

# The Value of Wetlands for Flood Mitigation: A Hedonic Analysis of Residential and Agricultural Properties in New York's Hudson Valley.



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# Introduction

- Floods are the most common natural disaster in the U.S.
  - Causing nearly \$3 Billion, on average, in property damage each year. (According to NFIP)
- Waterfront properties are heavily sought after
  - Homeowners in may not fully account for flood risks when purchasing
- Flood zones have been shown to negatively impact property values
- Wetlands are known to help reduce the severity of floods by slowing runoff

# Hypothesis

- Given the natural ability of wetlands to absorb runoff and reduce the severity of floods is it possible that the presence of wetlands could also reduce the negative impact on property values that come from living within a high-risk flood zone?
- Does the occurrence of a major flooding event negatively impact property values?
  - Could wetlands also help to lessen that impact?

# Flooding Literature

- 100-year flood zones are shown significantly reduce property values, *ceterus paribus*
  - In the wake of a major flood (Hurricane Floyd) that effect is magnified
    - (Bin and Polasky, 2004)

# Wetland Literature

- Meta-Analysis of Techniques
  - Brander et al. (2006)
    - Replacement Costs, Market Prices, and Contingent Valuation are most common methods
- Wetland Value
  - Wetlands reduce property values in rural areas
    - Bin and Polasky (2005)
  - Wetlands and open space are amenities in urban areas
    - Boyer and Polasky (2004), Smith et al. (2002)

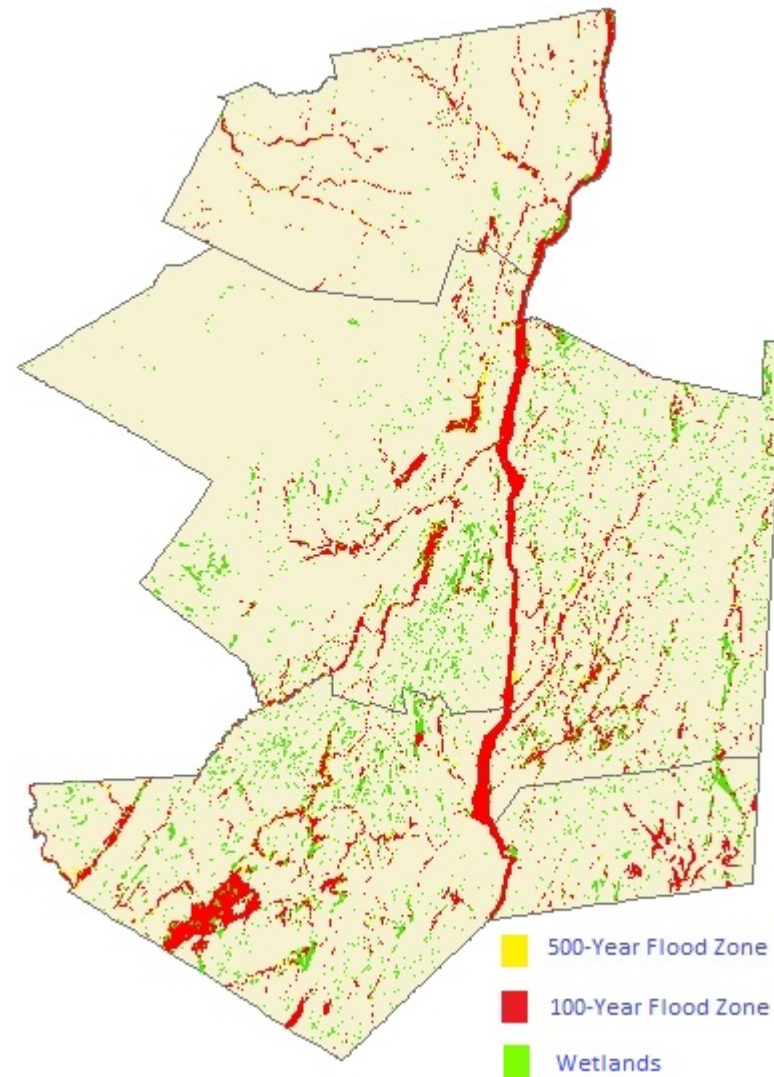
# Using Hedonics to Value Ecosystem Amenities

- Previously used in the valuation of wetlands for recreation and environmental amenities
- Able to determine the real market value for observable ecosystem services.
- No known work that specifically utilizes hedonic analysis to study the flood mitigation services that wetlands provide.

