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Riparian Areas Generate Property Value Premium for Landowners

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Photo provided courtesy of Novak Environmental, Inc. Photograph by Ray Allbright.

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Executive Summary

Property owners receive a premium when selling homes and land near riparian areas throughout the arid western United States. Statistical analyses of actual property sales can show the size of this property value premium and how far this premium extends from the riparian area. This report documents the effects of riparian corridors (proposed for protection by the Governor's Water Management Commission) on property values in the northeast Tucson metropolitan area.

Our analysis of thousands of residential home sales identifies a property value premium of three to six percent for homes located within half a mile of riparian areas proposed for protection, after accounting for the effects of lot size, home size, and other factors. This premium adds up to over $103 million dollars for the 25,560 homeowners located within 1.5 miles of the riparian corridors, and most of this premium ($77 million) is for homes in the first half mile.

Figure 1 illustrates this premium for a typical 2,000 square-foot home in the study area. The statistical model indicates a sale price for this home of $192,107 when located one-tenth of a mile from the riparian corridor. However, if the same home was located 1.5 miles from the riparian corridor, its price falls to $181,466. The difference of $10,640 (six percent) is the increased property value due to being located closer to the riparian corridor. Riparian areas generate a proportionally larger premium (as a percentage of property value) for undeveloped land. The increased property value for vacant land due to being located closer to a riparian corridor ranges from 10 to 27 percent. While this study examines only one portion of the metropolitan Tucson area, property value premiums also can be expected near riparian corridors elsewhere in Arizona's desert communities. Riparian buffer zones could help protect these premiums from being eroded by new groundwater pumping.

For property owners located in and near riparian corridors, limits on new wells provide some protection for a component of property value that otherwise could be lost. Proposed limits on new wells in riparian buffer zones help assure landowners that when they refrain from drilling a new well in order to protect riparian corridors, others also must refrain. This can prevent landowners from inadvertently damaging riparian resources that benefit each of them, but which no individual landowner can protect alone.

Acknowledgments

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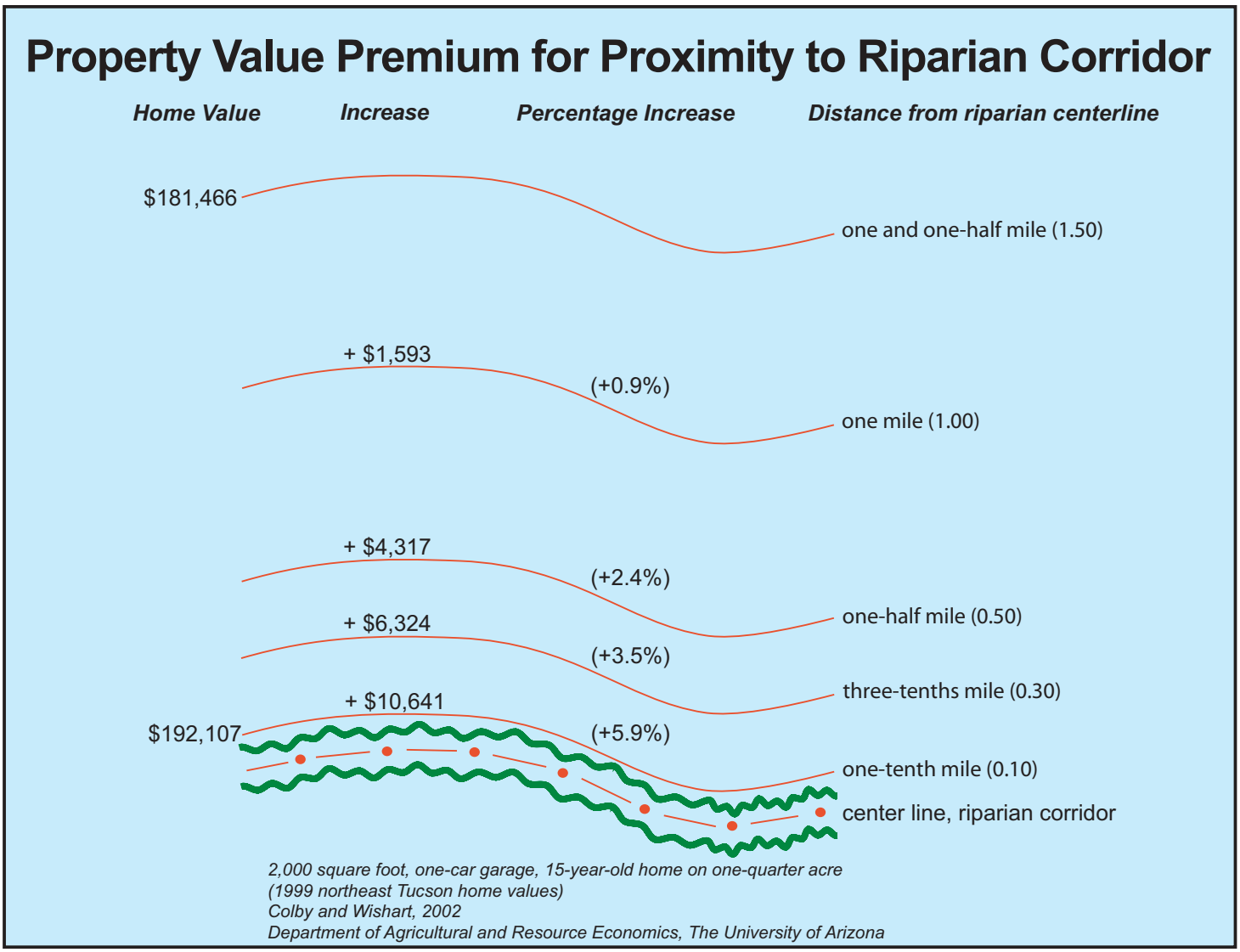

