Evaluating remote economic benefits of watershed-scale acid mine drainage restoration

Rachel Spirnak, M.S.

West Virginia Water Research Institute

West Virginia University

Overview

- Background & Significance
- Methodology
- Results
- Discussion

Background & Significance

Acid Mine Drainage (AMD) Impacts

- 5,000 km of streams impaired by AMD in Appalachian Basin (USEPA, 2015)
- Discoloration and noxious odors
- Biologically "dead"
- Loss of fishery & recreational opportunities

WestVirginiaUniversity.

AMD Remediation

- Neutralization of acidity and precipitation of metals
- Can be passive or active
- Costly
- Watershed-scale approach

Theresa Marthey, Preston County News (2017)

WestVirginiaUniversity

Economic Benefits of Watershed Restoration

- Market Values
  - Recreation & tourism-based spending
  - Decreased cost of water treatment
  - Housing sales/property values
- Non-Market Values
  - Ecosystem services
  - Biodiversity
  - Existence & bequest values

Valuating Economic Benefits of Watershed Restoration

Method	Description	Use	
		Estimate potential benefits	Quantify actual benefits
Hedonic modeling	Estimates prices of nonmarket amenities that may be capitalized in the price of a housing unit or property	X	X
Contingent valuation	Based on surveys of people's willingness to pay for restoration	X	
Travel cost method	Based on surveys of people's actual time and money spent traveling to an area	X	X
Benefit transfer	Applies outside data to the area of study for gross estimates	X	

Property Values

- Good option for capturing remote economic benefits?
- Increase in stream-side property values has been cited as a potential benefit of watershed restoration (Thurston et al., 2009).
- Few post-restoration studies have been completed to quantify actual benefits.

Property Value Literature

Study	Site	Benefit	Time Series or Cross Sectional
Epp and Al-Ani, 1979	Small Pennsylvania rivers and streams	Property value increase of 5.9% per unit increase in pH	CS
Michael, Boyle, and Bouchard, 1996	Selected Maine lakes	$144/ft increase in property value per 4 m increase in water clarity	CS
Rich and Moffitt, 1983	Housatonic River	Post abatement property value increase of $37 per occupied riparian acre	TS

Problem Statement

This project investigates changes in property values post-restoration in a West Virginia watershed as a case study for remote economic benefits of watershed-scale AMD restoration.

Objectives

1. Find percent change in property value over time for restored watershed.
2. Correlate property value changes to distance to stream.

Importance of Research

- Quantify a remote benefit of AMD remediation.
- Demonstrate success of watershed-scale treatment.
- Justification for future spending in similar watersheds.

