An Empirical Investigation of Federal Wetlands Regulation and Flood Delineation: Implications for Residential Property Owners

Authors

Randall S. Guttery, Stephen L. Poe and C. F. Sirmans

Abstract

Since the early 1970s, the federal government has undertaken extensive efforts to stem the loss of wetlands by regulating the use of land. This paper investigates the extent to which residential property owners are affected by federal wetlands regulation, by presenting an empirical investigation of such economic consequences. Results suggest that because of the Supreme Court's holding in *United States v. Riverside Bayview Homes, Inc.*, sale prices of properties located in a wetlands area were discounted nearly 8%, even after controlling for some sample properties being flood delineated.

For over thirty years, it has been official policy of the United States to preserve and protect the nation's wetlands. Recognizing their environmental importance, both as an essential source of food and habitat for fish, birds and other wildlife, and its roles in helping to prevent flooding, replenishing ground water supplies and performing valuable water purification functions, the federal government has undertaken a determined attempt to stem the loss of wetlands, with much of the effort directed at regulating the use of land so as to minimize the damage to wetlands. The most important regulations of this type have been promulgated by the U.S. Army Corps of Engineers (the Corps) and the Environmental Protection Agency (EPA), pursuant to their authority under the Clean Water Act (CWA), enacted in 1972.

Although the CWA establishes a regulatory scheme requiring landowners to obtain permits before embarking on projects that involve the dredging or filling of ''navigable waters of the United States,'' the Corps and the EPA have broadly interpreted this phrase (and thus expanded the scope of their regulatory power) to include wetlands, even those that are not contiguous to navigable bodies of water. Despite the controversy generated by this broad assertion of power, which fueled a split opinion among the federal appellate courts, the U.S. Supreme Court upheld

the validity of the regulations in 1985 in the seminal case, *United States v. Riverside Bayview Homes, Inc.* (hereafter, *Riverside*).

As the federal wetlands permitting program imposes considerable costs on the regulated community, both the Corps and Congress have taken steps to provide relief to builders, developers and landowners for activities that are assumed to cause only minimal adverse environmental impacts. Unfortunately for them, these relief measures have come under attack in the past few years, and as a result, both their availability and usefulness have been restricted. Although environmentalists and industry groups have taken part in this debate, one important group impacted by these developments has yet to be heard from—residential property owners. To what extent are such owners affected by federal wetlands regulation? To what extent are the potential costs of compliance impacting residential property prices? Although studies have documented the compliance costs that this program imposes on permit applicants, the effects of such regulation on residential property owners have not yet been determined.

The purpose of this article is to present an empirical study of economic consequences for residential property owners that arise upon implementation of federal wetlands regulations. Moreover, the data set expands Guttery, Poe and Sirmans (2000) to include non-wetlands properties situated in the 100-year flood plain; the omission of flood prone properties may have biased their results. Specifically, this study examines the effect of federal wetlands regulation on sale prices of residential properties in East Baton Rouge Parish, Louisiana. Located in the southeastern part of the state, this parish encompasses Baton Rouge, the state's capital. As the parish contains numerous wetlands due to proximity of the Mississippi River and a number of lakes, streams, bayous and creeks within its boundaries, compliance with these regulations is often necessary to develop land in this area. The costs of compliance with the wetlands permit process can be significant, due primarily to lengthy time-delays involved, expenses of preparing development impact studies and satisfying other paperwork requirements, and burdens associated with satisfying regulatory mitigation requirements. Given these costs, the alternative hypothesis of this study is that sale prices of residential properties where compliance with the wetlands permit process is highly probable are significantly different than those for comparable properties in otherwise similar locations where such compliance is not probable, *even after controlling for 93 sample properties (24%) having a flood delineation.* To measure the impact of such compliance, sale prices of residential properties prior to and after the Supreme Court's December 1985 ruling in *Riverside* are compared.

This paper proceeds as follows. The next section provides a brief overview of federal wetlands regulation and a discussion of the significance of the *Riverside* decision. The sections that follow discuss wetland delineation procedures and the economic consequences for landowners arising from federal wetland regulations. The empirical wetlands impact model is then presented, along with sample data and results. The final section provides the paper's findings.

An Overview of Federal Wetlands Regulation

The primary statutory source of the Corps' power to regulate wetlands development is found in Section 404 of the CWA. Section 404(a) generally bans the ''discharge of dredged or fill material into ... navigable waters'' of the U.S. without a prior permit from the Corps. Section 404(b)(1) provides that the permit decision is to be made using guidelines developed by the Corps and the EPA, and Section 404(c) authorizes the EPA to veto any permit issued by the Corps. In the residential context, ''discharge of dredged or fill material'' is most often associated with activities such as home building, land clearing and leveling, road construction, mixed-use development, storm water management and recreational uses.

Both the EPA and the Corps may make wetland determinations, and both have authority to enforce Section 404, because the Corps has the power to enforce the terms of a permit, while the EPA has the power to enforce the CWA against those who discharge without a permit. In determining whether a particular tract of land will be classified as ''wetlands'' for purposes of Section 404, two sources must be considered: the regulatory definition of the term used by the Corps and the EPA, and the process by which these agencies classify tracts as wetlands. The regulatory definition has been expanded considerably by these agencies in the last twenty-five years, in light of generous judicial interpretations of the authority Congress imparted to these agencies under the CWA.