Introduction

The Arizona Water Commission, after eighteen months of deliberations, produced a set of recommendations to fine-tune water management in Arizona's Active Management Areas. One of these recommendations, to be considered by the Arizona Legislature, proposes protection for a specific list of riparian areas. Desert riparian areas form ribbons of green, with cottonwood, mesquite, and willow trees that depend on a shallow depth of groundwater in order to survive. Riparian corridors support a wide variety of birds and other wildlife, which could not live in the desert without access to riparian areas. Groundwater pumping affects riparian areas when it causes the water table to drop beyond reach of the riparian plants. The Commission recommendations would require landowners seeking to drill new groundwater wells within a proposed riparian buffer zone (one-half mile from the center line of the watercourses in the listed riparian areas) to obtain their water from other sources. The proposal does not affect wells already in place, replacement wells, or new wells needed for livestock. The Commission recommended exemptions for those who do not have access to affordable alternative water supplies (Governor's Water Management Commission, Final Report, page 26).[2]

This paper examines riparian area property value impacts by statistically analyzing real estate sales near riparian corridors proposed for protection in northeast Tucson. In addition to increasing private property values, riparian corridors provide public benefits such as flood control, water quality filtration, recreation, open space, and wildlife habitat.[3] This paper focuses only on property value considerations and thus examines only one of many factors to be weighed in considering proposals to preserve riparian corridors.

Landowner Benefits from Riparian Corridors

Along riparian corridors, large stands of cottonwoods, mesquite, and willows support diverse birds and wildlife, providing benefits to nearby landowners. Homeowners enjoy scenic views, open space, bird and wildlife viewing, and a buffer from urban noise. Riparian trees provide shade, giving respite from summer heat and lowering home cooling costs.[4] Policies

[2] The Commission also recommends exemptions when hydrologic analysis demonstrates that the new well will not impact a riparian area. The Commission's recommendations, maps of riparian areas proposed for protection, and a minority report on the riparian buffer zone recommendation are available in the final report of the Commission, available on the Department of Water Resources Website: http://www.adwr.state.az.us.

[3] Riparian vegetation allows floodwaters to infiltrate into the ground with less erosion, channel destabilization and flood damage to nearby property (Pima Association of Governments).

[4] A survey of homeowners in Pima County found that 64 percent of respondents believed that loss of riparian vegetation near their home would have a negative impact on their property (Novak).

that protect riparian areas from new groundwater wells also help protect the water table for existing well owners. Declines in the water table not only affect riparian areas, they also cause higher costs for well owners who must pump from deeper levels and may need to invest in deeper wells.