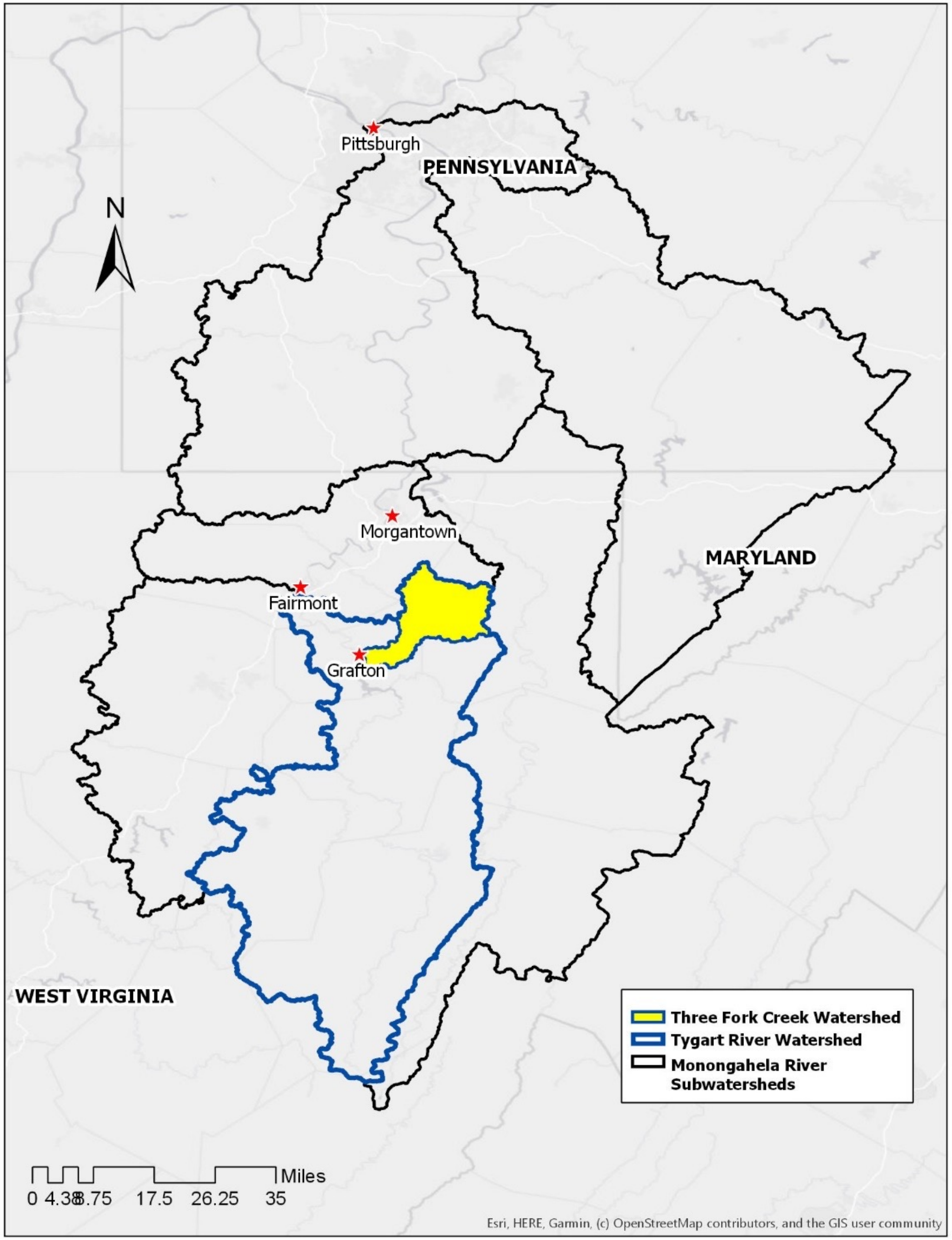
WestVirginiaUniversity.

Methodology

West Virginia University

Study Site

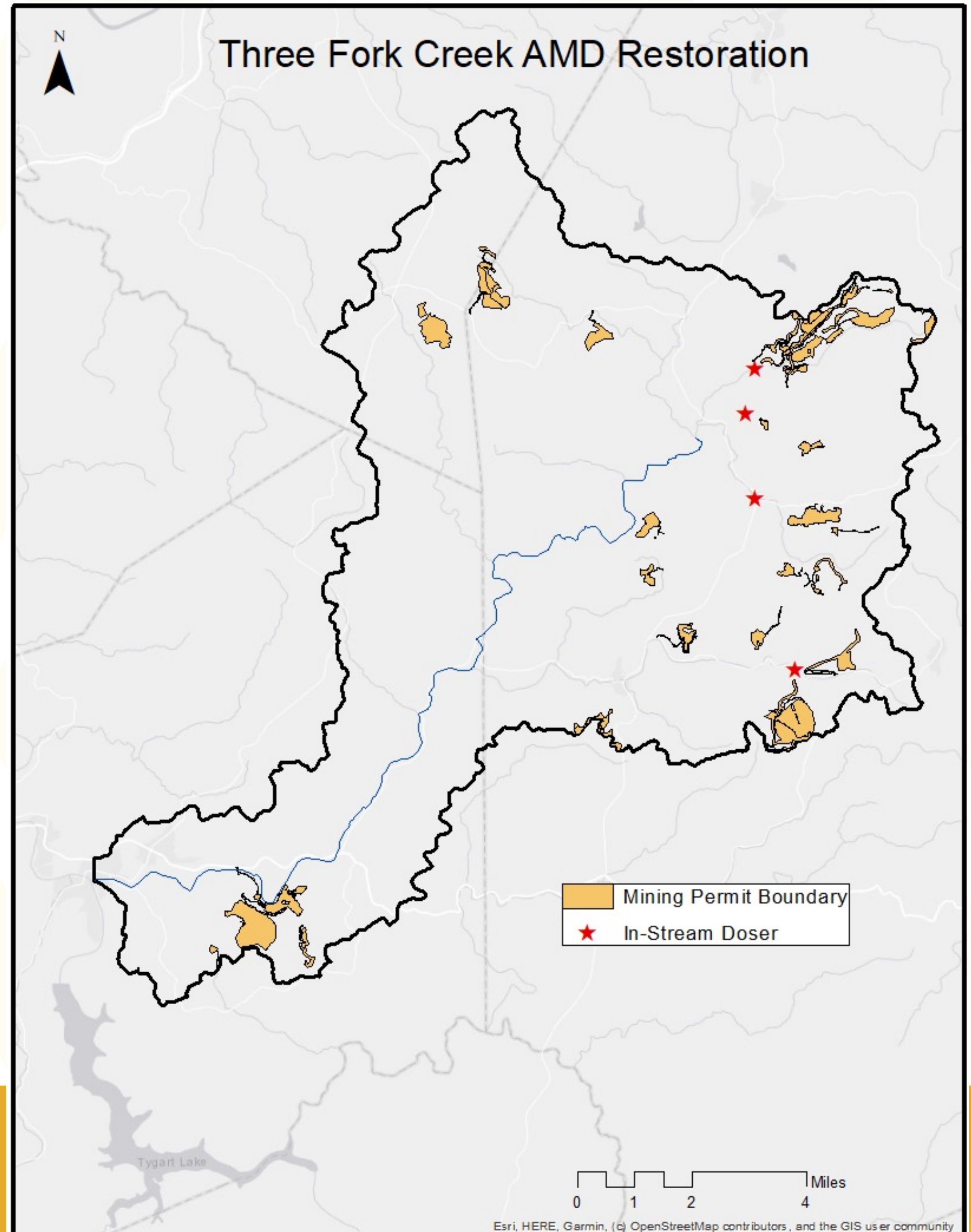
- Three Fork Creek Watershed
  - 103 square miles
  - Sub-watershed of Tygart River
  - Taylor, Preston, and Monongalia counties of northcentral West Virginia