The broad definition of wetlands initially caused a great deal of controversy and the validity of this interpretation even resulted in a split among the federal appellate courts. The extent to which the Corps and the EPA have the statutory authority to regulate more than navigable U.S. waters remained a controversial and unsettled issue until December 4, 1985. On that date, in the landmark case of *United States v. Riverside Bayview Homes, Inc.*, the U.S. Supreme Court for the first time examined the scope of the Corps' jurisdiction to regulate wetlands and other ''waters of the United States,'' as that term is used in the CWA. In a unanimous opinion, the Court held that ''waters of the United States'' included more than just navigable waters, and that the Corps had not violated its regulatory authority under the CWA by defining wetlands to include lands adjacent to navigable waters. In this seminal case, the Court disagreed with the contention of lower courts that property could be classified only as a regulated wetland if it were subject to periodic flooding by nearby navigable waters. Instead, the Court noted, the language of the Corps' regulation expressly provided that the requirements of a wetland were met if the property in question received enough saturation, either by surface or groundwater, to sustain wetlands vegetation.

The Supreme Court's opinion in *Riverside* was significant for two reasons: (1) it was the first occasion in which the Court has addressed the validity of the Corps' power to regulate wetlands, and (2) the Court settled the controversial issue of

whether this power extended beyond the traditional limit of navigable waters. In addition to rejecting the narrow view of this power adopted by lower courts, the Court effectively endorsed the broad view of the Corps' power. As a result of *Riverside*, the Corps has unquestioned power to regulate any wetlands adjacent to navigable waters of the U.S., even those located on private residential property, as long as a hydrological or ecological connection exists.

Perhaps not surprisingly, following *Riverside* both the Corps and the EPA further broadened the definition of wetlands for federal regulatory purposes. Today, wetlands are defined to mean areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. The regulatory definition also includes wetlands adjacent to navigable waters, artificially created wetlands and even ''isolated'' (non-adjacent) wetlands if such waters are part of a surface tributary system connected to a traditionally navigable water and the intended use, degradation or destruction could affect interstate or foreign commerce. As noted above, this expanded definition of navigable waters has greatly broadened the scope of the federal power to regulate land use under Section 404.

Wetlands Delineation Procedures

Although the Corps and the EPA use the same regulatory definition of wetlands, each has different procedures for determining whether a particular tract should be classified as wetlands and, thus, subject to the Section 404 permitting program. Although several federal agencies have manuals that regulate this wetlands delineation process, most use the 1987 Delineation Manual (hereafter, the Manual) issued by the Corps and the EPA. It specifies three conditions that indicate whether an area of land will be classified as wetlands: hydrology, vegetation and soil. The first condition is that the land must meet certain hydrology characteristics, meaning that it must be inundated permanently or periodically, or saturated to the surface during some point of the growing season of the existing vegetation. The second condition is that hydrophytic or wetlands vegetation must be prevalent and re-occur seasonally. To meet this requirement, such vegetation must have the ability to grow, effectively compete, reproduce and/or persist in anaerobic soil conditions.

The third condition is that the land must contain hydric or wetland soils (*i.e.*, soils that have been saturated, flooded, or ponded long enough during the growing season to develop anaerobic conditions that promote the growth of wetlands vegetation). The U.S. Soil Conservation Service has identified approximately 2,000 soil types as hydric soils. Although in most instances one or more wetland indicators of all three characteristics must be present during some portion of the growing season for wetlands classification, if an area of land contains hydric soils, there is approximately an 80% chance that the land will be designated as wetlands

[interview with Charles Jones of G&E Engineering, a Baton Rouge environmental consulting firm (May 29, 1997)].

Economic Consequences for Landowners Arising from Federal Wetlands Regulation

One of the more controversial issues arising from federal wetlands regulation involves the significant amount of time and money that landowners and developers must expend in complying with the Section 404 permit process, much of which is due to the mitigation obligations that they are required to satisfy in order to obtain an individual permit. The CWA requires that mitigation efforts be made to offset wetland losses, and the Corps has initiated a mitigation sequencing process to determine whether Section 404 permits should be granted. As no comprehensive federal policy specifies exactly what these obligations would be for a particular application, they are often decided and imposed on a case-by-case basis. As a result, landowners and developers are required in many instances to spend a great deal of time and money negotiating these requirements with the Corps.

Although the costs incurred by permit applicants such as builders and developers can be substantial, little is known about the extent to which these costs are passed along to buyers and sellers of residential property that has been delineated or is likely to be delineated as wetlands and, thus, subject to federal regulation.

In an attempt to shed some light on this issue, this study analyzes the effects of compliance with federal wetlands regulation on the sale prices of residential property in East Baton Rouge Parish, Louisiana. To measure the impact of such compliance, the sale prices of residential properties prior to and after the Supreme Court's 1985 holding in *Riverside* are compared. Although the Corps asserted regulatory jurisdiction over a broad variety of wetlands prior to the study period, federal courts were divided as to the legitimacy of this assertion. As previously discussed, in *Riverside* the Supreme Court definitively settled this issue, holding that the Corps' power extended to wetlands adjacent to navigable waterways, and strongly inferred that such power could extend even to isolated wetlands. Due to the significance of this decision and its impact on residential property, its date is chosen when determining the sample time period for the study.