Riparian corridors provide services that are not directly traded in markets. Market prices for conventional goods provide information about the value of those goods. There is no direct market where one may buy or sell the mix of services provided by a riparian corridor and thus no direct market value. However, careful statistical analysis of real estate transactions can identify riparian area contributions to property values. The hedonic valuation method has been used for many decades to examine the property value impacts of proximity to both desirable features (open space, beaches) and undesirable sites (landfills, airports). We use it here to examine the property value premium that riparian corridors provide to landowners. [5] This method can be used only where there is an active real estate market and the hedonic method *only* measures effects related to property values.[6]

The Data

Our analysis uses real estate and geographical information system (GIS) data for private property parcels within 2.5 miles of a 15 mile-long stretch of the Tanque Verde Wash and nearby riparian corridors proposed for protection under the Commission's recommendations (Pima County GIS). The statistical model analyzes single family residence (SFR) home sales over four years, 1996-1999. The data set includes 7,658 SFR home sales.

The model identifies the contributions to home prices of six variables: year of sale, home and parcel size, age of home, garage size, and distance to the riparian corridor. Appendix B describes the details of the statistical model and its results, and Table B-1 provides variable definitions and summary statistics.

[5] Appendix A provides background on the hedonic method and summarizes other studies that value riparian areas. The name of the method, hedonic, is based on a Greek word for the study of pleasant and unpleasant factors.

[6] A riparian corridor provides other benefits, such as recreation opportunities, for those who do not own land close enough to receive a property value premium. Riparian areas are used by large numbers of people for walking, bicycling, horseback riding, and birding. Most of the riparian areas that the Commission proposes for listing are accessible to the public.

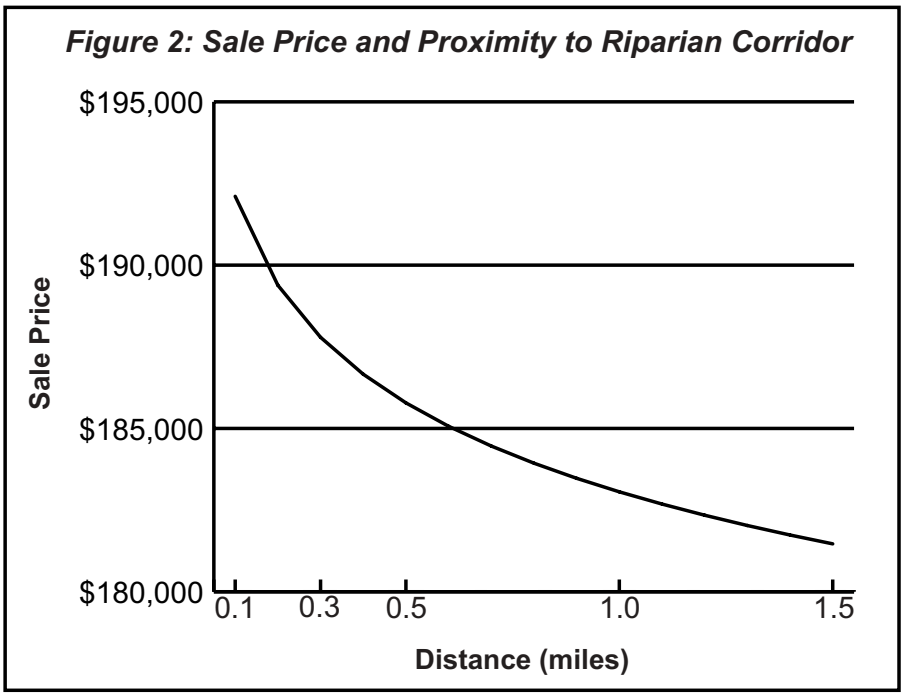

Figure 2 illustrates the statistical results. It shows how the value of a home increases as it is located closer to the riparian corridor.[7] Homes in close proximity (within half a mile) to the wash are priced at a considerable premium, compared to those farther out. Table 1 shows how a representative home increases in value as its location is moved closer to the riparian corridor. Table 1 indicates that a 15-year-old, 2,000 square-foot home, on a one-quarter acre parcel, and with a one-car garage would drop in market value by six percent if its location were changed from one-tenth of a mile from the riparian corridor to one and one-half miles away. The statistical analysis indicates that the zone of influence on property values extends out about 1.5 miles from the center of the riparian corridor, with only a small influence on property values beyond one mile. Riparian corridors have a notable positive effect on SFR property values, an effect which increases with a home's proximity to the riparian corridor.

Table 1: SFR Values and Proximity to Riparian Corridor

Distance (miles)	SFR Property Value	% Change from 1.5 Mile
0.1	$192,106	6.0
0.3	$187,790	3.5
0.5	$185,783	2.4
1.0	$183,059	0.9
1.5	$181,466	0.0

[7] The graph starts at one-tenth of a mile instead of at zero because homes are not located in the center of washes.

