
PROTECTING THE SOURCE
AND MAINTAINING
WATER AFFORDABILITY
ECOLOGIX GROUP
An Environmental Strategy Firm
Seneca State Park, Photo by Chesapeake Bay P

Prepared by EcoLogix Group for the Maryland Sierra Club

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- Audubon Naturalist Society and artist Judy Hanks

Outline of Presentation

I. Overview

II. Scope of study and results

- forest cover GIS analysis
- key findings on forest loss and stream health

III. Links between forest cover, water quality, and sediment loading

IV. Big picture for the mid-Potomac

V. Costs and benefits of a forest cover strategy

VI. Sierra Club-led discussion – What's already being done, and what more can be done?

I. Overview

- Forests and Trees provide the first line of defense in the multiple barrier approach and the foundation for protecting water quality and drinking water and provide numerous co-benefits.
- They must be combined with other strategies to completely address the sediment problem.
- We’re losing forests and tree canopy which increases the costs of water treatment.
- Sierra Club question: What more could government, WSSC, and citizens do to protect forests and plant trees?

Forests provide clean water.

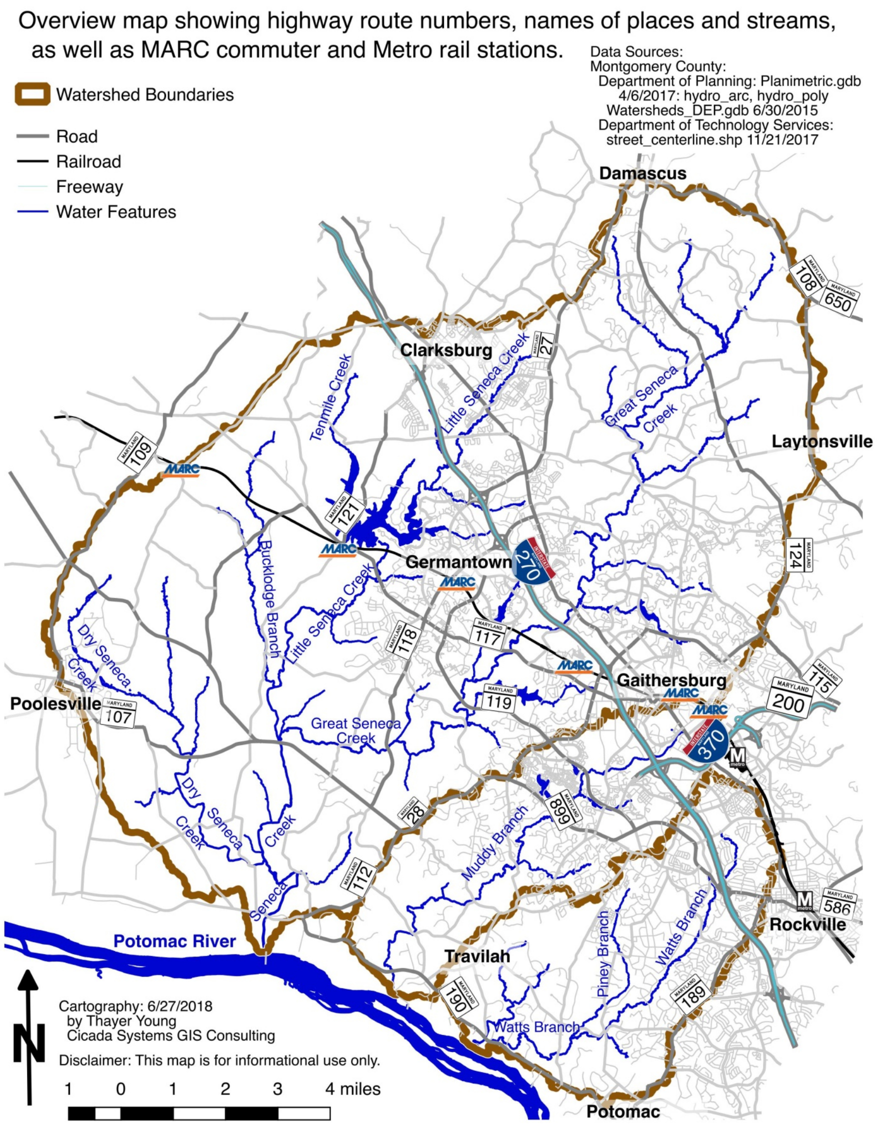
Image credits: Left: Piedmont Forest Hydrology Poster (detail) Audubon Naturalist Society & artist Judy Hanks; top: Lower Muddy Branch – Diane Cameron.

II. Scope of study and results

- Use Geographic Information Systems (GIS) to study forest cover, tree canopy trends

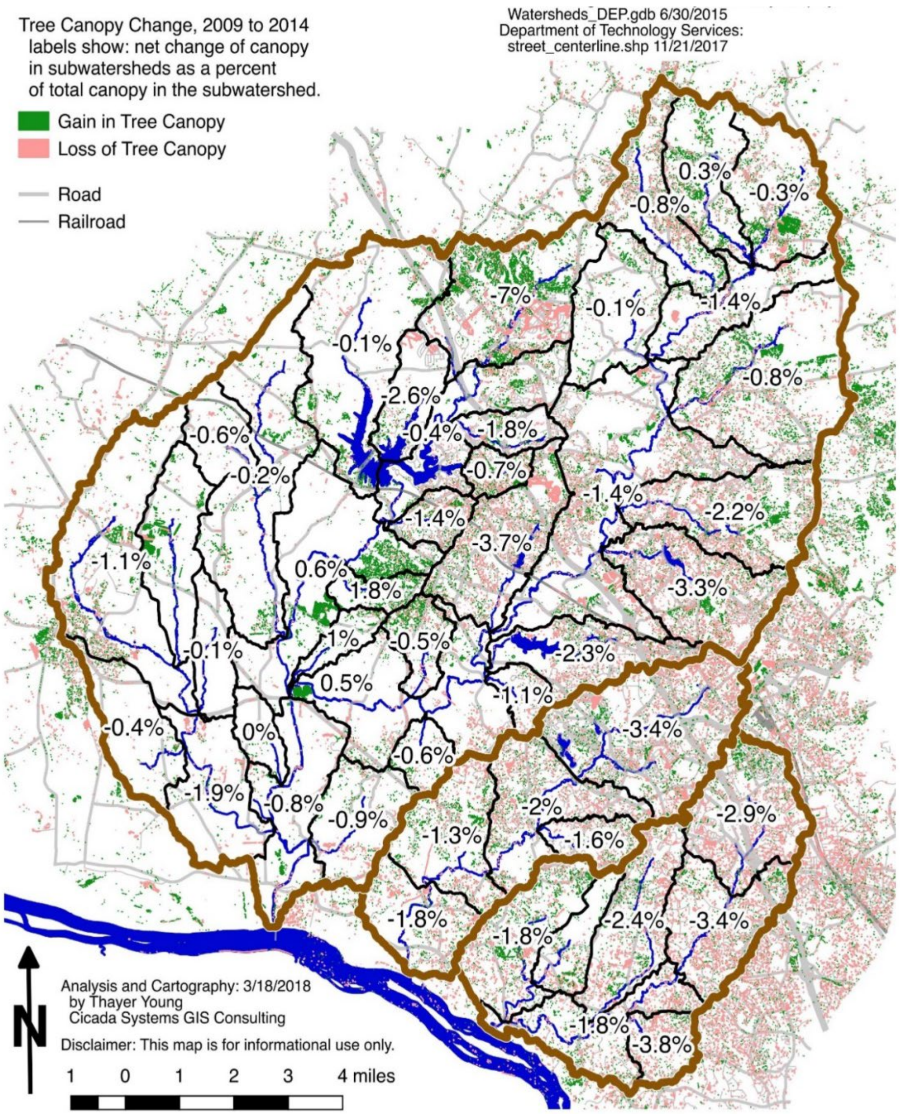
  - 3 case study watersheds in Montgomery County upstream from WSSC water intake
- Review data on:
  - Links between forest cover, sediment loading and water quality
  - Benefits and costs of increasing forest and tree canopy cover
  - Co-benefits of forest and tree canopy cover

