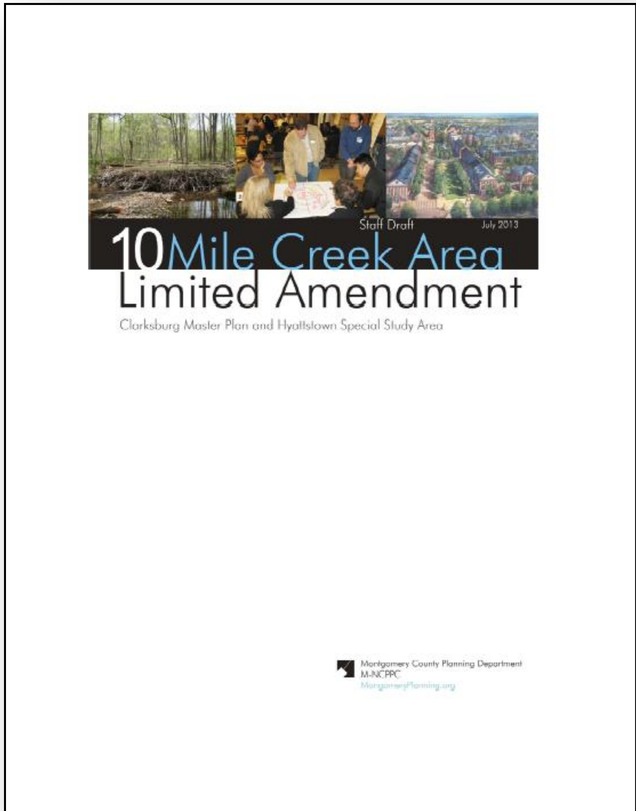

Staff Draft July 2013

10 Mile Creek Area
Limited Amendment

Clarksburg Master Plan and Hyattstown Special Study Area

Montgomery County Planning Department
M-NCPPC
MontgomeryPlanning.org

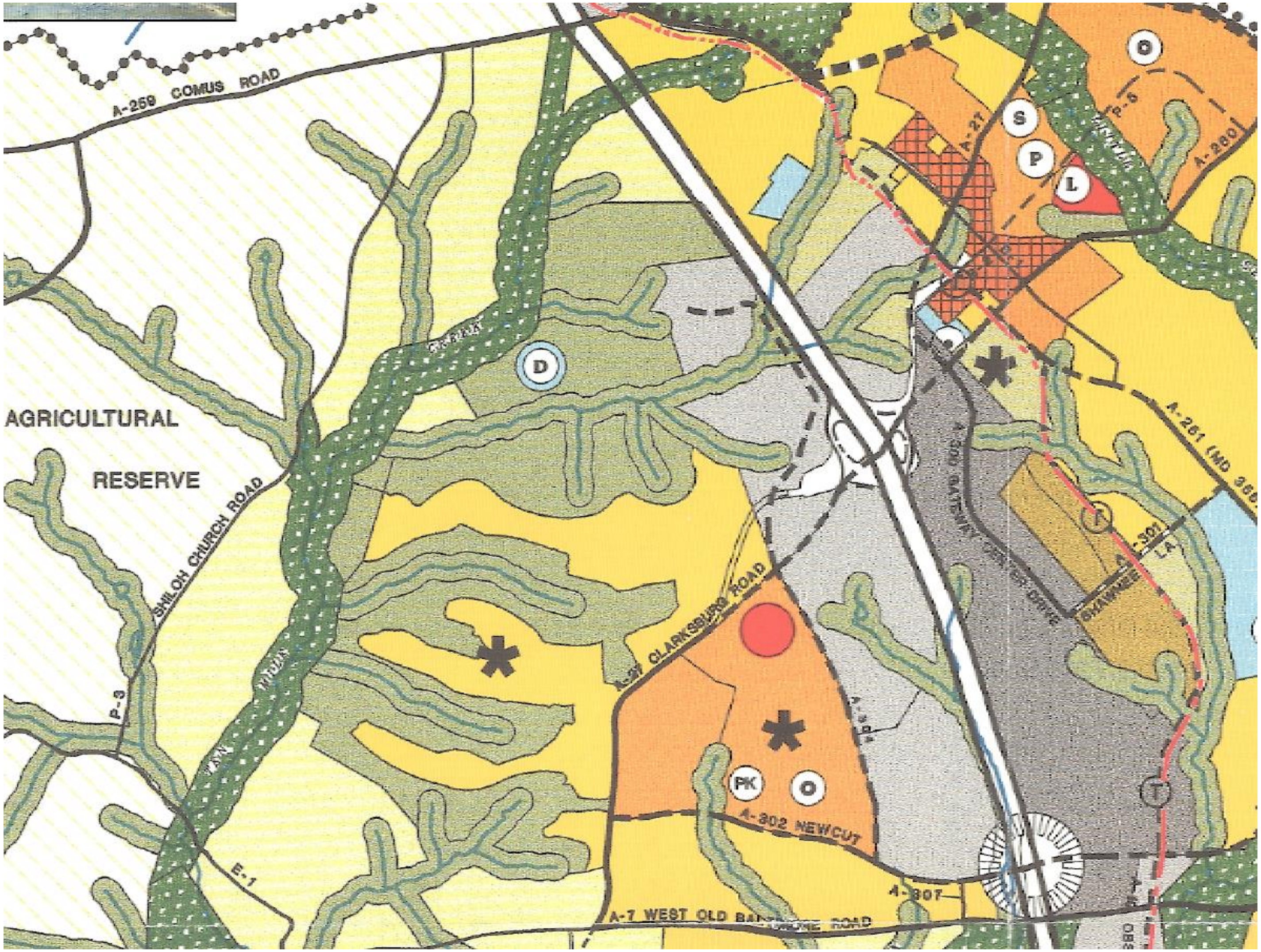
Clarksburg Limited Master Plan
Presentation to the
Joint County Council Committee Meeting
January 13, 2014

MONTGOMERY COUNTY PLANNING DEPARTMENT

Schedule

- Worksession 1
  - Summary of 1994 Plan and Direction from Council
  - Analytical approach, scope and directions to consultant
  - Watershed Principles and Environmental Site Design
  - Consultant Analysis of Existing Conditions
  - Consultant Modeling Analysis and Recommendations
  - Planning Staff Analysis
  - Planning Staff background on master plan protection of sensitive watersheds
- Worksession 2
  - Agency experts on water quality and imperviousness
  - Reservoir protection
  - Water and Sewer service
- Worksession 3
  - Land Use and Transportation

1994 Plan



MONTGOMERY COUNTY PLANNING DEPARTMENT

1994 Master Plan Policies and Recommendations

Policy 1: Town Scale of Development

- Historic district is a key element of the Town Center
- Land use recommendations balance environmental protection and sufficient densities to support transit
- High tech corridor employment at reduced scale
- Defined neighborhoods with a mixture of housing types

1994 Master Plan Policies and Recommendations

Policy 6: Town Center

- Mixed use with transit and pedestrian orientation
- Civic components create focus for public life
- “Main street” treatment for Md 355 protects historic district

Policy 2: Natural Environment

- Ten Mile Creek has countywide significance
- Public stream valley acquisition to support *Greenways (Policy 3)*
- Development guidelines for impacted streams

1994 Master Plan Policies and Recommendations

Policy 4: Transit System

Policy 8: Employment

- In the Town Center, transit availability supports higher residential densities and employment uses at appropriate town scale

Policy 7: Transit/Pedestrian Orientation

Policy 5: Hierarchy of Roads and Streets

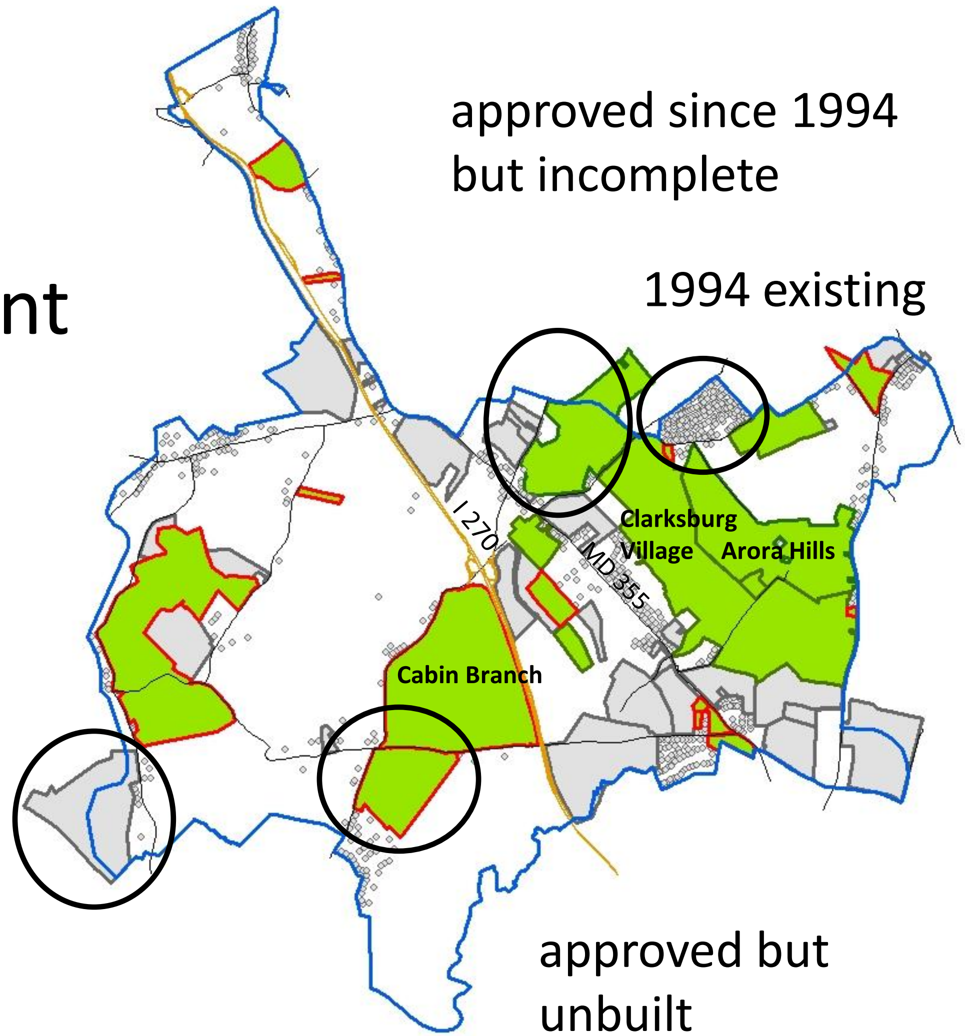
- Seven neighborhoods with pedestrian focus and connections to transit system
- Clear street hierarchy separates through from local traffic and connect streets within neighborhoods

1994 Master Plan Policies and Recommendations

Community Building

- These policies are the foundation of a clearly defined community with a range of land uses, including *Farmland Preservation (Policy 9)*
- Community building managed by a *Staging Plan (Policy 10)* to balance provision of civic infrastructure with pace of development

Current Development



MONTGOMERY COUNTY PLANNING DEPARTMENT

Current Development

Built and Unbuilt Residential

Neighborhood Totals							
	SFD	SFA	MF	Total	SFD %	SFA %	MF %
Town Center	450	805	359	1,614	0.28	0.50	0.22
Transit Corridor	276	658	194	1,128	0.24	0.58	0.17
Newcut Road	1,905	1,294	1,234	4,433	0.43	0.29	0.28
Cabin Branch	1,036	654	939	2,629	0.39	0.25	0.36
Ten Mile Creek	0	0	0	0	0	0	0
				9,804			

Commercial

- 600,000 sf built since plan approval
- 304,000 sf approved but unbuilt in town center and newcut road

Planning Process and Analytical Approach

- Determine Existing Conditions and Issues
  - Impact on Reservoir not considered an issue
- Understand the Potential Effect of Using ESD in a sensitive watershed
- Prepare Scenarios for testing a range of alternatives
- Determine findings from testing to inform recommendations
- Develop land use and zoning recommendations

Environmental Analysis for the Master Plan

- Limited time frame and budget
- Executive pledged a partnership with Planning to get the work done
- Able to use highly respected consultants already working with DEP on Countywide water quality issues
- Developed Scope of Work with the assistance of DEP and DPS
- Work expedited because
  - DEP data was thorough and available, limited field work needed
  - Consultants were asked to test only a limited number of alternatives
  - Planning level analysis and use of specific models was quickly vetted with federal, state and local agencies
  - Detailed assumptions for application of ESD reviewed with DPS
- All issues, work assumptions and analytical results were reviewed weekly with DEP and DPS at the regular check-in meeting with the consultants and M-NCPPC staff

Scope of Work for Consultant

- Data Collection
  - Extensive number of reports and studies conducted over the past 30 years
  - Detailed monitoring data from state and local sources over the past 20 years
  - Significant amount of GIS mapped information for modeling
- Analysis of data and literature regarding the effectiveness and application of Environmental Site Design
- Analysis of Scenarios
  - Annual pollutant load analysis using the Watershed Treatment Model
  - Hydrologic analysis evaluating the range of peak discharges and runoff
  - Spatial Watershed Analysis results including likely impacts to the landscape and other resources identified
    - Landscape corridors and patches
    - Estimate of natural land cover lost and restored (or enhanced)

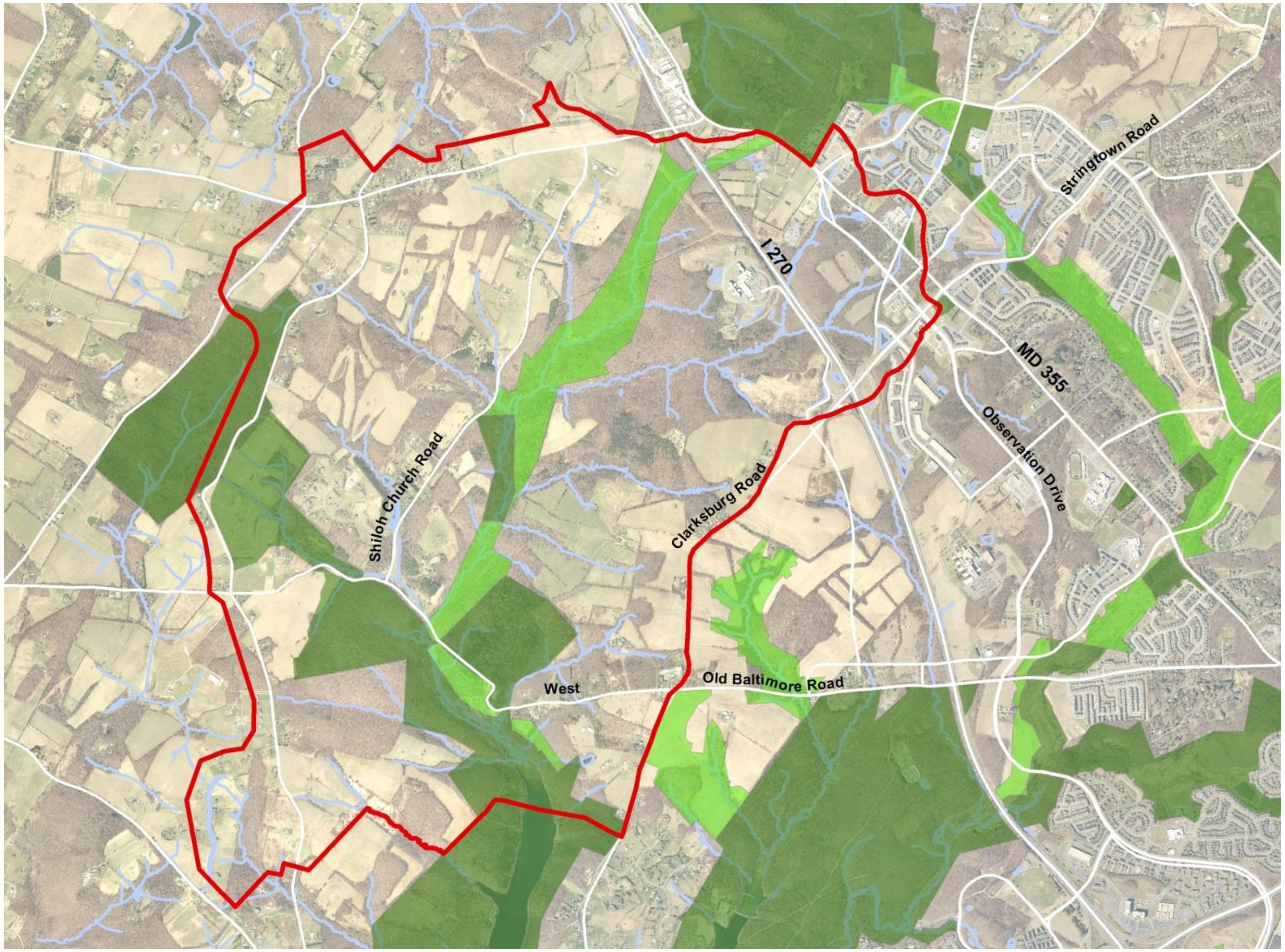
Charge to Consultants

- Work with all appropriate data and experts to provide the best analysis that can be done within the time frame provided
- Work collaboratively with the Agency Team
  - MNCPPC (Planning and Parks)
  - Department of Environmental Protection
  - Department of Permitting Services
- Analyze the Scenarios provided by Staff
- Provide advice based on that analysis to staff
- Not asked to:
  - Conduct extensive field work
  - Develop alternatives
  - Determine ideal levels of imperviousness
  - Develop land use recommendations
  - Study impacts on the reservoir

Additional Work by Planning Staff

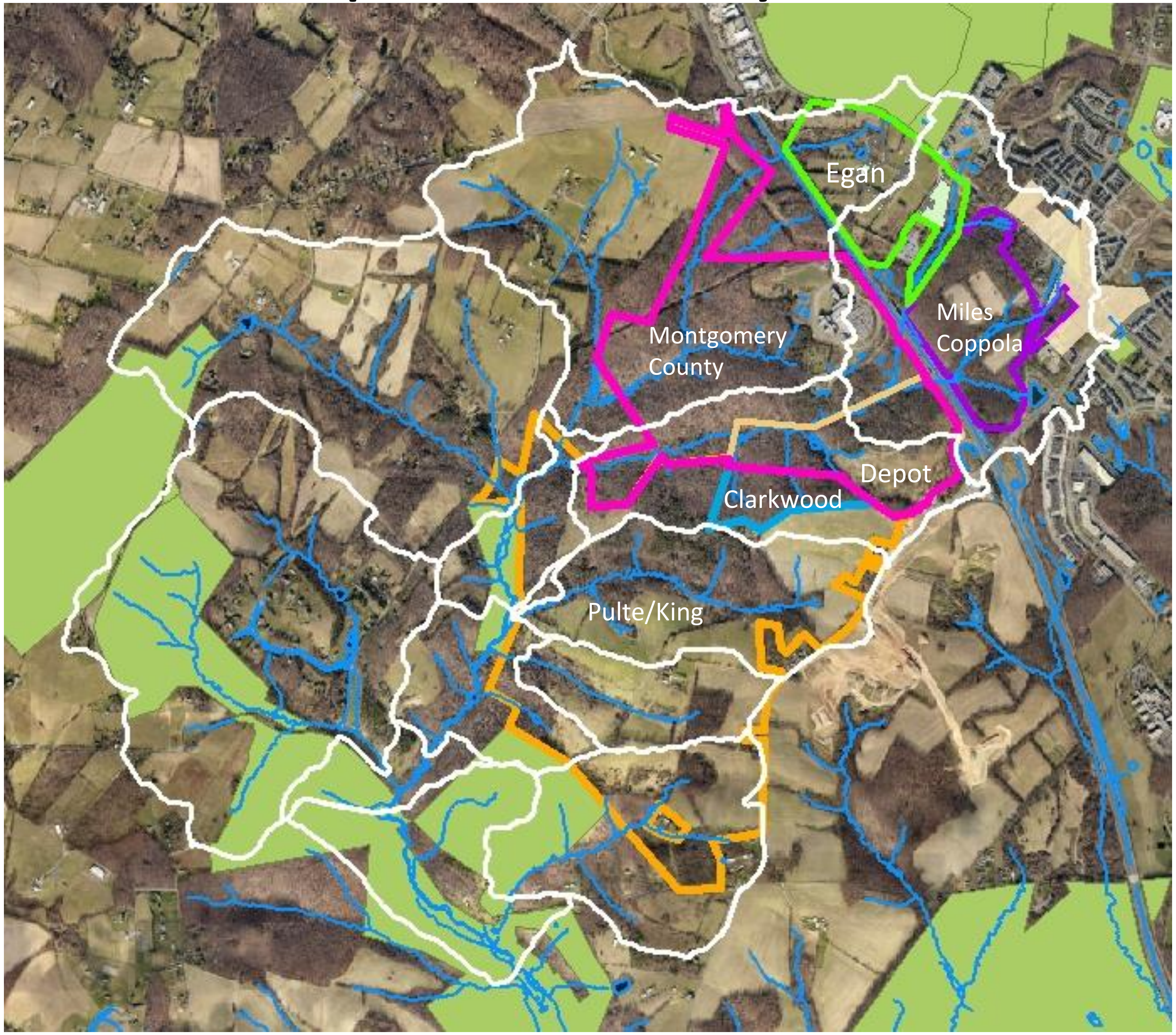
- Subwatershed analysis of potential change in imperviousness
- Based on a statistical analysis of monitoring results
- Estimates the potential change in stream condition rating
  - Predicts a range of potential change to stream conditions
  - Based on data from countywide monitoring of subwatersheds with mixed set stormwater management techniques applied
  - Only tool we have to answer the question of what stream condition is likely to result from each development scenario