Overall SFR Property Value Premiums

Here we consider the riparian corridor's property value effects for all homeowners located within 1.5 miles. The property value premium for each home is the difference between home value at the home's actual distance and at the 1.5-mile mark from the riparian corridor. Homeowners capture this premium when they sell their home, as compared to selling an identical home farther away from the riparian corridor. The property value premium to owners of the 25,560 single family residences located within 1.5 miles of the center line of the Tanque Verde Wash is 103.1 million dollars. Seventy-five percent of this riparian property value premium (77.3 million dollars) goes to homeowners located within a half mile of the riparian corridor. For homeowners located within the proposed riparian buffer zone, policies that limit new wells could provide some property value protection.

Riparian Property Value Premiums for Undeveloped Land

Undeveloped land falls into one of the following three categories, for the purposes of examining proposed limits on new wells:

1) Land which cannot, or likely will not, be developed. These include federal lands, other public lands not subject to development, and private lands unsuitable for development due to topography or lack of access. Limits on new wells help maintain scenic and recreational values associated with riparian areas near these lands.

2) Land which is most cost-effectively developed by obtaining water service from a public water provider or private water company. Landowners in this category do not have increased costs from limits on new wells, and such limits may help maintain their riparian property value premiums.

3) Land which would, in the absence of the riparian buffer zone, be developed through drilling a new well. Under the Commission's proposal, this category of landowner will need to arrange for alternative water supplies, or obtain an exemption so that they can drill a well.

The Arizona Department of Water Resources prepared a summary of land ownership patterns within the proposed riparian buffer zones for the Arizona Water Commission. The summary suggests that little land falls into the third category. Less than half of the land area within the

proposed riparian buffer zone is private land, and most of those private lands already are within the service area of a public water provider or a private water company (Arizona Department of Water Resources).[8]

Owners of undeveloped land who were planning to drill a new well in the proposed buffer zone may have higher water supply costs if new wells are limited.[9] For these landowners, the water supply cost of the Commission's proposal is the *difference* between the cost of drilling a new well and the cost of their next best water supply alternative. Balanced against this cost is the landowner's property value premium from being located near the riparian corridor.

Statistical analysis quantifies the portion of undeveloped land values that is linked to proximity to the riparian area.[10] Undeveloped land values are represented in our analysis by the county assessor's full cash value for each parcel, due to few actual undeveloped land sales. Land values increase significantly with proximity to the riparian corridor.

Table 2: Undeveloped Land Values and Proximity to Riparian Corridor

Distance (miles)	Value (1 acre)	% Change from 1.5 miles
0.1	$45,006	27.00
0.3	$40,781	14.69
0.5	$38,954	10.36
1.0	$36,505	3.42
1.5	$35,297	0.00

A one-acre parcel is valued at $45,006 when located one-tenth of a mile from the riparian corridor. The value drops to $35,299 when located 1.5 miles away. Table 2 summarizes the effect of proximity to a riparian corridor on the value of a one-acre parcel. For the 4,237 parcels of undeveloped land located within 1.5 miles of the riparian corridor, the riparian property value premium is estimated to be $18.4 million.[11] Given that county assessor full cash values lie below actual market values, this figure is a low estimate of the premium that proximity to riparian corridors provides for owners of undeveloped land.

[8] Federal lands account for most of the land area in the proposed riparian buffer zones located in the state's five Active Management Areas. State trust lands account for seven percent.
[9] The Commission's proposal recommends exemptions that allow wells to be drilled when there is not an affordable alternative supply.
[10] See Appendix B for the details of the undeveloped land statistical model and its results.
[11] This riparian premium was calculated in the same way as for SFR parcels. The premium for each parcel is the difference in full cash value between the parcel at its actual location and the full cash value of an identical parcel located 1.5 miles from the riparian corridor.

Conclusions

Riparian corridors contribute substantially to the property values of nearby landowners, particularly within the first half mile of the riparian area. This report documents a property value premium of $103.1 million for the owners of 25,560 single family residences that lie within 1.5 miles of riparian corridors proposed for protection. Three-quarters of this premium ($77.3 million) goes to homeowners located within a half mile of the riparian area. While this study focused on northeast Tucson, property value premiums can be expected for homeowners located near riparian corridors elsewhere in Arizona's desert cities.