Overview of study area

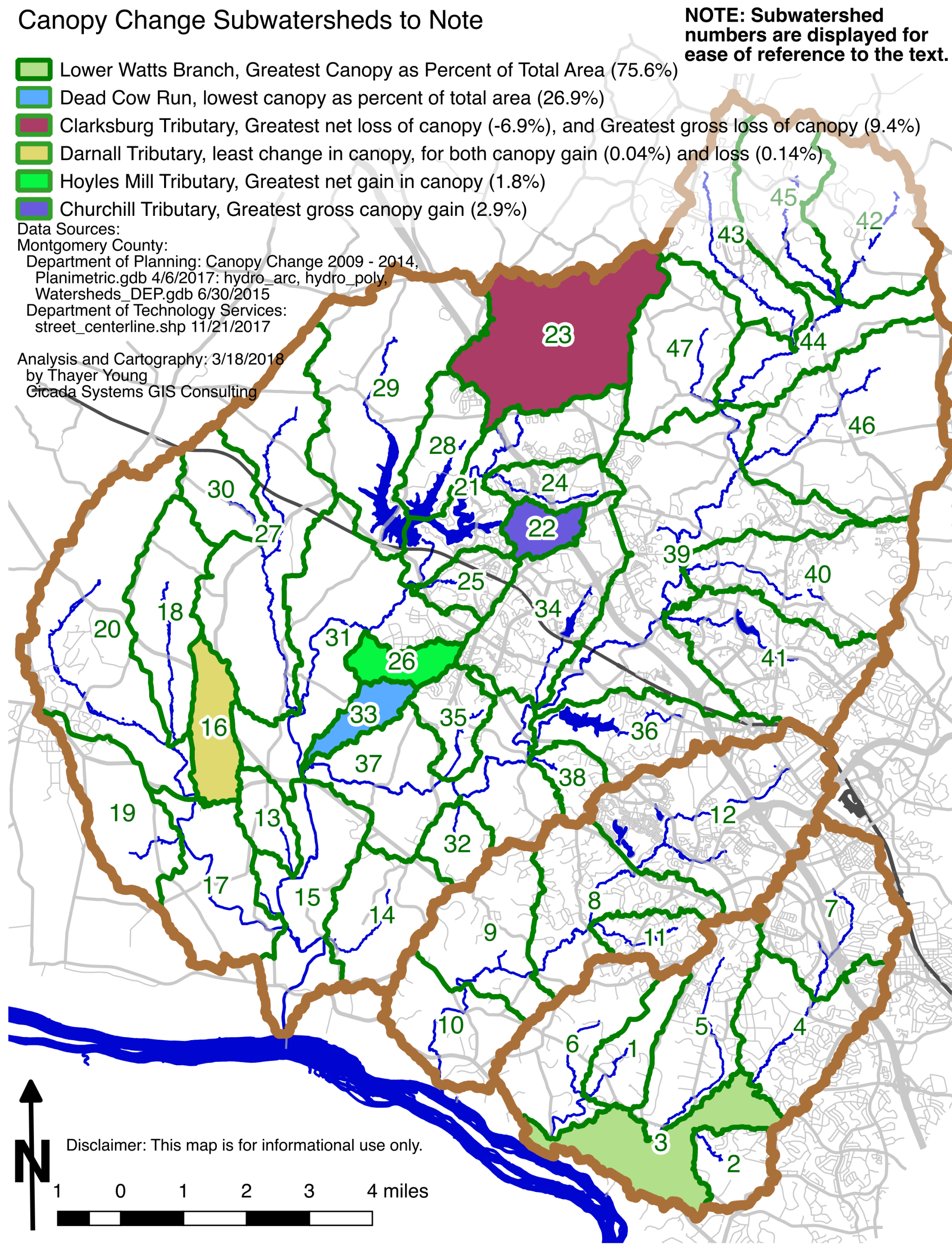


Tree canopy change in the three case study watersheds:

- Watts Branch
- Muddy Branch
- Seneca Creek

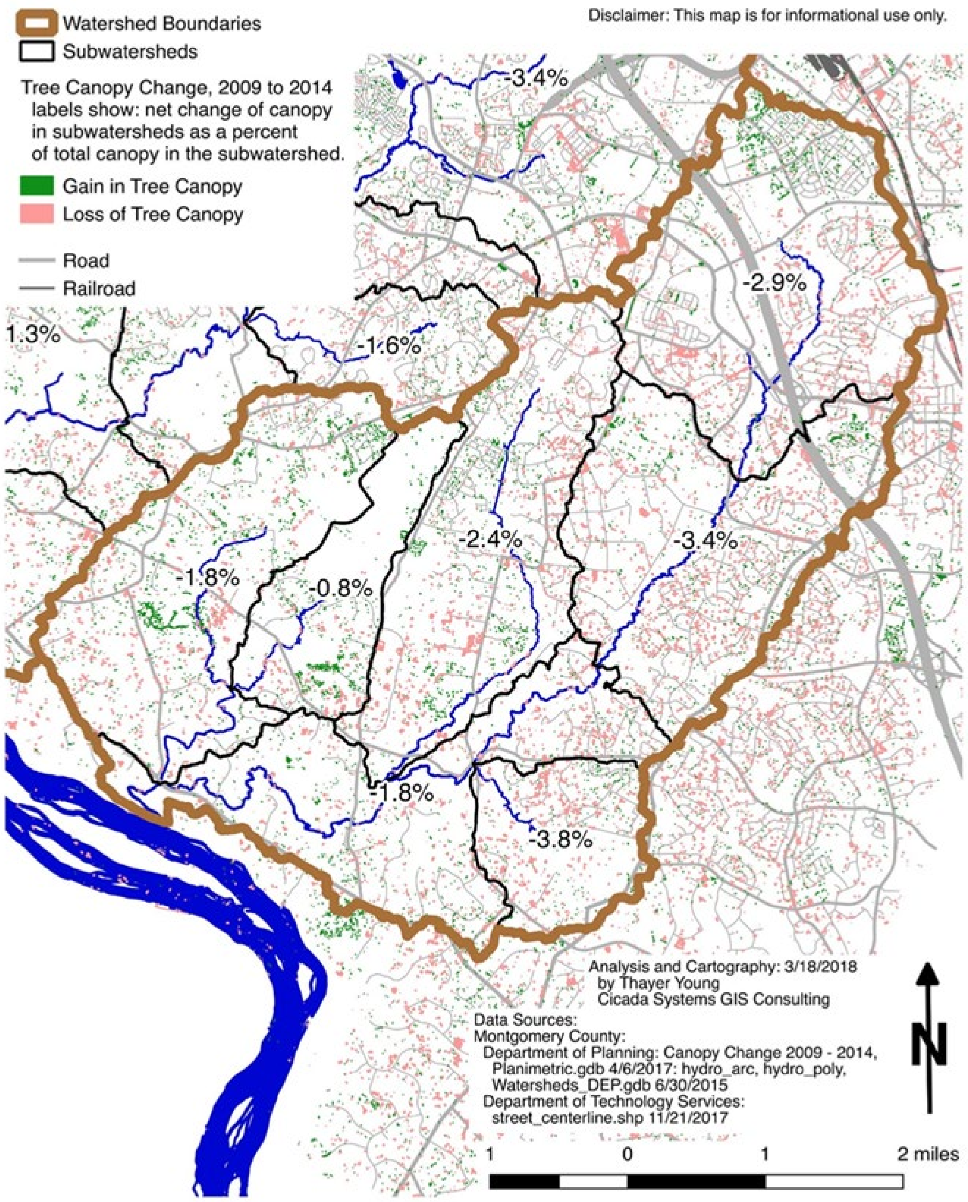


Canopy change sub-watersheds of note



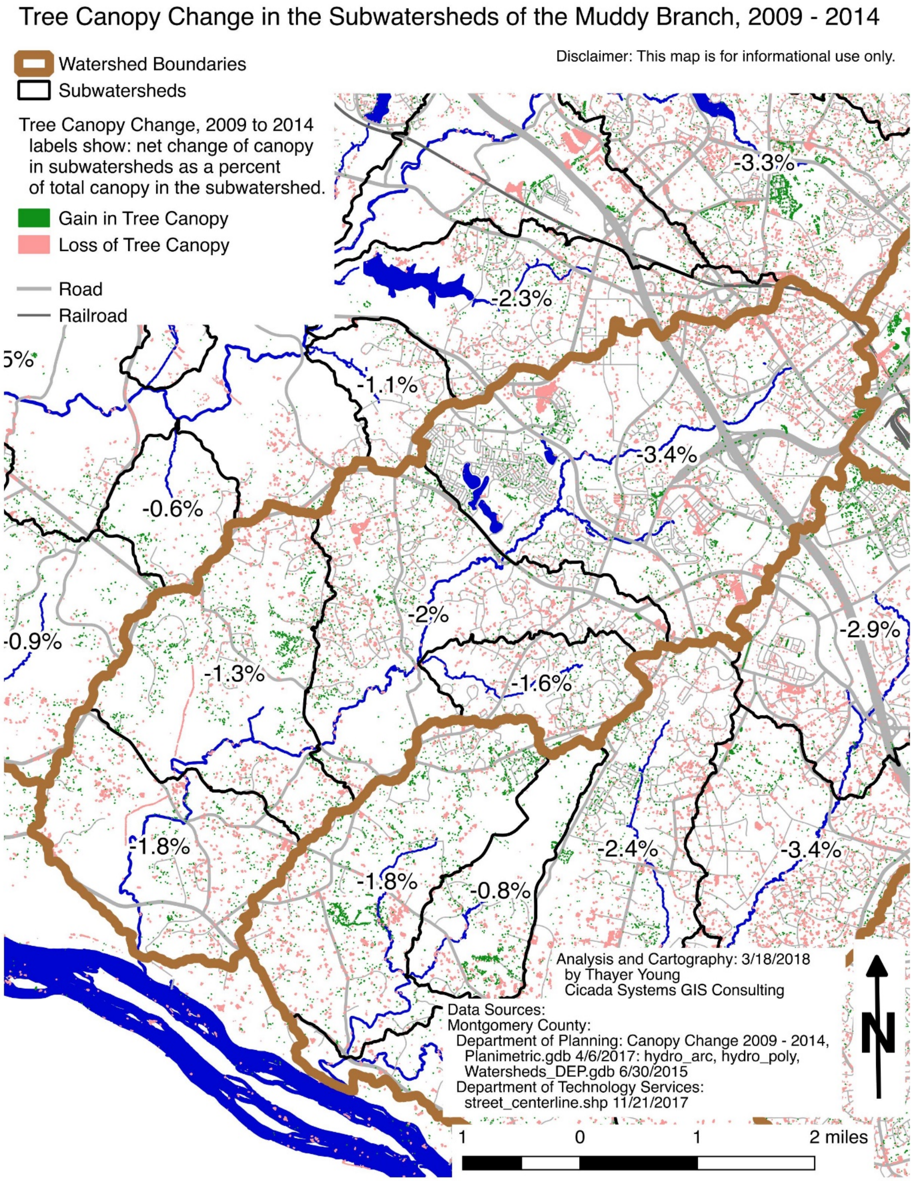
Watts Branch sub-watersheds

Forest cover changes



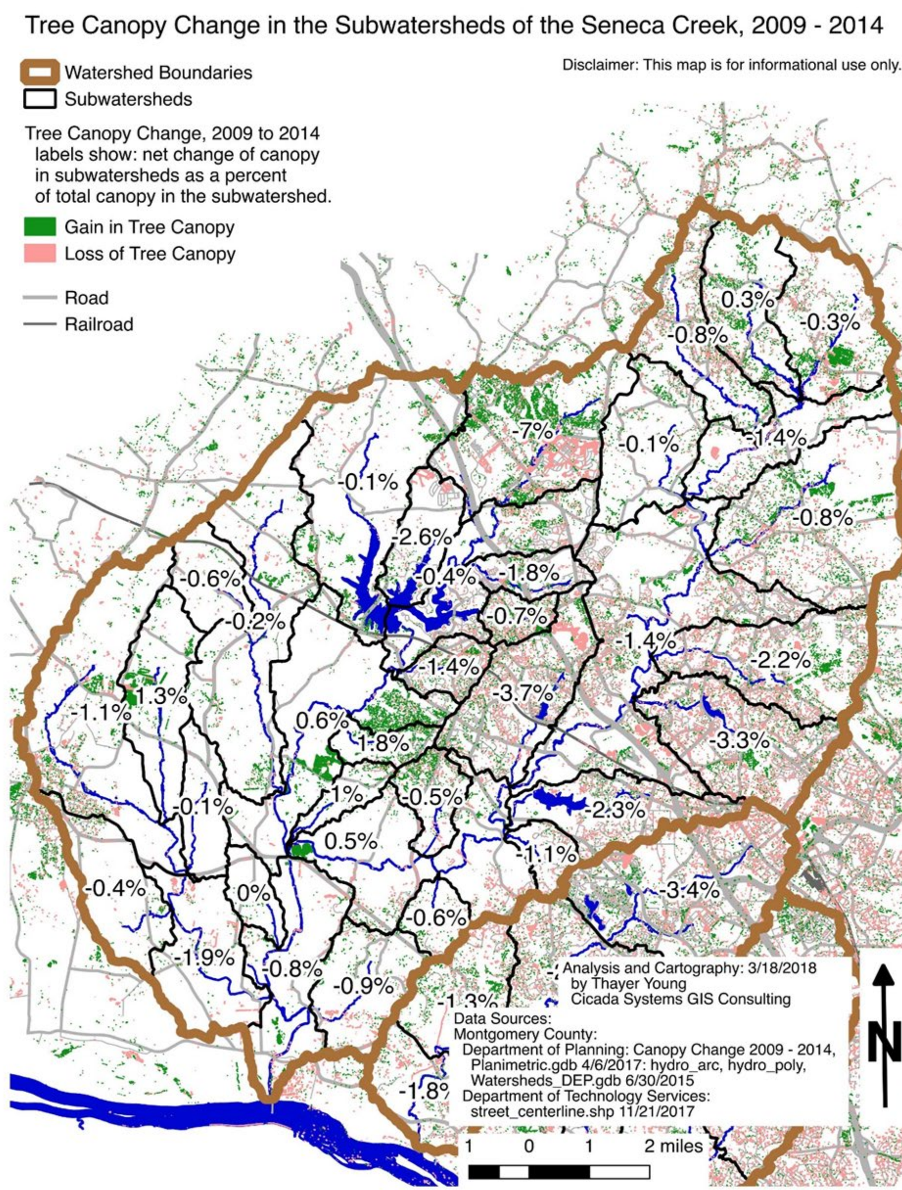
Muddy Branch sub-watersheds

Forest cover changes



Seneca Creek sub-watersheds

Forest cover changes



Forest and Tree Canopy Changes in Three Montgomery County Watersheds, 2009-2014						
Watershed	Total Area, Square Miles	Canopy, % of Total Area	Canopy Gain, Acres	Canopy Loss, Acres	Net Canopy Change, Acres	Net Change in Canopy, %
Watts Branch	22.2	58.6	36.8	239	-202	-2.42
Muddy Branch	19.6	55.2	30.5	183	-153	-2.20
Seneca Creek	129.6	50.6	300.4	731	-431	-1.03
Source: GIS analysis, March 2018, by Thayer Young, Cicada GIS Systems, using Montgomery County Land Cover data for 2009 and 2014.						

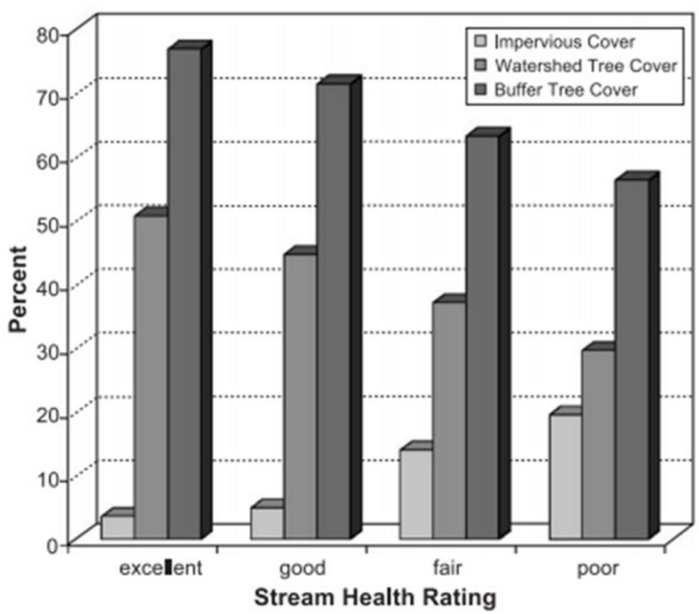
Table 1: Tree canopy changes in three Montgomery County Watersheds, 2009-2014

Key Findings: forest loss and stream health

- Canopy cover has declined during the study period (2009-2014)
  - Watts Branch (-2.42)
  - Muddy Branch (-2.20), and
  - Seneca Creek (-1.03)
- The loss in individual sub-watersheds ranged from -.02% in Dawsonville to -7% in the Clarksburg Tributary
- In 10 out of 11 sub-watersheds where declines in stream biological condition were observed, canopy loss was also observed over the same general time period.

III. Links between forest cover, water quality, and sediment loading

Relationship between stream health, impervious cover and forest cover



Across all watersheds there is a significant *decrease* in stream health rating with:

1) More impervious cover
2) Fewer trees in buffer
3) Less tree cover in watershed

Source: Goetz et al 2004

Key questions

- Would the increase of forest cover in the watersheds immediately upstream of WSSC’s Mid - Potomac River intake pipe reduce sediment loadings, and if so, to what extent and at what cost?
- What do the 3 watershed case studies indicate about the relation of forest cover to sediment loadings in the Mid Potomac?
- What are the co-benefits from increasing forest and canopy cover?