Orientation



MONTGOMERY COUNTY PLANNING DEPARTMENT

Properties Analyzed



Outline

1. Consultant Team Background and Qualifications
2. Watershed Science Overview
3. Analysis Approach and Assumptions
    a) Existing Conditions
    b) Natural Resource Disturbance
    c) Spatial Analysis
    d) Hydrologic modeling
    e) Pollutant Loading
4. Findings and Recommendations

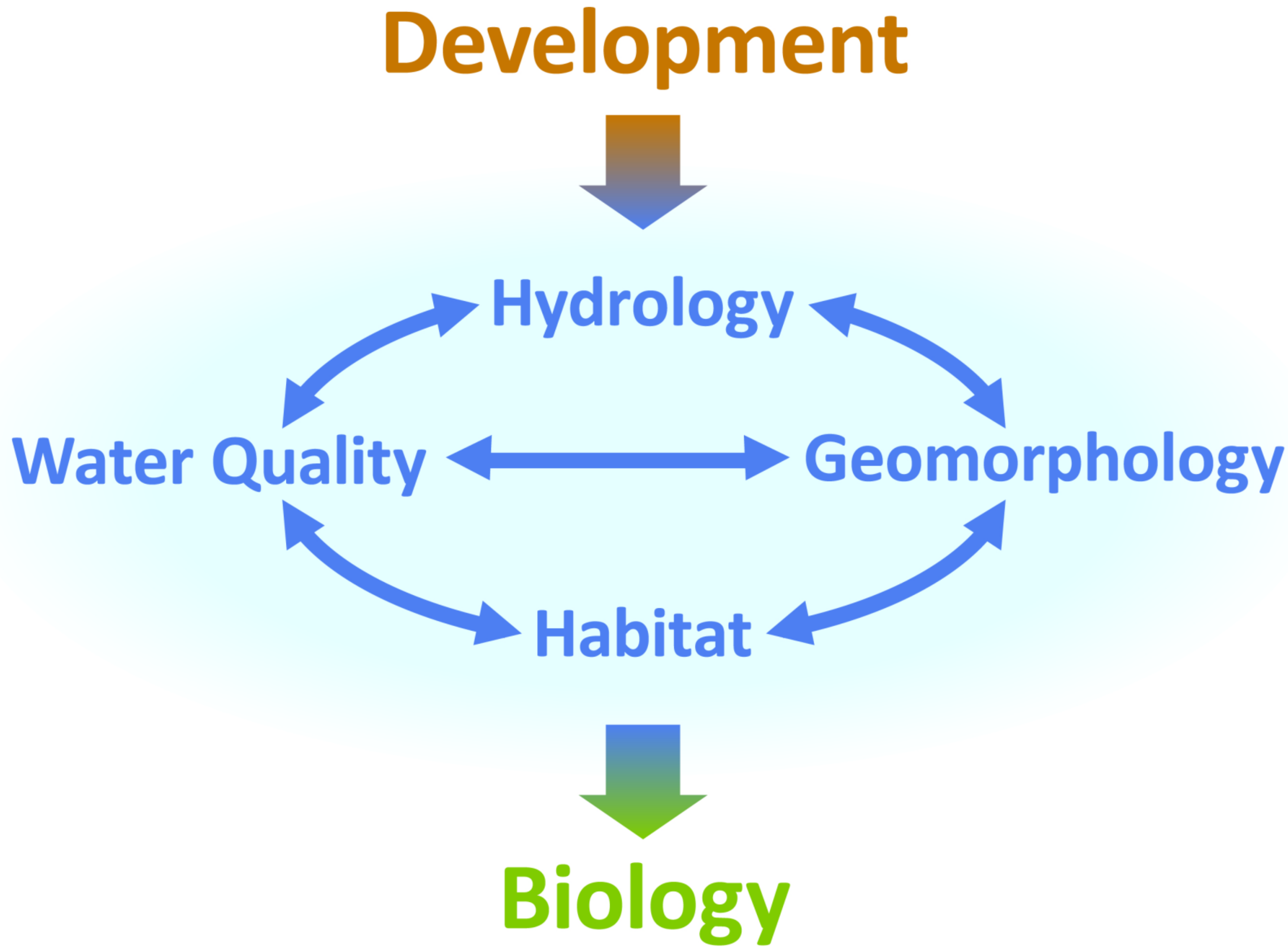
Environmental Team

- Brown and Caldwell/Biohabitats/Center for Watershed Protection
  - Analyze current conditions - natural resources and water quality
  - Model potential impacts of development
  - Recommend protective measures, guidance for development, and ways to mitigate potential impacts
- Collaborating Partners
  - County Departments (e.g., Planning, DPS, DEP)
  - State and Federal Agencies (e.g., USGS, DNR, MDE)
  - Academic Institutions and Researchers (e.g., Clarksburg Monitoring Partnership)

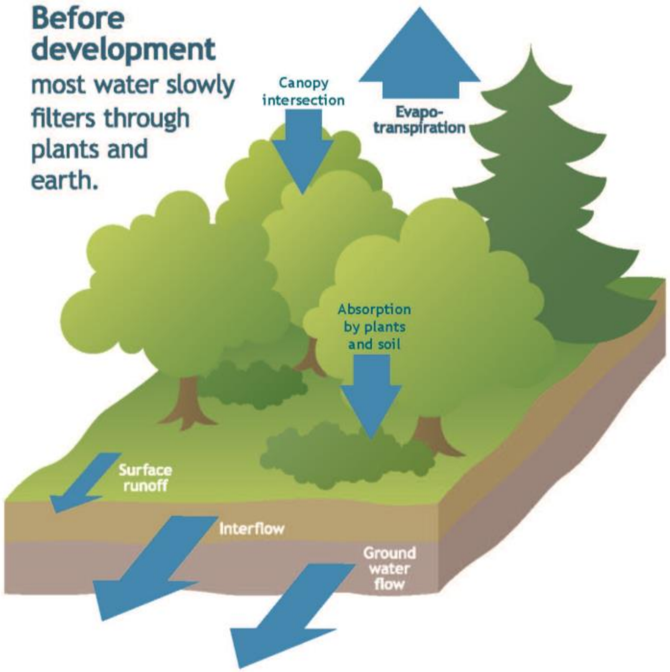
Outline

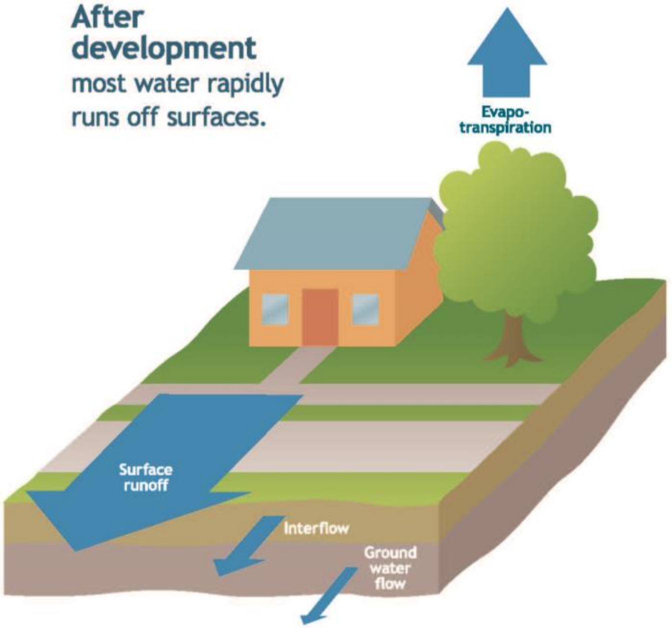
1. Consultant Team Background and Qualifications
2. Watershed Science Overview
3. Analysis Approach and Assumptions
   a) Existing Conditions
   b) Natural Resource Disturbance
   c) Spatial Analysis
   d) Hydrologic modeling
   e) Pollutant Loading
4. Findings and Recommendations

Changes in Watersheds Resulting from Development



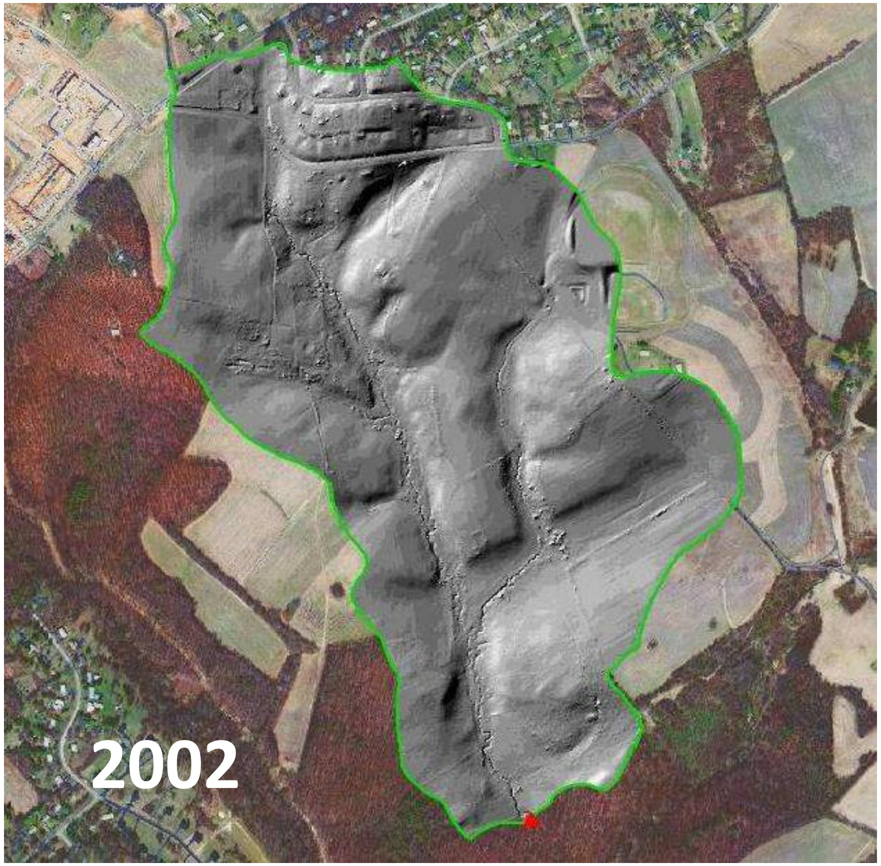
Changes in Watersheds Resulting from Development



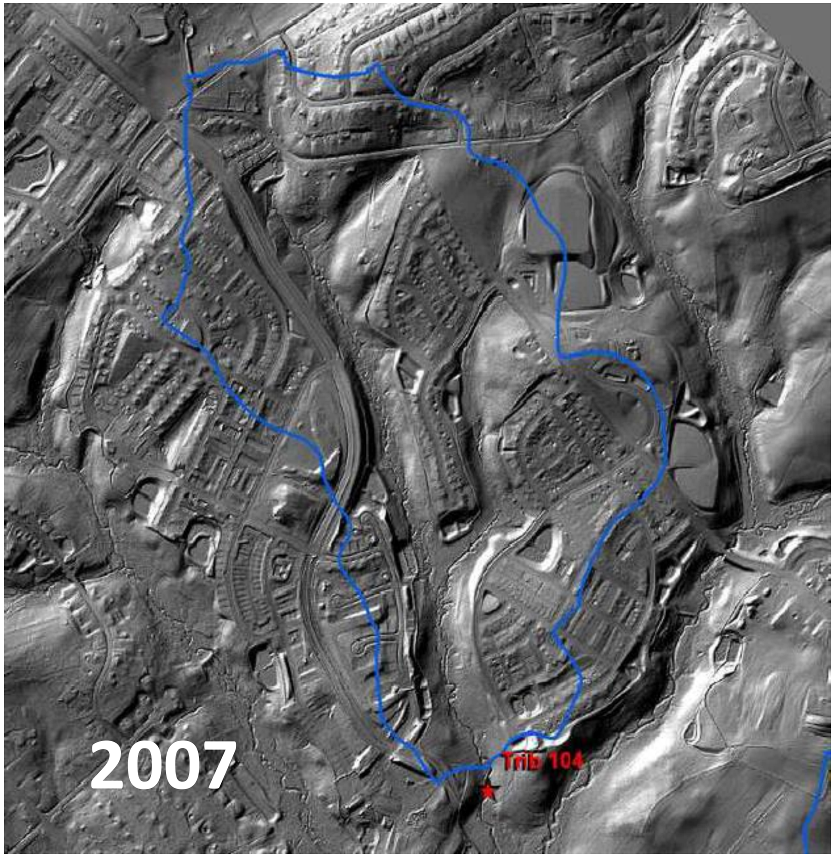


MONTGOMERY COUNTY PLANNING DEPARTMENT

Clarksburg Before Development



Clarksburg After Development

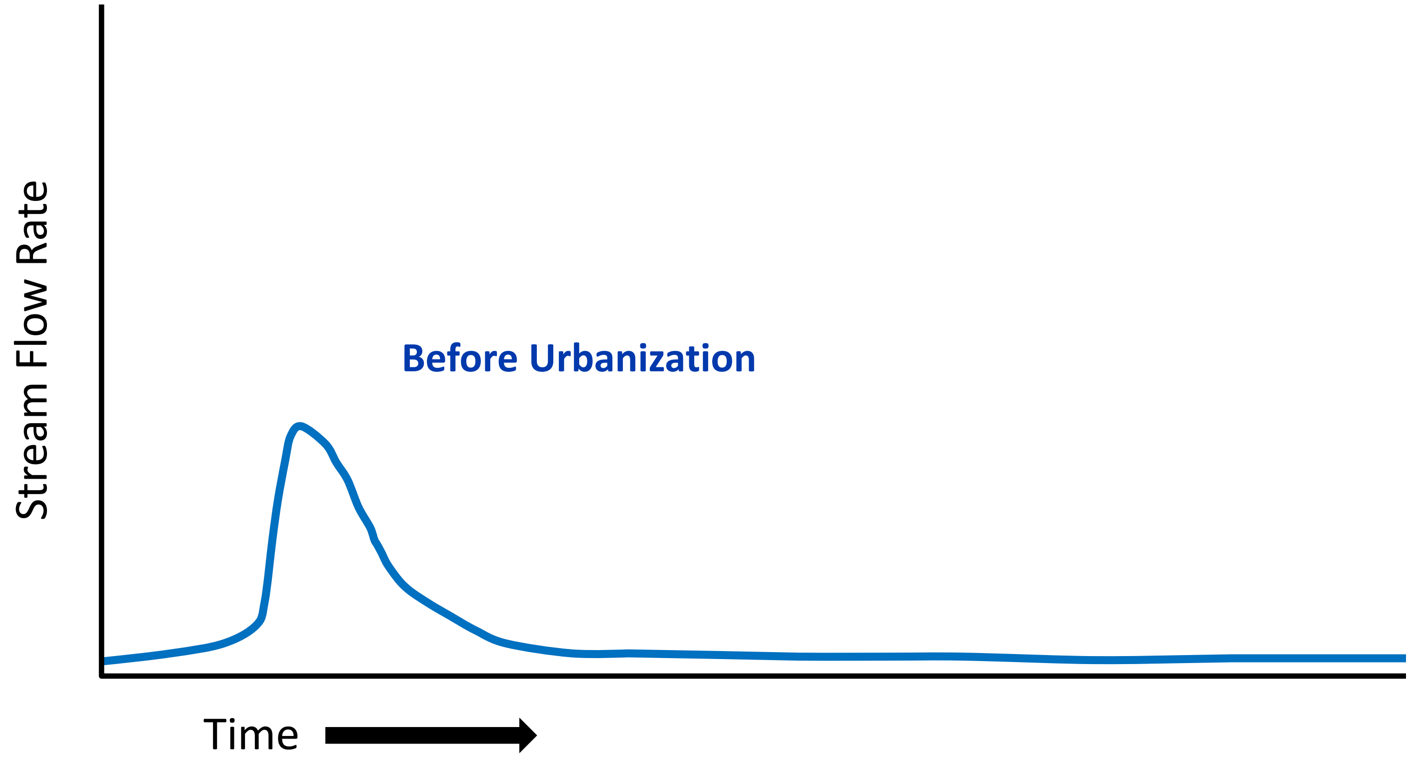


LIDAR Data showing actual land surface

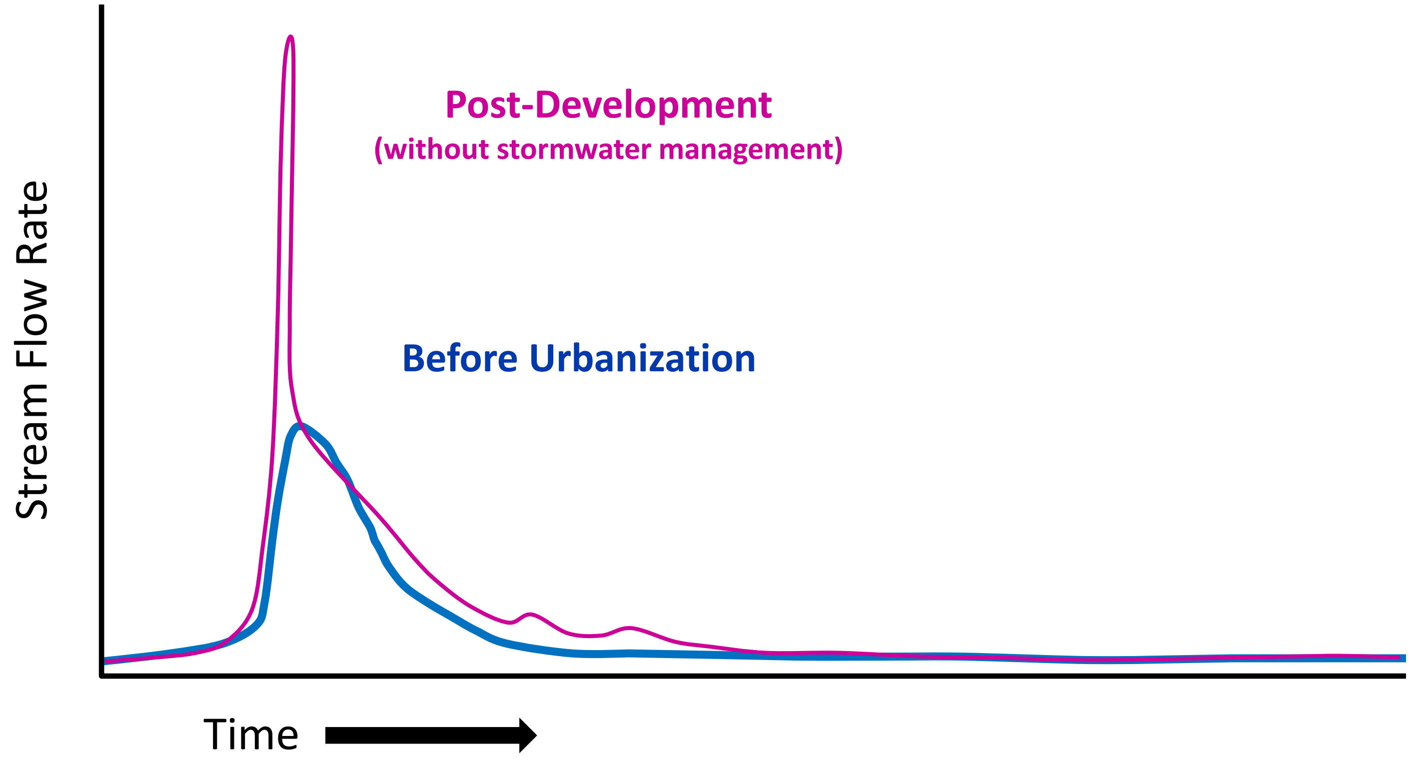
Pathway of Runoff to Streams

RUNS OFF IMPERVIOUS SURFACE **FLOWS INTO STORM DRAIN** **DISCHARGES TO STREAMS**

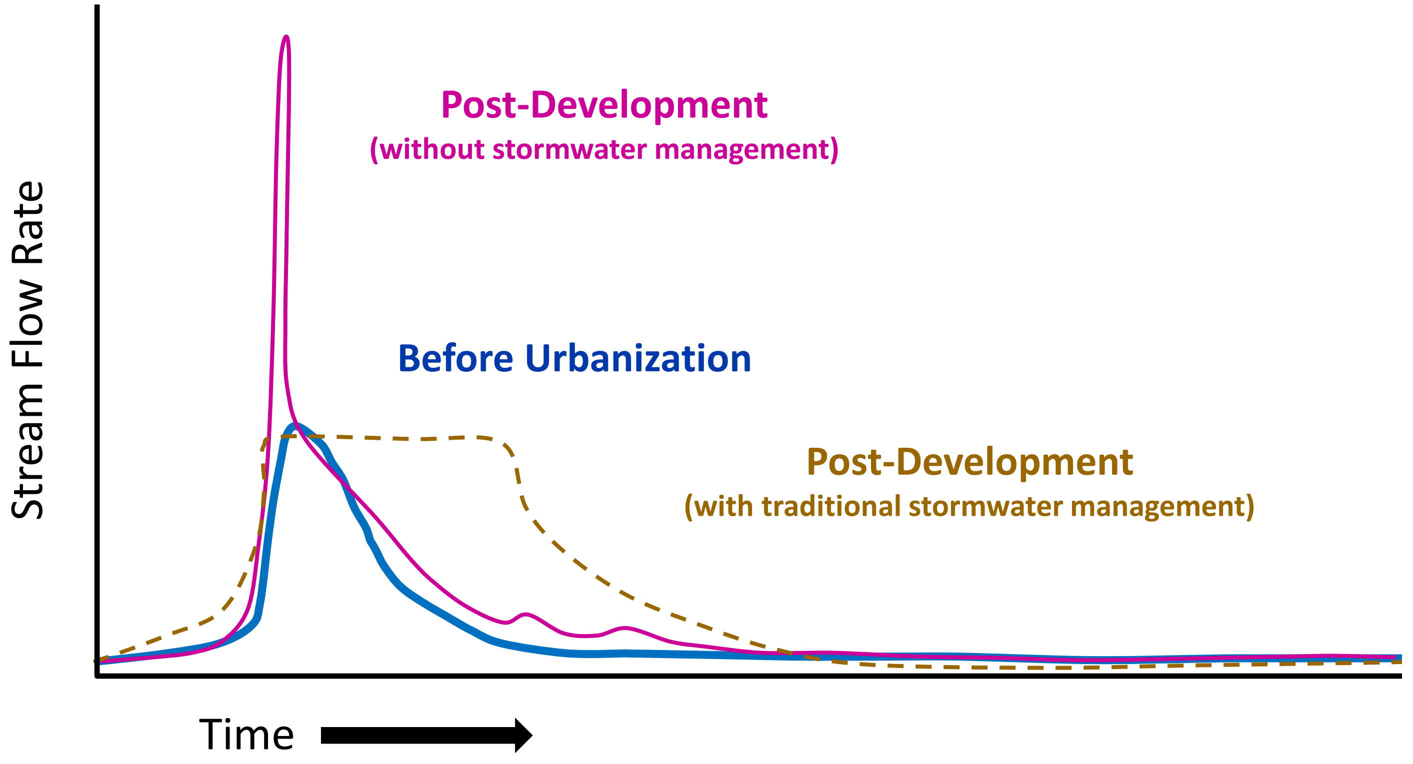
Change in Volume and Rate Affects the Hydrograph