Undeveloped landowners also receive a property value premium. For the owners of undeveloped parcels located within 1.5 miles of northeast Tucson riparian corridors, this premium adds up to over $18.4 million. If riparian areas are allowed to decline due to uncontrolled groundwater pumping, these property value premiums could be affected. This is likely to be of great concern to current landowners who paid for this premium when purchasing their property and who count on recapturing it when they sell their property.

Proposed limits on new wells in riparian buffer zones could help maintain the riparian component of property values for nearby landowners. Limits on new wells provide assurance to each landowner that when they refrain from drilling a new well in order to protect riparian corridors, others also must refrain. Such policies could prevent individuals from inadvertently damaging a resource that benefits each of them, but which no single landowner has the power to protect on their own.

About the Authors

Bonnie G. Colby is Professor of Agricultural and Resource Economics at The University of Arizona, where she has been a faculty member since 1983. She has authored numerous publications on the economics of water issues, including the books *Water Markets in Theory and Practice* and *Indian Water Rights: Negotiating the Future*. She has provided invited testimony on these matters to state legislatures around the West, and to Congress. She served on the National Research Council's Committee on Western Water Management, the Committee on Managing Glen Canyon Dam, and on the National Academy of Science committee investigating use of economic methodology by the Army Corps of Engineers for billion-dollar proposed projects on US waterways.

Steve Wishart, a native Minnesotan, is finishing his M.S. degree in agricultural and resource economics at The University of Arizona. He plans to complete a Ph.D. in this field and is a champion cyclist in his free time.

About the Department

The University of Arizona Department of Agricultural and Resource Economics strives for excellence in teaching, research, and outreach. The Department offers undergraduate and graduate degrees focusing on natural resource economics, international trade and development, econometric methods, agribusiness, and management. Faculty members have been honored on many occasions for their outstanding teaching, research, outreach, and public service. Additionally, the Department's graduate students have achieved much recognition and work worldwide as professionals in water management, agriculture, advanced data analysis, natural resource economics, and international development.

Appendix A: Background on the Hedonic Property Price Method

The hedonic method has been used by economists for many years. Freeman (1993) presents an excellent description of the underlying theory and the uses of the hedonic method. Ridker (1967) was the first to apply this theory by investigating the effect of air quality on residential housing prices in St. Louis. Since then, there have been hundreds of studies using the hedonic method. The hedonic property price method statistically relates real estate sale prices to a set of factors that influence property prices (age, size of parcel, square footage of home, etc.). Using this method, the value of proximity to a riparian corridor can be quantified separately from the other components of value.

Numerous other studies have documented property value premiums associated with riparian areas. For instance, Mahan, Polasky, and Adams (2000) estimated the value of wetlands in the Portland, Oregon area. Using 14,233 real estate transactions, sale prices of residential homes were statistically linked to a set of variables that include proximity to urban wetlands. This study found that a home's value increased by $436.17 for being located 1,000 feet closer to the nearest wetland.

In the early 1980s, King, White and Shaw (1991) examined the effects of proximity to riparian habitat and other wildlife habitat on the value of single family residences throughout the Tucson metropolitan area. After accounting for the many other factors that affect home sale prices (square footage, age of home, location, etc.), this study identified a three to five percent premium in the sale prices of single family residences located within one-half mile of large open space preserves, riparian areas, and other wildlife habitat.

Appendix B: Statistical Models and Results

The Single Family Residence Model and Statistical Results

The model used in our statistical analysis is:

SALE PRICE is a function of: YEAR SOLD, PARCEL SIZE, LIVING SPACE, AGE, GARAGE, LN(DISTANCE).

Table B-1 provides definitions of these variables and summary statistics. The model includes a nonlinear relationship between DISTANCE and SALE PRICE because the marginal effect on home price is not constant with respect to distance from the riparian corridor. Instead, the property value premium is proportionally higher for homes close to the riparian area than for those located farther away. Table B-2 summarizes the statistical results.

Table B-1: Variables Used to Examine Property Value Impacts[12]

Variable Name	Description
Dependent Variable	
SALE PRICE	Sale price of home.
Independent Variables	
1996	Variable representing a 1996 home sale (1594 sales)
1997	Variable representing a 1997 home sale (1832 sales)
1998	Variable representing a 1998 home sale (2339 sales)
1999	Variable representing a 1999 home sale (1893 sales)
PARCEL SIZE	Size of land parcel, measured in square feet
LIV. SPACE	Total living space of home, measured in square feet
AGE	Age of home at time of sale, in years
GARAGE	Number of garaged parking spaces
DISTANCE	Distance to centerline of riparian corridor, in miles