West Virginia University

Study Site Cont.

- In 2004, was noted as second highest contributor of AMD in the Monongahela River Basin (USEPA, 2016).
- Four active in-stream lime dosers installed in 2011.
- Treat impaired headwater streams.



West Virginia University

Study Site Cont.

- Documented visual improvements.
- Removed from WV impaired waters list for aluminum in 2014 (USEPA, 2016).
- Fish diversity and brook trout populations increased significantly and continue to increase (Long, 2019).

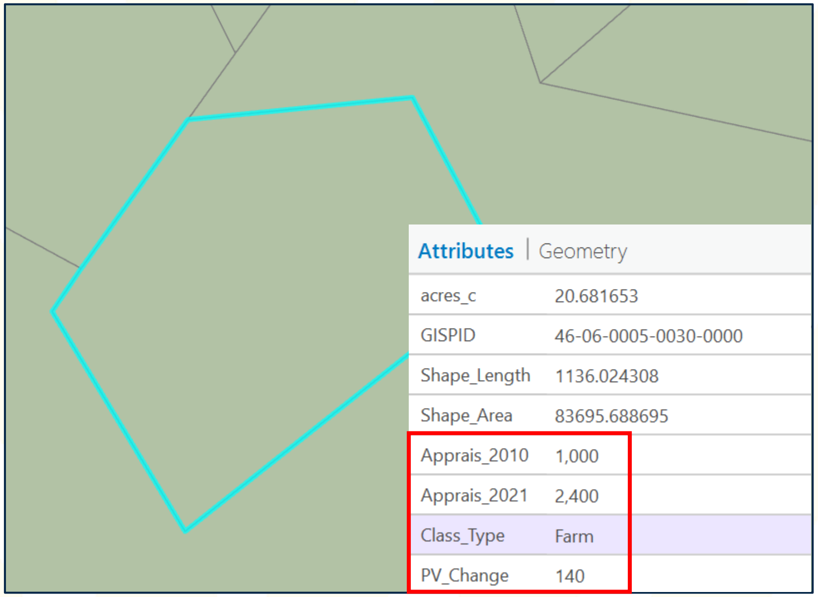
Birds Creek Before

Birds Creek After

WV Office of Abandoned Mine Lands and Reclamation, n.d.

