



Jacob's Well, Headwaters of Cypress Creek

Understanding Hill Country Water Resources

Assessment of the economic contribution of Cypress Creek to
the economy of Wimberley, Phase II Final Report

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Understanding Hill Country Water Resources

The Hill Country of Central Texas is a rugged, rural landscape with near-pristine watersheds, springs, specialized flora and fauna, and an expanding population with growing water demands. Here, three major aquifers – Trinity, Edwards and Carrizo-Wilcox – supply nearly all of the water to metropolitan and rural populations. The aforementioned increasing water demands and the current prolonged drought place stress on natural ecosystems, and often reduce or completely cease flows in historically ephemeral creeks and streams.

The *Understanding Hill Country Water Resources* research effort began in 2011 to improve our understanding of groundwater issues and, thus, support a sound basis for civic and stakeholder actions through: 1) an economic study of land valuations around a unique Hill Country creek; 2) a synthesis of groundwater data and related information into a website for public use; and 3) an increase public and stakeholder awareness of groundwater concerns.

This report presents the results of economic valuations of additional monetary contributions of 1) Cypress Creek to riparian properties in Wimberley, TX, 2) residents' willingness to pay to maintain the creek and 3) preliminary contributions of tourism related to the area's water resources. The report also addresses further evaluations that would increase our understanding of Cypress Creek's economic contribution and value to the local economy. The second and third items are addressed in a sister report, entitled "Groundwater Resources, Website and Public Outreach, Final Report." Groundwater data, records, information and other materials pertinent to groundwater resources and issues in the Hill Country are summarized in this sister report, located at <http://www.txhillcountrywater.org/>. This website on "Hill Country Water Resources" was developed as public education and outreach resource.

Project Summary – Assessment of the Economic Contribution of Cypress Creek to the Economy of Wimberley

The Cypress Creek watershed resides in the Edwards Plateau region of the Texas Hill Country and flows through northern Hays County near the City of Wimberley, Texas. Much of the Cypress Creek Watershed's 24 square-mile terrain is typical of the Texas Hill Country. Jacob's Well is a naturally flowing artesian spring



Figure 1. Cypress Creek

located in the bed of Cypress Creek. During low flow conditions, Jacob's Well constitutes the headwaters of Cypress Creek. Water from Jacob's Well flows into Cypress Creek as it runs through downtown Wimberley, ultimately providing inflows to the Blanco River several miles downstream. The Blanco River provides recharge to both the Trinity and Edwards Aquifers. In July 2000, prolonged drought caused Jacob's Well – the primary source for the creek – to cease flowing for the first time in recorded history, thereby degrading fish, wildlife, and water quality. Flows ceased again in 2008 and low flow conditions currently persist.

Along with much of Central Texas, the Cypress Creek watershed is under increasing demands from rapidly growing population. Hays County is listed as the 31st fastest growing county in the United States. Recent projections show the county's population growing nearly 400% by 2040 (TSDC 2009). Such rapid growth in areas reliant upon the Trinity Aquifer will put untold strain upon local and regional groundwater resources.

Cypress Creek and Jacob's Well provide wildlife habitat and water for instream flows; and Wimberley, Woodcreek and other surrounding areas benefit financially from the intrinsic character and "natural services" provided by the creek and springs. The Meadows Center and its collaborators have laid the groundwork for studies regarding water-related economic issues in the region. Research has focused on potential changes in land values due to environmental degradation or cessation of flow; estimating the willingness of residents to pay to avoid future deterioration of the water quantity and quality of Jacob's Well, Cypress Creek and Blue Hole; and identifying potential local economic contributions of tourism tied to the water resources.

These studies provide critical information for determining how the creek and springs contribute to the regional economy. As a first step, it is important to understand the potential economic losses from reduced property values. Quantifying the residents' valuation of their local resources provides worthwhile insight. And, it is vital that residents and decision-makers understand reduced water quality and quantity lead to lost revenues for the tourism and hospitality industry.

The ability to assign economic value to natural resources is an important management tool, especially in light of population increases, water shortages, variable climate conditions and other increasing water quality concerns. Such a tool could help Central Texas communities and governing agencies preserve, conserve, manage and protect both the declining natural resources and their associated economic benefits.