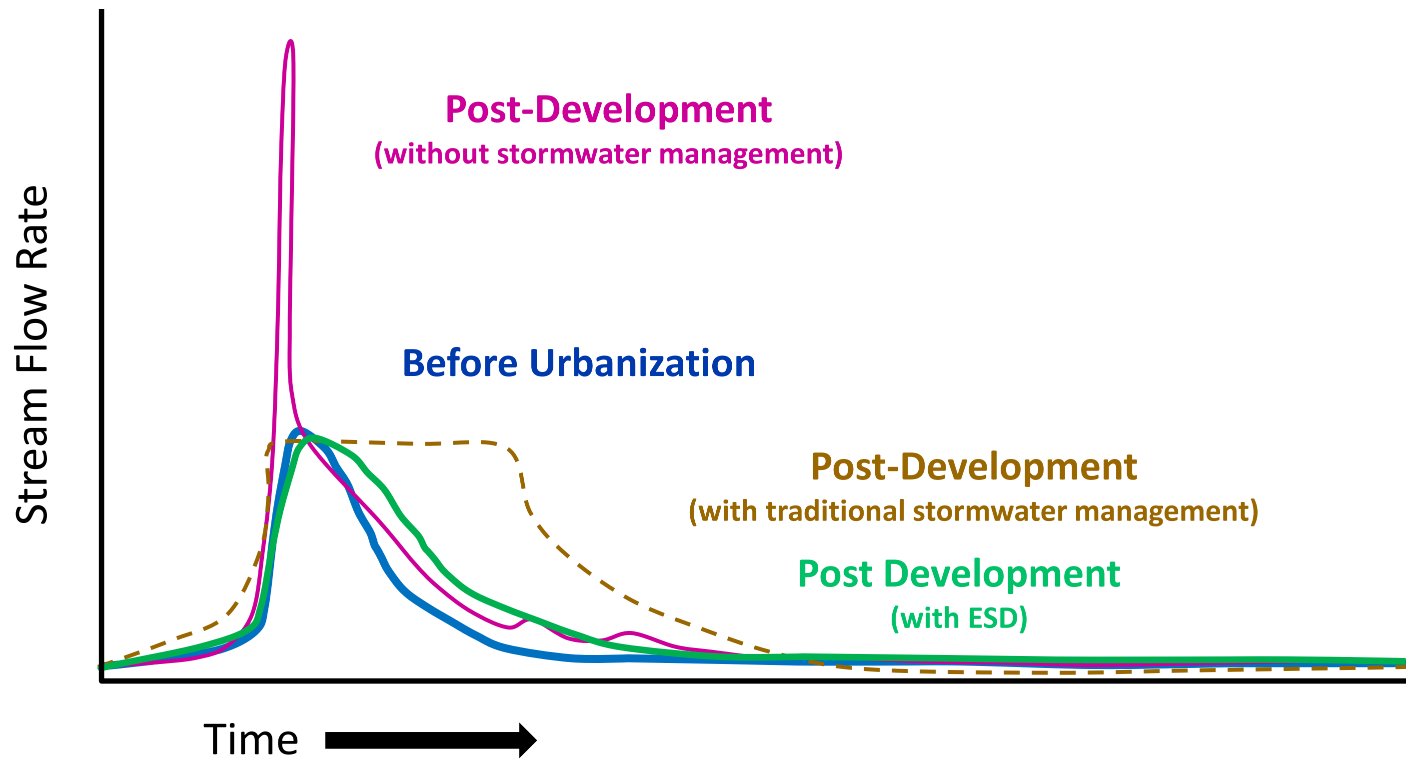
Change in Volume and Rate Affects the Hydrograph



Change in Volume and Rate Affects the Hydrograph



Change in Volume and Rate Affects the Hydrograph



Hydrology

More frequent flooding

Changes in baseflow

Increased flood peaks

Geomorphology (Stream Form)

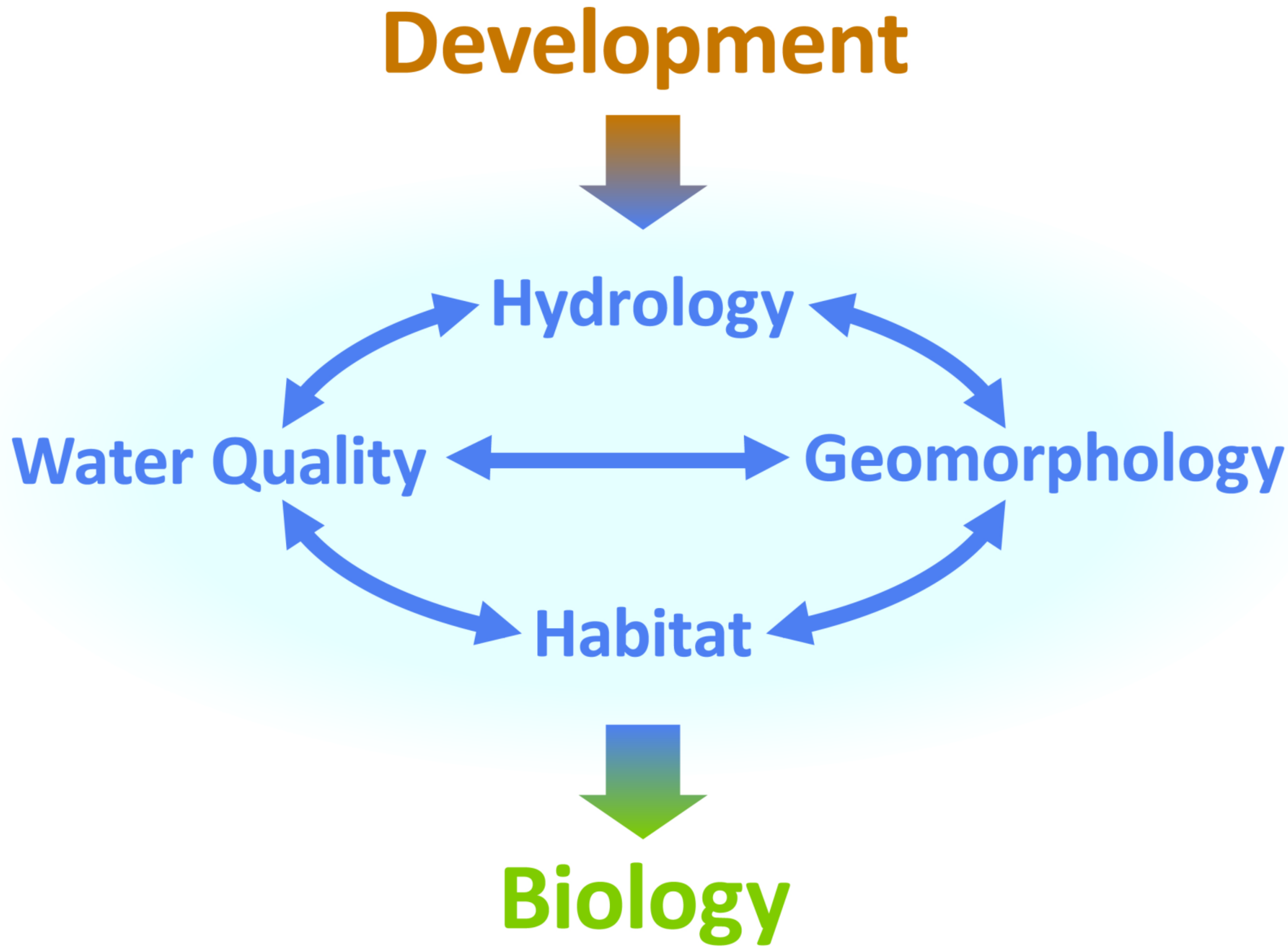
INCREASING DEVELOPMENT IN WATERSHED

Water Quality

Habitat and Aquatic Life

Habitat and Aquatic Life

Changes in Watersheds Resulting from Development



Ecosystem Services Provided by Healthy Watersheds

- Carbon sequestration
- Return of water to the air by evapotranspiration
- Release of oxygen to the air
- Contiguous upland and riparian habitats
- Terrestrial and aquatic plant and animal communities
- Natural soil structure and biology
- Infiltration and filtration of rainwater
- Surface and ground water flow and treatment
- Moderation of air and water temperature
- Minimal pollution inputs
- Nutrient and sediment processing

Different Stormwater Practices

- Stormwater Before in Clarksburg
  - Focused on retention, detention and filtering
  - Gradual release of water to stream to reduce immediate impact
  - Special Protection Area requirements also included measures in series

- Environmental Site Design
  - Designed to more closely mimic natural systems in terms of how water gets to the stream
  - More, smaller treatment systems closer to the source of the runoff
  - Cannot replace the biological and nutrient cycling components of natural systems (plants, animals, carbon sequestration, cooling effects)
  - Cannot eliminate the impact of development

Introduction to ESD

- Preserve natural features
- Better site planning and design
- Minimize the footprint of development
- Mimic natural hydrology
- Slow down and break up runoff
- Infiltrate and evapotranspire
- Small scale stormwater management practices distributed across sites

Typical Centralized Detention Pond

Small Scale, Integrated ESD Practices

ESD Landscape Positions

Rooftops

Parking Lots

Around Buildings

Walkways and Other Paved Areas

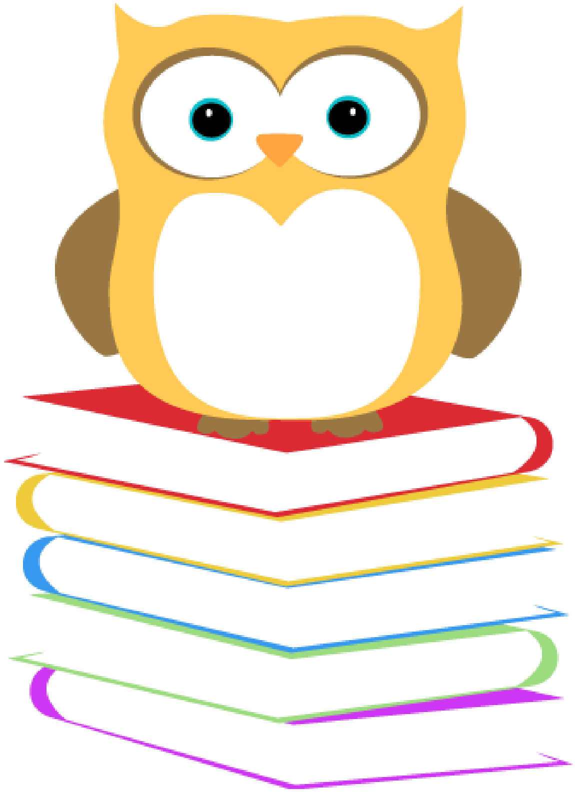
Streets and Streetscapes

Landscape

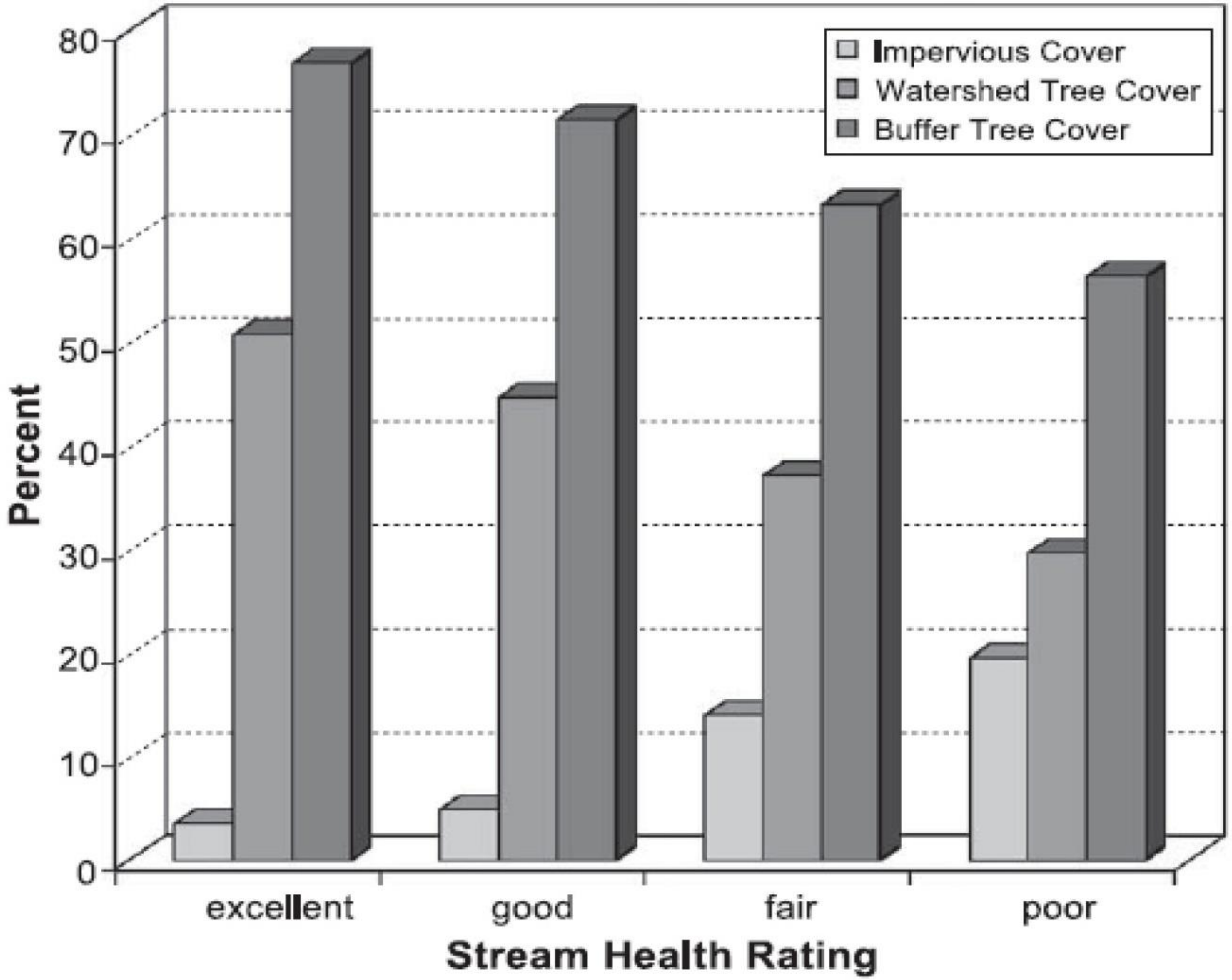
ESD Literature Review

Overview:

- Reviewed over 140 documents
- Focused on Impacts of Urbanization and Impervious Cover and Benefits of ESD on:
  - Hydrology
  - Water Quality
  - Habitat/Geomorphology
  - Biology



Impact of Montgomery County Land Cover on Stream Quality



(Goetz, 2003)

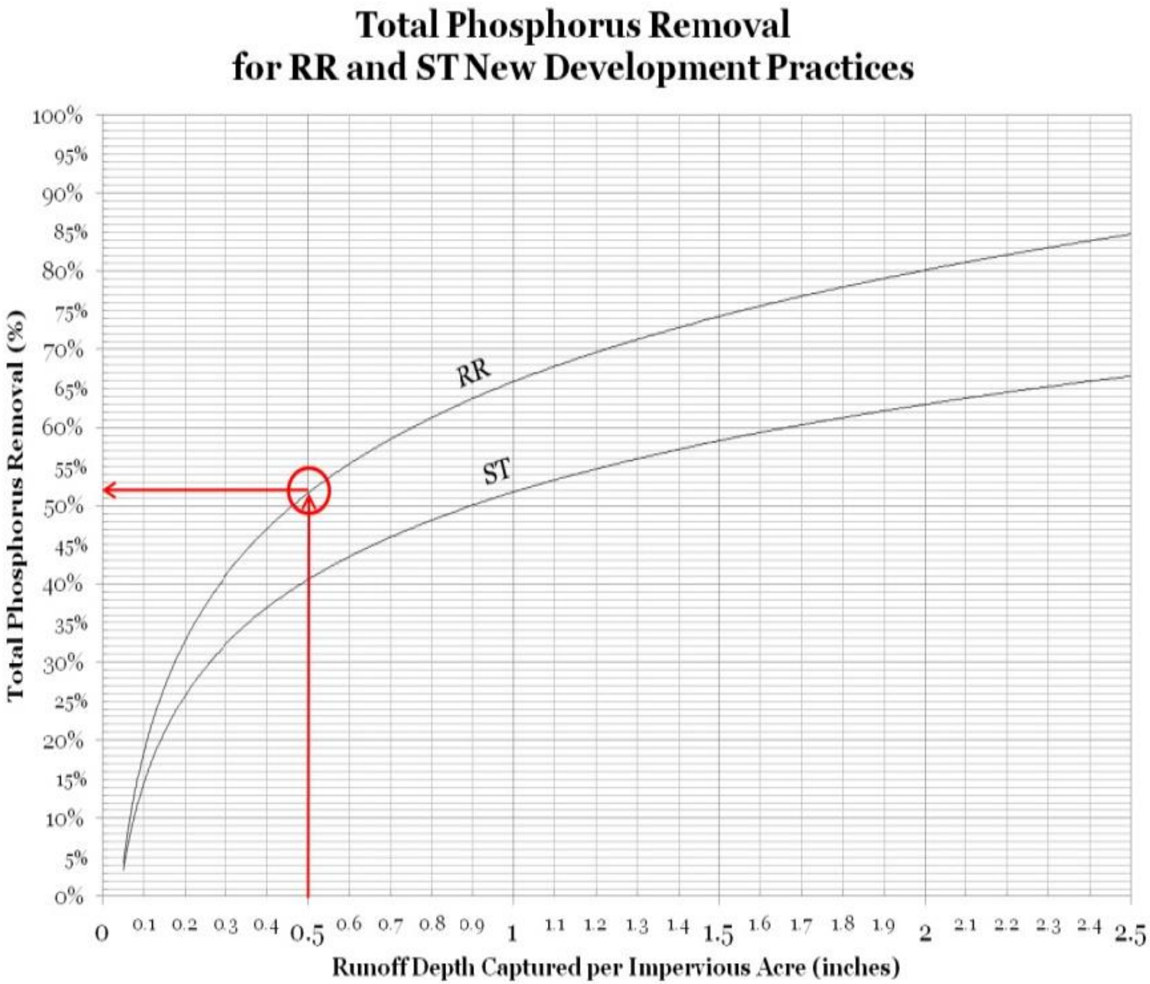
What is ESD Good At?