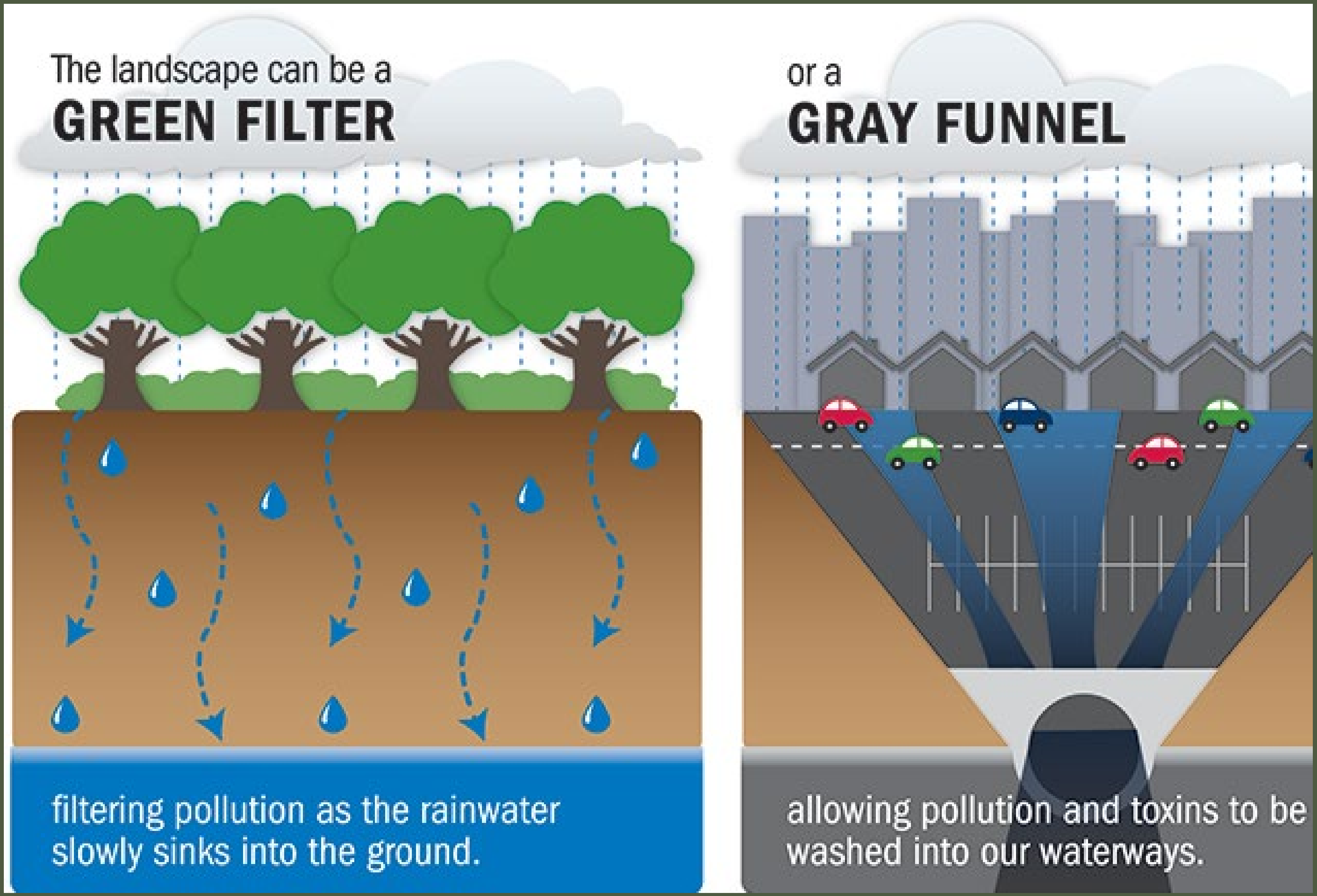


Image credit: © Chesapeake Bay Foundation

Runoff - Before vs. After Urbanization

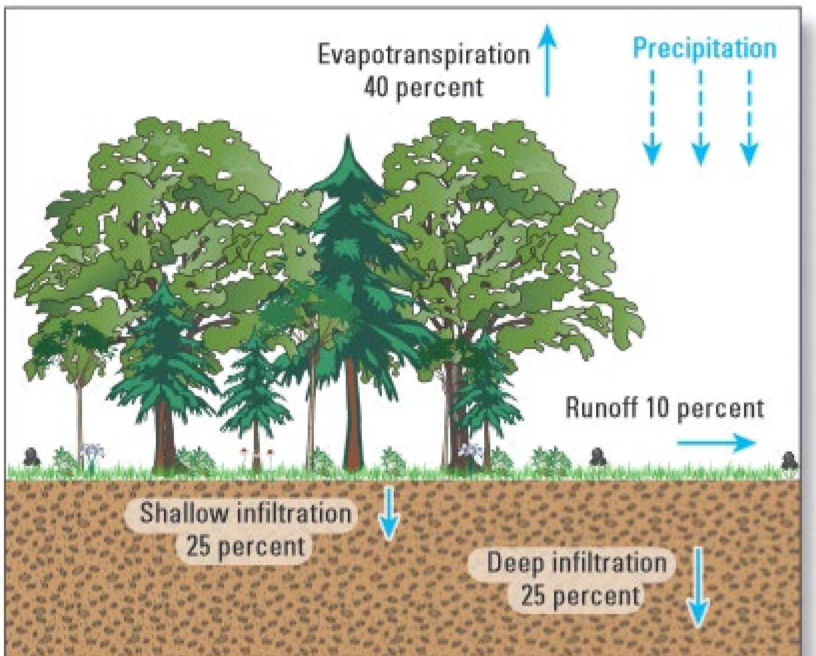


Figure 2–4. In a natural setting, about 40 percent of precipitation returns to the atmosphere through evapotranspiration from vegetation, 50 percent infiltrates into the groundwater system, and 10 percent runs off the land surface. (Modified from Livingston and McCarron, 1992.)