Assessing Property Value Contributions from Cypress Creek

Initially, potential land value changes associated with creek and watershed degradation were evaluated through the Cypress Creek Project by using available data and input from local business owners, entrepreneurs, real estate agents, and land owners within the watershed. Initial estimates indicated that prolonged reduced flow conditions could reduce market values in the portion of the watershed adjacent to the creek by as much as 25-45%, while decreased water quality would result in a 20-30% decline in market values.

Valuation of land premiums attributed to lots in proximity to Cypress Creek was intended to provide some measure of potential economic contributions of the creek to the local community. Contributions include higher than average property values and income from property taxes that may be assessed in the future. Analyses found that a land value premium of at least \$2.62 per square foot can be attributed to properties in the riparian area and very close proximity to the "wet," or spring fed portion of Cypress Creek (0-0.05 miles from the center of the creek). Findings estimate that the cities of Woodcreek and Wimberley could collect annual property tax revenues of over one million dollars from land value premiums associated with properties adjacent to Cypress Creek. However, due to different levels of elevation and topographical features, properties in the dry portion of Cypress Creek do not follow the same valuation pattern. Instead, it appears that while less significant, there is a land value premium for properties with appropriate

topography for building and high enough elevation for panoramic views, which are most likely to be located farther from the creek, at least 0.21 miles from the creek bed.

Although few similar studies exist, analyses determining property value premiums associated with proximity to natural resource amenities in Central Texas and Colorado have comparable findings – the closer properties are to natural resources like creeks, the higher the average price and potential property tax income.

Assessing Residents’ Perceived Value of Cypress Creek

The contingent valuation method was utilized to estimate Wimberley residents’ perceived value of avoiding future deterioration to the flow of Cypress Creek. Study results show residents’ are willing to pay \$79 to \$94 per person per year to ensure the continued flow, water quantity and quality of Cypress Creek, its spring-fed source, Jacob’s Well, and nearby recreational areas, such as Blue Hole. Even more significant, results indicate that 91% of residents recognize the benefits derived from direct use of the Creek (e.g. swimming, paddling), as well as indirect use, (e.g. providing habitat for aquatic species) and are willing to contribute economic resources to protect the resource.

Assessing Economic Value Contributions from Tourism Related to Cypress Creek

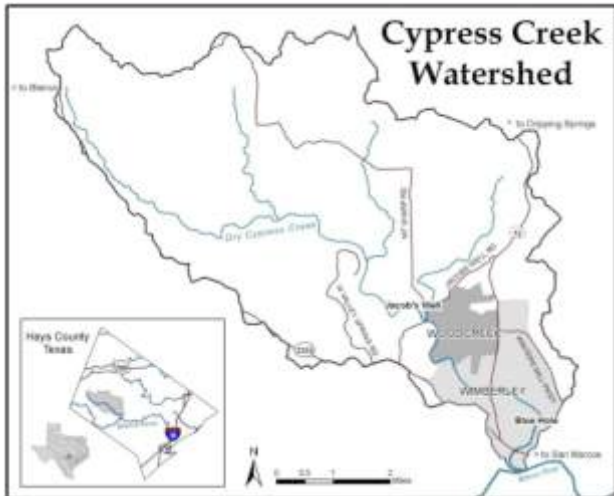
The economic impact of Wimberley’s tourism and hospitality industries is strongly tied to Cypress Creek. Several methods for valuing this relationship and its annual revenues were assessed. A mixed methods approach was utilized, and although limited, found that in 2010, revenues from the tourism and hospitality sectors totaled more than \$65 million, generated \$391,799 in sales tax revenues (accounting for 70% of the total sales tax revenues collected by the City of Wimberley) and employed at least 517 local residents. Approximately \$13.75 million in wages can be attributed to tourism and hospitality.

Background Information

Cypress Creek Landscape

The Cypress Creek watershed is a part of the Edwards Plateau region of the Texas Hill Country and is located in northern Hays County in and around Wimberley, Texas. Much of the terrain in the area is characterized by thin topsoil layers, steep slopes, predominant karstic limestone features, and relatively sparse vegetation (Cypress Creek Project 2010). The Cypress Creek watershed encompasses approximately 24.27 square miles, most of which is undeveloped, except for the dense residential development in Woodcreek and commercial/residential development in the City of Wimberley.

Cypress Creek is commonly divided into two segments: The 9.5-mile segment above Jacob’s Well is usually dry, except during major rainfall events, and is referred to as “Dry Cypress Creek” while the 4.9-mile long stream segment below Jacob’s Well is fed by the spring and consistently contains flowing water. This downstream segment is referred to as Cypress Creek or “Wet Cypress Creek.” The Dry Cypress watershed is approximately twice the size of the wet Cypress Creek watershed (Hays-Trinity, 2008).



