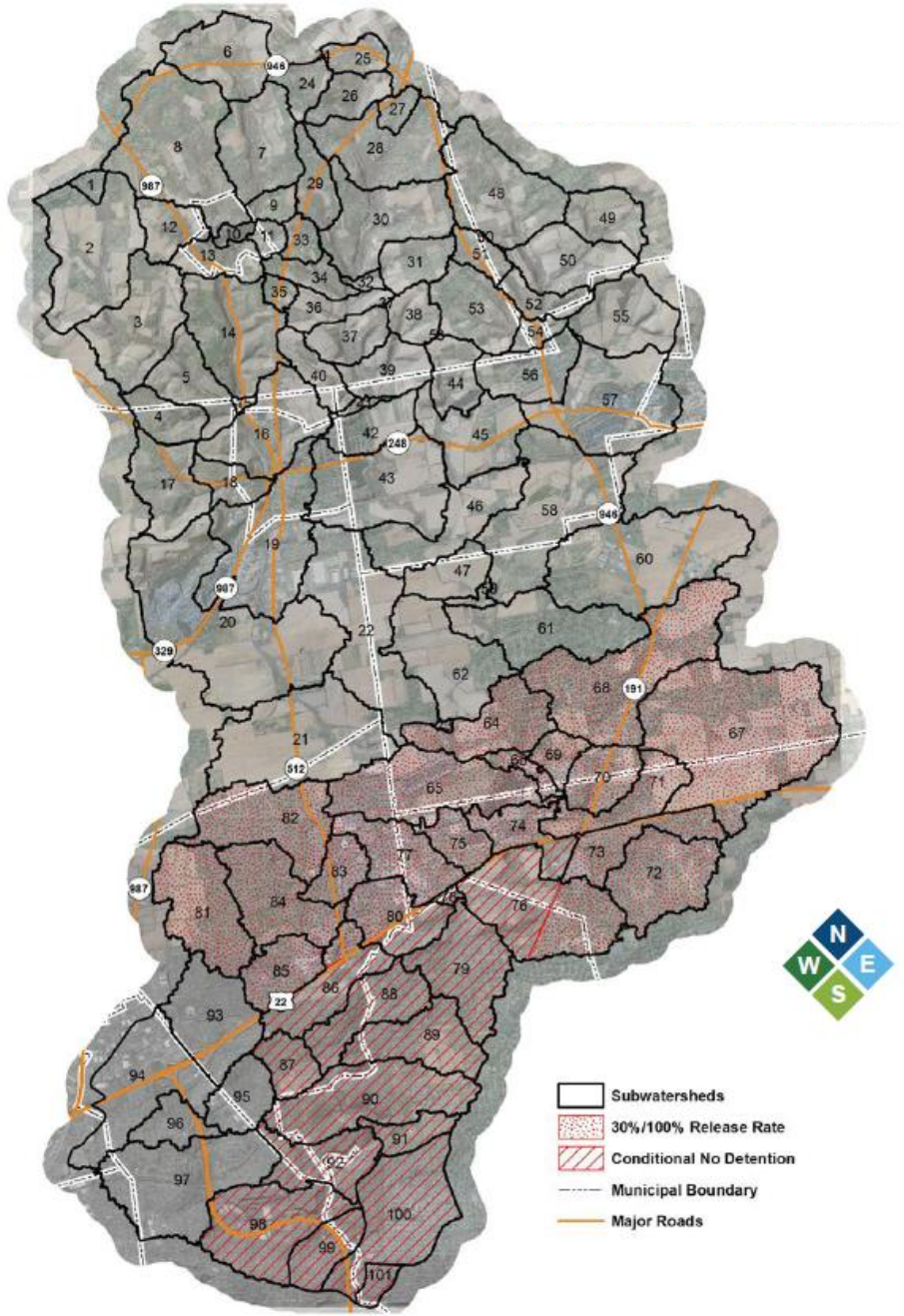
Monocacy Creek Watershed – Release Rate Development

Tested by estimating the impacts future development in the model

- Future development is assumed to be a full build-out of existing zoning
- Detention basins designed for each subarea to control future development to a Release Rate
- If the peak is controlled throughout the watershed, repeat for the next subarea