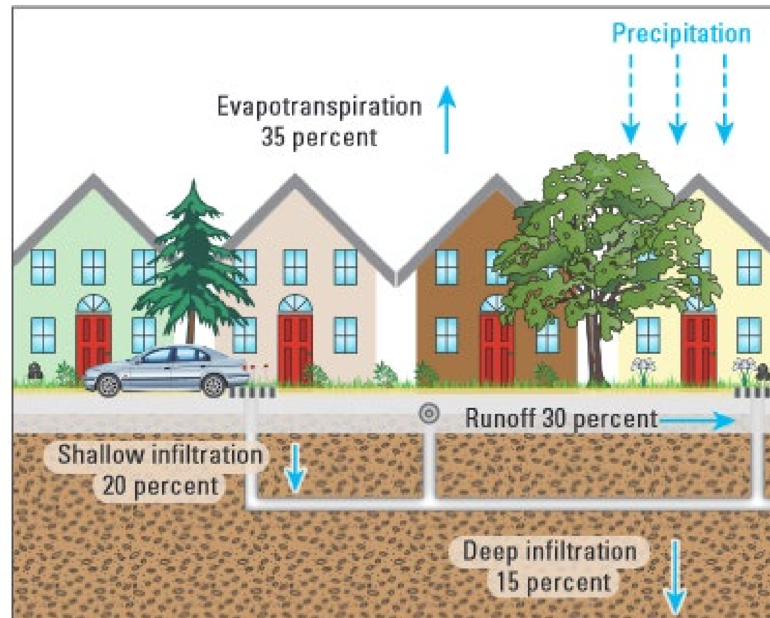
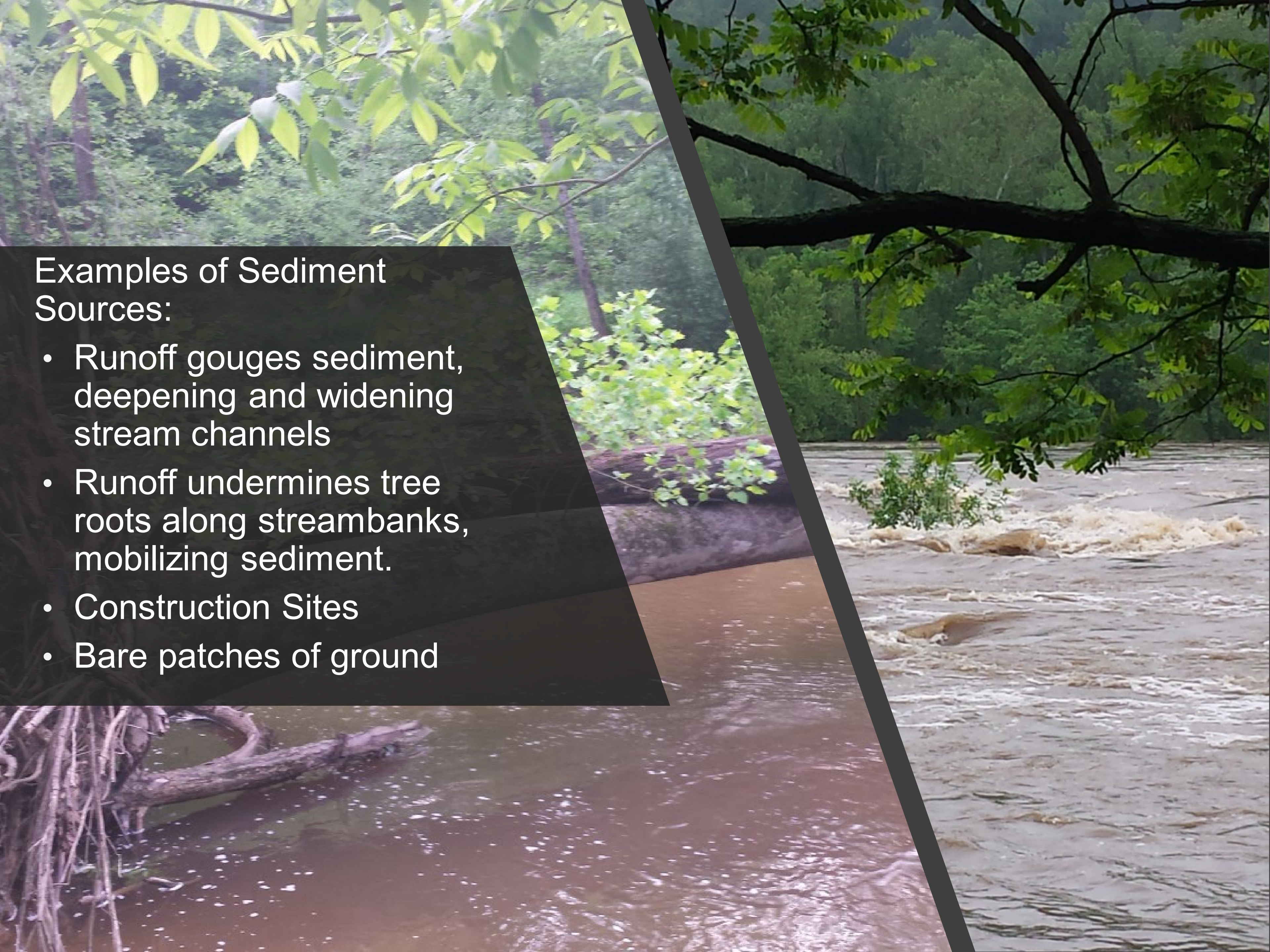
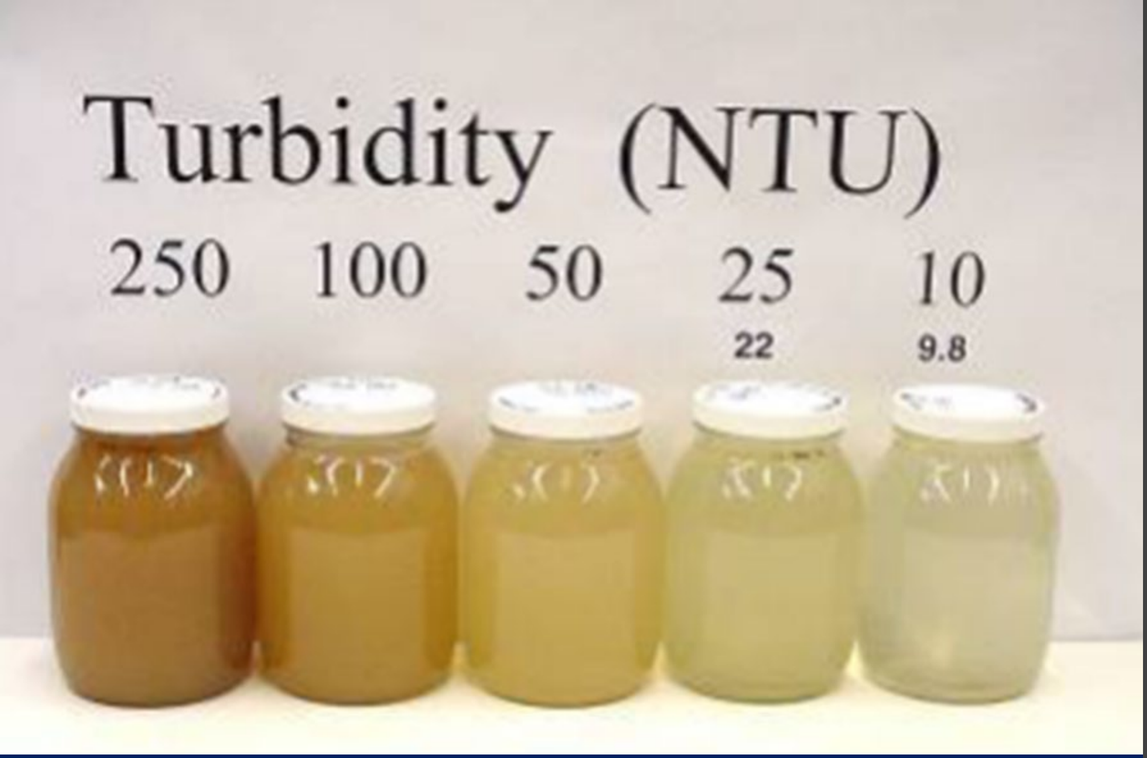


Figure 2–7. Impervious cover and storm drains deliver precipitation rapidly to urban streams, conveying pollutants and adversely affecting stream habitat, chemistry, and aquatic biota. About 35 percent of precipitation in an urban setting returns to the atmosphere through evapotranspiration from vegetation, 35 percent infiltrates into the groundwater system, and 30 percent runs off the land surface, compared

Source: USGS (2011) Circular 1373.


Examples of Sediment Sources:
• Runoff gouges sediment, deepening and widening stream channels
• Runoff undermines tree roots along streambanks, mobilizing sediment.
• Construction Sites
• Bare patches of ground



Turbidity is a measure of cloudiness versus clarity of water. It's a measure of suspended and dissolved sediment in water samples.

Jars of water with different levels of sediment, measured by Turbidity (NTU = Nephelometric Turbidity Units).

Image Credit: Professor Rich McLaughlin, Soil Scientist, NC State University www.soil.ncsu.edu.

SEDIMENT POLLUTION

- Increases cost of treatment for drinking water supplies
- Carries bacteria, heavy metals and other pollutants.

USGS SPARROW model shows that developed areas in the Piedmont account for higher total sediment loads than agriculture even though they occupy a smaller area.