Hydrology:

- Excellent performance for reducing runoff volumes

Water Quality

- Pollutant removal is typically better than traditional BMPs
- Better than ponds for in-stream temperature



ESD Limitations

Hydrology/Water Quality:

- Mixed results in attaining actual "pre-developed condition" performance.
- Practices still can't remove all pollutants and chemicals

Habitat:

- Can't fix direct impacts, such as loss of natural drainage areas
- Can't reproduce all the functions of forest and undisturbed soils

Biology:

- No examples of ESD preserving or enhancing in-stream biology

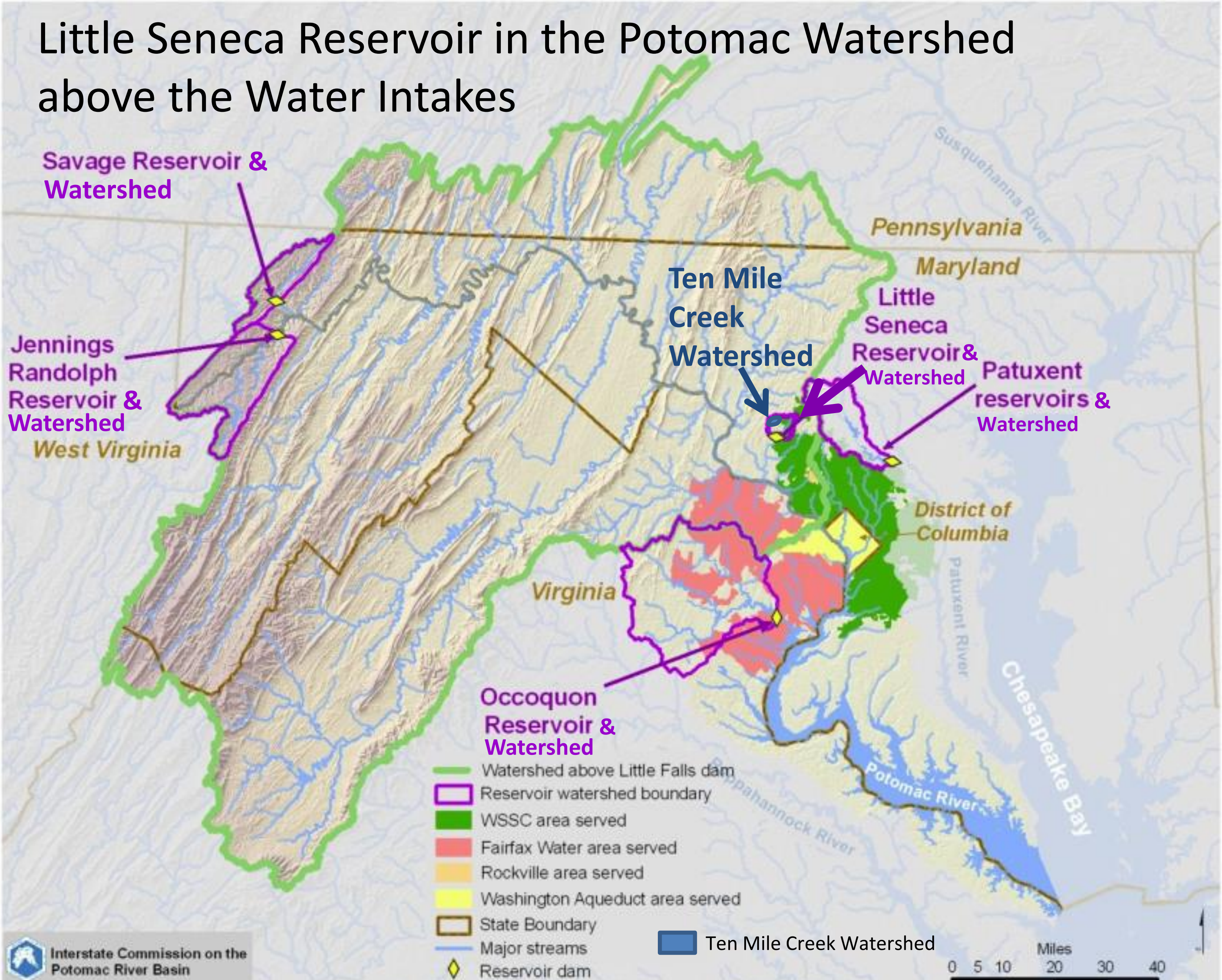
Outline

1. Consultant Team Background and Qualifications
2. Watershed Science Overview
3. Analysis Approach and Assumptions
    a) Existing Conditions
    b) Natural Resource Disturbance
    c) Spatial Analysis
    d) Hydrologic modeling
    e) Pollutant Loading
4. Findings and Recommendations

Science-Based Approach to Analysis

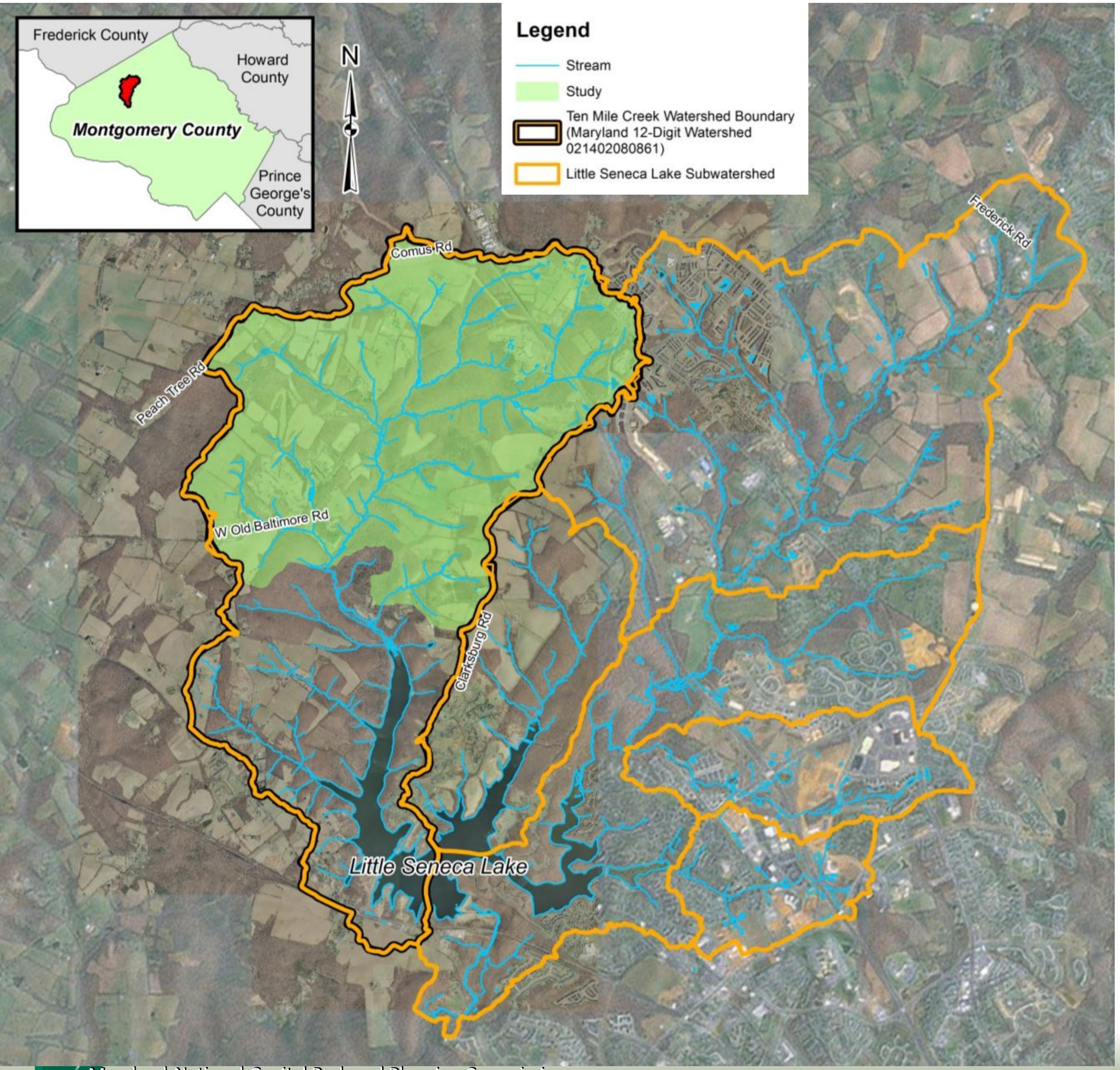
- Combination of approaches used to formulate recommendations
  - Scientific literature review
  - Documentation of existing watershed conditions
  - Field observations
  - Natural resource disturbance and spatial analysis
  - Hydrologic modeling
  - Pollutant load analysis
- Planning level study
  - Consistent level of detail and assumptions across the study area used to evaluate both existing conditions and different master planning scenarios
  - All scenarios studied relative to existing conditions

Little Seneca Reservoir in the Potomac Watershed above the Water Intakes



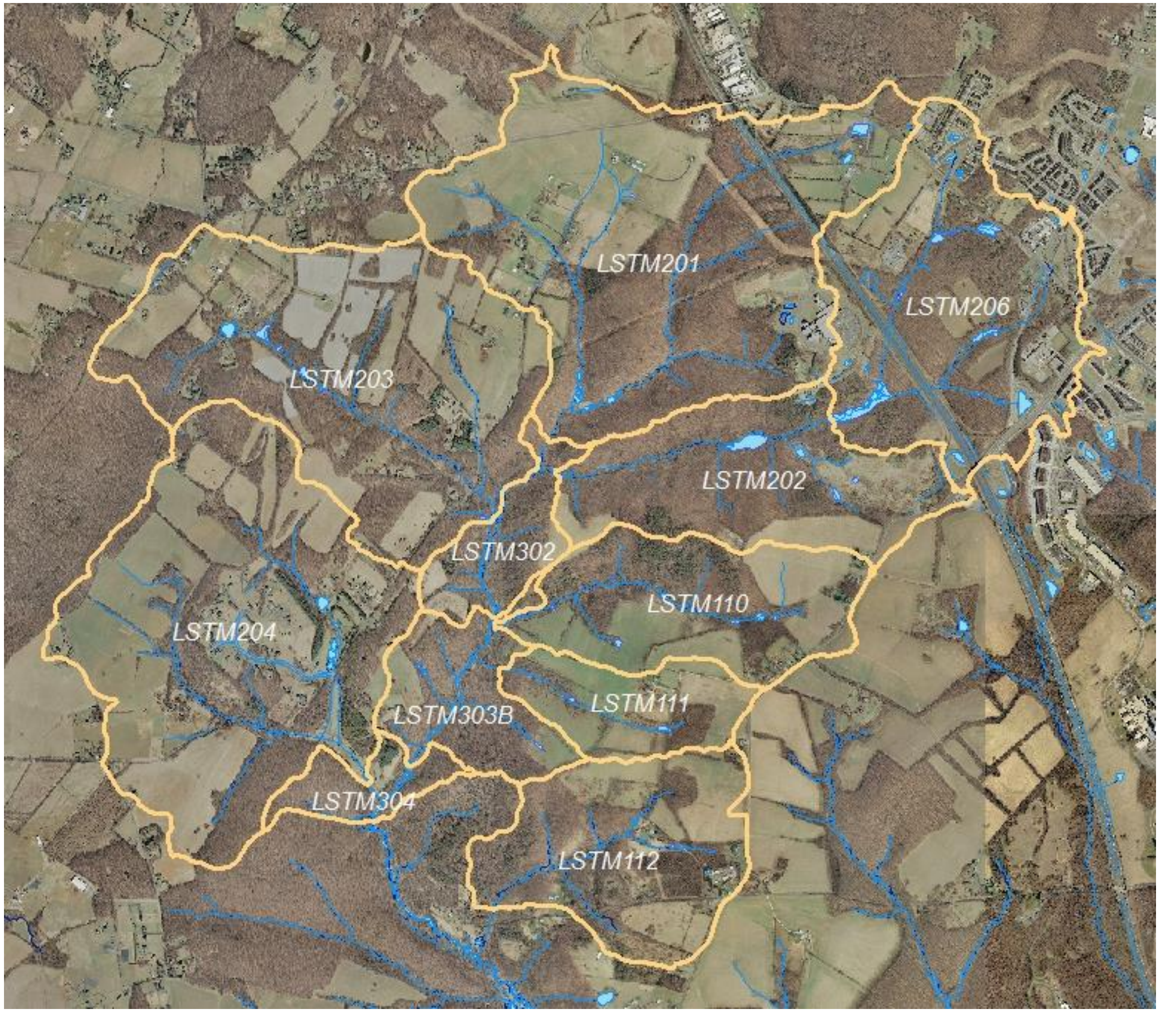
MONTGOMERY COUNTY PLANNING DEPARTMENT

Little Seneca Lake & 10 Mile Creek

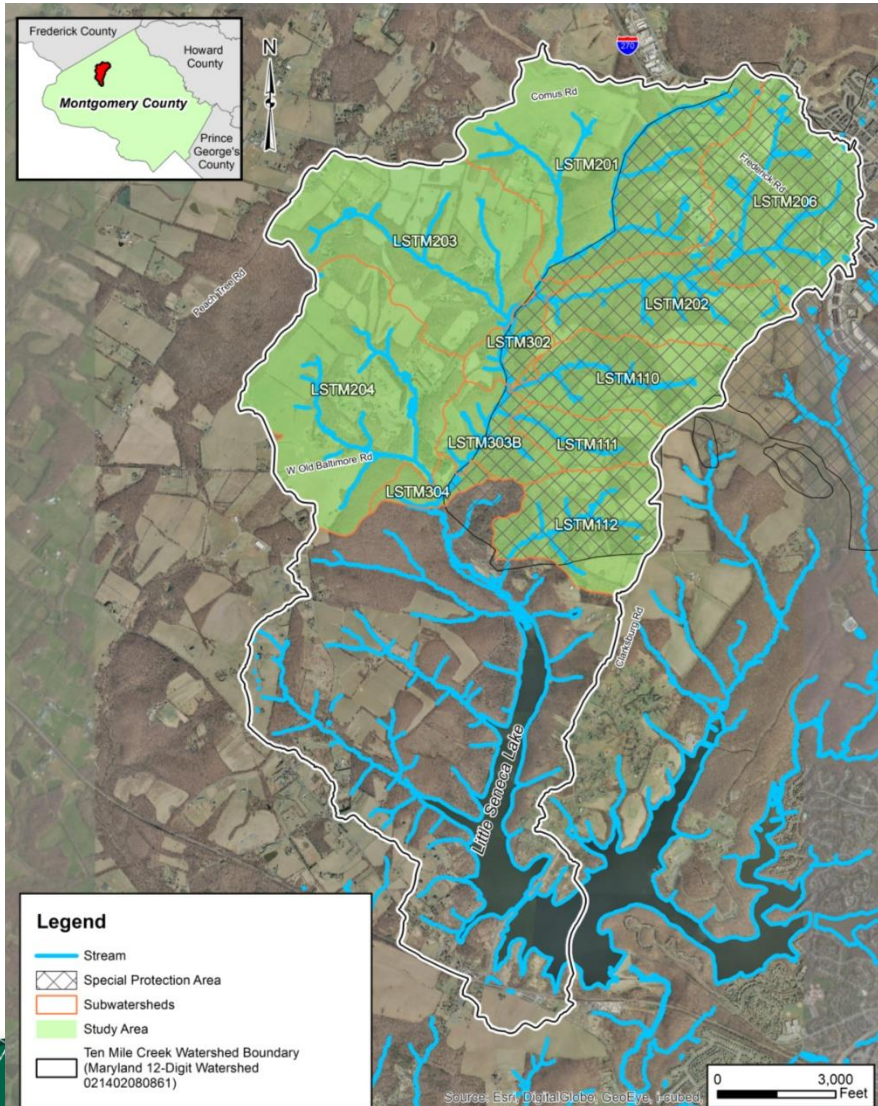


- Originates just north of Frederick Road
- Drains to Little Seneca Lake
- 4.8 square miles with 22 miles of stream
- Dominated by forest cover & agricultural land uses west of I-270
- Eastern portion within Clarksburg Special Protection Area (SPA)

Sub Watersheds



Understanding Existing Conditions



Land Use and Land Cover

Community Features

- Existing Infrastructure
- Stormwater Management

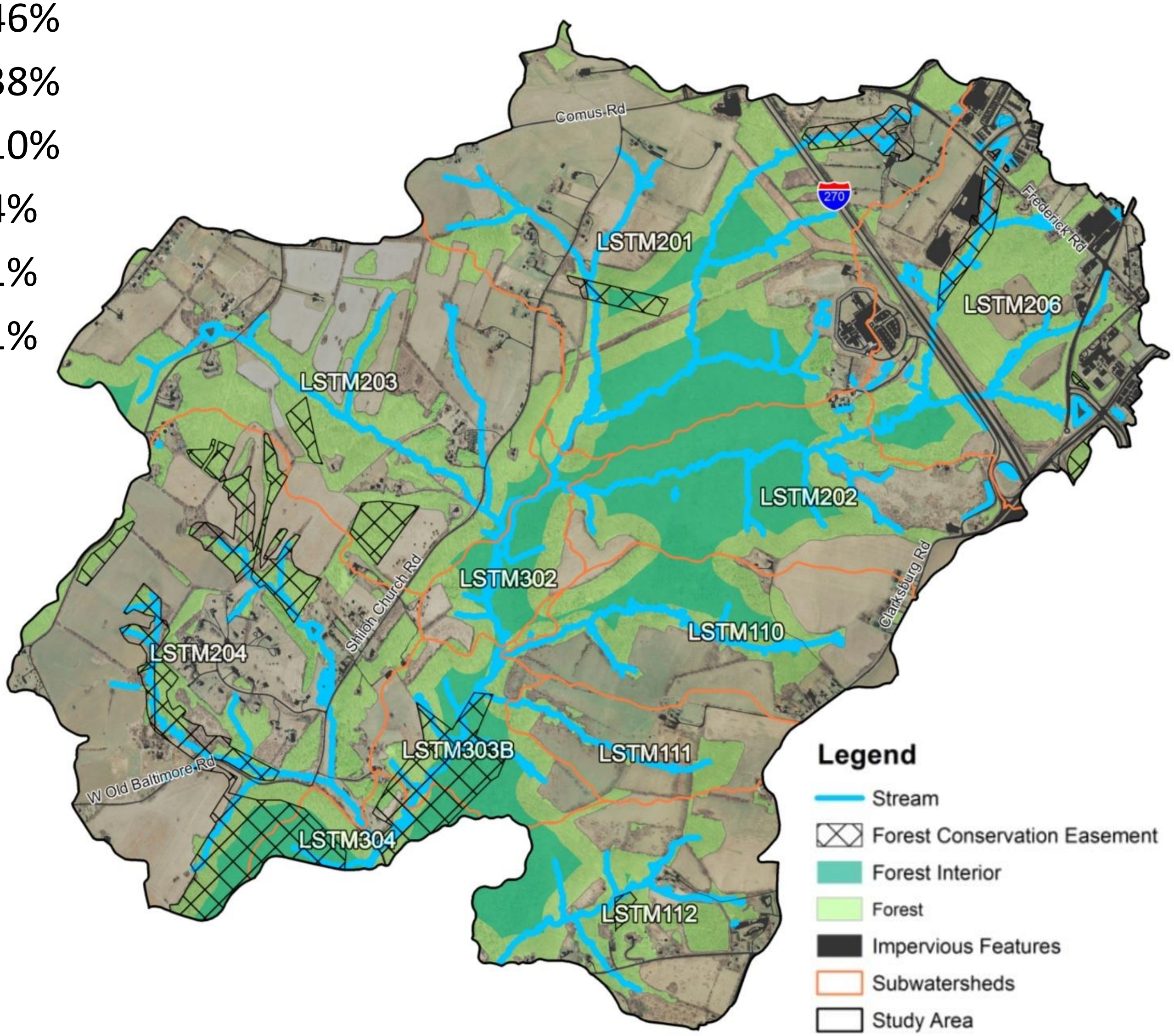
Natural Features

- Hydrology
- Geomorphology
- Water Quality
- Habitat
- Biology

MONTGOME

Existing Land Cover

Forest	46%
Cropland & Pasture	38%
Other Pervious	10%
Imperviousness	4%
Bare Ground	1%
Water & Wetlands	1%