Wetlands Impact Model

A standard regression model is used to examine the relationships between real property price, wetlands delineation and typical property characteristics (*e.g.*, square feet of living, the number of days a property is on the market, age, date sold, flood delineation, location). Regression models have been used to examine property values since the early 1960s. Bailey, Muth and Nourse (1963) pioneered the methodology and numerous academicians have improved it to the point that the regression results are highly reliable, precise and efficient (see Rosen, 1974).

Researchers have used such regression models to estimate and/or quantify the impact of public land-use controls (*e.g.*, zoning) on residential housing values. Dowall and Landis (1982) find that density controls and land availability systematically affect housing prices. Mark and Goldberg (1986) suggest that various zoning classifications and land uses affect housing values both negatively and positively, while Speyrer (1989) shows that a hedonic price index reveals that higher prices are paid for homes in Houston, Texas neighborhoods with land-use controls.[1] Pollakowski and Wachter (1990) find that measures of land-use constraints collectively have larger effects than individually. This contradicts many other findings, but the authors point out that empirically examining land-use control devices one at a time, as if each were independent of the other, may lead to underestimates of the impact of growth controls.

Beaton (1991) posits that up to the time of adopting land-use controls, vacant land gains in value at a rate higher than land in other areas; following adoption, vacant land values in the most restrictive zones fall, while values in the least restrictive zones rise. Shilling, Sirmans and Guidry (1991) suggest that land-use regulations have a significant impact on both the demand for and the supply of residential land, as expected.

All of these researchers find land-use controls have statistically significant impacts on housing values. Some controls increase values (*e.g.*, density restrictions in expanding urban areas, reducing negative influences) while others adversely affect residential values (*e.g.*, zoning variances, restrictions not allowing properties to be operated in their highest and best uses, overallocating land designated for one use over another).

This methodology has been applied to numerous additional influences affecting property values, as well. Jud and Watts (1981) estimate a model of housing prices that measures the extent to which public schools exert an influence on residential location decisions and the demand for area housing. They find that school quality has a strong positive effect on housing values. Guy, Hysom and Ruth (1985) study the effect of subsidized housing on values of adjacent housing, suggesting that subsidized housing has a negative impact on the value of adjacent properties, but declines as distance from the subsidized housing increases.

Izraeli (1987) examines the effect of environmental attributes on housing values in 237 standard metropolitan statistical areas, finding that a trade-off exists between the quantity and quality of environmental goods, earnings levels and housing values. In other words, an improved environment generates some gains to business and residents. Kohlhase (1991) analyzes the impact of toxic waste sites on housing values, finding that when the EPA announces that a toxic waste site is on the Superfund list for cleanup, a new market for ''safe housing'' is created, thereby increasing values. Parsons and Wu (1991) study coastal land-use controls, showing that density restrictions on coastal properties increase value, all else held equal, but opportunity costs of lost coastal access amenities prevail.

Finally, Des Rosiers, Theriault, Kestens and Villeneuve (2002) investigate landscaping and housing values, finding improved landscaping positively affects value. This finding is in line with former landscaping studies, but extends the research to spatial concerns. They also offer a quite extensive literature review on environmental hedonic studies.

This study applies multiple regression analysis to estimate the impact of federal wetland regulation and flood delineation on the sale prices of small multifamily (*i.e.*, two-to-four units) residential dwellings in East Baton Rouge Parish, Louisiana.[2] These properties were selected because of their high degree of homogeneity and to ensure a large enough sample size of wetland-delineated properties. Unlike many housing markets, East Baton Rouge Parish's housing stock includes thousands of these types of residential properties.[3]

The OLS regression equation for the wetlands model is written as:

$$\begin{aligned} SP_i = {} & \beta_0 + \beta_1 WETREGS_i + \beta_2 FLOOD_i + \beta_3 VOLUME_i \\ & + \beta_4 AGE_i + \beta_5 QTRSOLD_i + \beta_6 BRperUNIT_i \\ & + \beta_7 LIVING_i + \beta_8 LOTSIZE_i + \beta_9 DOM_i \\ & + \beta_{10} AREA1_i + \ldots + \beta_{14} AREA5_i + \varepsilon_i, \end{aligned} \tag{1}$$

where:

SP_i = The sale price of the ith property;
WETREGS = (1,0) binary dummy variable with value one for a wetlands delineated property that sold after 1985;
FLOOD = (1,0) binary dummy variable with value one for a non-wetlands delineated property located in the 100-year flood plain;
VOLUME = The number of properties sold in a given quarter;
AGE = The age of the property when sold;
QTRSOLD = A time-trend variable for the quarter when the property sold;
BRperUNIT = The total number of bedrooms divided by the total number of units;
LIVING = The square feet of living area;
LOTSIZE = The square feet of the lot;
DOM = The number of days the property was on the market;
AREA1 ... AREA5 = (1,0) Binary dummy variable with value one for the respective Multiple Listing Service area (a sixth area is the base case to which the other five are compared.);
β = Parameters to be estimated, including a constant term; and
ε = A random error term.