Jacob's Well is a natural flowing artesian spring located in the bed of the wet portion of Cypress Creek, and is a significant source of flow to the creek. During low flow conditions, Jacob's Well forms the headwaters for Cypress Creek, which runs through downtown Wimberley, and provides inflows to the Blanco River several miles downstream. The Blanco River provides recharge to both the Trinity and Edwards Aquifers. Figure 2 below shows the Cypress Creek watershed, while Figure 3 illustrates the wet and dry portions of the watershed.

Figure 2. Cypress Creek Watershed

The Cypress Creek watershed is under increasing demands from rapid population growth. Hays County is listed as the 31st fastest growing county in the United States. Projections show that the county's population could grow from 97,589 in 2000 to 509,876 in 2040 (TSDC 2009). The two communities of Wimberley and Woodcreek reside within the watershed and have grown rapidly over the past 20 years. There are over 70 approved subdivisions in the Cypress Creek watershed, several of which are only partially developed or completed.

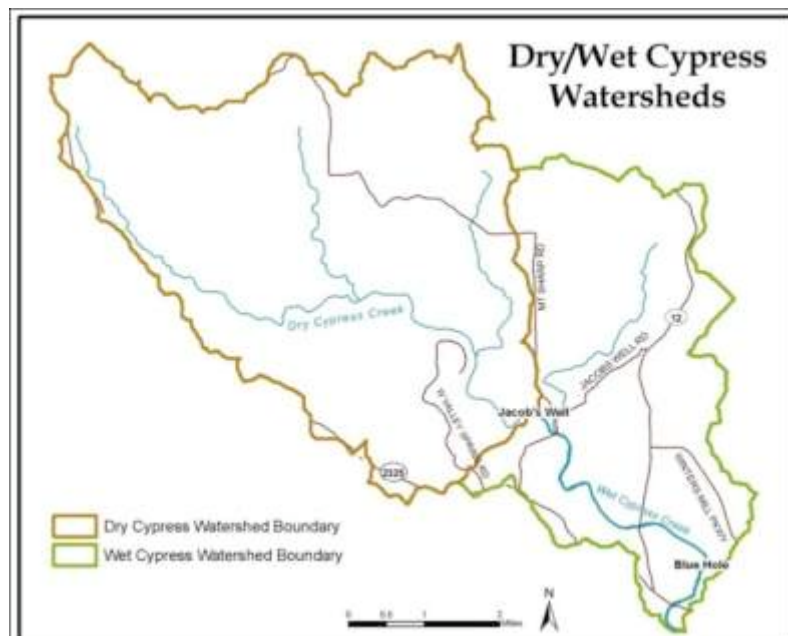


Figure 3. Wet and Dry Delineations of Cypress Creek Watershed

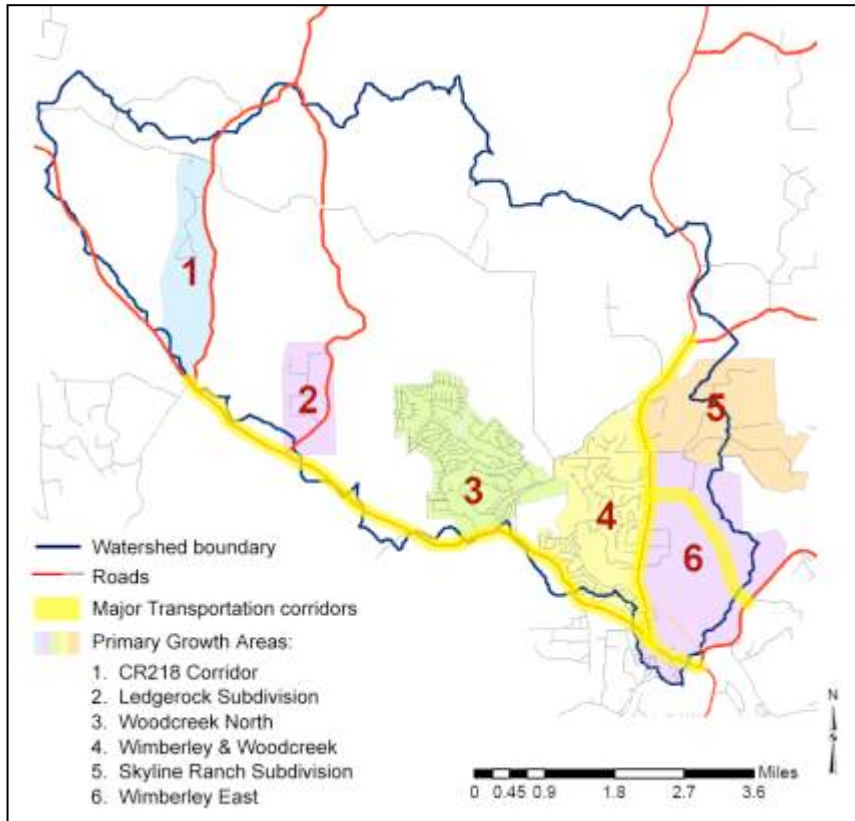


Figure 4. Primary growth areas in the Cypress Creek watershed (Cypress Creek Project)

The primary growth areas shown above in Figure 4 are based on existing road networks, Hays County’s 2025 Transportation Plan, city limits and extra-territorial jurisdiction areas (ETJs), water and wastewater service areas, and existing parcel boundaries. Major transportation corridors were defined as 150 m (approximately 500 ft) buffers along both sides of roadway. The primary growth areas are:

1. CR218 corridor: This area includes the Shadow Valley subdivision in the north and a swath of land to the south approximately ½ mile wide along CR218.
2. Ledgerrock subdivision: This area follows established subdivision boundaries.