Existing Imperviousness

Subwatershed Boundaries

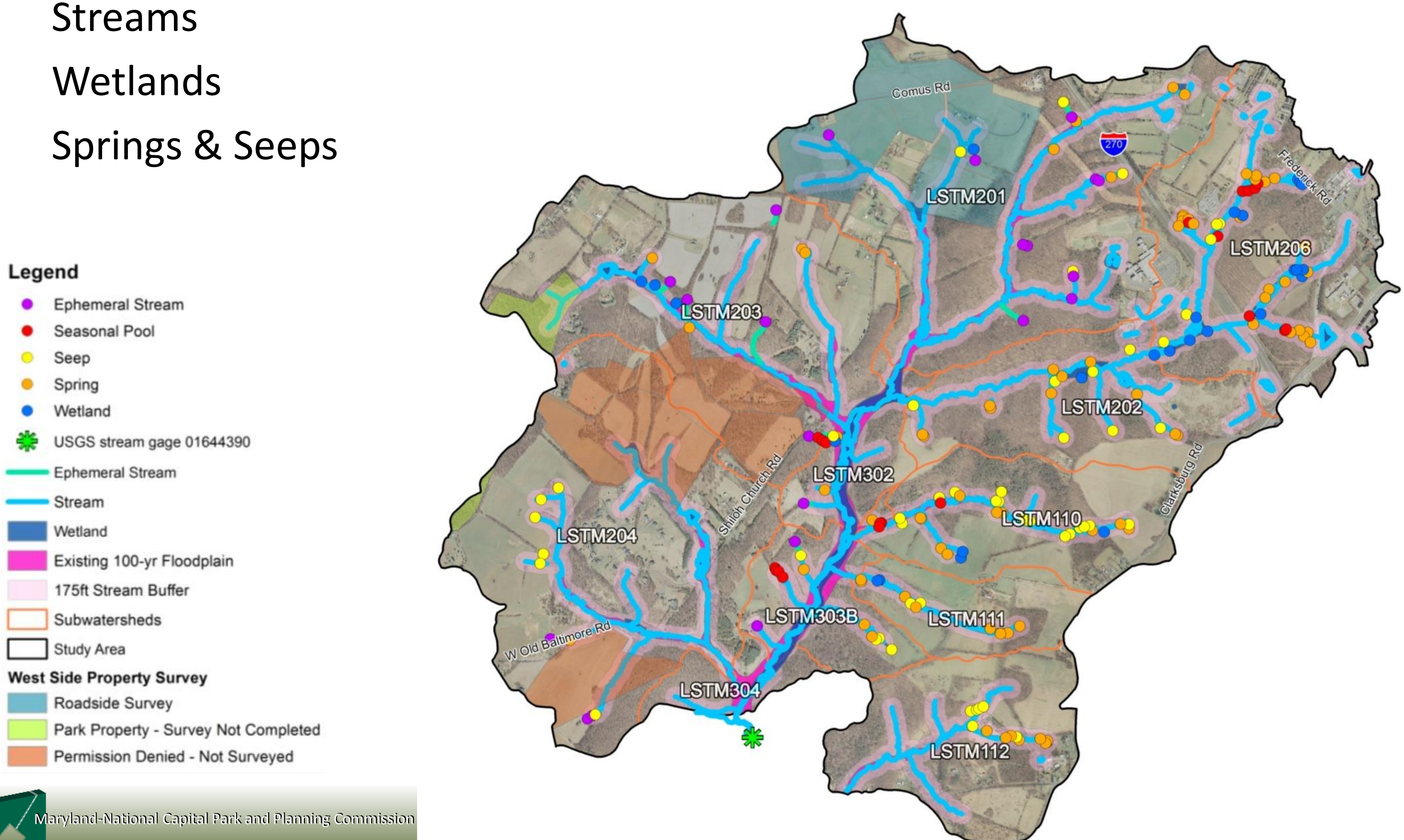
Subwatershed Imperviousness

Scenario_1

- 0.0 - 0.05
- 0.05 - 0.08
- 0.08 - 0.12
- 0.12 - 0.40

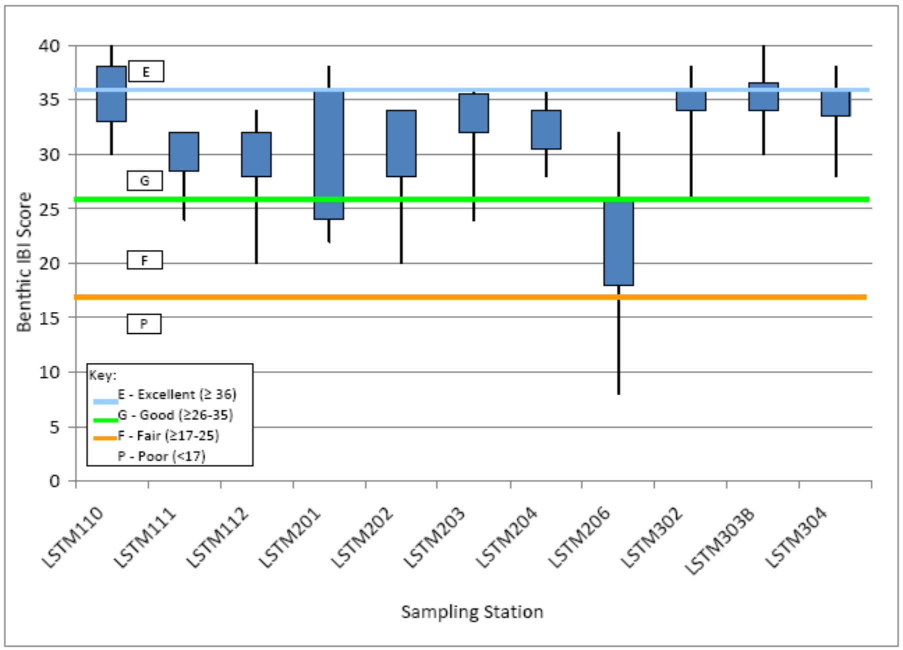
Hydrology

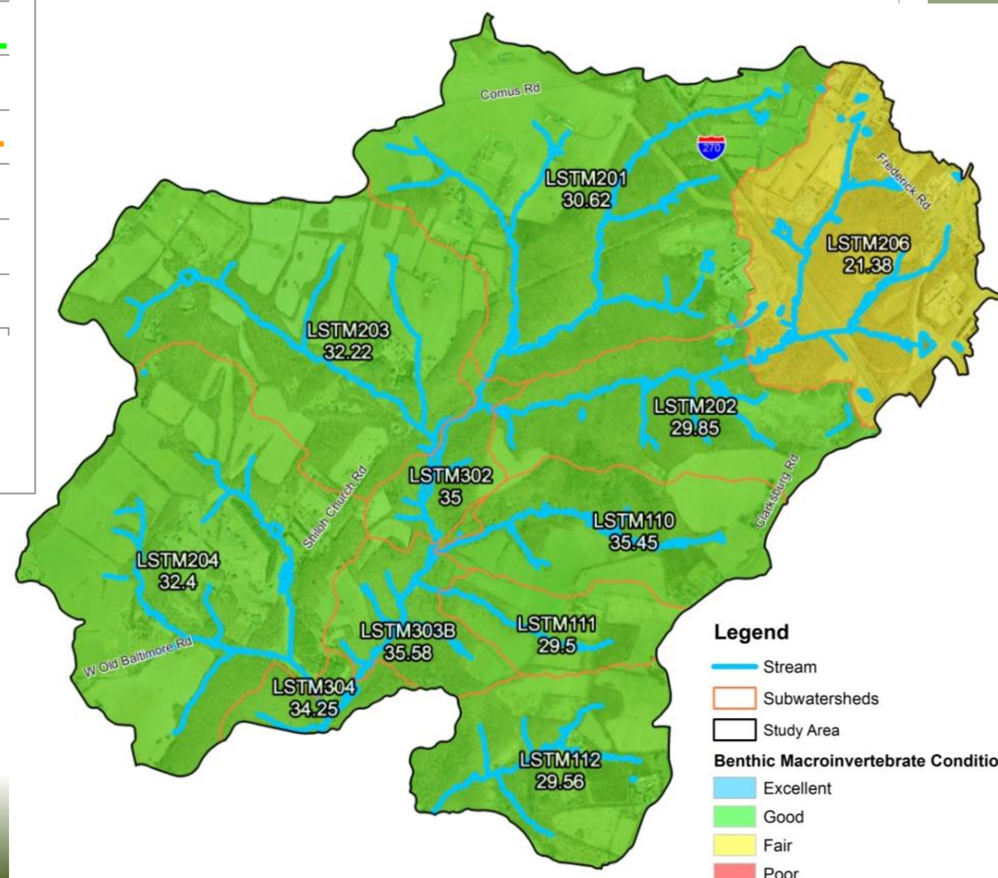
- Streams
- Wetlands
- Springs & Seeps



Stream Health
Aquatic Habitat & Biology

Benthic IBI, Average, 1994-2012



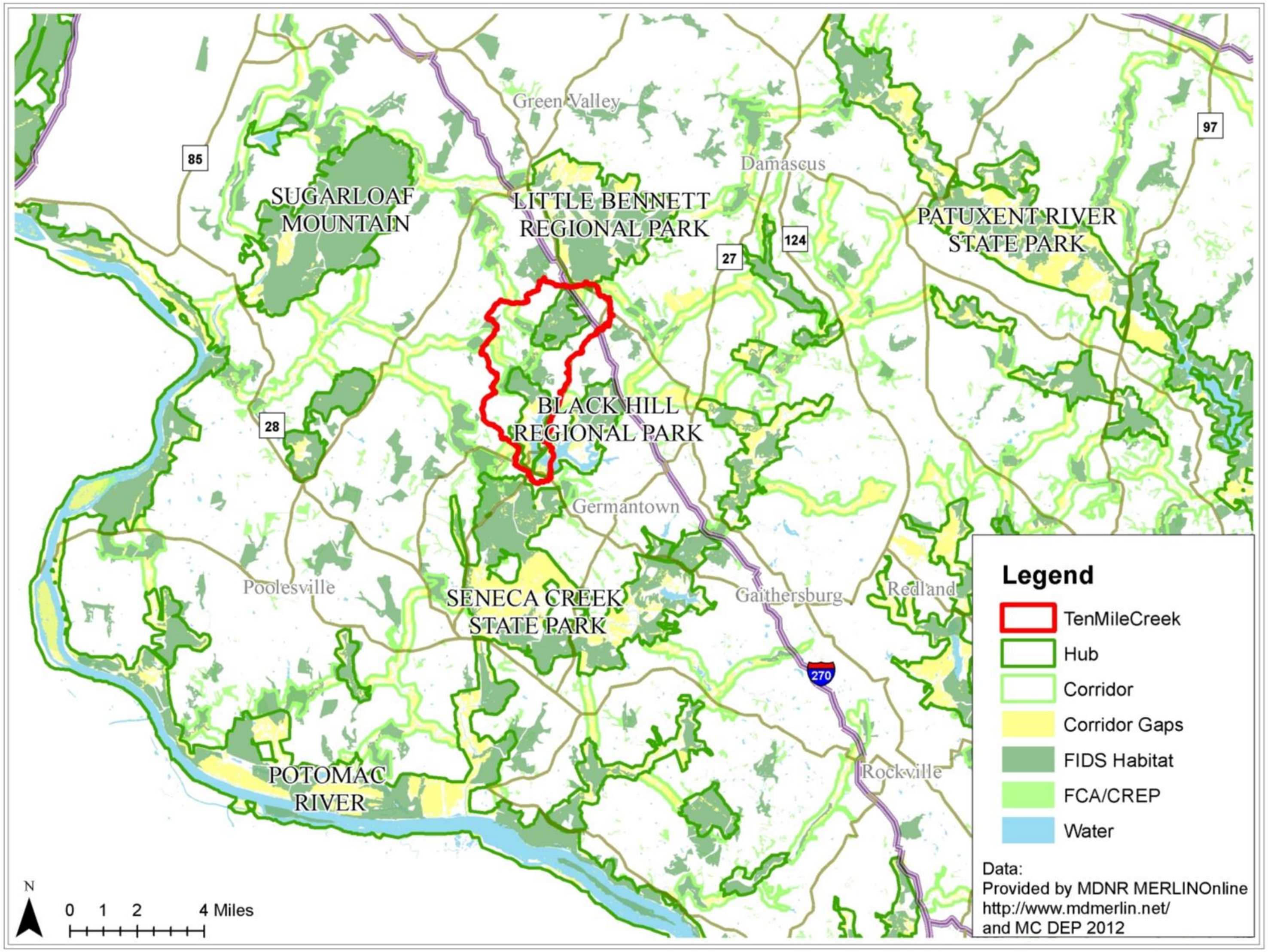


Upland Habitat & Biology

Hubs

Corridors

Gaps



High Quality & Sensitive Conditions

- Long-term monitoring indicates overall biological condition is healthy & diverse.
- Majority of the streams are small and spring fed with cool, clean groundwater (headwater streams).
- Mainstem characterized by high concentrations of interior forest and wetlands.
- Stable channels with good access to the floodplain.
- Distinct areas of steep slopes and erodible soils.
- **One of a small group of high quality watersheds still remaining within the County (e.g., many Patuxent River tributaries, Bennett Creek, and Little Bennett Creek).**
- **Reference stream in Montgomery County.**

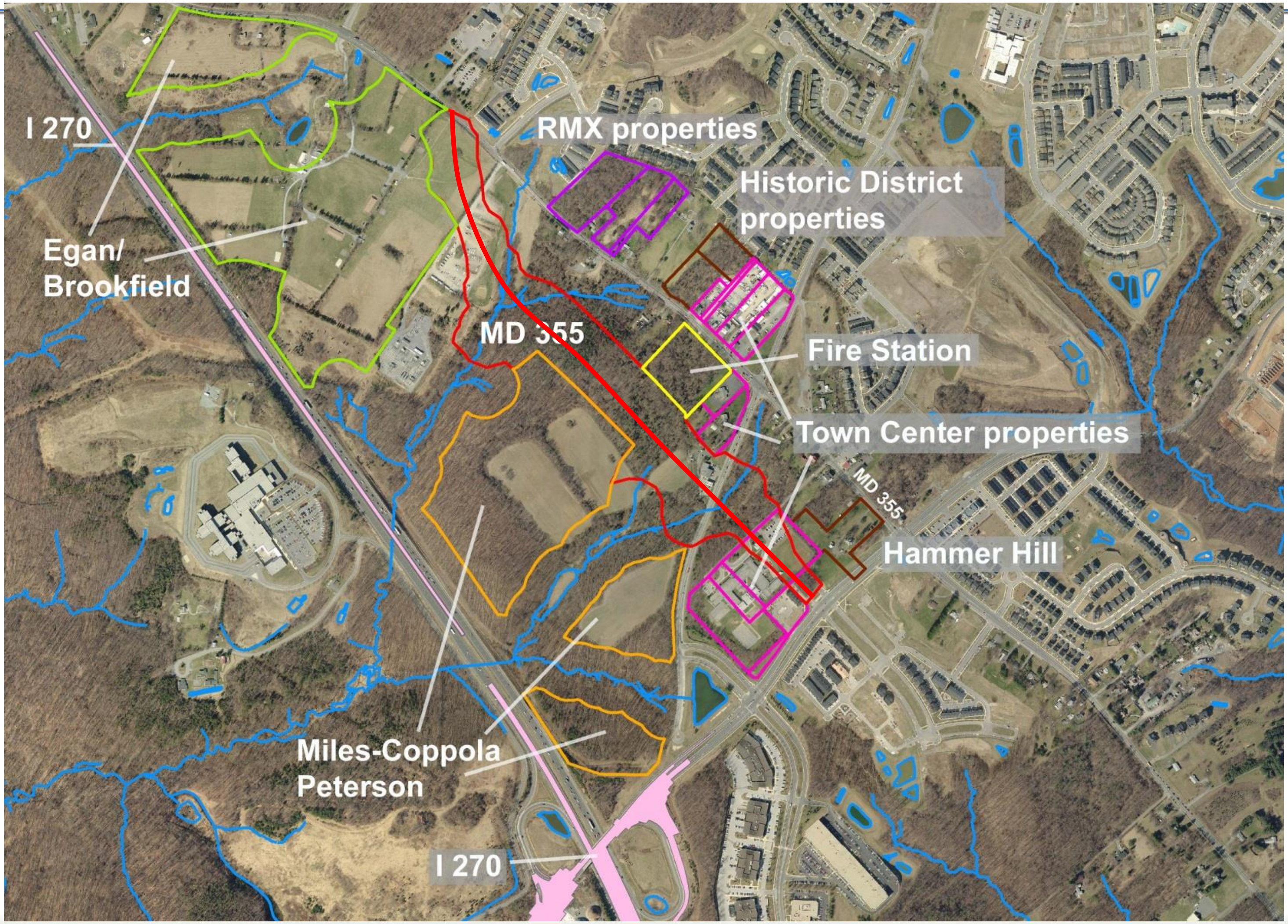
Development of Scenarios to Test

- Used the 1994 plan as a guide to address both community building and environmental goals
- Based impervious projections for each site on examples of similarly zoned land
- Residential zones and commercial zones at higher densities result in similar amounts of imperviousness
- Used a wider range of residential scenarios and county property development on the west side of I-270
- Limits of disturbance defined:
  - For east side, a grading study was done to look at the interaction of the bypass and development envelopes
  - For the west side, a reduced LOD was drawn to minimize grading and protect environmental resources

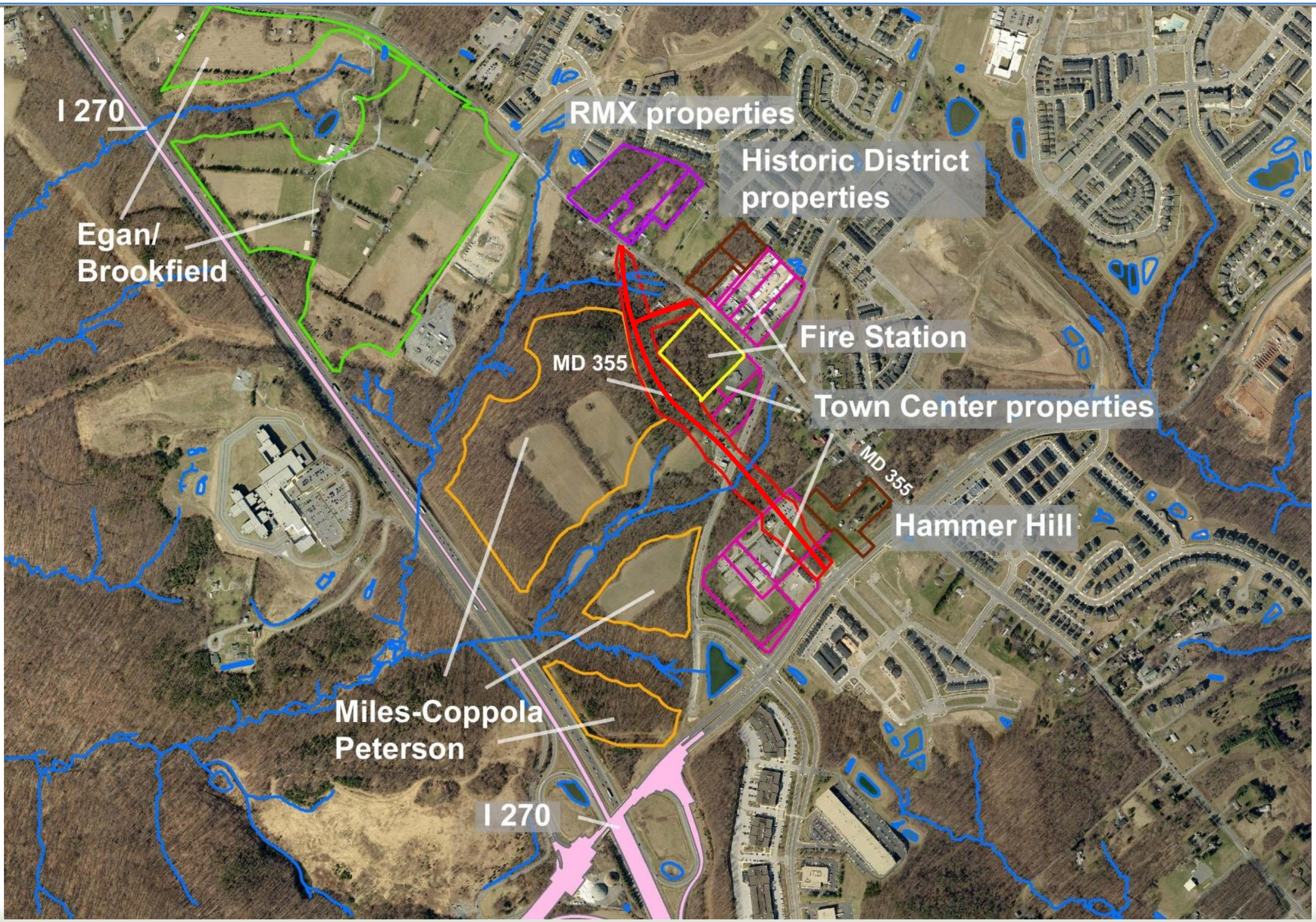
Scenarios Tested

2. **1994 Plan** - The 1994 Clarksburg Master Plan recommendations for density and land use in Stage 4, assuming full ESD
3. **1994 Plan - Reduced Footprint, Same Yield** - The same as Scenario 2, but with a reduced development footprint for the Pulte properties. Assumes approximately the same number of units permitted by the 1994 plan, but on less land.
4. **1994 Plan - Reduced Footprint, Lower Yield** - The same as Scenario 2, but with the same residential mix for the Pulte property recommended in the 1994 Plan resulting in fewer units.
5. **7% Watershed Imperviousness** – The same as Scenario 3, but a reduced yield and imperviousness on Miles/Coppola, Egan, and the County properties, with slightly less development on the Pulte property.

