Do Property Values Reflect Flood Mitigation Benefits? Hedonic Pricing of the Restored North Campus Open Space Wetlands

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Final Project Report

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Research Question & Objective

Research question: How much benefit, in regards to flood risk reduction, has resulted from the restoration of the North Campus Open Space (NCOS) wetlands in Goleta, California?

Objective: This analysis will use a hedonic pricing approach to quantify the flood risk reduction benefits of wetlands for properties adjacent to NCOS.

Significance

As climate change intensifies, increasing the frequency and severity of extreme weather events, the demand for reliable flood control measures has grown significantly (Van Coppenolle 2019). Nature-based solutions, including wetlands, offer an effective alternative to traditional flood control techniques, such as levees and stormwater infrastructure. Wetlands, with their ability to absorb and store excess water, present a sustainable solution to this challenge.

However, valuing the benefits provided by wetlands remains a significant challenge. Many of the ecosystem services wetlands deliver, such as flood mitigation, water purification, and carbon sequestration, are public goods that lack a direct market to evaluate their monetary value. This often leads to the underappreciation and underinvestment in the decision-making processes of these public goods and services derived from wetlands. Non-market valuation methods, such as hedonic pricing, can help address this issue by quantifying the economic benefits of wetlands based on their influence on surrounding property values.

By applying non-market valuation to the NCOS wetlands, this study highlights their contribution to flood risk reduction and their broader economic value. Understanding these benefits is essential to justify investments in wetland conservation and restoration, particularly as communities face mounting pressures to adapt to climate-related threats.

Background

Wetlands can serve as natural water infrastructure for nature-based adaptation to climate change. A wetland is saturated with water, either permanently or seasonally, and encompasses a broad range of wet environments, including marshes, bogs, swamps, wet meadows, and floodplains (EPA 2024). Wetlands provide many ecosystem services ranging from flood control, water quality improvement, groundwater recharge, nutrient cycling, habitat for wildlife, recreation, education and research, aesthetics and landscaping, and carbon sequestration (EPA 2024, Dehnhardt et al., 2019). These benefits that humans derive from wetlands are often not accounted for in traditional markets as they are public goods with a non-market value. Conserving wetlands has the potential to be economically beneficial given the plethora of ecosystem service benefits that they provide.

The project's geographic scope will focus on the NCOS coastal wetlands located in Goleta, California near UC Santa Barbara (Figure 1). The NCOS restoration project began in 2009, when UCSB's

Cheadle Center set out to restore the Ocean Meadows golf course to its original wetland ecosystem (CCBER, 2024). Following a comprehensive environmental review confirming project feasibility, construction commenced in 2017. The NCOS project restored 40 acres of wetlands that were historically part of the Devereux Slough and that were filled in the mid-1960s to create the Ocean Meadows golf course (Clark & Stratton, 2019). Over a five-month period, approximately 350,000 cubic yards of soil were excavated to reestablish the wetland's natural hydrological connection to the Devereux Slough (CCBER, 2024). This restoration significantly mitigated flood risks, reducing flood elevations in adjacent neighborhoods by nearly two feet, highlighting the wetland's role in flood management and community resilience (Stantec, 2016).

To assess the economic benefits of the NCOS wetlands, this report will incorporate hedonic pricing, a method used to estimate how non-market values of wetlands influence real estate values. Hedonic pricing has long been used by economists to study wetlands. For example, in a study in Perth, Australia, researchers used a hedonic property pricing approach to determine that distance to nearest wetland and the number of wetlands within 1.5km of a property significantly influenced house sale prices (Tapsuwan et al., 2009). In a meta-analysis study from 2018, Beltrán et al. describes the disparity between property values and price discounts for homes located in and out of floodplains when comparing coastal and inland properties. Their research revealed a price discount ranging from -75.5 percent to +61 percent, highlighting the variation in property values in and out of the floodplain (Beltrán et al., 2018). Another study using hedonic pricing to determine flood risk impacts on US home values reported that houses located in the 100-year floodplain have a –0.3 to –0.8% lower price (Daniel et al., 2009). In the case of NCOS, this approach evaluates the extent to which restored wetland ecosystems enhance surrounding property values through flood mitigation benefits. By capturing these economic benefits, the analysis underscores the value of investing in wetland conservation projects like NCOS.

Approach & Methods

We used hedonic pricing, a revealed preference method, to assess the value of flood risk mitigation for properties nearby the restored NCOS wetland. The hedonic method is based on the assumption that property values differ based upon location-specific attributes, such as number of bedrooms, square footage, and proximity to parks or other amenities. We adopted this approach for our study on the basis that property values would capture the costs associated with being located in a floodplain. By collecting a variety of data to describe other structural and environmental characteristics of these properties, we aimed to isolate and measure the specific floodplain effect on property value using linear regression.