All of these control variables are included in the analysis to estimate the impact of wetlands regulation on sale prices. Some of these property characteristics should have a positive impact on sale price. All else held equal, an increase in the square footage of living area (*LIVING*) should increase sale prices because more living area is preferred to less. Similarly, a larger lot (*LOTSIZE*) should command a higher sale price. Finally, an increase in the number of sales per quarter reduces supply, all else held equal, which in turn should cause an increase in sale prices. On the other hand, this increased volume could be a function of sale prices and value or construction costs not being in equilibrium. Therefore, no a priori prediction is made as to the sign of the *VOLUME* variable.

Other characteristics are expected to have a negative impact on sale prices. The longer a property is on the market, the more apparent it becomes that it is not desirable at its list price; thus, the regression coefficient for days on the market, *DOM*, is expected to be negative. Older properties, all else held equal, should command a lower price because of physical deterioration (''wear and tear''), functional obsolescence (inferior design or structure) and external depreciation (exogenous influences adversely affecting value, such as pollution or noise), so the *AGE* variable is hypothesized to be negative. The five location coefficients are expected to be negative because the most affluent area of town is chosen as the base case to which the other locations are compared. Hence, there are a total of six study areas.

Baton Rouge's economy did not fare well over the sample period. Its civilian labor force unemployment rate averaged 8.7%, population declined 1.2%, average one-to-four family housing prices dropped 13.0%, and inflation-adjusted per capita personal income rose only 0.2%.[4] Thus, the variable used to proxy changing market conditions, *QTRSOLD*, likely will be negative.

An increase in the number of bedrooms is expected to affect value negatively (see Guttery, 2002). While this may seem counter-intuitive, there is justification to this a priori prediction. Basic regression analysis assumes that when one explanatory variable is being examined, no other variables change. If this were not the case, then one would not be able to isolate a given variable's impact on value. Therefore, if the number of bedrooms is increased *while the square footage of living area does not change*, then the additional bedroom(s) will cannibalize other areas of the dwelling, such as the living room or dining room. So, *BRperUNIT* is expected to be negative.

Properties located in the 100-year flood plain that are not wetlands-delineated are included in the sample, in order to determine whether Guttery, Poe and Sirmans' (2000) findings (*i.e.*, post *Riverside* wetlands values declined significantly) still hold. Properties located in federally designated flood plains are less desirable, all else held equal, because of the possibility of improvements being damaged or destroyed by rising waters.[5] Therefore, sale prices of ''flood zone'' properties should be less than those of otherwise identical properties located outside the flood plain and *FLOOD* likely will be negative.

An important distinction should be made, however, between flood zone properties and wetland-delineated properties. As stressed by Charles Jones, wetlands expert with G & E Engineering of Baton Rouge, Louisiana, being in a flood zone does not necessarily indicate a wetlands designation (and vice versa). For example, an open meadow may have a small bog that has a wetland delineation, but does not flood. Moreover, a river's embankment may be under water for short periods of time during rising waters and, therefore, be designated in the flood plain, yet not satisfy the definition of wetlands (*e.g.*, no saturation, no hydrophytic vegetation, no hydric soils).

It is expected that wetland-delineated properties will have a statistically and significantly negative impact on sale prices *once federal wetlands regulation began to substantially restrict landowners' rights.* In other words, if a property is located in a wetlands area, corresponding regulation should adversely affect its sale price because of land-use restrictions.

Perhaps a distinction also should be made between improved and unimproved land, as wetland regulation may not affect developed property once it is in place. Even if the empirical results suggest that wetlands have a significantly negative effect on sale prices, it may be due to factors in addition to regulation, such as being located in a flood plain or in a low swampy site. In the absence of regulation, the land still may be less desirable because less of the site is physically usable or because the cost of backfilling or dredging is too costly.

Nevertheless, wetland delineation should affect both improved and unimproved properties because wetlands regulation also restricts property owners' rights *to further improve* the site. For example, one may be prohibited from constructing an in-ground swimming pool, building a garage, or cultivating a garden. Land-use restrictions remove some of the rights associated with fee simple ownership and, therefore, may reduce value. Certainly, there are such restrictions that may prevent value diminution (*e.g.*, zoning laws that prohibit a dump site in a residential neighborhood), but many will likely decrease a property's attractiveness (*e.g.*, the re-zoning from residential to commercial use of property directly adjacent to single-family housing). Of course, prices should not be affected on those sites in the sample prior to significant federal wetlands regulation. Without such restrictions, one could simply backfill to construct an improvement or dredge to create a body of water, such as a lake or pond.[6]

An ideal test of whether wetlands regulation affects sale prices is to compare data on land sales that pre-date the implementation of such regulation to the sale prices on similar sites sold after significant wetlands regulation became effective. As a control group, the empirical test should include land sales, both before and after the implementation of regulation, without wetland concerns. If the price effect of being in a wetlands in the pre- versus post-implementation periods were statistically and significantly different, then one could conclude that wetland regulation was correlated with the decline in price.