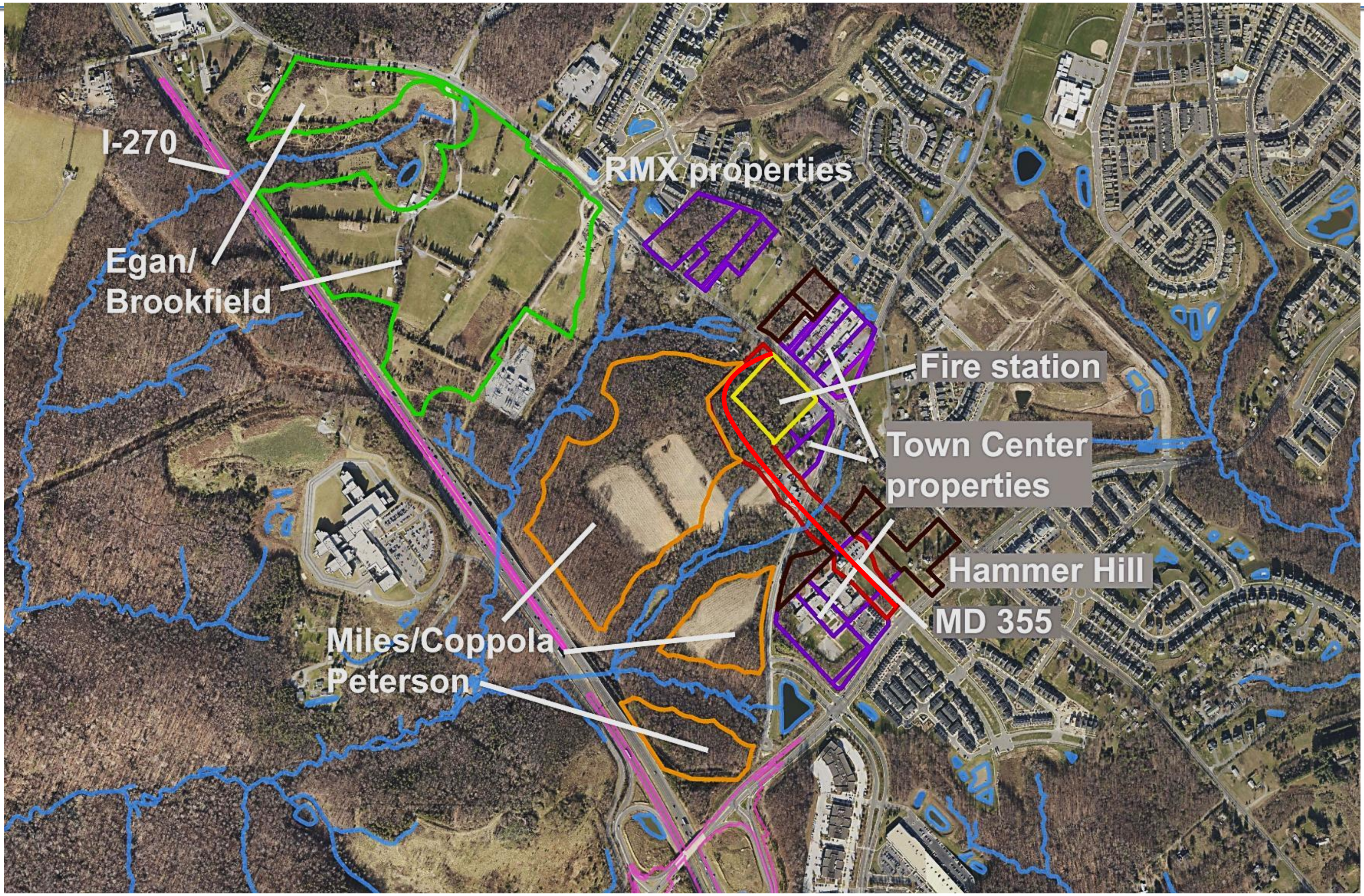
East Side I-270 - Scenario 2



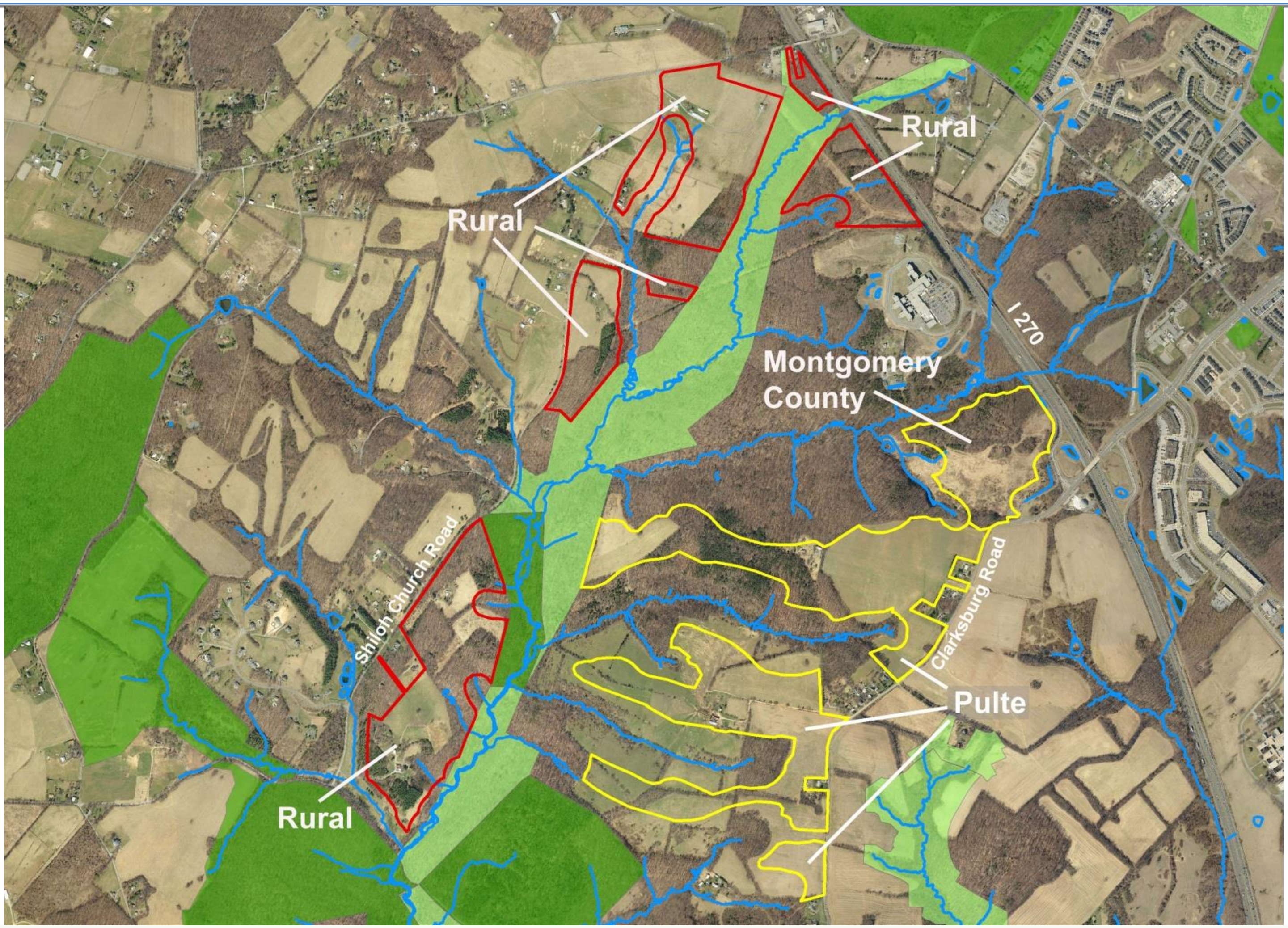
East Side I-270 - Scenarios 3 and 4



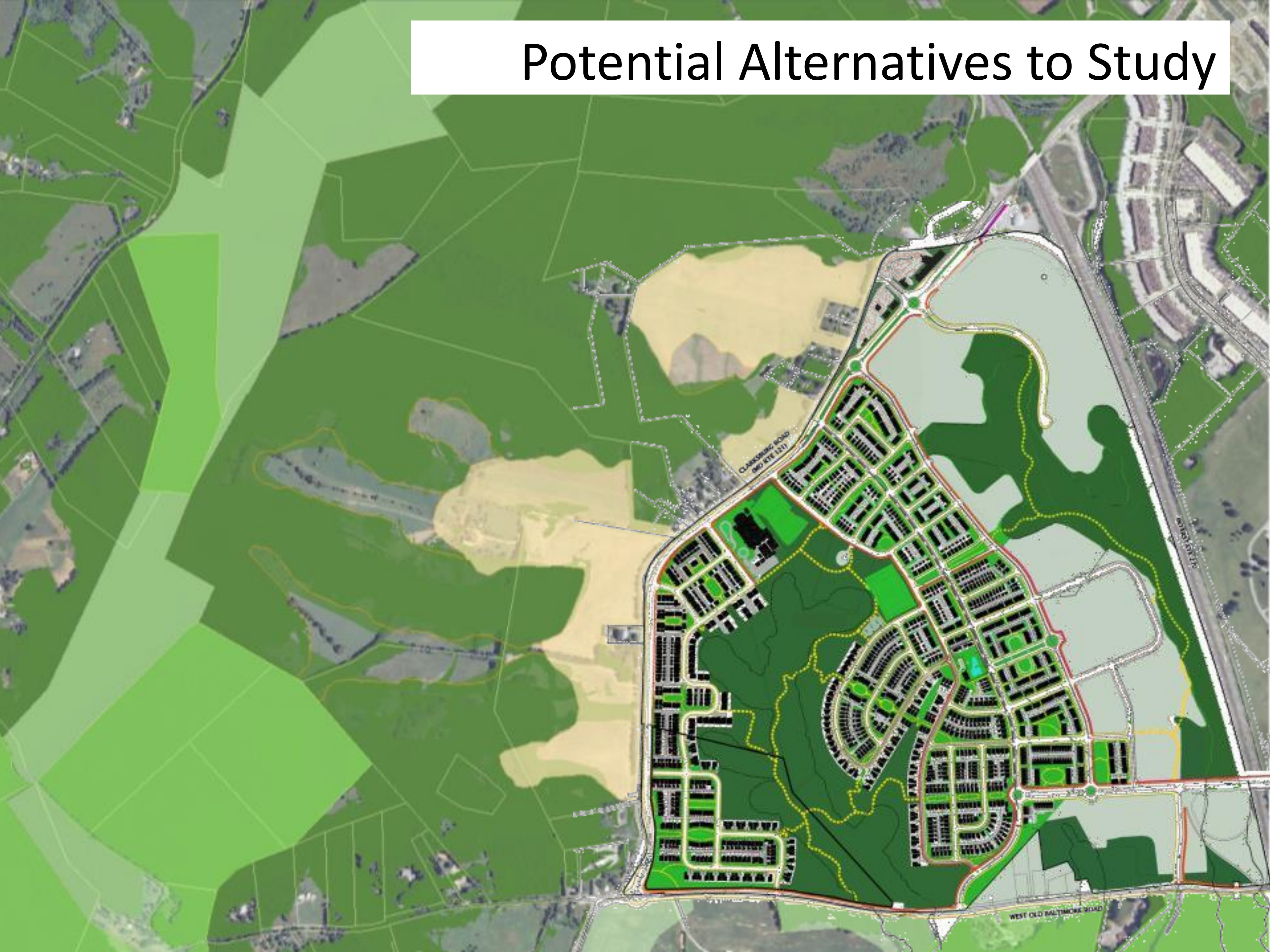
Scenario 5


I-270
RMX properties
Egan/
Brookfield
Fire station
Town Center
properties
Hammer Hill
MD 355
Miles/Coppola
Peterson

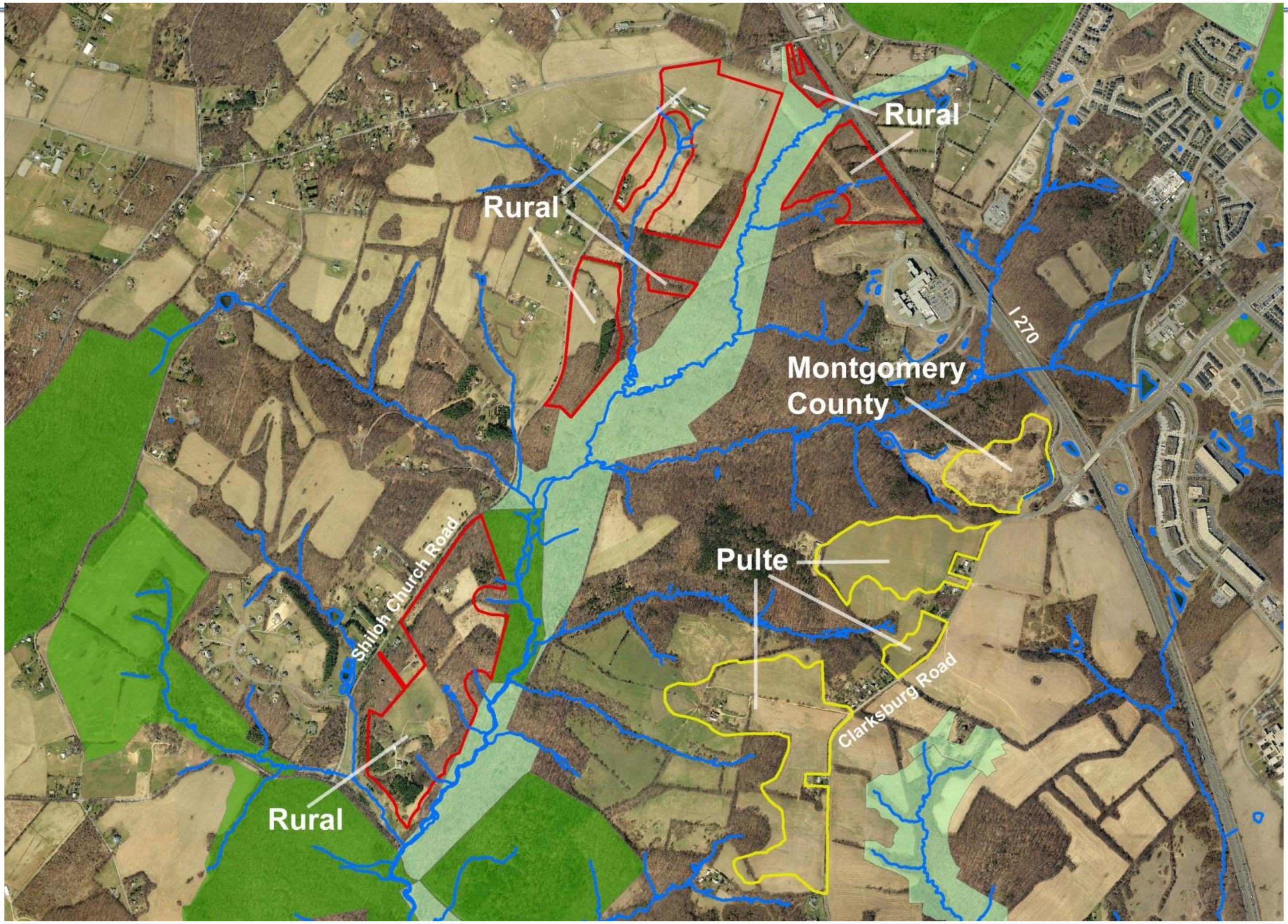
West Side I270 - Scenario 2



Potential Alternatives to Study



West Side I270 - Scenarios 3, 4 and 5



Scenarios Tested

	Existing Condi-tions	Scenario 5: 7% Impervious-ness	Scenario 4: Reduced Footprint, Reduced Density	Scenario 3: Reduced Footprint, 1994 Density	Scenario 2: 1994 Plan (as modeled)
Egan	Existing	R200 (20%)	PD4 (31%)	PD4 (31%)	PD4 (28%)
Miles/Coppola	Existing	CR (20%)	MXPD (30%)	MXPD (30%)	MXPD (26%)
Fire Station	Existing	Build (37%)	Build (37%)	Build (37%)	Build (37%)
Historic Dist.	Existing	Build	Build	Build	Build
Bypass	Existing	Build shorter	Build shorter	Build shorter	Build total length
Clarkwood	Existing	No Dev	No Dev	No Dev	RE1/TDR (12.5%)
County Depot	Existing	0%	8%	8%	RE1/TDR & I-3 (15%)
County Detention	Existing	4.5%	4.5%	4.5%	15%
Pulte	Existing	RNC (7% cap)	RNC (7.5% cap)	RNC (9% cap)	RE1/TDR (12.5%)
Impervious in LSTM110 , 111	1.6%, 1.2%	7.5%, 9.7%	7.9, 10.4%	9.3%, 12.2%	13.5%, 15%
Overall Imp.	4+%	7.0%	8.4%	8.5%	9.3%

LOWER RISK → HIGHER RISK

Scenarios Results

	Existing Conditions	Scenario 5: 7% Impervious-ness	Scenario 4: Reduced Footprint, Reduced Density	Scenario 3: Reduced Footprint, 1994 Density	Scenario 2: 1994 Plan (as modeled)
Additional Residential Density	0	1003	1143	1400	1400
Acres of New Disturbance	0	320	320	320	436
Acres of Forest Loss	0	45	45	45	117
Overall Imp.	4+%	7.0%	8.4%	8.5%	9.3%

LOWER RISK → HIGHER RISK

Science-Based Approach to Analysis

- Combination of approaches used to formulate recommendations
  - Scientific literature review
  - Documentation of existing watershed conditions
  - Field observations
  - Natural resource disturbance and spatial analysis
  - Hydrologic modeling
  - Pollutant load analysis

Natural Resource Impacts Identification	
WHAT IT CAN DO	• Project direct impacts to natural resources within proposed limits of disturbance
WHAT IT CANNOT DO	• Predict aquatic and terrestrial biota population numbers directly impacted by development • Account for "site fingerprinting" integrated into development design

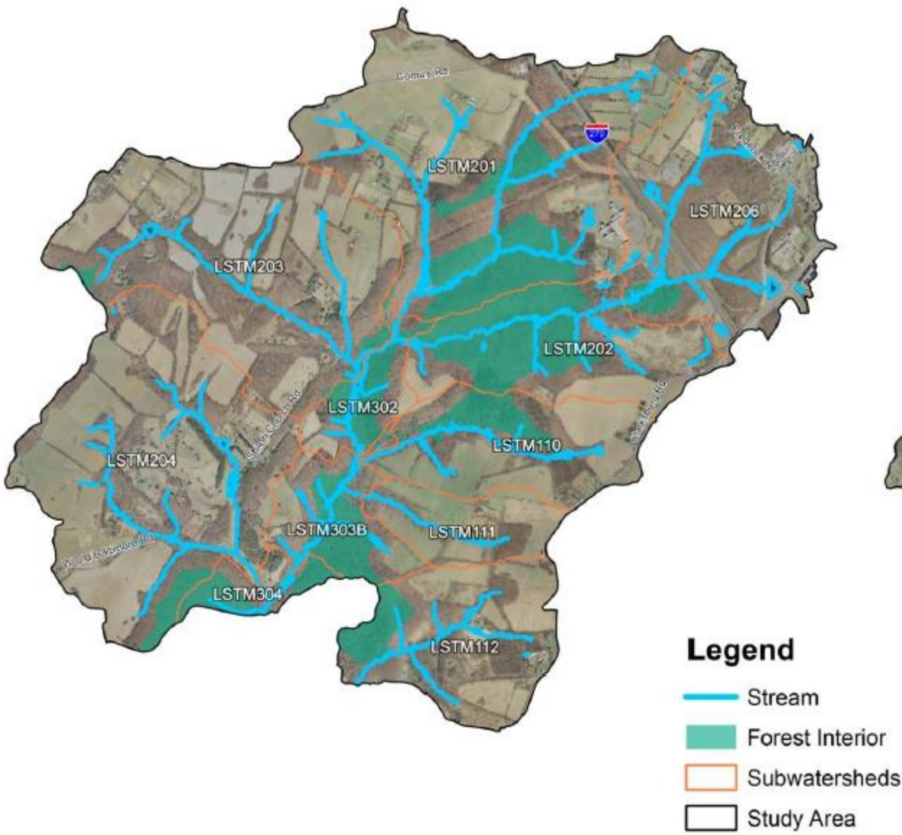
Limit of Disturbance (LOD) Across the Subwatersheds

Scenario #2 – 1994 Master Plan

Subwatershed	Subwatershed Area (acres)	LOD within Subwatershed (acres)	% of Subwatershed	% of Total LOD
110	211	88.1	42%	21%
111	104	47.5	46%	11%
112	228	21.7	10%	5%
201	611	36.2	6%	9%
202	243	60.1	25%	14%
203	493	-	0%	0%
204	544	-	0%	0%
206	370	157.7	43%	37%
302	77	5.1	7%	1%
303B	117	5.9	5%	1%
304	49	-	0%	0%
TOTAL	**3,046**	**422.3**	**14%**	**100%**