3. Woodcreek North: This area follows the subdivision boundaries for Woodcreek Phase II, west of Jacob’s Well Road.
4. Wimberley & Woodcreek: Includes the remainder of the Woodcreek subdivision east of Jacob’s Well Rd. and some surrounding parcels, plus areas of northern Wimberley and its ETJ to the RR12/RR2325 intersection in downtown Wimberley.
5. Skyline Ranch subdivision: Includes the Skyline Ranch, Skyline Acres, Sagemont, and Wimberley Heights subdivisions.

6. Wimberley East: Includes downtown Wimberley along RR12 and areas to the north and east of RR12. Includes several large-lot inholdings, the Cypress Creek Acres, Ranch at Wimberley, and Pinnacle Ridge subdivisions, and areas along Winter's Mill Pkwy. Much of this area is within Wimberley and Woodcreek ETJs.

This rapid residential development is causing increased demand on municipal water resources. Regional municipal use is expected to grow from less than one quarter of total water use to between 40% and 50% of total water use and groundwater withdrawal. Nearly a third of these additional water demands are expected to be supplied by conservation of existing supplies; but additional (new) sources of surface and groundwater will be required to meet most of the increased demand and may not be readily available. In fact, more than 100 Water User Groups in Central TX are projected to have water shortages by 2030 if drought conditions persist in conjunction with rapid population growth.

Real Estate Values in Wimberley

Median real estate values in the Wimberley area are more than twice as high as the state median value and nearly twice the national cost. Table 1 summarizes home values in Wimberley and shows that more than 1600 homes are valued above the state median price. Additionally, 41% of the 2,233 homes in the Wimberley area do not carry a mortgage, greater than the state and national rates of 6.6% and 11.9%, respectively. Local real estate experts expect new development to follow similar trends.