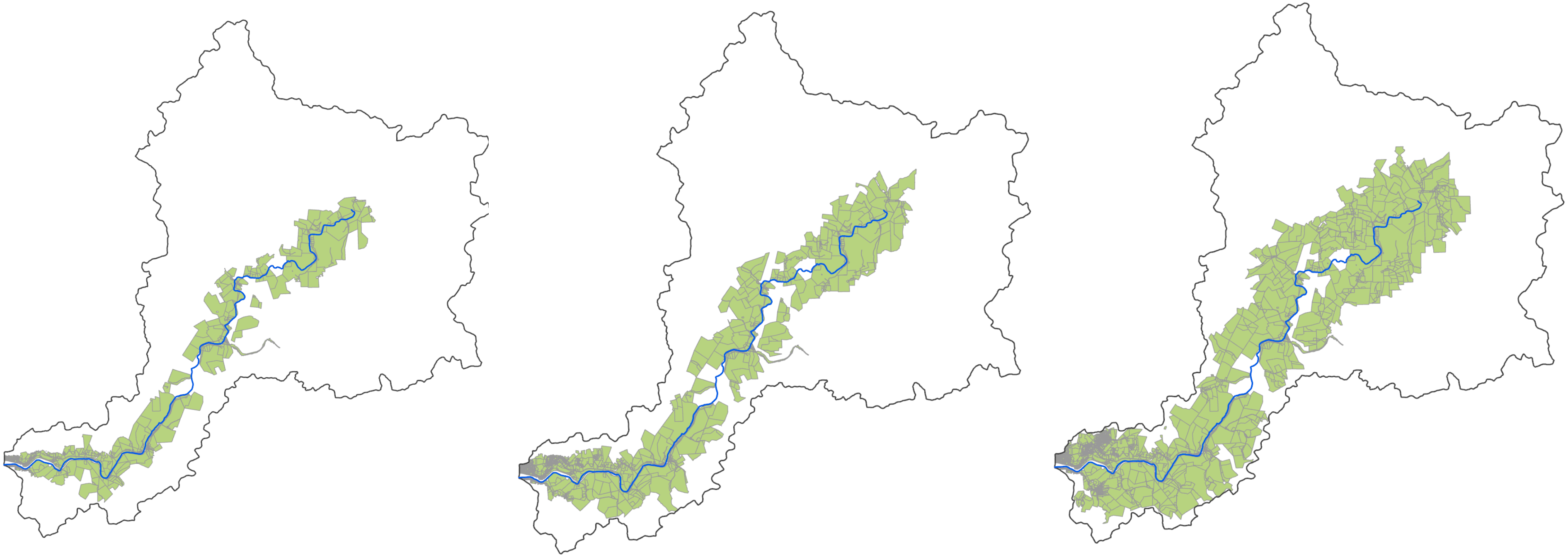
Data Collection

1. Obtained 2010 and 2021 parcel assessment records via WV Property Viewer.
2. Geo-coded into GIS parcel shapefile in ArcGIS Pro.
3. Adjusted 2010 to 2021 dollars to account for inflation.
4. Calculated percent change in property value.



$$\%\ PV\ Change = \frac{Apprais_{2021} - Apprais_{2010\,a}}{Apprais_{2010\,a}} \times 100$$