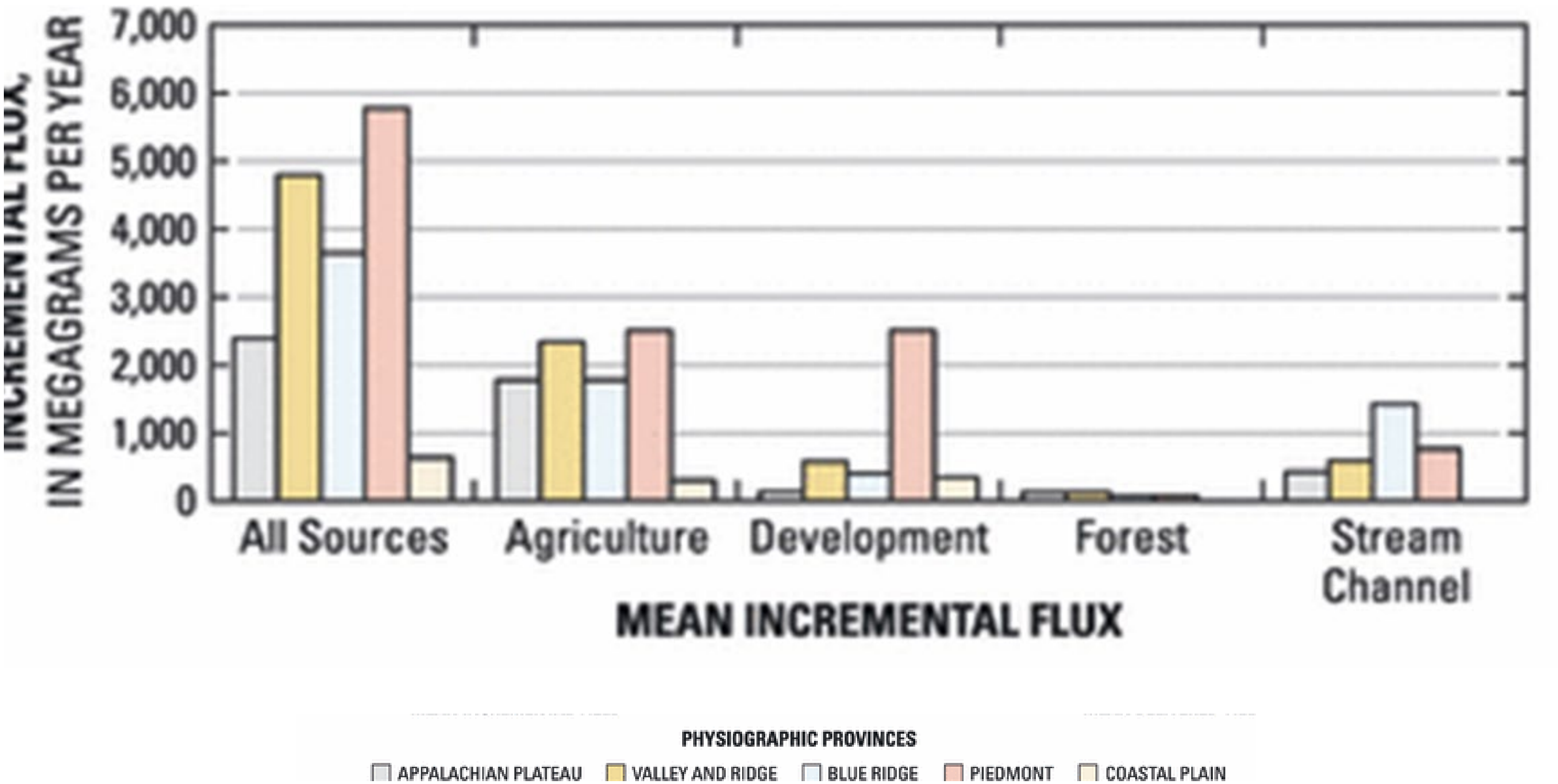
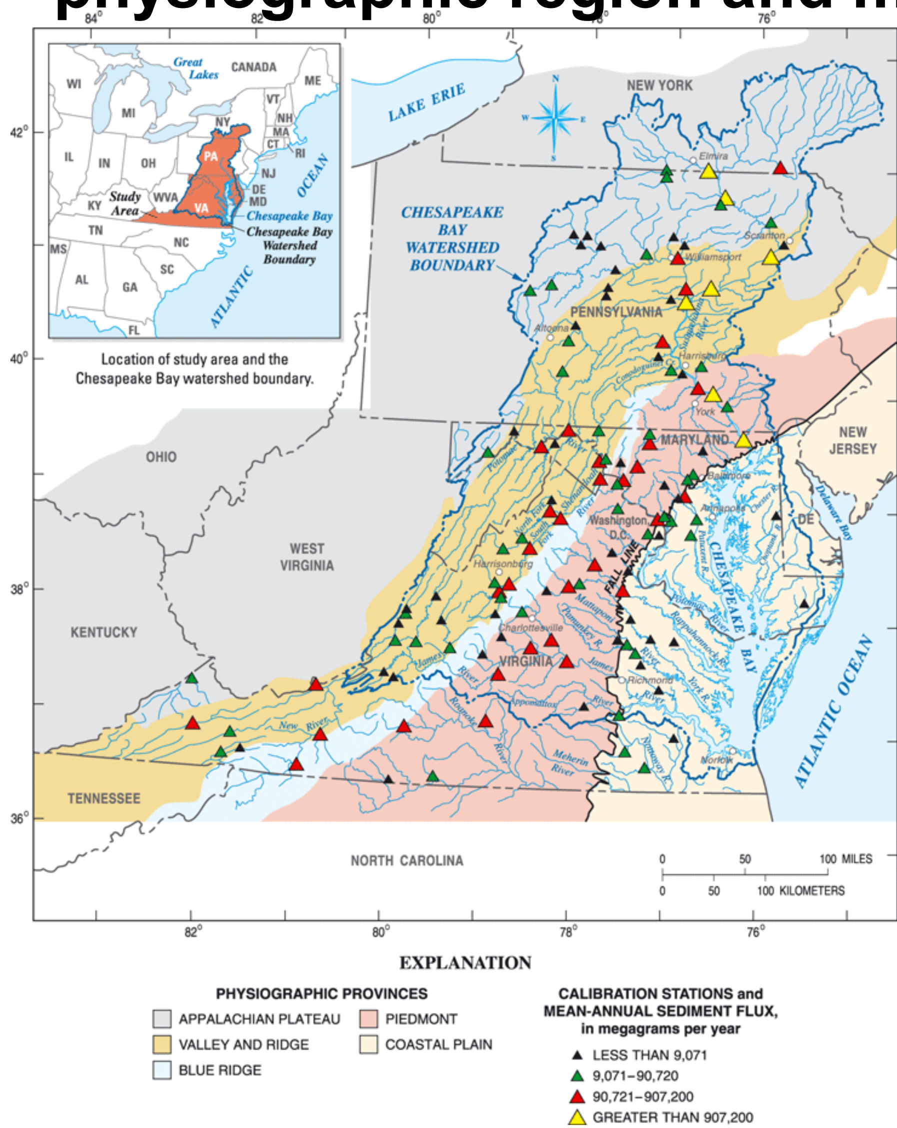
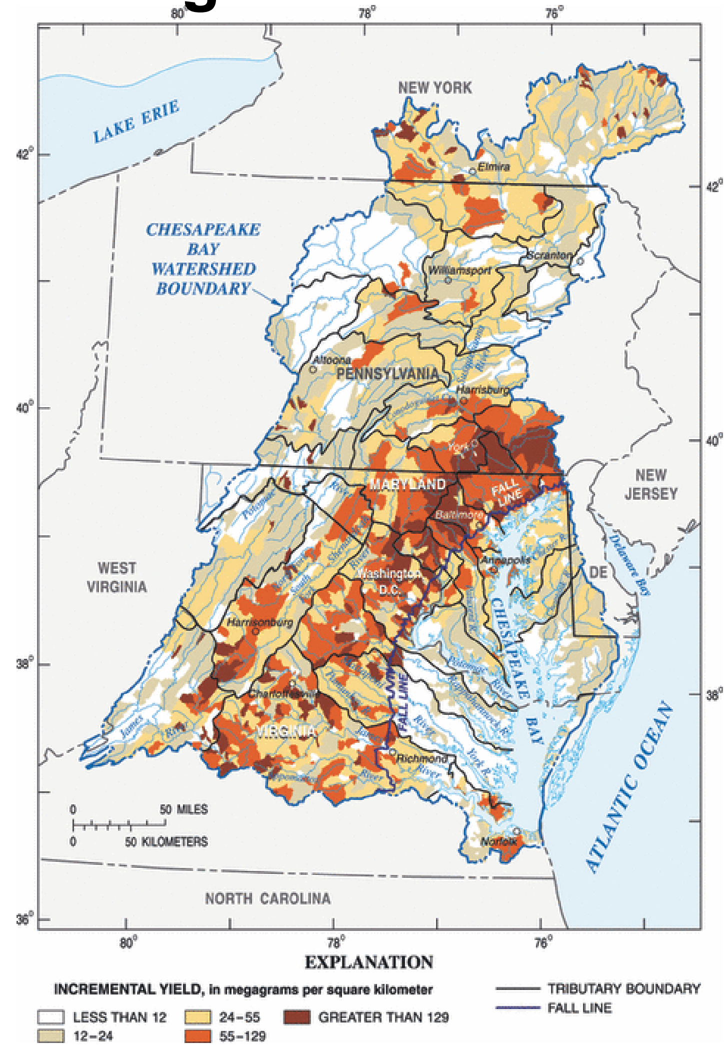


Figure excerpted from: Sources of Suspended-Sediment Flux in Streams of the Chesapeake Bay Watershed: A Regional Application of the SPARROW Model1, Volume: 46, Issue: 4, Pages: 757-776, First published: 26 July 2010, DOI: (10.1111/j.1752-1688.2010.00450.x) - Brakebill et al 2010 JAWRA

Sources of sediment to the Chesapeake Bay by physiographic region and monitoring locations





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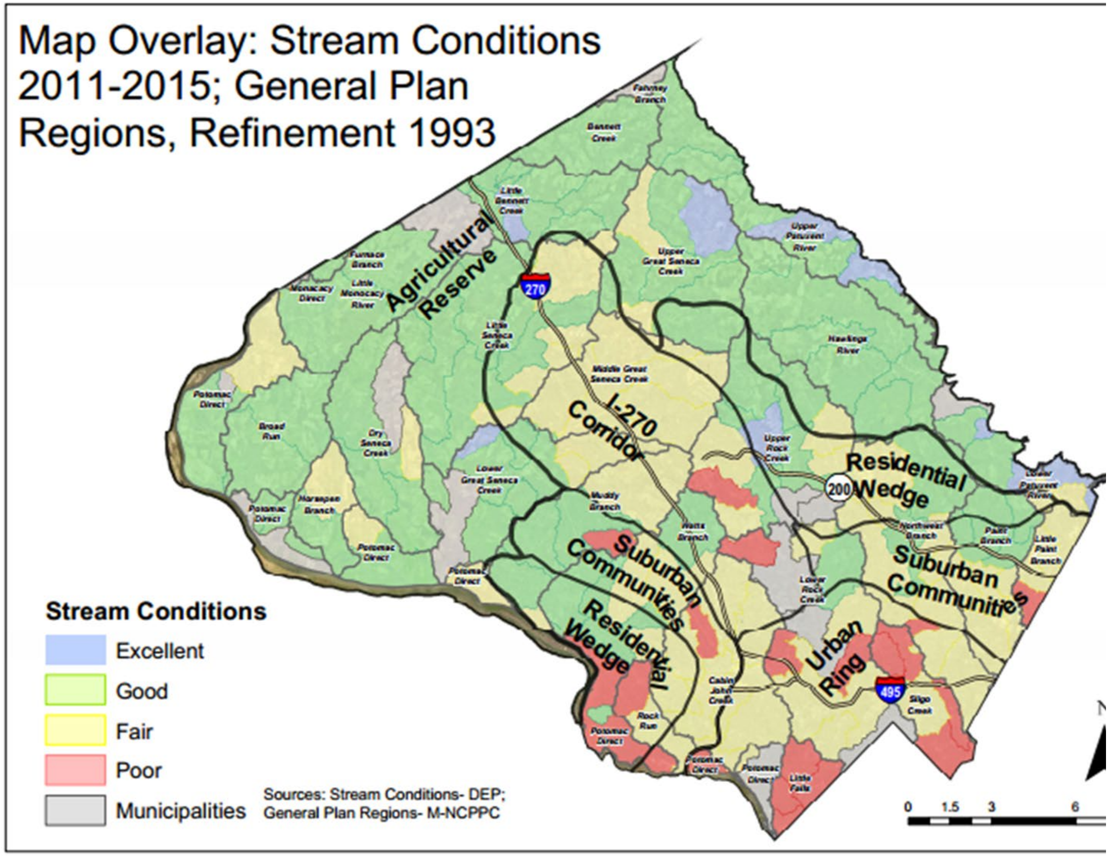