Resource Impact within Limit of Disturbance (LOD) Across the Watershed

Interior Forest, Existing



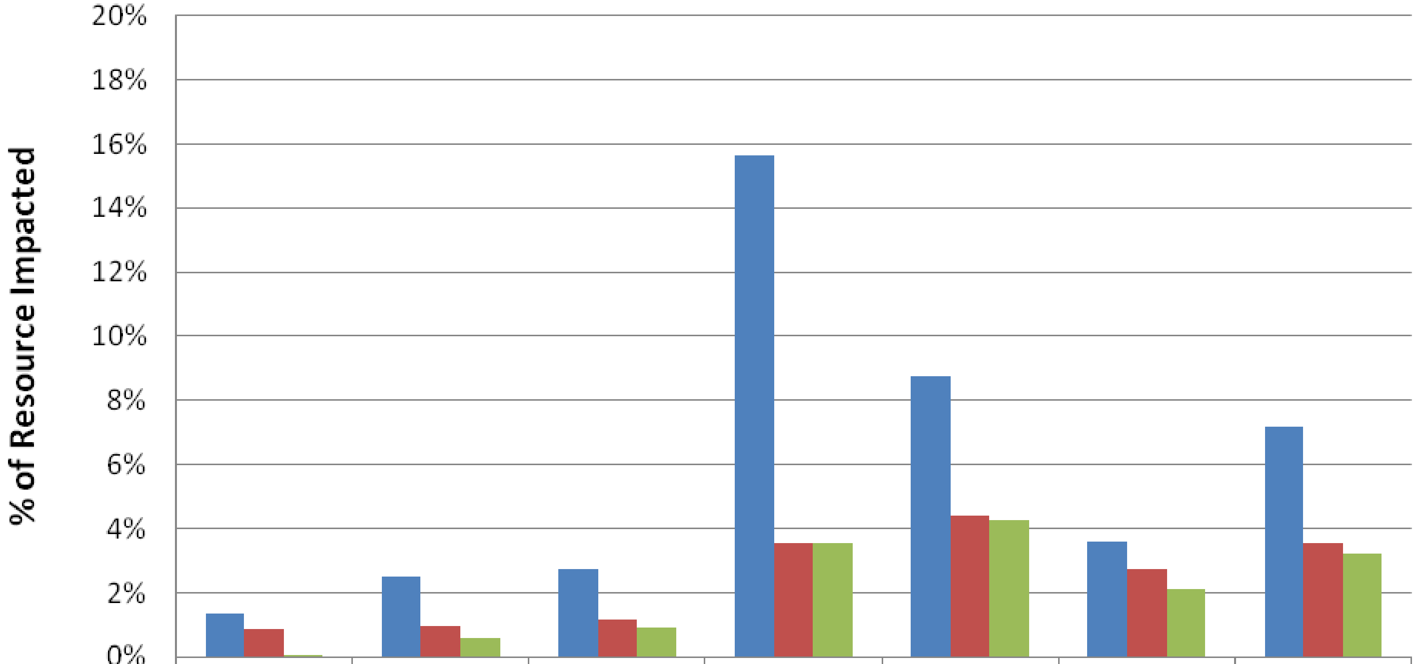
Interior Forest, 1994 Master Plan Scenario

Resource Impacts within Limit of Disturbance (LOD) Across the Watershed

Scenario #2 – 1994 Master Plan

Attribute	Existing	Within the LOD	% Affected
Forest (acres)	1,389	121.9	9%
Forest Interior (acres)	409	64.0	16%
Areas with Slopes >15% (acres)	805	58.0	7%
Areas with Slopes >25% (acres)	183	6.5	4%
Perennial Stream Buffer, 175' (acres)	867	23.9	3%
Stream Length (feet)	116,093	2,886.7	2%
Wetlands (acres)	86	1.2	1%

Resource Impacts within Limit of Disturbance (LOD) Across the Watershed



	Wetlands (acres)	Stream (feet)	Perennial Stream Buffer (acres)	Forest Interior (acres)	Forest (acres)	Areas with Slopes >25%	Areas with Slopes >15%
Scenario 2	1.3%	2.5%	2.8%	15.6%	8.8%	3.6%	7.2%
Scenario 3-4	0.9%	1.0%	1.1%	3.5%	4.4%	2.7%	3.5%
Scenario 5	0.1%	0.6%	0.9%	3.5%	4.3%	2.1%	3.2%

Spatial Watershed Analysis	
WHAT IT CAN DO	• Distinguish areas of high ecological value within the watershed • Identify areas of high ecological value that overlap with proposed limits of disturbance
WHAT IT CANNOT DO	• Predict aquatic and terrestrial biota population numbers directly impacted by development • Account for "site fingerprinting" integrated into development design

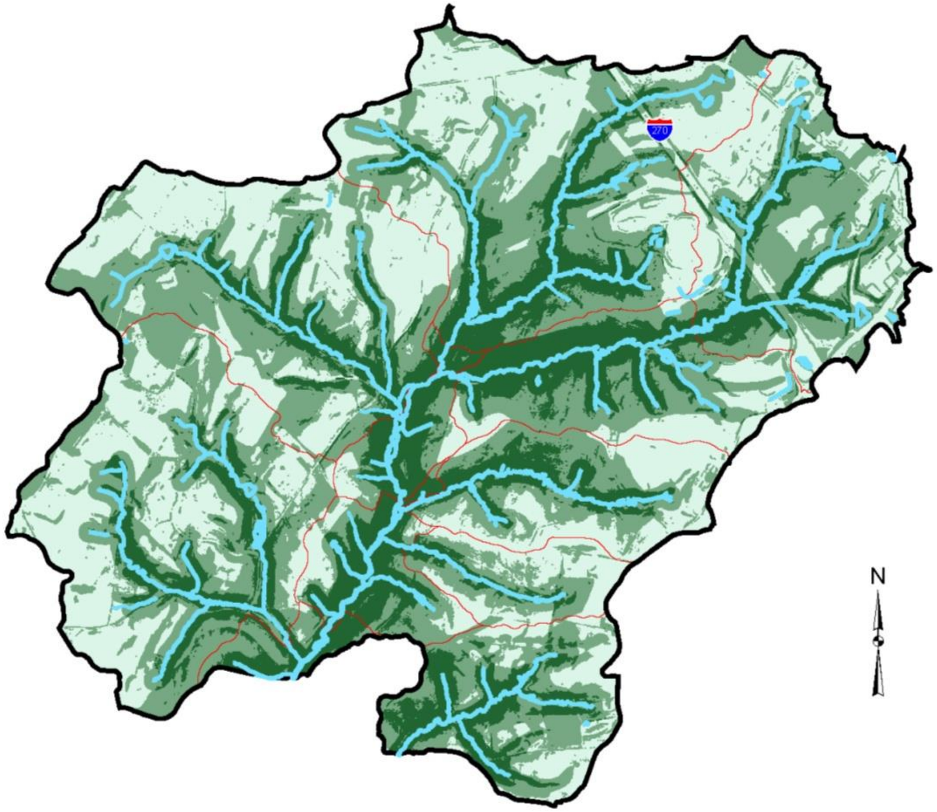
Spatial Watershed Analysis

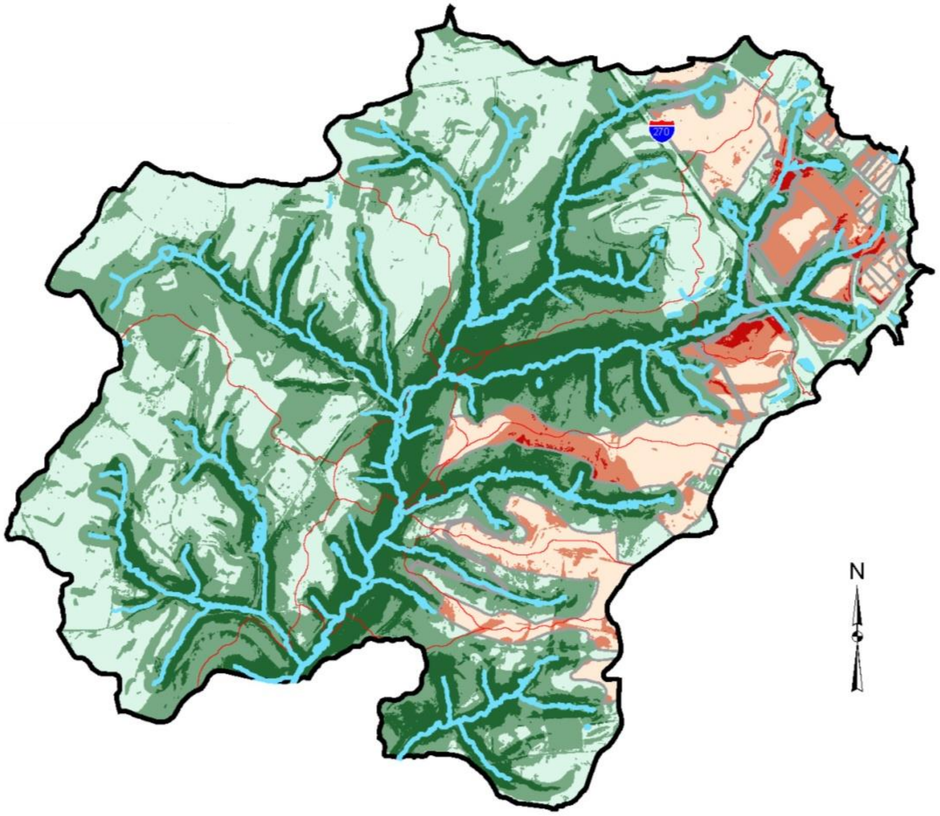
Attribute	Score	
	Present	Absent
Steep Slopes, >15% – presence/absence	1	0
Steep Slopes, >25% – presence/absence	1	0
Erodible Soils – presence/absence	1	0
Hydric Soils – presence/absence	1	0
Forest – presence/absence	1	0
100-Year Floodplain – presence/absence	1	0
Perennial/Intermittent Streams – presence/absence	1	0
Ephemeral Channels – presence/absence	1	0
Wetlands – presence/absence	1	0
Springs, Seeps, and Pools – presence/absence	1	0
Maximum Possible Score	**10**	
Interior Forest – presence/absence	1	0
Maximum Possible Score	**11**	

Spatial Watershed Analysis

Scenario #2 – 1994 Master Plan

Forest Interior Included

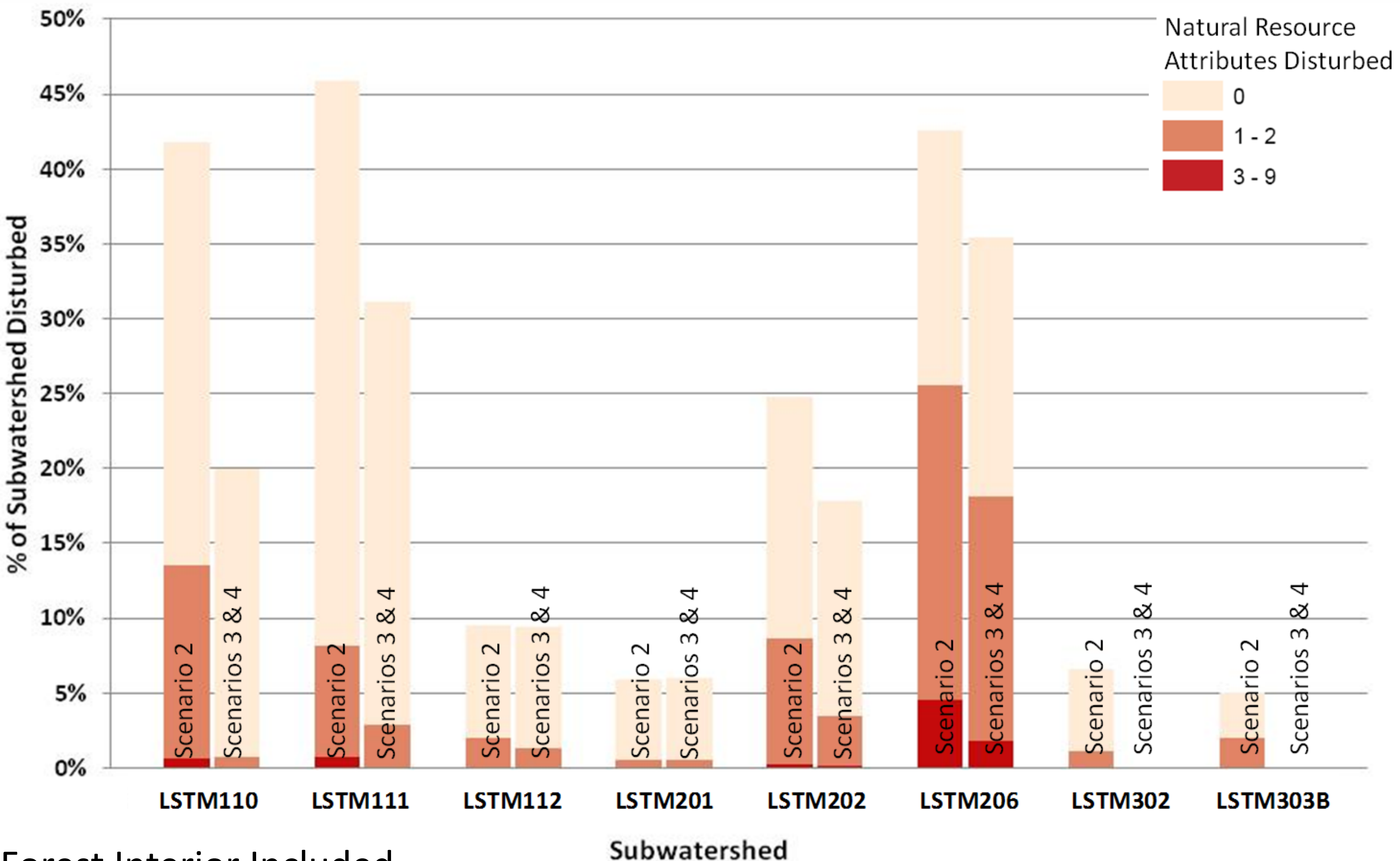




Areas that will be Impacted by Scenario 2

Attribute Scores/Categories	With Forest Interior	
	Area (acres)	% of Disturbed Area
0	258.9	61%
1 to 2	143.8	34%
3 to 9	19.7	5%

Spatial Watershed Analysis



Forest Interior Included

Hydrologic Modeling	
WHAT IT CAN DO	• Predict changes to stream flow and stream velocity
WHAT IT CANNOT DO	• Predict the effect on stream biology • Predict the effects of pollutants on the stream

Hydrologic Modeling at the Planning Scale

- Provides one tool to predict potential impacts of land use alternatives
- Relies on currently available information used at watershed scale
- Strength is the ability to compare peak flows among scenarios.
- Incorporates a level of conservatism to account for generalizations, variations and unknowns

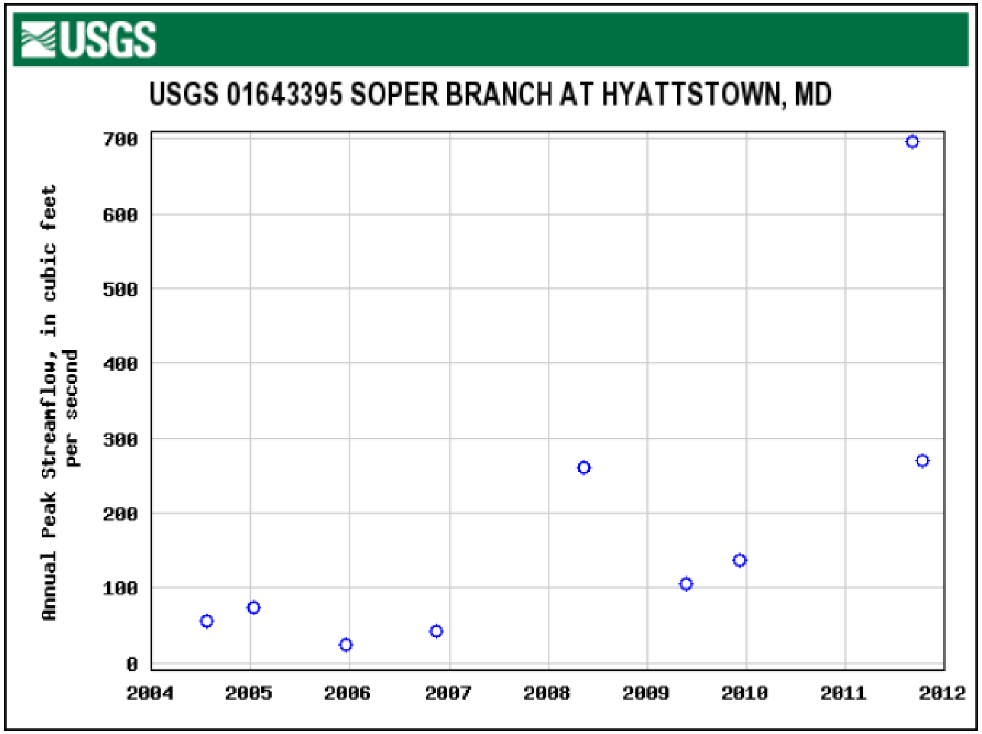
MONTGOMERY COUNTY PLANNING DEPARTMENT

Ten Mile Creek Hydrologic Modeling Approach

- Widely-used modeling program (XP-SWMM).
- Runoff from different land types calculated using accepted method and parameters.
- One representative ESD practice (micro-bioretention)
- Design parameters selected by Montgomery County Planning, Department of Environmental Protection, and Department of Permitting Services to represent
    - Average watershed-wide performance; and
    - An adequate margin of safety for planning-level evaluations

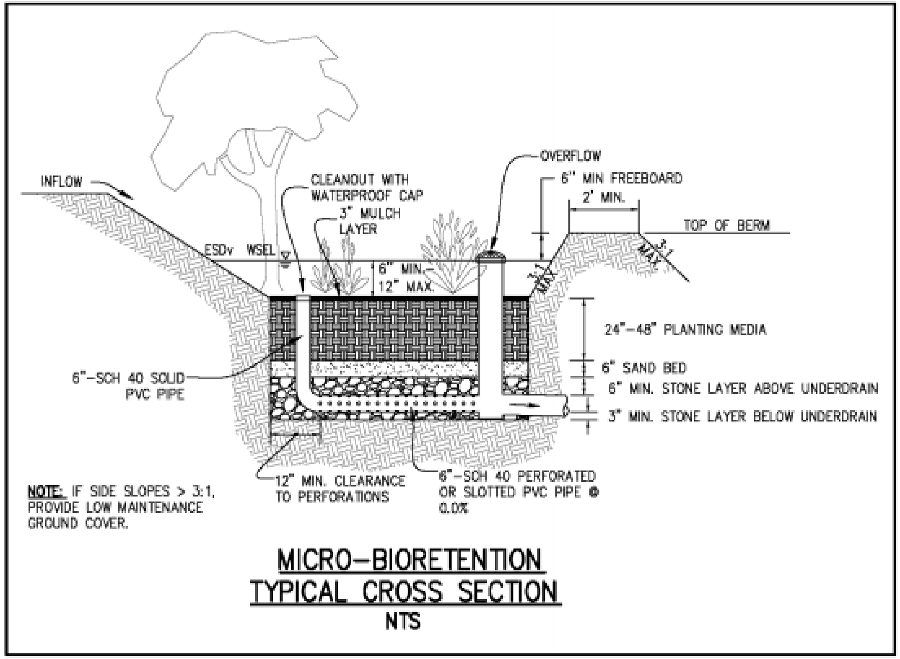
Planning model predictions overlap with range of independent stream flow estimates

- Planning model based on accepted methods & parameters
- Hydrologic impacts predicted even if existing flows are higher



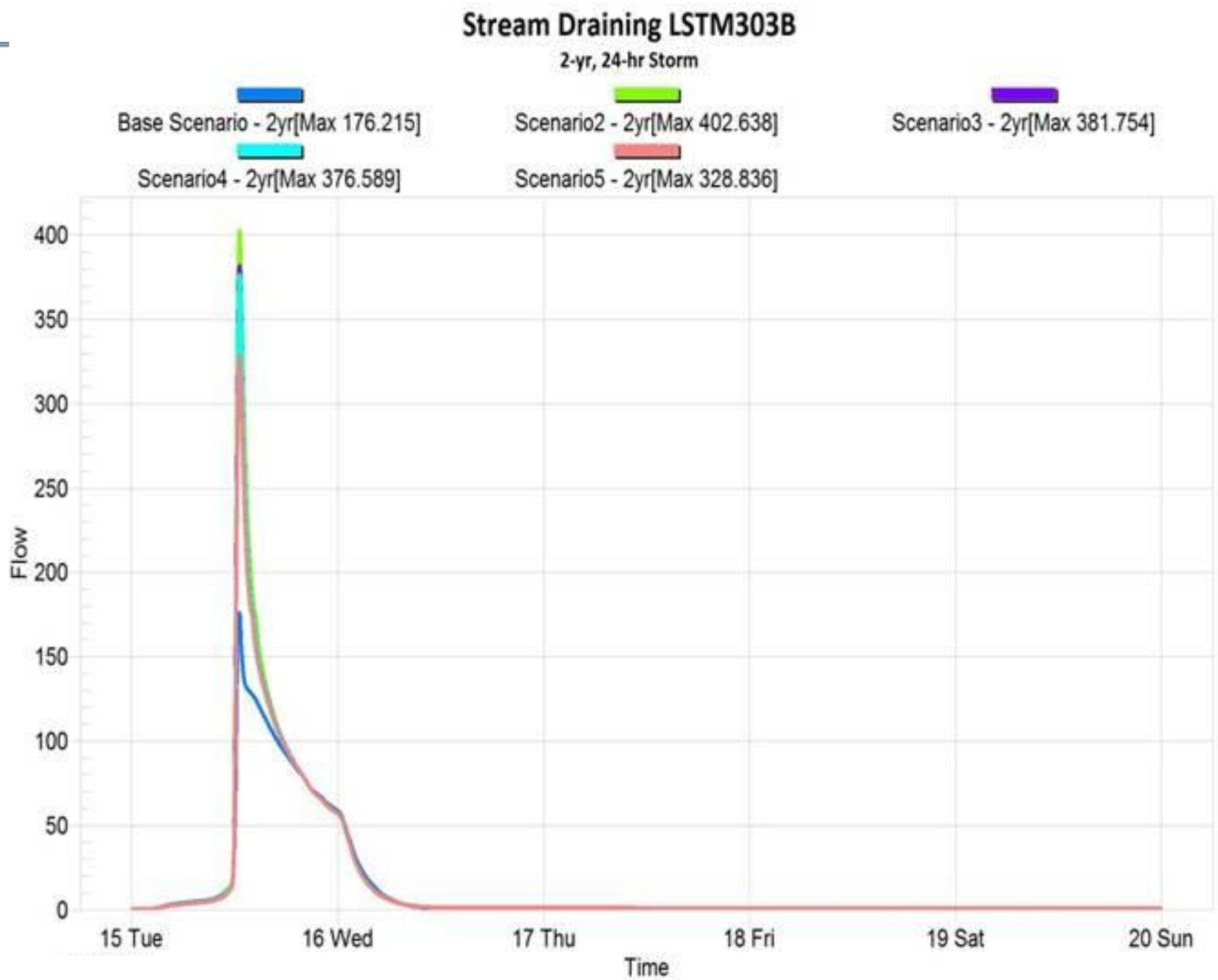
Planning model a reasonable, conservative representation of ESD function.