The 100-year floodplain is a regulatory mechanism created and maintained by FEMA. It identifies the areas with a 1% annual risk of flooding, or in other words, the areas with a chance of flooding once in every 100 years. Owners of properties located within the 100-year floodplain who have a federally-backed mortgage are required to buy flood insurance. We could not specifically study insurance prices for this project, as much of this data is private. Instead, we chose to study whether

and how property values would be impacted by a property's location inside or outside of the regulatory floodplain.

Description of Data

Parcels removed from the floodplain by the North Campus Open Space restoration project were identified by an official report by Stantec (Stantec, 2016). This set of 24 properties consists of eight single family units and sixteen condominium units (see Appendix). For comparison, we selected another 24 properties adjacent and similar to these first 24, but which had never been located within the FEMA 100-year floodplain. We selected a similar mix of unit types: eight single family units and sixteen condominiums. Upon collecting property value data for this control group of properties, two without available market value estimates were excluded from further study. Two additional control properties did not have market value estimates for 2015, and those were excluded from the 2015 regression analysis. All properties and locations are shown in Figure 1.

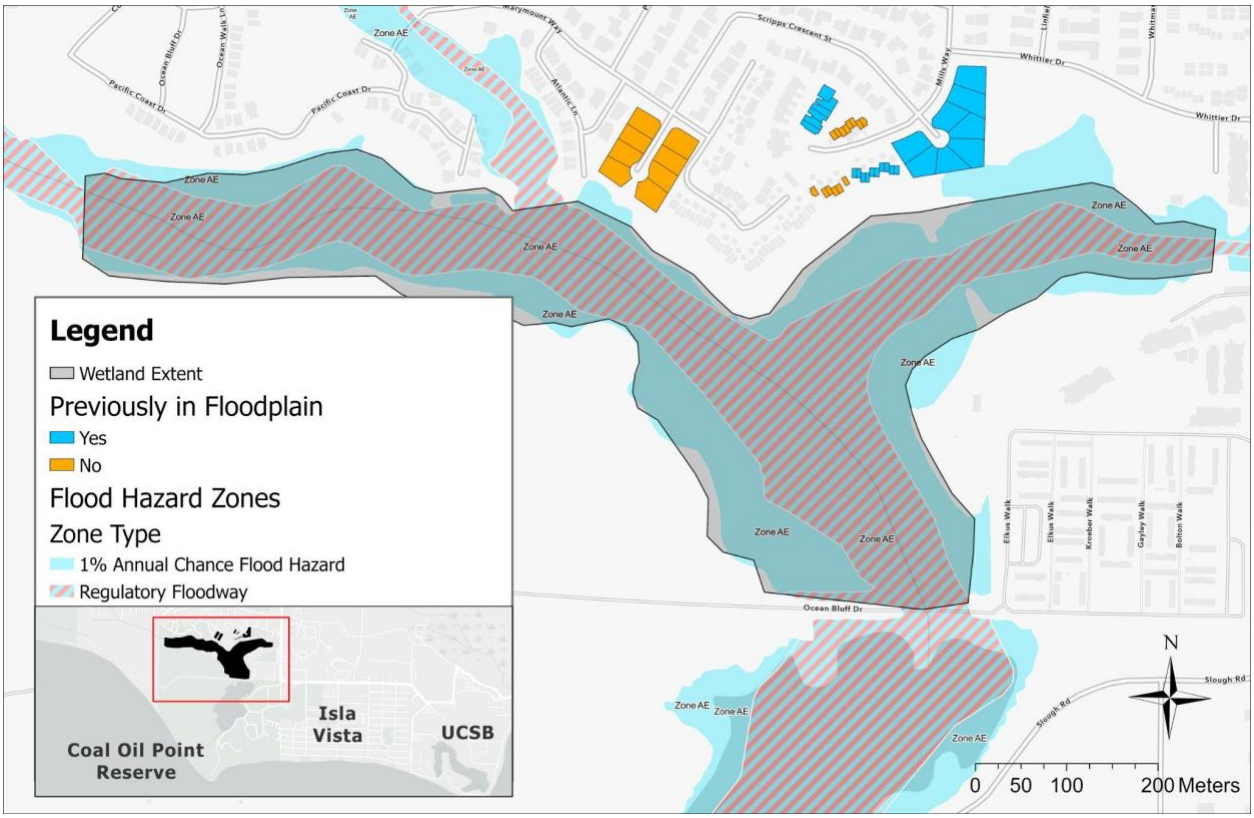

Figure 1. *Map of selected properties by the North Campus Open Space wetland. Properties that were previously within the FEMA 100-year floodplain are colored blue, while those which were never within the floodplain are colored orange. The extent of the restored wetland is outlined in black and shaded in gray. The current 100-year floodplain, as designated by FEMA, is shown in light blue.*