Furthermore, using a variable to control for flood properties (*FLOOD*) will separate out the potential price effect of simply being in a flood plain.

Therefore, one variable in Equation 1 captures the effect wetland regulation may have on the sale prices of residential properties, even after controlling for some properties having a flood delineation. The *WETREGS* variable is a (1, 0) binary dummy variable with value one (zero) for a wetland-delineated property sold after (before) 1985 (1986), when *Riverside* was decided. Its coefficient's significance and sign are the basis of the alternative hypothesis: post-*Riverside* wetland sale prices were significantly and negatively affected by the extension of federal wetland regulation to these properties.

Sample Data and Results

The Greater Baton Rouge Multiple Listing Service (MLS) provided data for the sample from its Quarterly Comparable Sales Books (the MLS Comp Books). These ''books'' (now in electronic form) contain sales data on properties sold in the previous calendar quarter. The selling agent inputs the relevant sales data after title transfers and the books are distributed to REALTORS® and appraisers for further use. The data are used to estimate comparable property listing prices and values.

Specifically, the sample consists of 385 duplexes, triplexes and fourplexes located in East Baton Rouge that sold over the period January 1983 through December 1988. Sales are excluded from the sample if any relevant information is omitted from the MLS Comp Books or if the properties are located outside of the six MLS areas investigated.

The geographic region covered by these six MLS areas are the same distance from downtown, encompass only south Baton Rouge and the area is not extensive. Within this sample area, neighborhoods are well identified and there are no spatial complications. The data are not grouped in one site and the wetland-delineated properties are scattered across all six MLS areas. This is a spatially diverse data set.

Because the MLS Comp Books do not specify if a property has a wetland delineation, the U.S. Department of Agriculture's *Soil Survey: East Baton Rouge Parish, Louisiana* was used to identify if a property contains hydric soils.[7] Exhibit 1 reports the seventeen types of hydric soils found in East Baton Rouge Parish.

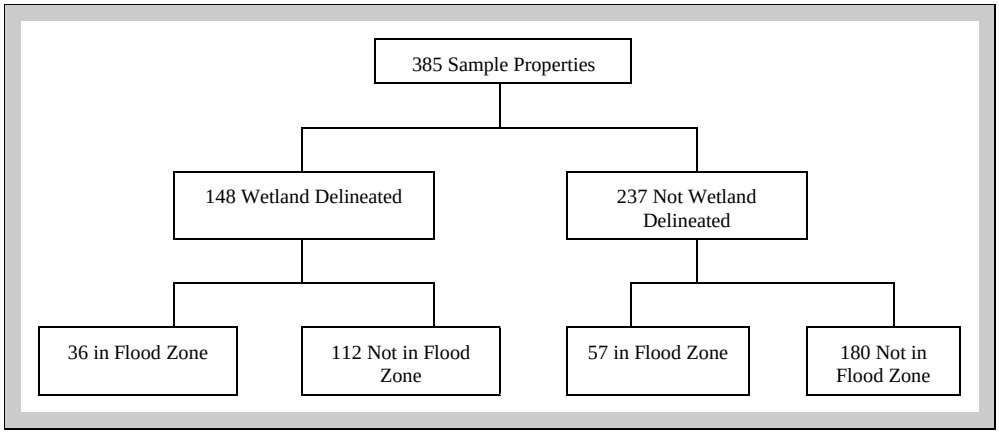
Exhibits 2 and 3 offer flowcharts of sample wetlands and flood zone properties. Of the 385 sample properties, 148 (39%) are delineated as wetlands and 237 (61%) are not. Sixty of the 148 wetlands properties (41%) sold before the 1985 *Riverside* decision, while 88 (59%) sold after. Thirty-six properties (9%) satisfying the definition of a wetland and are in the 100-year flood plain; hence, only 24% (36 of 148) of wetland-delineated properties are also in the flood plain. The remaining

Exhibit 1 | Hydric Soils of East Baton Rouge Parish, Louisiana

Soil Type	Symbol Map	Dispersion	Permeability	Wetness	Runoff
Calhoun silt loam	Cc	Slow to very slow	Moderate	Wet	Slow to very slow
Calhoun-Bonn & Fountain silt loams	Cf	Slow	Moderate	Wet	Slow to very slow
Cascilla silt loam, undulating, overflow	Cl	Moderate	Low to moderate	Not wet	
Fountain silt loam	Fn	Moderately slow	Moderate	Wet	Slow
Fountain & Bonn silt loams	Fo	Slow	Moderate	Wet	Slow
Frost silt loam	Fw	Slow	Moderate	Wet	Slow
Loamy alluvial land & Mhoon soils, overflow	Lm	*	*	*	*
Mhoon silty clay	Mh	Very slow	Low	Wet	Slow
Mhoon silty clay loam	Mn	Slow	Low	Wet	Slow
Mhoon-Sharkey complex	Ms	Very slow	Low	Wet	Slow
Sharkey clay	Sc	Very slow	Low	Wet	Slow
Sharkey silty clay loam	Sh	Very slow	Low	Wet	Slow to very slow
Sharkey-Tunica association, overflow	Sk	Very slow	Low	Wet	Very slow
Sharkey-Tunica clays, overflow	Sm	Very slow	Low	Wet	Very slow
Springfield silt loam	Sp	Very slow	Moderate	Moderately wet	Slow
Waverly-Falaya silt loams, overflow	Wf	Moderate to moderately slow	Moderate	Wet	Slow
Zachary silt loam	Za	Slow	Moderate	Wet	Very slow

Notes:
*Material too variable to rate.
Source: Department of Agriculture, Soil Survey: East Baton Rouge Parish, Louisiana (1968).