Stream Conditions in Montgomery County

Overlay:

- Stream Conditions
- Montgomery County General Plan – shows boundaries of:
  - Agricultural Reserve
  - Low density Residential areas
  - Suburban areas
  - Urban areas

Shows relationship of zoning to stream conditions

Image credit: Theodora Sideris, Montgomery Parks

IV. Big Picture for the Mid-Potomac Drinking Water Supply

- Potomac Filtration Plant
- Map of Potomac River Basin
- Costs of water treatment
- New ICPRB study released
- Planned Submerged Channel Intake

Drinking Water Protection

- WSSC's Potomac Water Filtration Plant serves more than 1.6 million customers in Montgomery and Prince George's Counties.
- The mid-Potomac River serves the entire Washington Metropolitan Area

Potomac watershed. Image by K. Musser. Own work, Elevation data from SRTM, hydrologic data from the National Hydrography Dataset, urban areas from Vector Map, all other features from the National Atlas., CC BY-SA 3.0, https://commons.wikimedia.org/w/index.php?curid=12568535

Potomac River Watershed

Water treatment to remove sediment is costly

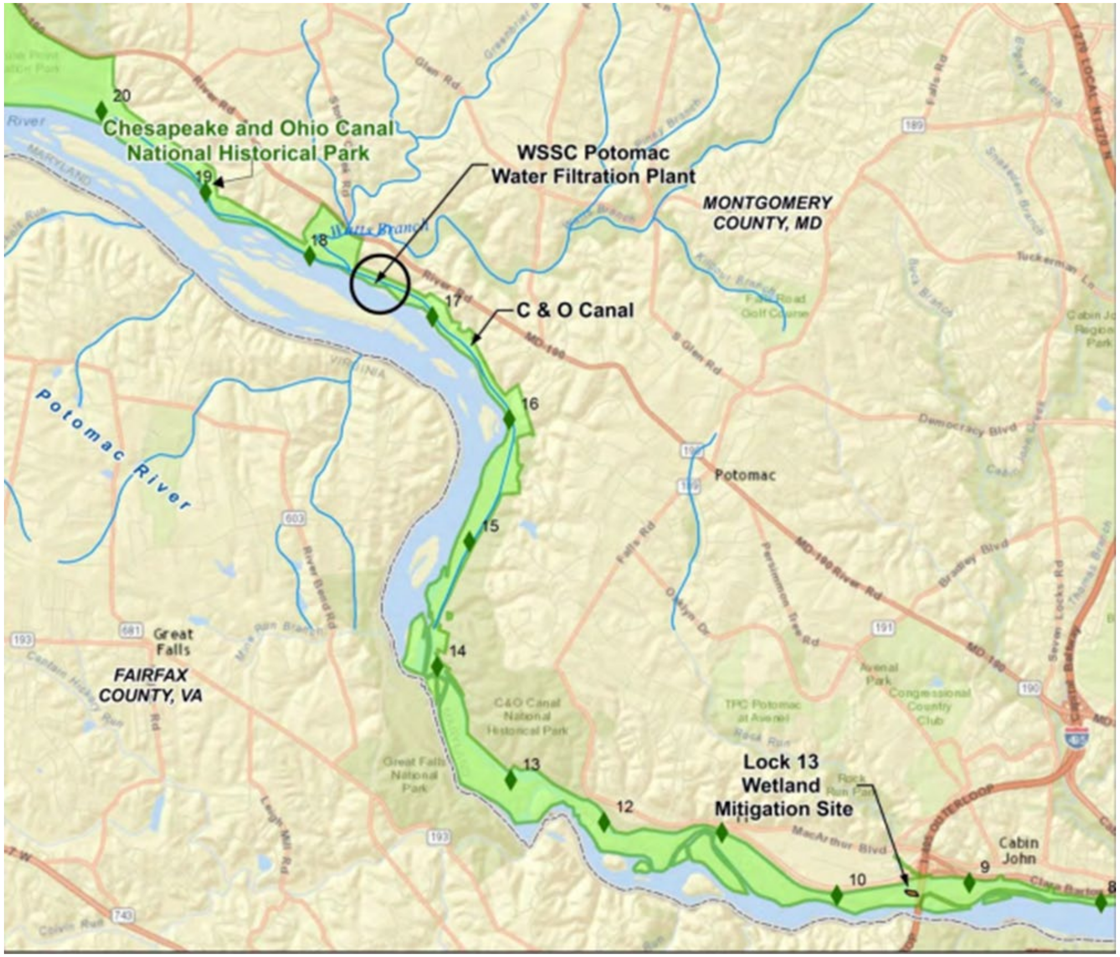
- Submerged Channel Intake proposed to avoid increased costs of water treatment associated with runoff from Watts Branch
  - $83 million
- Upgrade of Water Filtration Plant due to sediment discharge above permitted level:
  - $157 million
- Combined cost: $240 million
  - Bond payments would add 2.6% to current water rates*

Source of cost information: WSSC Adopted FY 2019-2024 CIP;

* Estimate by author, Sylvia Tognetti, based on total rate revenue reported by WSSC.

Findings from ICPRB study

- A recent study by the Interstate Commission on the Potomac River Basin (ICPRB found that forest conservation and increases in forested buffers in the entire 11,560 mi^2 upper Potomac River basin would:
  - Improve water quality from 1 to 5%
  - reduce chemical treatment costs by 1.6%
- However, this result could be different if the study had considered:
  - watersheds closer to the intake that have higher levels of imperviousness and are subject to more development pressure
  - Contaminants not effectively removed by conventional treatment
  - treatment costs beyond those of added chemicals.



"Watts Branch causes sudden negative changes in raw water quality and treatability at the Potomac WFP intake. Negative changes are characterized by sudden and extreme increases in suspended solids, fecal coliforms, as well as decreases in pH and alkalinity."

The planned Submerged Channel Intake was recommended in the 2002 Source Water Assessment because of pollution from stormwater runoff in the Watts Branch watershed.

Source: Potomac River Source Water Assessments for MD Plants – prepared by Becker and O'Melia LLC et al for MDE and WSSC (2002).