Parcel-level data was gathered from the Santa Barbara County tax assessor website for the 46 selected properties (*Assessor Map Secured Property Look Up*, n.d.). For each property parcel, the

following data was collected: address, use description, acreage, square footage, year built, number of bedrooms, number of bathrooms, number of fireplaces, garage square footage, pool and/or spa presence, and the most recent net assessed value. Market values for November 2024 and November 2015 were obtained from Zillow by inputting each property's address and finding the Zestimate for each time point. Each parcel was also given a binary value to indicate whether it had been within the FEMA 100-year floodplain before the wetland was restored (0 = yes) or whether it had never been within the floodplain (1 = no).

The distance to the wetland was calculated for each parcel using ArcGIS Pro. Using a shapefile containing all tax-assessed parcels in Santa Barbara County, the 46 parcels for the study were selected and saved as a new data layer (County of Santa Barbara Tax Assessor, 2024). Then, the wetland boundary was created by overlaying a data layer of North Campus Open Space habitat onto the map (CCBER, 2019) and tracing around the saltmarsh and transitional/high saltmarsh areas to denote the boundary. The "Near" geoprocessing tool was then used to calculate the distance from each parcel to the closest point on the wetland boundary. This data was saved and added to the original data table containing the rest of the property data, described above. Model variables, descriptions, and summary statistics are displayed in Table 1.

Upon completion of the data collection, three linear regression analyses were performed. Market value (2015), market value (2024) and net assessed value (2024) were used as the dependent variables, while other property characteristics in Table 1 were used as independent variables. For each regression, the estimated coefficients, p-values, and R-squared values were recorded.

Table 1. *Model variables with their descriptions and statistics, excluding floodplain and pool/spa dummy variables.*

Variable	Description	Mean	Minimum	Maximum
market_value_2024	Market value of the home from Zillow as of November 2024 (USD)	1,137,023	720,600	2,100,000
market_value_2015	Market value of the home from Zillow in November 2015 (USD)	643,825	481,300	994,800
net_assessed_value	Assessed value of the home for property tax (USD)	612,615	105,855	2,093,000
acreage	Total land area or lot size in acres	0.0695	0	0.23
area_square_feet	Total area of house in square feet	1,337	944	2,092
years_old	Age of the house in years	53	50	58
number_bedrooms	Number of bedrooms	1	2.5	4
number_bathrooms	Number of bathrooms	1.858	1.5	3.5

number_fireplaces	Number of fireplaces	0.93	0	1
garage	Size of the garage in square feet	325.7	200	484
pool_spa	Pool or spa in the home (pool, spa, none)	–	–	–
distance_to_wetland	Distance to the edge of the wetland nearest the property in feet	230.84	93.92	435.44
in_floodplain1	Home historically in the floodplain (0 = yes, 1 = no)	–	–	–

Results

The linear regressions took the following functional form:

$$\textbf{Market Value} = \beta_0 + \beta_1\textbf{acreage} + \beta_2\textbf{area\_square\_feet} + \beta_3\textbf{years\_old} + \beta_4\textbf{number\_bedrooms} + \beta_5\textbf{number\_bathrooms} + \beta_6\textbf{number\_fireplaces} + \beta_7\textbf{garage} + \beta_8\textbf{pool\_spaNone} + \beta_9\textbf{pool\_spaPool} + \beta_{10}\textbf{pool\_spaSpa} + \beta_{11}\textbf{distance\_to\_wetland} + \beta_{12}\textbf{in\_floodplain}$$

with β_0 as the y-intercept, and other β values as the coefficients for each dependent variable. The results of these regressions are shown in Tables 2 - 4.