Spatial Analysis: Buffers



0.25 mile

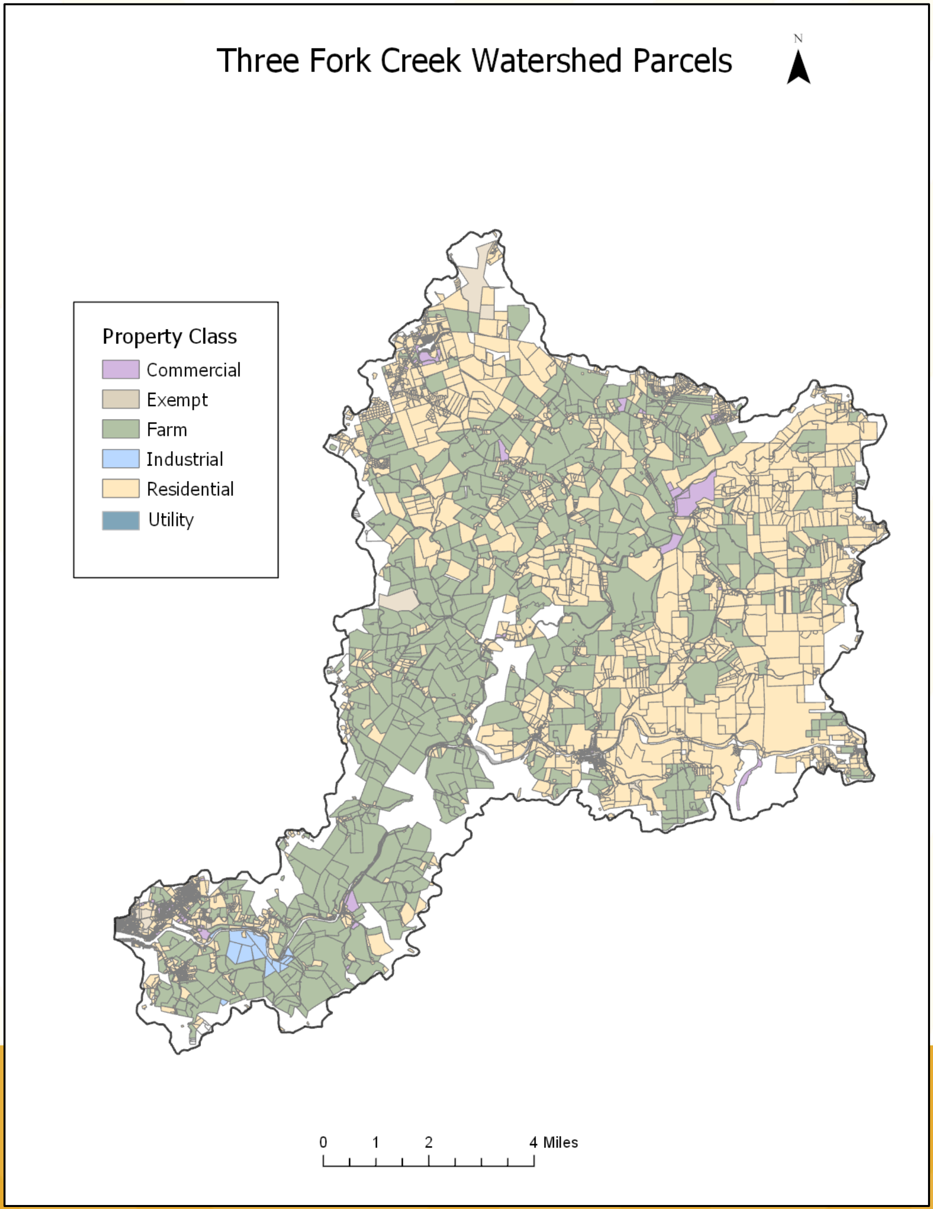
0.5 mile

1 mile

Results

Property Class

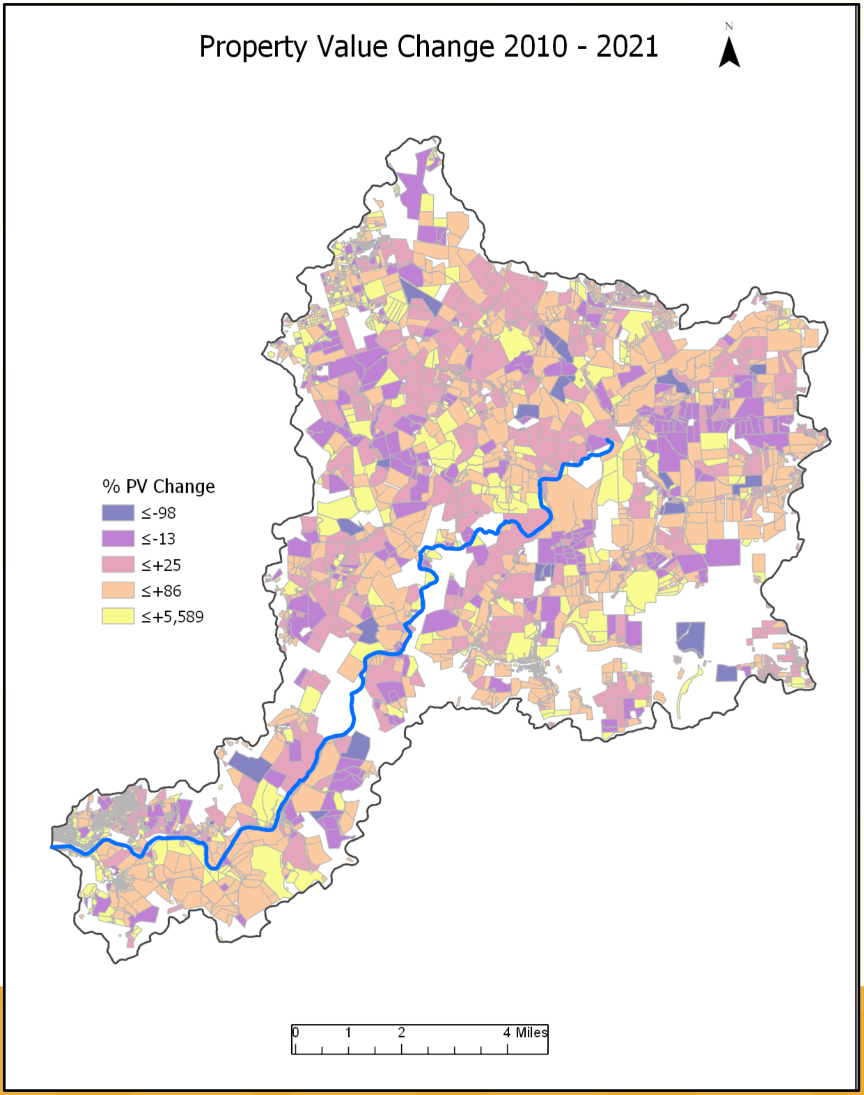
Property Class	No. Parcels	% Of Total
Commercial	186	3%
Exempt	218	4%
Farm	628	12%
Industrial	13	<1%
Residential	4,409	81%
Utility	7	<1%
Total	5,461	100%