Summary Statistics

Variable Name	Average	Minimum	Maximum
SALE PRICE ($)	182,295.10	29,900	1,855,584
PARCEL SIZE (sq. ft.)	23,782.23	2,023.70	3,606,709
LIV. SPACE (sq. ft.)	2,052.16	800	7,765
AGE (years)	15.37	0	98
GARAGE (# of spaces)	1.54	0	6
DISTANCE (miles)	.84	.10	2.50

[12] The data was checked for inaccuracies by examining each variable in turn, and inspecting for extreme values. For example, we dropped 5 observations from the data set that listed the area of the land parcel to be under 200 square feet, 10 which listed zero bathroom fixtures, and one observation which indicated that the home had 200 garaged parking spaces.

Table B-2: Statistical Results: Single Family Residences[13]

Variable	Robust Coef.	Std. Err.	t	P>|t|
1996	-58537.37	5663.41	-10.34	0.00
1997	-55185.27	5750.45	-9.60	0.00
1998	-49514.99	5703.83	-8.68	0.00
1999	-31320.59	6034.53	-5.19	0.00
PARCEL SIZE	.43	.07	6.32	0.00
LIV. SPACE	105.88	3.22	32.93	0.00
AGE	-560.38	81.94	-6.84	0.00
GARAGE	6290.79	1128.88	5.57	0.00
LNDISTANCE	-3929.19	890.43	-4.41	0.00

The model has an R-squared of 0.9125, which indicates that it is an excellent predictor of home prices.[14] The t-statistics for each independent variable indicate that each of them has a significant influence on home price. All coefficient estimates are significant at the five percent level, a common benchmark for evaluating statistical significance.

All of the variables, except lnDISTANCE, are linear with respect to sale price. Their coefficients represent the "marginal implicit price" for the variable. That is, the coefficients are the amount that a home's sale price will change, for a one-unit change in the independent variables. The model also demonstrates how home square footage, garage size, and the age of the home affect the value of the home. The size of the land parcel has a positive effect, as does increased living space. Distance from the riparian corridor has a negative impact on home price. The variable for distance to the riparian corridor is included in the statistical model as a logarithmic function. Its regression coefficient is equal to the *proportional* change in home price per unit change in distance (Johnston and DiNardo, 1997). Figure 2 (in the body of this report) illustrates this relationship. Table B-3 shows the contributions of each variable in the model to the value of the average home in our data set.

[13] Ordinary least squares regression was used to estimate the hedonic price model. The results were then checked for heteroskedasticity using the Cook-Weisberg (Breusch-Pagan) test. The tests indicated heteroskedasticity and White's (Huber's) method was used in a second regression to recover consistent estimates for the standard errors of the coefficients. Number of obs = 7658; F(9, 7649) =11186.99; Prob > F = 0.0000

[14] R-squared (the co-efficient of multiple correlation) measures the proportion of the total variation in the independent variable that is explained by the model composed of the independent variables (Johnston & DiNardo, 1997). A review of six other published hedonic price studies revealed an average R-squared of .722, with a range of .4148 to .939.

Table B-3: Contributions of the Variables to Property Values

Variable	Increase in Home Value for a one-unit increase in the variable (for the average home)
PARCEL SALE	$ 0.43 per sq. ft.
LIV. SPACE	$ 105 per sq. ft.
AGE	$ 560 per year (negative)
GARAGE	$ 6290 per garaged parking space
DISTANCE	$ 4650 per mile (negative)

Undeveloped Land Model

The model used in our statistical analysis is:

LN(FULL CASH VALUE) is a function of: YEAR SOLD, LN(PARCEL SIZE), LN(DISTANCE)

Table B-4: Statistical Results; Undeveloped Land[15]

Variable	Robust Coef.	Std. Err.	t	P>|t|
1996	4.38	.19	22.47	0.000
1997	4.87	.20	23.96	0.000
1998	4.52	.19	23.81	0.000
1999	4.63	.18	26.01	0.000
lnParcelSize	.55	.02	31.27	0.000
lnDistance	-.09	.03	-2.71	0.007

The R-squared of 0.9825 indicates this model is an excellent predictor of the full cash value of vacant land and the t-statistics indicate that proximity to the riparian corridor has a significant influence on the full cash value of undeveloped land.

[15] Regression with robust standard errors. R-squared = 0.9825, Number of obs = 2679, F(6, 2673) = 25258.72, Prob > F = 0.0000.

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