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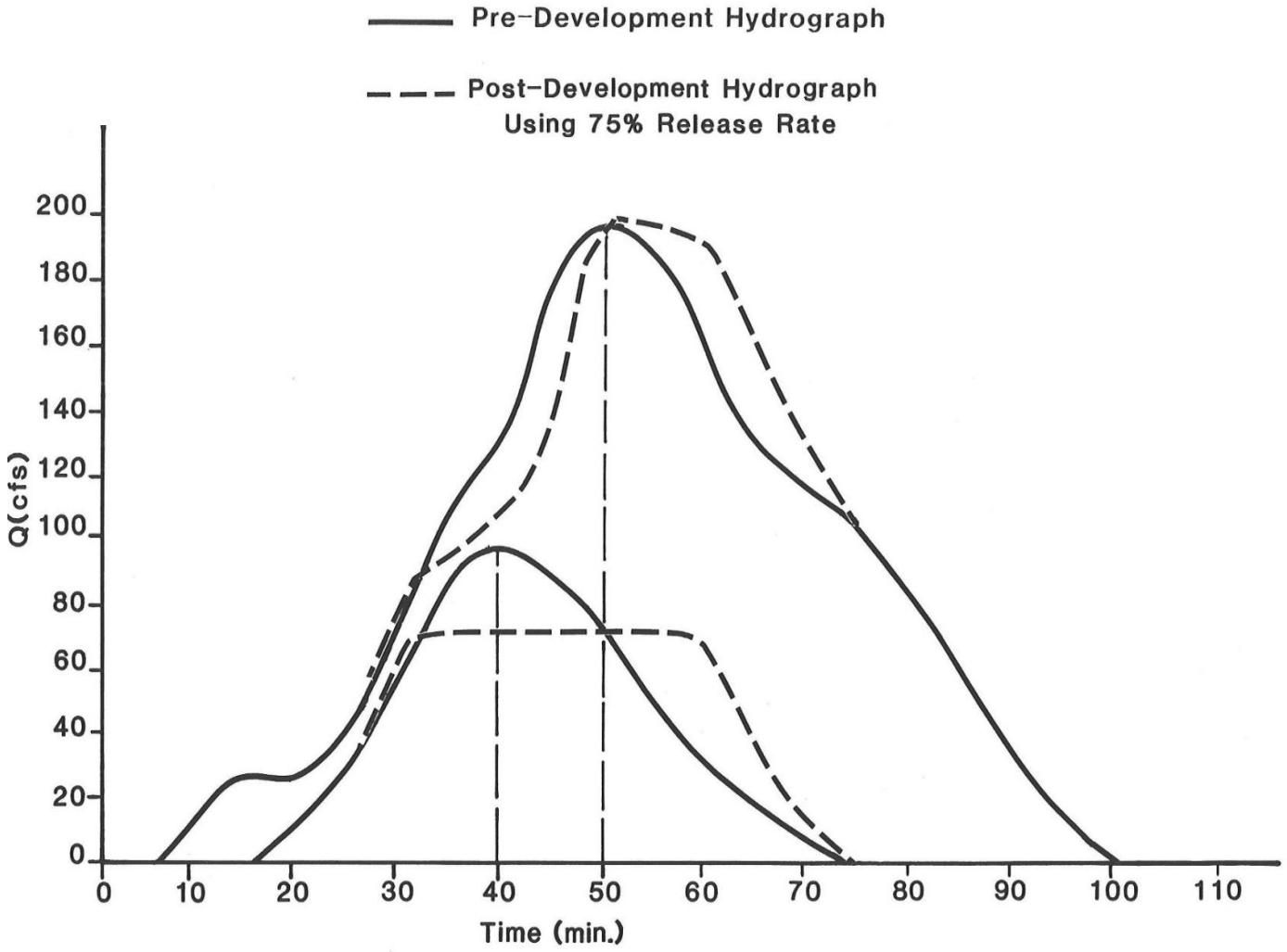
RELEASE RATE DEVELOPMENT



Release Rates control runoff based on its impact on the flood peak

- Expressed as a percentage of the existing runoff that can be discharged after development
- Ranges from 30% to 100%

Goal to allow development, but not increase peak flow at any point in the watershed

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Exercise

Audience Group Discussion

PROBLEM AREA IN YOUR COMMUNITY ?

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POSSIBLE ORDINANCE CHANGES

- Green infrastructure standard
- Water balance standard
- PA DEP Post Construction Stormwater Management Manual
- Current and projected rainfall data (Type II vs. updated distribution)
- Solar Arrays
- Managed Release Concept

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POSSIBLE ORDINANCE CHANGES

- Volume Control vs. Volume Credits
- 10,000 sq. ft. Exemption Criteria
- Continuous Modeling vs. Design Storm
- Low-impact Design
- Riparian Buffer Standard
- Small Detention, Infiltration, Bioretention Standards

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Summary of Update Process

- Data Collection – Municipal Survey, LVPC GIS & Research
- Watershed Modeling and Alternative Analysis
- Update Model Ordinance Standards
- Develop Stormwater Management Plan Update
- Municipal Review, Public Hearing and County Adoption
- WorkshopLV-Water & Public Engagement – Planning for 6 over the 2-year project term
- Sub-committees – Engineering/Other

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Next Steps

Municipal Survey

- Problem Areas Corrected
- New Areas to be Added
- Ordinance Improvements
- Ordinance Effectiveness
- Concerns/Issues
- Special Studies

Questions?