WestVirginiaUniversity.

Property Value Changes

Location	No. Parcels	Average % Property Value Change
Watershed	5,461	85%
1 Mile Buffer	2,593	107%
0.5 Mile Buffer	1,744	143%
0.25 Mile Buffer	1,062	181%



West Virginia University

Discussion

West Virginia University

Implications

- Furthers growing research in quantifying economic benefits of watershed restoration.
- Can be used to demonstrate successes of treatment and as justification for similar projects.

Limitations

- Assumption that property values respond to environmental factors
- Other characteristics affecting property values
- Does not account for improvements to headwater tributaries

Recommendations for Future Research

1. Full scale hedonic study utilizing the property value data collected in this study.
2. Investigate correlation with water quality.
3. Combine with other valuation methods for full picture of economic benefits.
4. Georeference property value data across West Virginia to allow simple replication across other watersheds.

References

Epp, D., and K.S. Al-Ani, 1979. The effect of water quality on rural nonfarm residential property values. Amer. J. Agric. Econ. (August): 529–534

ESRI, n.d. How proximity tools calculate distance. <https://pro.arcgis.com/en/pro-app/2.7/tool-reference/analysis/how-near-analysis-works.htm>

Long, Rebecca Anne, 2019. "Ecological Benefits of Watershed-scale Restoration in Two Intensively Mined Cold- and Warm-water Ecosystems." Graduate Theses, Dissertations, and Problem Reports. 3799.

Michael, H.J., Boyle, K.J., Bouchard, R., 1996. MR398: Water Quality Affects Property Prices: A Case Study of Selected Maine Lakes. Maine Agricultural and Forest Experiment Station Miscellaneous Report 398

Rich, P.R., Moffitt, L.J., 1982. Benefits of Pollution Control on Massachusetts' Housatonic River: A Hedonic Pricing Approach. J Am Water Resources Assoc 18, 1033–1037

Thurston, H., Heberling, M., Schrecongost, A. (Eds.), 2009. Local Economic Benefits of Restoring Deckers Creek: A Preliminary Analysis, in: Environmental Economics for Watershed Restoration. CRC Press, pp. 140–160

United States Environmental Protection Agency (USEPA), 2015. 303(d) Listed Impaired Waters NHDPlus Indexed Dataset with Program Attributes

United States Environmental Protection Agency (USEPA), 2016. Nonpoint Source Success Story: Installing Limestone Dosers Improved Three Fork Creek. EPA 841-F-16-001C

Acknowledgements

United States Geological Survey 104(b) Program

Davis College of Agriculture, Natural Resources and Design

Michael Strager, PhD

Paul Kinder, PhD

John Chambers College of Business and Economics

Eric Bowen , PhD

Daniel Centuriao

Christiadi, PhD

West Virginia Water Research Institute

Eliza Siefert

Jude Platz

Jacob Morris

Sarah Cayton

Melissa O'Neal

Jason Fillhart, M.S.

Paul Ziemkiewicz, PhD

WestVirginiaUniversity. USGS science for a changing world WEST VIRGINIA WATER RESEARCH INSTITUTE

Questions?

West Virginia University