Exhibit 2 | Flow Chart of 385 Sample Properties Delineated by Wetlands



112 wetland properties (76%) are not in the flood plain. This supports G & E Engineering's opinion that wetland delineation and flood designation are not highly correlated.

Fifty-seven of the 237 non-wetlands properties (24%) are in the 100-year flood plain, while 180 (76%) are neither wetland nor flood delineated. So, there are a total of 93 sample properties (24%) with a flood delineation, of which 36 (39%) are wetland properties and 57 (61%) are not. The remaining 292 sample properties (76%) are not in the flood plain, of which 112 (38%) are wetland-delineated and 180 (62%) are not.

Exhibit 3 | Flowchart of 385 Sample Properties Delineated by Flood Zone

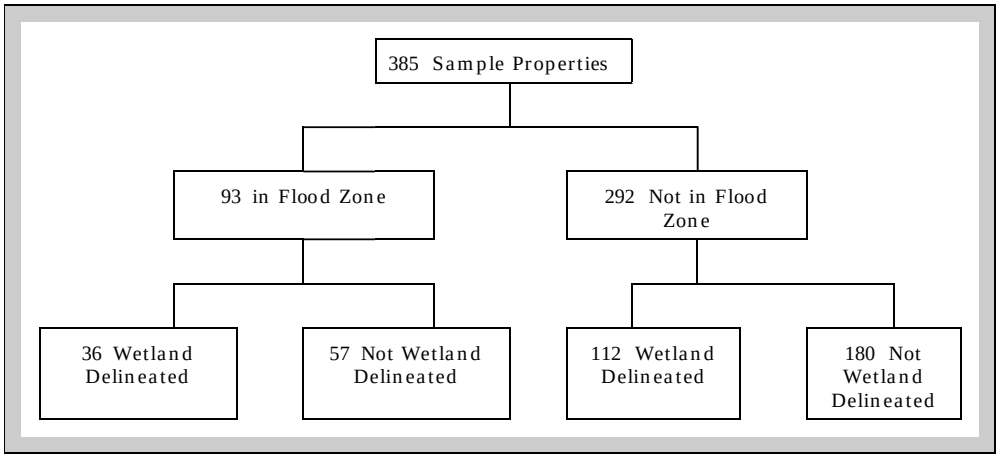


Exhibit 4 reports descriptive statistics for all variables. The sale prices of sample properties range from $8,800 to $218,000, with a mean of about $89,000. Mean living area is 3,560 square feet, the average age is about 12 years and the typical lot size is 8,827 square feet. *DOM*, a proxy for market conditions, averages 106 days for the sample.

In December 1985, the Supreme Court's decision in *Riverside* conclusively settled the issue of whether federal wetlands regulation could apply to residential property (see Manning, 1987). The sample period of this study covers the 24 quarters from 1983 through 1988; thus, the date of the *Riverside* decision allows the bifurcation of the sample properties into equal time periods: 83Q1 through 85Q4 and 86Q1 through 88Q4. Should the regression coefficient on *WETREGS* be statistically significant and negative, then one could conclude that the extension of wetland regulation to residential property contributed to the decline in sale prices.

Exhibit 5 reports the regression results for the six-year sample. Approximately 80% of the total variance in the regression equation model is explained by variations in the independent variables, as measured by the coefficient of determination, Adjusted-R^2. The *F*-Statistic, 108.80, which measures the overall validity of the regression equation, is significant at the 1% level. Other regression

Exhibit 4 | Descriptive Statistics

Variable	Mean	Std. Deviation	Max.	Min.
SALE PRICE	89032.72	48909.46	218000	8800
Log *SALE PRICE*	11.25	0.56	12.29	9.08
WETREGS	0.23	0.42	1	0
FLOOD	0.24	0.43	1	0
VOLUME	24.05	13.08	43	4
AGE	12.08	12.69	66	3
QTRSOLD	13.70	8.39	24	1
BRperUNIT	2.17	0.45	3	1
LIVING	3560.40	1011.25	6400	921
LOTSIZE	8826.57	3128.69	25536	3456
DOM	106.47	125.60	831	1
AREA 1	0.09	0.29	1	0
AREA 2	0.11	0.32	1	0
AREA 3	0.23	0.42	1	0
AREA 4	0.08	0.27	1	0
AREA 5	0.19	0.39	1	0