Top left: location of the WSSC Potomac Water Filtration Plant

Location of Potomac Water Filtration Plant and existing water intake

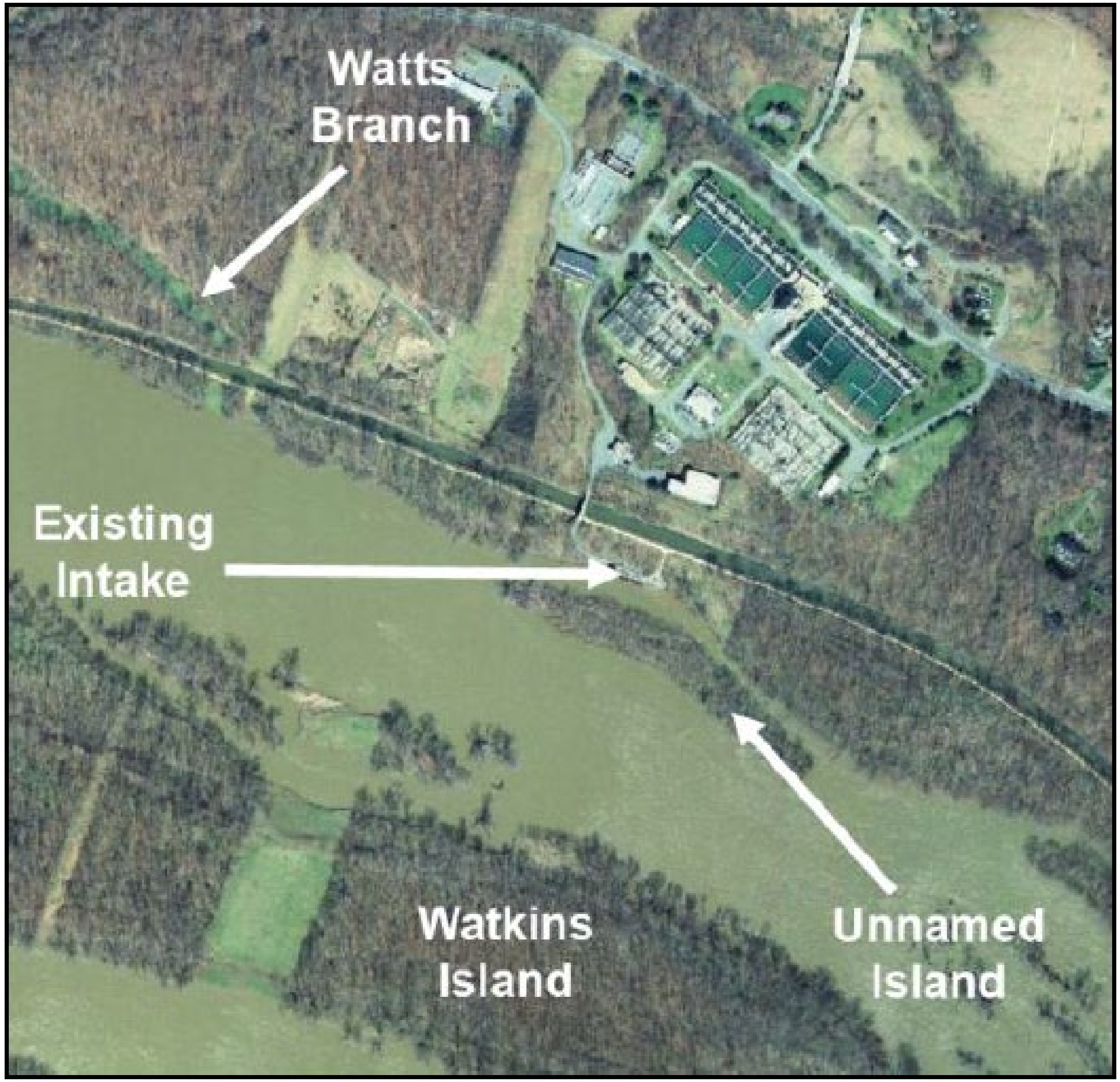


Image credit: Montgomery County Planning Department Staff Memo 3-13-2014

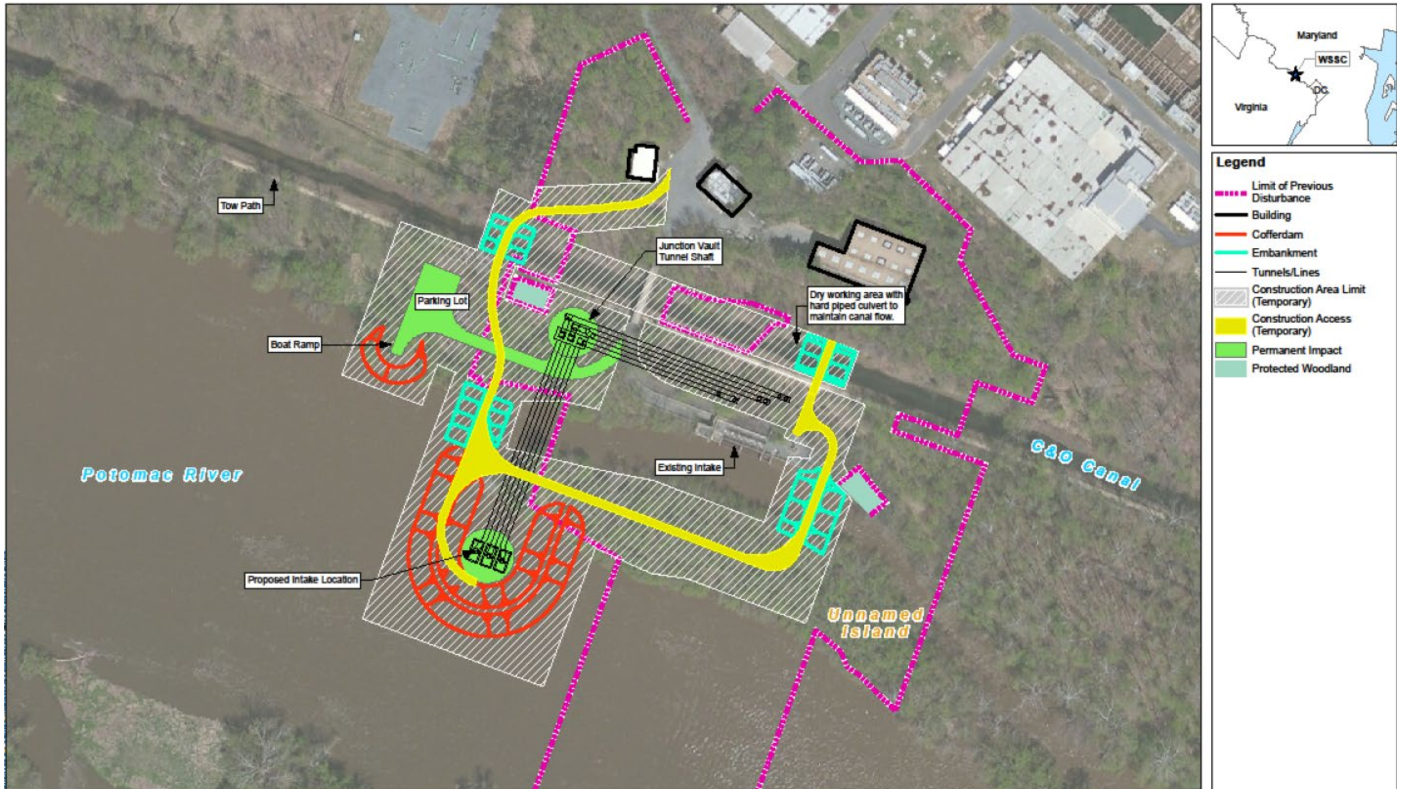


Figure 2
Alternative 2 Tunnel to Shaft West of Existing Intake

Source:
Black & Veatch 2013
ESRI 2012

Projection: NAD 83 Maryland StatePlane Feet
Date: October 2013

0 100 200
Feet

Planned Submerged Channel Intake

Potomac Water Filtration Plant

Costs and benefits of proposed capital project solutions:

- They are expected to provide more consistent and predictable water quality at the intake pipe
- This will make it easier to treat in the short term, as well as to comply with the plant's discharge permit
- They do not address the source of the problem pollution in the contributing watersheds.

V. Key findings: Costs and benefits of forest canopy cover

- An increase in forest cover would reduce sediment loading but would not be sufficient because much of the load is from eroded stream channels and is associated with the legacy of past land uses
- Increasing forest cover provides a foundation for watershed protection that needs to be combined with other strategies
- Costs and benefits of forest retention and restoration to the drinking water supply are much more difficult to estimate
- A more comprehensive assessment is needed of gray and green alternatives that identifies opportunities for forest protection and restoration along with their co-benefits

Co-Benefits of Increasing Forest Cover & Tree Canopy

Water Quality Benefits

- reduction of sediment loads
- runoff volume and velocity reduction
- increased dry-weather baseflow of small streams
- protection of well water
- decreased nutrient loadings
- avoidance of increases in drinking water treatment chemicals
- decrease in sediment handling costs

Co-Benefits

- carbon sequestration/ carbon capture in healthy forest canopies, understory, & duff (leaf litter)
- soil conservation
- reduction of urban heat island effects – benefits for health, energy savings
- reduction of air pollution
- reduction of flooding
- recreational and aesthetic values
- wildlife habitat
- increase in property values
- job creation and stimulation of economic development

Conclusions

1. Forests are the first line of defense in the multiple barrier approach
2. Canopy cover has declined in Watts Branch, Muddy Branch, and Seneca Creek during the study period (2009-2014).
3. Increased forest and canopy cover would reverse this negative trend and would help to reduce sediment loadings to the Mid Potomac.
4. Estimated costs of increased forest and canopy cover: range from $33,000 per acre to reforest publicly-owned streamside buffers, to $150,000 per acre for land purchase for forest retention.
5. Co-benefits will increase returns for an investment in increasing canopy cover significantly.
6. Additional information and analyses needed (beyond scope of present study): modeling of sediment yield and estimation of costs for forest cover scenarios; costs of drinking water treatment with potential sediment load reductions, other contaminant reductions, spill and runoff contamination risk reductions and other benefits of watershed restoration; estimation of the economic value of co-benefits.

VI. Sierra Club Discussion: What is already being done?

Selected examples:

Public Agencies, Landowners

- Forest Conservation Law
- Tree Canopy Law
- Stream Valley Parks - Reforestation
- Legacy Open Space
- DEP Whole-Watershed Plans
- Tree Montgomery
- Stormwater management:
  - Ponds with plantings
  - Bioretention may include trees
  - Stream Channel restoration
  - Rainscapes – incentives for tree planting on private land

Private Groups, Landowners

- Tree-planting trees on private land
- Home Tree Care 101 - Conservation Montgomery
- Education around clean water and forests/trees

How to get involved

- Join Sierra Club's Water Team
- Volunteer with the Montgomery County Sierra Club
- Attend Screening of "What Lies Upstream"
  - 11/26 @ 7pm Elkridge Branch Library in Howard County

Top Left: Montgomery County Stormwater Partners Network, 2006
Top Right: Montgomery County Department of Environmental Protection staff at a stream restoration site (2018)
Bottom Left: Blair High School students in Young Environmental Writers Program, hosted by Conservation Montgomery (2017)