Table 1. Homeowner Statistics and Home Values

| 2010 US Census Bureau Homeowner Statistics and Home Values | | | | | | |
|--|---------------|------------|-----------|------------|---------------|------------|
| | Wimberley, TX | | Texas | | United States | |
| Owner Occupied Units | 2,233 | | 5,973,803 | | 80,110,230 | |
| Owner Households, With Mortgage | 1,312 | 58.76% | 3,905,299 | 65.37% | 56,600,910 | 70.65% |
| Owner Households, With No Mortgage | 921 | 41.24% | 2,068,504 | 34.63% | 23,509,320 | 29.35% |
| Housing, Median Value | \$263,516 | | \$118,954 | | \$177,046 | |
| Home Values | # Units | Percentage | # Units | Percentage | # Units | Percentage |
| Less than \$20,000 | 4 | 0.18% | 196,743 | 3.29% | 1,586,221 | 1.98% |
| \$20,000-\$39,999 | 12 | 0.54% | 400,355 | 6.70% | 2,651,355 | 3.31% |
| \$40,000-\$59,999 | 28 | 1.25% | 653,914 | 10.95% | 4,517,518 | 5.64% |
| \$60,000-\$79,999 | 32 | 1.43% | 490,873 | 8.22% | 3,837,391 | 4.79% |
| \$80,000-\$99,999 | 83 | 3.72% | 770,848 | 12.90% | 7,176,493 | 8.96% |
| \$100,000-\$124,999 | 80 | 3.58% | 625,404 | 10.47% | 7,044,722 | 8.79% |
| \$125,000-\$149,999 | 122 | 5.46% | 457,414 | 7.66% | 6,347,736 | 7.92% |
| \$150,000-\$174,999 | 174 | 7.79% | 393,460 | 6.59% | 6,362,319 | 7.94% |
| \$175,000-\$199,999 | 236 | 10.57% | 358,137 | 6.00% | 6,494,011 | 8.11% |
| \$200,000-\$249,999 | 259 | 11.60% | 313,810 | 5.25% | 6,136,553 | 7.66% |
| \$250,000-\$299,999 | 320 | 14.33% | 328,973 | 5.51% | 6,983,047 | 8.72% |
| \$300,000-\$399,999 | 302 | 13.52% | 317,464 | 5.31% | 6,910,570 | 8.63% |
| \$400,000-\$499,999 | 218 | 9.76% | 230,151 | 3.85% | 5,096,919 | 6.36% |
| \$500,000-\$749,999 | 176 | 7.88% | 233,694 | 3.91% | 5,078,867 | 6.34% |
| \$750,000-\$999,999 | 140 | 6.27% | 118,916 | 1.99% | 2,412,280 | 3.01% |
| More than \$1,000,000 | 47 | 2.10% | 83,647 | 1.40% | 1,474,228 | 1.84% |

Tourism in Wimberley

Tourism in Wimberley and surrounding areas is primarily driven by the local water resources. Although the creek is not heavily used for tubing or paddling, it winds through downtown Wimberley, creating a setting for shopping and dining. The City collects a 1% sales tax on all taxable purchases within city limits. Wimberley depends on these sales tax revenues, franchise fees and other monies to provide basic city services. The city of Wimberley does not levy property or ad valorem taxes, but collected \$628,460 in local sales tax revenues in 2012, an increase of \$34,031 collected in 2011 (City of Wimberley 2012). \$247,502 in franchise taxes/fees were also collected in 2012, up from \$224,573 in 2011. Sales tax revenues accounted for 30% of total revenues for the city and franchise taxes contributed an additional 11.8% in 2012.

Woodcreek collected \$34,271 (1% local) in local sales tax revenues from its few businesses and vacation rentals and \$189,764 in property tax revenues in fiscal year 2011 (US Census Bureau 2012b). According to the 2012 City of Woodcreek's Annual Financial report, an additional \$17,135 in sales tax was collected in 2012 for the Wimberley Village District. A significant portion of these revenues are assumed to be generated from tourism.

Wimberley's art galleries, antique shops and other retail stores, restaurants, wineries, distilleries and local theatres draw many visitors to the area. The monthly outdoor market known as "Market Days" is the second largest in the state, with more than 475 vendors. On average, 10,000 people shop at Market Days each month. In 2010, 22,538 guests were logged at the Wimberley Visitor Center and similar numbers have been counted annually for over ten years.

Blue Hole Regional Park, Jacob's Well Natural Area, Cypress Falls Swimming Hole and other unique swimming areas are visited by thousands annually. In 2010, more than 14,000 people visited Blue Hole and numbers of guests increase annually. The Emily Anne Theatre draws between 430 and 2370 visitors annually for theatrical productions and 1500 guests for their annual "Butterfly Festival", and more than 21,000 attendees for their annual holiday "Trail of Lights" in November and December. Data collected since 2008 indicates that these numbers increase every year, along with revenues. In 2010, the Theatre recorded 27,678 visitors, most of which were from "out of town."

According to the State of Texas Comptroller, the 109 hotels, bed and breakfasts and resorts in Wimberley generated \$1,271,832 in just the first quarter of 2013. In 2012, \$6,277,345 in revenue was generated from lodging in Wimberley. Woodcreek generated \$5850 from its three registered lodgings in the first quarter of 2013 and \$66,289 in 2012. In 2010, Wimberley generated \$4,844,084.80 in hotel revenue and Woodcreek generated \$16,147.