Exhibit 5 | Regression Results

	Dependent = *Sale Price*		Dependent = *Log Sale Price*	
Variable	Coefficient	*t*-Statistic	Coefficient	*t*-Statistic
WETREGS	−7128.883	−2.164**	−0.088	−2.265**
FLOOD	−3889.893	−1.285	0.065	−1.836*
VOLUME	−202.004	−2.131**	−0.005	−4.064***
AGE	−933.052	−6.628***	−0.013	−7.812***
QTRSOLD	−4477.373	−27.536***	−0.047	−24.869***
BRperUNIT	−10958.940	−3.600***	−0.082	−2.286**
LIVING	19.731	12.971***	0.000	13.198***
LOTSIZE	1.270	3.092***	0.000	3.898***
DOM	8.967	0.931	0.000	0.622
AREA 1	−4584.661	−0.938	−0.063	−1.099
AREA 2	−4771.342	−1.155	0.015	0.319
AREA 3	−1488.535	−0.441	−0.001	−0.027
AREA 4	−6348.030	−1.139	0.061	0.940
AREA 5	−6862.485	−1.926**	−0.018	−0.425
Intercept	113483.511	11.024***	11.365	94.192***
Adj. R^2	0.80		0.79	
F-Statistic		108.797***		101.424***

Notes:
* Significant at 90% confidence interval.
** Significant at 95% confidence interval.
*** Significant at 99% confidence interval.

diagnostics suggest no evidence of collinearity among the explanatory variables, so the regression results are generally reliable.[8]

Every significant explanatory variable and all but one of the insignificant variables (DOM) are of the hypothesized signs.[9] After *Riverside*, the *WETREGS* variable is significantly negative at the 5% level, as expected for this post-decision period. Therefore, one can be 95% confident that the extension of wetlands regulation to residential property significantly diminished sale prices.

The standard regression results suggest that after *Riverside*, the average wetland-delineated property was discounted about $7,100. Given a mean selling price of nearly $89,000, this equates to a percentage discount of about 8%, relative to similar properties not located in a wetland area. The semi-log functional form results[10] nearly mirror those of the linear form.[11]

These findings are consistent with the notion that properties with the wetlands delineation sell at a discount because of land-use restrictions placed on them. While the magnitude of these findings may be, in part, a function of this sample, the implications are clear. Wetlands delineation contributes negatively to overall selling prices of real property, even after controlling for some properties having a flood delineation. Additional studies are recommended to confirm or challenge the findings of this investigation.

Conclusion

The results from this study suggest that because of the Supreme Court's holding in *Riverside*, sale prices of residential properties in the sample that were located in areas likely to be delineated as wetlands were discounted about $7,100 (8%), even after controlling for some sample properties having a flood delineation. This finding is consistent with Guttery, Poe and Sirmans (2000) that such properties would sell at a discount due to the possibility of being subject to federal wetland regulation.

This study analyzes data from 1983 to 1988, a period in which the regulatory burden imposed by the Section 404 permit process was lighter that it is today. Given the significant costs imposed by the process on the regulated community and the attendant economic consequences for residential property owners, the Corps should perhaps reconsider its position regarding wetland regulation.

Endnotes

[1] This is an important finding because Houston is the largest metropolitan city in the U.S. with no zoning laws.

[2] The analysis is reported in the linear functional form, as this allows an interpretation of the coefficients in dollars. It is also reported in the semi-log form, which expresses coefficients as relative, rather than absolute, implicit prices. Des Rosiers, et al. (2002) find this allows for a more flexible interpretation of the contribution of housing attributes to property value.

[3] To provide statistical evidence of the large quantity of two-to-four family properties in the parish, the 1990 Census of Housing, Louisiana, General Characteristics, *Occupancy, Structural Characteristics, and Age of Householder* (Table 49) was utilized. This table is categorized by the number of units in a structure. Then the number of structures for each category is listed for each parish. The data are further disaggregated into ''All Housing Units'' and ''Renter-Occupied Housing Units.'' While only 5.1% of All Housing Units in Louisiana were duplexes, triplexes, or fourplexes, the number doubled to 10.1% in East Baton Rouge Parish. In fact, this was the fifth highest of the 64 parishes, with 15,862 two-to-four unit dwellings. More compelling evidence is provided by the Renter-Occupied Housing Units category. For Louisiana, 14.4% were two-to-four family; for East Baton Rouge Parish, 21.7% were such properties, making it the twelfth highest of the 64 parishes. In other words, nearly one of every four rental dwellings had two, three,

or four units; therefore, they represented a sizable percentage of the housing stock. Large apartment complexes are not as common in this area.

[4] U.S. Department of Commerce, Bureau of Econ. Analysis, 4 *Local Area Personal Income, Southeast Region, 1983–1988* 173; Bureau of Labor Stat., *Employment and Unemployment in States and Local Areas* (1983–1988); Louisiana State University, Real Estate Research Institute, 5 *Housing Affordability in Louisiana: 1984–1993* 22 (1994) (data on average 1–4 family housing prices for 1983 were unavailable, as LSU did not begin compiling such data until 1984).

[5] Additional building costs (*e.g.*, pillars, adapted access) may also make flood-prone properties less desirable.

[6] As anecdotal evidence of how wetland delineation can devalue real estate, in 1981 48 acres of property were platted by East Baton Rouge Parish for a small subdivision with a density of four houses per acre. The owner incurred all development costs, but after the Corps determined that over 90% of the property was wetlands in 1995, the seller sold the property to a local real estate broker for $58,000, a fraction of the seller's cost. Prior to purchase, however, the buyer hired a local university geology professor to bore for soil samples. The professor convinced the Corps that only two of the 48 acres satisfied the definition of wetlands, so it reversed its ruling on the remaining acreage.