Table 2. *Linear Regression Results for Model 1 - 2024 Market Value. Adjusted R-squared: 0.963, p-value: < 2.2e-16. Blue rows are statistically significant (p < 0.05).*

Variable	Estimate	Standard Error	Statistic	P-Value
(intercept)	1,712,363.58	792,644.15	2.16	0.039
acreage	2,587,909.22	288,057.09	8.98	0
area_square_feet	219.34	112.11	1.96	0.059
years_old	-32,529.25	17,717.53	-1.84	0.076
number_bedrooms	54,010.04	37,050.04	1.46	0.155
number_bathrooms	138,938.43	41,553.09	3.34	0.002
number_fireplaces	-12,619.27	4,8813.21	-0.26	0.798
garage	772.58	381.08	2.03	0.051
pool_spaNone	5,655.1	39,731.71	0.14	0.888
pool_spaPool	45,244.51	46,361.39	0.98	0.337
pool_spaSpa	143,522.58	67,275.78	2.13	0.041

distance_to_wetland	179.45	176.12	1.02	0.316
in_floodplain1	-10,726.16	27,483.84	-0.39	0.699

Table 3. *Linear Regression Results for Model 2 - 2015 Market Value. Adjusted R-squared: 0.9444, p-value: < 2.2e-16. Blue rows are statistically significant (p < 0.05).*

Variable	Estimate	Standard Error	Statistic	P-Value
(intercept)	-439,265.94	421,571.15	-1.04	0.305
acreage	435,470.61	153,204.39	2.84	0.008
area_square_feet	157.14	59.63	2.64	0.013
years_old	14,342.83	9,423.14	1.52	0.138
number_bedrooms	41,048.38	19,705.22	2.08	0.046
number_bathrooms	-43,072.28	22,100.18	-1.95	0.06
number_fireplaces	37,908.46	25,961.51	1.46	0.154
garage	124.84	202.68	0.62	0.542
pool_spaNone	12,087.3	21,131.48	0.57	0.571
pool_spaPool	6,789.05	24,657.5	0.28	0.785
pool_spaSpa	67,855.18	35,780.91	1.9	0.067
distance_to_wetland	-162.01	93.67	-1.73	0.094
in_floodplain1	-4,174.97	14,617.4	-0.29	0.777

Table 4. *Linear Regression Results for Model 3 - 2024 Net Assessed Value. Adjusted R-squared: 0.5644, p-value: 4.985e-05. Blue rows are statistically significant (p < 0.05).*

Variable	Estimate	Standard Error	Statistic	P-Value
(intercept)	4,490,156.66	2,462,645.8	1.82	0.078
acreage	2,594,455.57	894,957.2	2.9	0.007
area_square_feet	76.6	348.33	0.22	0.827
years_old	-96,260.06	55,046.13	-1.75	0.09
number_bedrooms	-20,382.92	115,109.82	-0.18	0.861
number_bathrooms	401,201.01	129,100.22	3.11	0.004
number_fireplaces	105,433.06	151,656.5	0.7	0.492
garage	-111.62	1,183.96	-0.09	0.925
pool_spaNone	-169,875.27	123,441.45	-1.38	0.179

pool_spaPool	-94,087.37	144,039.02	-0.65	0.518
pool_spaSpa	448,161.63	209,017.4	2.14	0.04
distance_to_wetland	1,668.81	547.19	3.05	0.005
in_floodplain1	-117,995.55	853,88.84	-1.38	0.177

Figure 2 displays mean market values to compare properties that were previously in the floodplain with those outside of it in both 2015 and 2024. Within each year, the mean market values are consistent between properties in and out of the floodplain. There is a clear increase in all property values over time from 2015 to 2024.