- Parameters selected to represent County design requirements.
- Results reflects potential overflow under certain storm events.

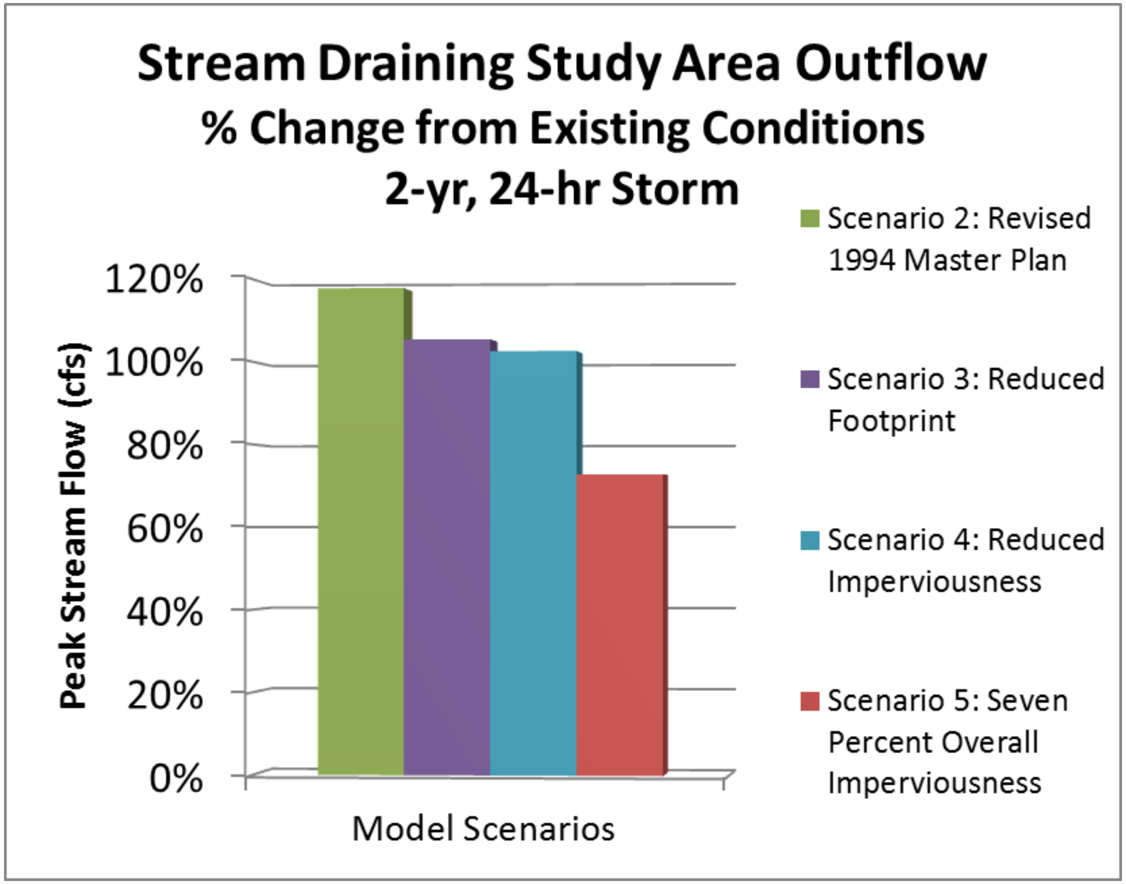


Montgomery County's Micro-Bioretention Design Standard

Key Findings of Hydrologic Model



Key Findings of Hydrologic Model



MONTGOMERY COUNTY PLANNING DEPARTMENT

Key Findings of Hydrologic Model

- ESD may not fully mitigate the impacts of development on hydrology
- Development can impact the different subwatersheds to a varying degree
- Subwatersheds with biggest increase in development have:
  - Biggest potential for hydrologic impacts
  - Most improvement from reduced footprints

Pollutant Load Modeling	
WHAT IT CAN DO	• Predict the amount of certain pollutants that will be delivered to surface water
WHAT IT CANNOT DO	• Predict the effects of all pollutants on stream biology • Predict the effects of pollutants on groundwater

Overview of Pollutant Load Modeling

Used the Watershed Treatment Model (CWP, 2010)

- A simple spreadsheet-based model
- Models Nitrogen (TN), Phosphorus (TP), Sediment (TSS) and Annual Runoff Volume
- Includes loads from septic systems and urban lawns
- Includes ESD as required by Maryland
- Urban land contributes less nutrients than agricultural land, but urban land also generates other pollutants, such as metals, hydrocarbons, pesticides, bacteria, salt, and trash — all of which can impact local water quality and watershed health

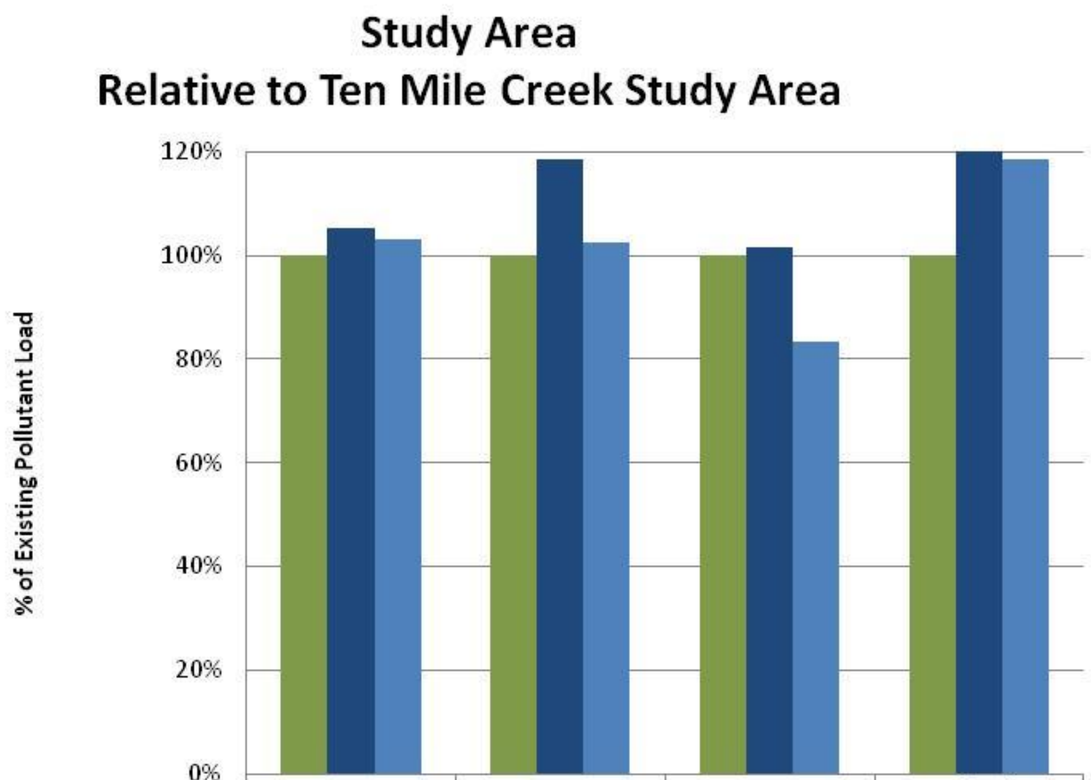
Modeled Existing Conditions & the 1994 Plan

- Existing Conditions
  - Current Land Use
  - Some Assumptions for "Cropland" (½ Hay and ½ Row Crops)

- 1994 Master Plan (Scenario 2), During Construction
  - With 10% of urban land in Active Construction

- 1994 Master Plan (Scenario 2), Post Construction
  - Build-Out according to 1994 Master Plan
  - Reforestation of non-forested land in the forested buffer

Results: Watershed-Wide



	TN	TP	TSS	Runoff Volume
Existing	100.0%	100.0%	100.0%	100.0%
Scenario 2 During Construction	105.1%	118.7%	101.5%	120.9%
Scenario 2 Post Construction	103.1%	102.5%	83.4%	118.5%

Results: Watershed-Wide

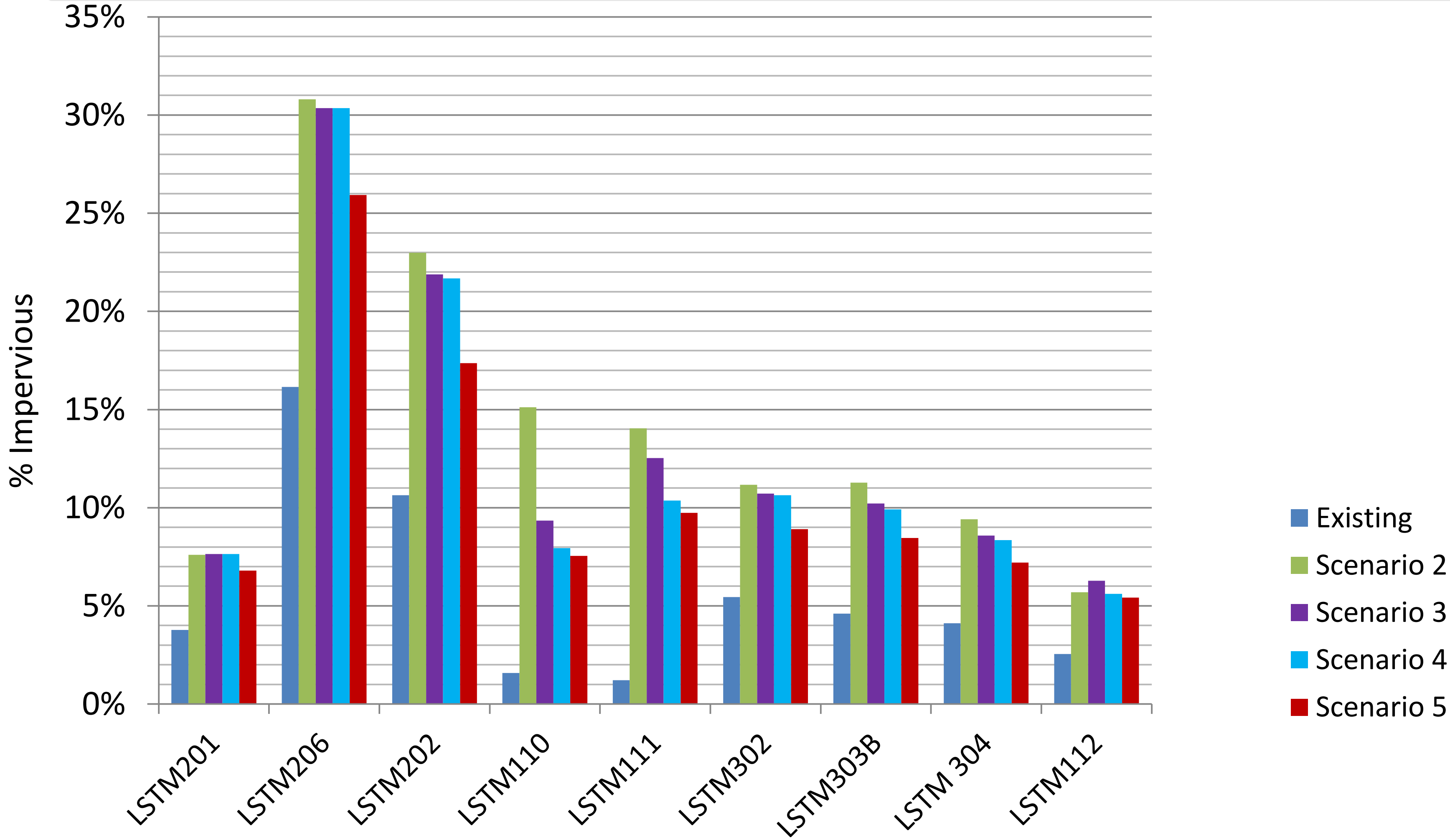
Table 1. Annual Load - Total Nitrogen (lb/year)

Subwatershed	Existing Conditions	1994 Masterplan (during construction)	Change (%)	1994 Masterplan (After Construction)	Change (%)
LSTM 110	2,406	2,786	16%	2,516	5%
LSTM 111	1,327	1,469	11%	1,322	0%
LSTM 112	2,902	2,862	-1%	2,866	-1%
LSTM 201	6,955	7,443	7%	7,301	5%
LSTM 202	2,370	1,941	-18%	1,820	-23%
LSTM 203	6,083	6,083	0%	6,083	0%
LSTM 204	7,928	7,928	0%	7,928	0%
LSTM 206	4,079	5,160	27%	5,159	26%
LSTM 302	364	436	20%	426	17%
LSTM 303B	637	732	15%	725	14%
LSTM 304	179	179	0%	179	0%
Watershed	**35,229**	**37,019**	**5%**	**36,326**	**3%**

Pollutant Modeling Conclusions

- Nutrient loadings are overall moderate due to the conversion from cropland in the watershed.
- Sediment appears to increase during the construction phase, and decline after development has occurred, but this model does not include channel erosion.
- Annual runoff volume increases both during construction and in the post-construction phase in all watersheds.
- Loading projections can differ significantly across subwatersheds due to site specific land cover and proposed land use.

Approximate Imperviousness of Proposed Scenarios



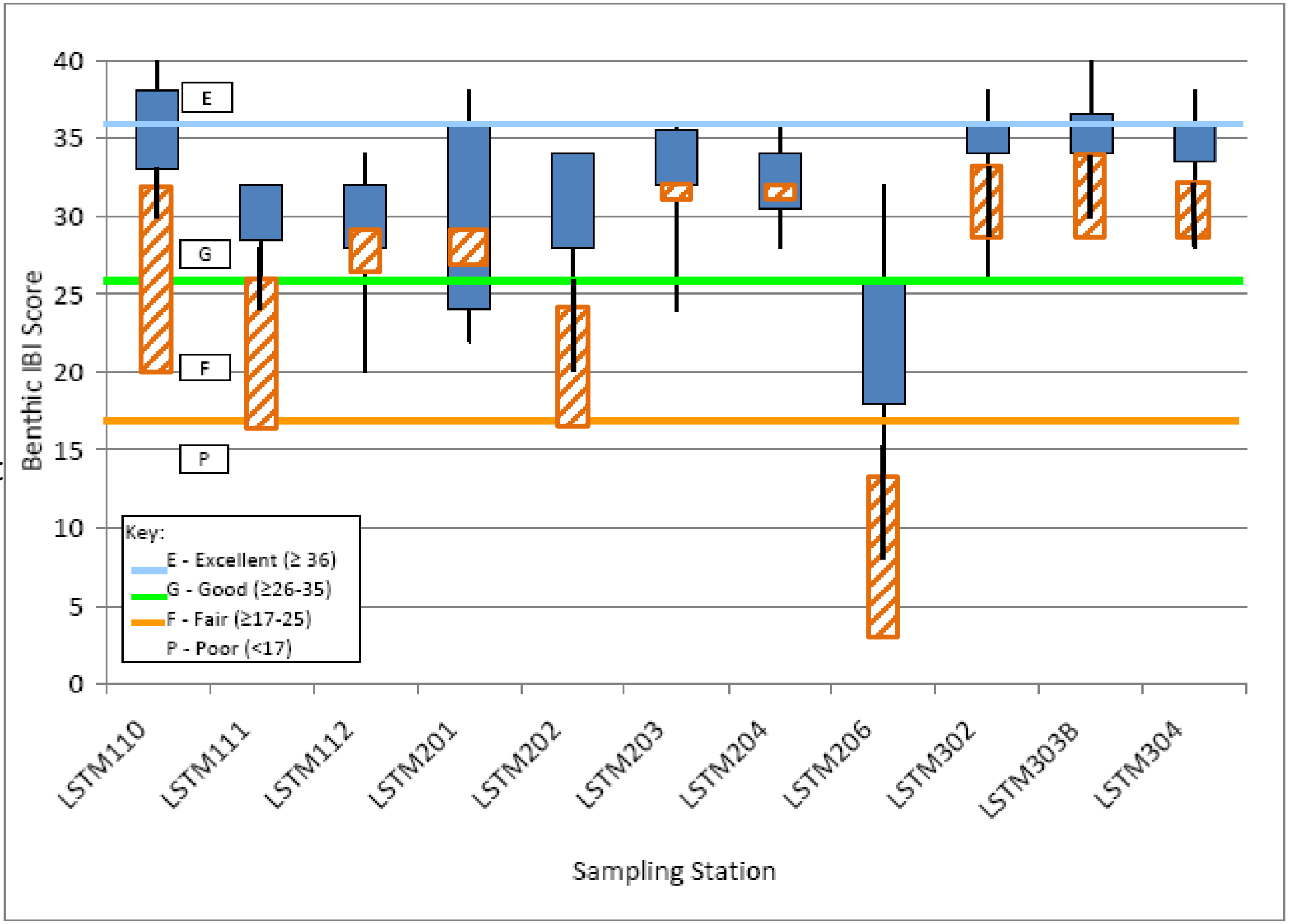
Comparison: TMC Existing Benthic IBI with Estimated Post-Development IBI

Based on statistics from existing traditional stormwater practices

1994-2012 Benthic IBI (range of the middle 50% of scores)

Max – Min

Estimated range of Benthic IBI Post Development*



*The top of the striped bar indicates the best potential outcome (high score) for imperviousness resulting from Scenario 5 (8% overall watershed imperviousness), while the bottom is the lowest likely outcome (low score) for Scenario 2 (1994 Plan).

Outline

1. Consultant Team Background and Qualifications
2. Watershed Science Overview
3. Analysis Approach and Assumptions
   a) Existing Conditions
   b) Natural Resource Disturbance
   c) Spatial Analysis
   d) Hydrologic modeling
   e) Pollutant Loading
4. Findings and Recommendations

Environmental Analysis Conclusions

- East of I270 has highest levels of existing impervious cover and fair stream conditions
- West of I270 dominated by small, high quality tributaries, forest cover and rural land uses
- Increases in stormwater runoff in all development scenarios despite application of ESD practices
- ESD represents the state of the practice
- Rigorous and comprehensive implementation across or within watersheds has not occurred nor been monitored
- Protecting high quality watersheds requires the fullest application of ESD including maximizing the resource protection and the smallest possible footprint

Environmental Analysis Conclusions

Measures Needed to Reduce Impacts to Ten Mile Creek

- Minimize disturbance of natural resources
- Reduce development in high quality, sensitive subwatersheds
  - Reduce impacts to upland forested areas and steep slopes.
  - Preserve existing conditions in high quality headwater subwatersheds LSTM110 (King Spring) and LSTM111
  - In LSTM 202, reduce the extent of development on County-owned property to retain existing forest
- If development occurs in LSTM110 and LSTM111, apply reduced limits of disturbance
- Focus and prioritize development within subwatersheds already impacted
- Establish buffers around ephemeral streams not currently regulated

Environmental Analysis Conclusions

Measures Needed to Reduce Impacts to Ten Mile Creek

- Minimize impacts to natural resources associated with new infrastructure (MD 355 Bypass and sanitary sewer extension)
- Employ site planning techniques as the first measure of Environmental Site Design
  - prioritize preservation and protection of natural resources
  - conserve natural drainage patterns
  - minimize impervious areas
  - cluster of development
  - limit soil disturbance, mass grading and compaction
- Design outfalls to reduce impacts associated with large flows