[7] Department of Agriculture, Soil Survey: East Baton Rouge Parish, Louisiana (1968). In addition, G&E Engineering graciously confirmed the wetlands codification of sample properties. Interview with Charles Jones of G&E Engineering, a Baton Rouge environmental consulting firm, in Baton Rouge, LA (June, 1997).

[8] To greatly reduce the risk of multicollinearity, the number of bedrooms and the number of units were recast to be the number of bedrooms per unit, as suggested by the referee. The coefficient covariance matrix confirmed the usefulness of doing so.

[9] Various interaction terms were run to test whether wetlands impact may vary as a function of property quality. As expected, none of the coefficients was significant.

[10] The Adjusted-R^2, while not directly comparable to the one obtained linearly, again provides an indication of the fit (see Des Rosiers, Lagana and Theriault, 2001).

[11] A double-log functional form was run, also, where all non-dummy independent variables and the dependent variable were logged. The results are robust to the specification, as they, too, are nearly identical to the other two forms. In all three cases, *WETREGS* is significantly negative at the 5% level.

References

Bailey, M., R. Muth and H. Nourse, A Regression Model for Real Estate Price Index Construction, *Journal of the American Statistical Association*, 1963, December, 933–42.

Beaton, W. P., The Impact of Regional Land-Use Controls on Property Values: The Case of the New Jersey Pinelands, *Land Economics*, 1991, 67, 172–94.

Des Rosiers, F., A. Lagana and M. Theriault, Size and Proximity Effects of Primary Schools on Surrounding House Values, *Journal of Property Research*, 2001, 18, 149–68.

Des Rosiers, F., M. Theriault, Y. Kestens and P.Y. Villeneuve, Landscaping and House Values: An Empirical Investigation, *Journal of Real Estate Research*, 2002, 23, 139–61.

Dowall, D. E. and J. D. Landis, Land-Use Controls and Housing Costs: An Examination of San Francisco Bay Area Communities, *Journal of the American Real Estate and Urban Economics Association*, 1982, 10, 67–93.

Guttery, R. S., S. L. Poe and C. F. Sirmans, Federal Wetlands Regulation: Restrictions on the Nationwide Permit Program and the Implications for Residential Property Owners, *American Business Law Journal*, 2000, 37, 301–41.

Guttery, R. S., The Effects of Subdivision Design on Housing Values: The Case of Alleyways, *Journal of Real Estate Research*, 2002, 23, 265–73.

Guy, D. C., J. L. Hysom and S. R. Ruth, The Effect of Subsidized Housing on Values of Adjacent Housing, *Journal of the American Real Estate and Urban Economics Association*, 1985, 13, 378–87.

Izraeli, O., The Effect of Environmental Attributes on Earnings and Housing Values Across SMSAs, *Journal of Urban Economics*, 1987, 22, 361–76.

Jud, G. D. and J. M. Watts, Schools and Housing Values, *Land Economics*, 1981, 57, 459–70.

Kohlhase, J. E., The Impact of Toxic Waste Sites on Housing Values, *Journal of Urban Economics*, 1991, 30, 1–26.

Manning, G. V., *The Extent of Groundwater Jurisdiction Under the Clean Water Act After Riverside Bayview Homes*, 1987, *La. Law Review*, 47, 859–71.

Mark, J. H. and M. A. Goldberg, A Study of the Impacts of Zoning on Housing Values over Time, *Journal of Urban Economics*, 1986, 20, 257–73.

Parsons, G. R. and Y. Wu, The Opportunity Cost of Coastal Land-Use Controls: An Empirical Analysis, *Land Economics*, 1991, 67, 308–16.

Pollakowski, H. O. and S. M. Wachter, The Effects of Land-Use Constraints on Housing Prices, *Land Economics*, 1990, 66, 315–24.

Rosen, S., Hedonic Prices and Implicit Markets: Product Differentiation in Pure Competition, *The Journal of Political Economy*, 1974, 82, 34–55.

Shilling, J. D., C. F. Sirmans and K. A. Guidry, The Impact of State Land-Use Controls on Residential Land Values, *Journal of Regional Science*, 1991, 31, 83–92.

Speyrer, J. F., The Effect of Lane-Use Restrictions on Market Values of Single-Family Homes in Houston, *Journal of Real Estate Finance and Economics*, 1989, 2, 117–130.

The authors acknowledge the helpful comments and suggestions of Ko Wang, and three anonymous reviewers. The authors wish to acknowledge and thank Charles Jones of G & E Engineering for his guidance. This paper was funded in part by a grant from the National Association of Home Builders. We also thank the American Business Law Journal for publishing a companion paper that studies the legal aspects of federal wetland regulation.

Randall S. Guttery, University of North Texas, Denton, TX 76203 or guttery@unt.edu.

Stephen L. Poe, University of North Texas, Denton, TX 76203 or poe@unt.edu.

C. F. Sirmans, University of Connecticut, Storrs, CT 06269-2041 or cf.sirmans@business.uconn.edu.