# Study Area

- 5 Counties in Hudson River Valley
  - Greene, Dutchess, Orange, Ulster, and Putnam
- 4 Major flooding events:
  - April 2005 (Greene and Ulster Counties)
  - October 2005 (Dutchess County)
  - April 15-16 2007
  - Tropical Storm Irene (August 28 2011)

# Study Area





# Data

- Sample of over 50,000 property transactions across the Hudson Valley region of NYS from 2004-2012.
- Data includes home and property characteristics and locational information.
- Merged with GIS data concerning the location of towns, roads, streams, wetlands, and flood zones.

# Data Sources

- Transactions:
  - NYS Department of Taxation SalesWeb
- Parcel Polygons:
  - NYSGIS Clearinghouse and Individual County Offices when necessary
- DFIRM (Digital Flood Insurance Rate Maps):
  - FEMA Map Service Center
- Wetlands:
  - Fish and Wildlife Service National Wetlands Inventory: CONUS Polygons

# Methodology

- Utilizing local area Fixed-Effects Hedonic Analysis
  - Analyzed data at two FE levels:
    - Census Block Group
    - Census Block
  - Addresses omitted variables bias and reduces the scope of spatial dependence.
- Included spatial analysis from GIS to determine the proximity to geographical features
  - This included:
    - Calculating the total acreages of nearby wetlands and distances to a number of features
    - Determining if properties fall in a Flood Zone

# Methodology

- Dummy variables for properties that sold after a major flood
  - Three and Six Months
- Utilize a three part interaction term:
  - Flood Zone x Flood x Total Acreage of Wetlands

# Census Block Fixed-Effects Results

	<b>Sold Within 3 Months After Major Flood</b>			
<i>Variable</i>	<i>Coefficients</i>			
<b>Property is in 100-Year Flood Zone</b>	<b>-0.076***</b>	<b>-0.076**</b>	<b>-0.086***</b>	<b>-0.083***</b>
Property is in 500-Year Flood Zone	-0.032	-0.032	-0.032	-0.032
100-Year FZ * Wetland Acres 1/2K	0.000*			
100-Year FZ * Wetland Acres 1K		0.000		
100-Year FZ * Wetland Acres 2K			0.000	
100-Year FZ * Wetland Acres 5K				0.000
Acreage of Wetlands within 1/2K	<b>0.000*</b>			
Acreage of Wetlands within 1K		-0.000		
Acreage of Wetlands within 2K			-0.000	
Acreage of Wetlands within 5K				-0.000
<b>Flood3Month</b>	<b>-0.031**</b>	<b>-0.031*</b>	<b>-0.031*</b>	<b>-0.031*</b>
<b>Flood3month*100-Year FZ</b>	0.022	-0.041	<b>-0.184*</b>	<b>-0.184**</b>
<b>ThreeMonthfloodhalfkwetland</b>	<b>-0.001***</b>			
ThreeMonthflood1kwetland		0.001		
<b>ThreeMonthflood2kwetland</b>			<b>0.000188*</b>	
<b>ThreeMonthflood5kwetland</b>				<b>0.000186**</b>

# Census Block Fixed-Effects Results

## Sold Within 6 Months After Major Flood

Variable	Coefficients			
<b>Property is in 100-Year Flood Zone</b>	<b>-0.076**</b>	<b>-0.079**</b>	<b>-0.085***</b>	<b>-0.084***</b>
Property is in 500-Year Flood Zone	-0.032	-0.031	-0.031	-0.031
100-Year FZ * Wetland Acres 1/2K	0.000			
100-Year FZ * Wetland Acres 1K		0.000		
100-Year FZ * Wetland Acres 2K			0.000	
100-Year FZ * Wetland Acres 5K				0.000
Acreage of Wetlands within 1/2K	<b>0.000*</b>			
Acreage of Wetlands within 1K		-0.000		
Acreage of Wetlands within 2K			-0.000	
Acreage of Wetlands within 5K				-0.000
<b>Flood6Month</b>	<b>-0.034**</b>	<b>-0.034**</b>	<b>-0.034**</b>	<b>-0.034**</b>
<b>Flood6month*100-Year FZ</b>	0.022	0.006	<b>-0.104*</b>	<b>-0.105*</b>
SixMonthfloodhalfkwetland	0.000			
SixMonthflood1kwetland		0.000		
<b>SixMonthflood2kwetland</b>			<b>0.000135***</b>	
<b>SixMonthflood5kwetland</b>				<b>0.000135***</b>

# Wetlands and Flood-Zones

- The significant and positive coefficients of interaction terms between 100-year flood zones, flooding events, and the total acreage of wetlands within 2 or 5 kilometers of the parcel, indicates that wetlands mitigate the negative impacts of floods on properties in flood prone areas.