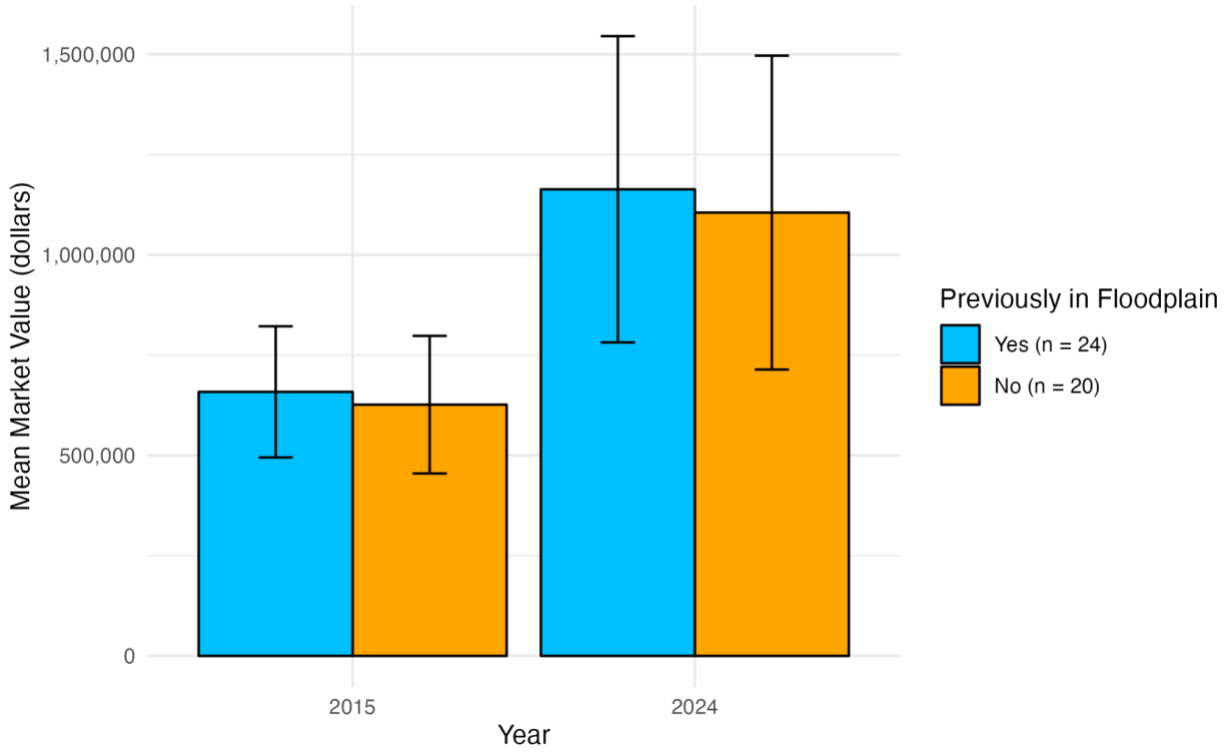

Figure 2. *Plot of mean market value in 2015 and 2024 across 44 selected properties by the North Campus Open Space wetland. Properties that were previously within the FEMA 100-year floodplain are colored blue, while those which were never within the floodplain are colored orange.*

Discussion

The results of these regressions indicate that a property's location inside the floodplain and its distance away from the wetland do not significantly influence its market value (Tables 2 - 4). Other factors, such as the property's acreage, number of bathrooms, and presence of a spa do have a significant influence. One explanation for these findings is that property values are generally high within the studied community due to its desirable coastal location, and that effectively masks the

costs of higher flood risk. Previous studies have shown that the value of coastal benefits tends to outweigh the costs of flood risk associated with coastal properties (Beltrán et al. 2018).

Property values increased in the period between 2015 and 2024 (Figure 2). While the increase is likely due to a variety of factors, some portion of it may be due to the creation of the open-access wetland and trail system in place of a private-access golf course.

This study has a few limitations. First, the market value of properties was inspected at only two points in time: November 2015 and November 2024. While this captured time points before and after the restoration project, it may not provide the most accurate picture. It could have been beneficial to obtain additional data (for instance, from every year between 2015 and 2024) in order to better inspect trends and changes over time. Additionally, only publicly available property value data was used as the dependent variables in this analysis. Since we know that FEMA floodplain delineations influence homeowner flood insurance rates, more robust analyses would benefit from accessing and analyzing data on flood insurance costs. Third, the small sample size (n = 46) makes statistical analyses inherently less robust, as there is a greater chance of random variation impacting the results. Despite these limitations, we believe that this analysis provides a preliminary look at the drivers of property value differences near the North Campus Open Space.

Conclusion

Our analysis concludes that property values near NCOS were not seemingly influenced by the FEMA floodplain revision, but we believe additional research may be able to better quantify the value of wetlands in this area. For instance, future analyses that incorporate flood insurance data could provide further insights into the monetary benefits to homeowners whose properties are no longer in the floodplain. Additionally, this analysis did not determine whether the conversion of the area from a golf course to a wetland had a causal impact on property values. Though many factors contributed to the increase in mean market values from 2015 to 2024 (Figure 2), it is likely that the benefits from wetland restoration are included in this observed increase. To quantify this impact, future researchers could conduct a difference-in-differences analysis. Finally, due to our limited scope, this analysis only included a hedonic pricing method to evaluate the flood mitigation benefits of wetlands. Future research could incorporate alternative evaluation methods which may better capture the benefits of wetlands, such as benefits transfer.

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Appendix

Table 1. *Residential units (parcel ID numbers) near the North Campus Open Space that were removed from the floodplain by the wetland restoration project.*

Single Family Units	Condominium Units	Condominium Units
073-181-001	073-290-001	073-290-017
073-181-002	073-290-002	073-290-018
073-181-003	073-290-003	073-290-019
073-181-004	073-290-004	073-290-020
073-181-005	073-290-005	073-290-021
073-181-006	073-290-006	073-290-022
073-181-007	073-290-015	073-290-023
073-181-008	073-290-016	073-290-024