# Conclusions

- Wetlands are a valued amenity in areas with a high risk of flooding, in the wake of a serious flood.
- Increasing the total acreage of wetlands in a flood prone area will not only reduce the intensity of floods when they happen, but may also help to stabilize property values, in flood prone areas.



# Non-Flood Results

Variable	Coefficient	Standard Error
Acres	0.003**	0.001
Number of Kitchens	-0.051**	0.020
Number of Full Bathrooms	0.092***	0.028
Number of Half Bathrooms	0.045**	0.019
Number of Bedrooms	0.008	0.013
Number of Fireplaces	0.084***	0.012
Central Air	0.052***	0.019
Overall Conditions	0.100***	0.027
Square Feet of Living Area	0.000***	0.000
Age of Home	-0.001**	0.000
Age of Home <sup>2</sup>	0.000	0.000
Agricultural Property	-0.565	0.418
Two Family Residence	-0.113***	0.033
Three Family Residence	-0.145***	0.049
Rural with Acreage	0.354***	0.041
Estate	1.394***	0.386

Variable	Coefficient	Standard Error
Seasonal	-0.797***	0.184
Mobile Home	-0.770***	0.201
Multiple Residences	0.314***	0.045
Distance to DEC Owned Land	-0.002	0.013
Distance to a Trail	-0.004	0.003
Distance to Nearest Town	0.020***	0.006
Distance to NYC	-0.066	0.054
Distance to Albany	0.024	0.102
Distance to Road (55-65mph)	0.024**	0.012
Distance to Street (35-45mph)	0.015***	0.005
Distance to I-90	0.022	0.058
Distance to I-87	-0.003	0.006
Distance to Railroad	0.022**	0.010

*All Distances are Natural Log*

Variable	Mean	Std. Dev.
Sale Price	306435.4	346932.2
Normalized Sale Price (2000)	556815.5	616379.7
Acres	2.38848	14.60971
Number of Kitchens	1.102775	0.3727704
Number of Full Bathrooms	1.629325	0.7512181
Number of Half Bathrooms	0.3850542	0.5260065
Number of Bedrooms	3.117134	1.042373
Number of Fireplaces	0.4626354	0.6319944
Central Air	0.173107	0.3783435
Overall Condition Rating	3.158794	0.596245
Square Footage	1739.929	807.3568
Age	54.86365	59.30748
Age^2	6527.328	89829.66
Distance to a DEC Land	16794.8	10535.52
Distance to a Stream	1099.379	849.8389
Distance to a Lake	9381.57	6214.541
Distance to a Pond	1410.173	1146.635
Distance to a Road (55-65mph)	13746.81	15538.6
Distance to a Street (35-45mph)	2961.482	3403.969
Distance to Center of Town	9737.105	8435.04
Distance to Bridge over Hudson River	58711.05	41352.74
Distance to a DEC Trail	28270.56	15608.76
Distance to Albany	373610.1	102695.9
Distance to NYC	352838.4	97863.93
Distance to a Railroad	15459.67	16721.28
Distance to I-90	304138.8	96956.29
Distance to I-87	53557.58	39237.63
Distance to Hudson River	50492.65	43753.35
Elevation	142.0585	99.62997
Distance to a Wetland	1220.435	1204.824
Total Acreage of Wetlands Within .5K	16.63447	41.24908
Number of Wetlands Within .5K	3.370437	3.6329
Total Acreage of Wetlands Within 1K	54.35606	78.11984
Number of Wetlands Within 1K	12.91246	11.09911
Total Acreage of Wetlands Within 2K	192.9991	177.2034
Number of Wetlands Within 2K	51.41308	36.44121
Total Acreage of Wetlands Within 5K	1115.684	630.8931
Number of Wetlands Within 5K	327.1027	178.9549