A 2008 City of Wimberley report, found that the top ten Industry Categories (by number of businesses) in the Wimberley area include included Retail, Accommodation and Food Services, Other Services and Arts, Entertainment and Recreation. In 2006, the majority of sales tax revenues in the Wimberley area were generated from Retail businesses and four of the top ten Industry Categories were tourism oriented. 2010 tax rolls show similar portions of total sales tax revenues generated by tourism related businesses (See Table 2). Unfortunately, data collection criteria changes between 2006 and 2010 making any direct

comparisons over time difficult. It is clear, however, that the same tourism related Industry Categories are responsible for a large portion of revenue in Wimberley and at least 37% of Wimberley’s businesses have some potential for contributing to the tourism-based revenue generated. Other data and methodologies are used to estimate this economic contribution later in the report.

Table 2. Wimberley Area Tourism Related Industry Categories in 2008 and 2010

| Wimberley Area Tourism Related Industry Categories, % of total Number of Businesses and Gross Revenues Generated | | | |
|---|--|--|------------------------------------|
| | 2006 | 2010 | 2010 |
| Industry Category (Ranking by Frequency) | % Total Industry in Wimberley | % Total Industry in Wimberley | Gross Revenue Generated |
| Retail Trade (#1 ranking) | 46.8% * including Market day vendors | 19% * NOT including Market day vendors | \$68,768,821 |
| Accommodation and Food Service (#5 Ranking) | 6.5% | 8.2% | \$9,844,199 |
| Other Services (#6 Ranking) | 5.2% | 8.2% | \$2,569,667 |
| Arts, Entertainment and Recreation (#9 Ranking) | 4.1% | 2.4% | \$281,443 |
| Total Potential Tourism Related Businesses | 62.6% * including Market day vendors | 37.8% * NOT including Market day vendors | \$81,464,130 |

Retail Sales data for Wimberley is recorded by The US Census Bureau (US Department of Commerce) as well as the Texas Comptroller of Public Accounts. However, federal and state statistics are captured using different categories and methodologies. 2010 federally collected information is presented below in Table 3 and totals over \$91 million in gross revenue. \$48 million, more than one half of total calculated retail sales, is categorized as “Nonstore Purchases.” Although no specific information is available, local Wimberley residents and area experts estimate that sales from Market Days and art work from local artists comprise most of the revenue in this category. Local residents’ expenditures likely comprise the majority of federal retail categories, such as “Building Materials and Garden Store Sales” and “Motor Vehicles Related Sales.”

Revenue data collected by the State is presented by NAICS Industry Categories, coinciding with Table 2. Retail Trade revenues totaled \$68,768,821 in 2010; \$71,915,262 in 2011 and \$76,792,157 in 2012. Revenues from NAICS categories “Accommodation and Food Service,” “Arts, Entertainment and Recreation,” and “Other Services” are reported separately and if combined, all four NAICS categories totaled \$81,464,130 in 2010. Although state revenues are smaller than the federal Retail Sales values, discrepancies can be accounted for by the different methods of collecting and compiling data.

Table 3. 2010 Wimberley Retail Sales

| 2010 Bureau Retail Sales Statistics for Wimberley, TX | | |
|---|--------------|--------|
| Total Retail Sales | \$91,932,000 | |
| Building Materials and Garden Store Sales | \$3,508,000 | 3.82% |
| Clothing and Accessories Store Sales | \$134,000 | 0.15% |
| Food and Beverage Store Sales | \$17,554,000 | 19.09% |
| Food Services | \$4,526,000 | 4.92% |
| Gasoline Stations Store Sales | \$10,266,000 | 11.17% |
| General Merchandise Store Sales | \$1,050,000 | 1.14% |
| Health and Personal Care Store Sales | \$383,000 | 0.42% |
| Home Furnishings Store Sales | \$1,866,000 | 2.03% |
| Miscellaneous Store Sales | \$2,692,000 | 2.93% |
| Motor Vehicles Related Sales | \$1,709,000 | 1.86% |
| Nonstore Purchases Sales | \$48,086,000 | 52.31% |
| Sporting Goods Store Sales | \$158,000 | 0.17% |

Employment in Wimberley

Wimberley is home to approximately 2,626 residents, more than 40% of whom work in retail or service jobs, including, 16.1% of Wimberley’s population that work specifically in lodging and food services and 17.9% in Retail Trade.

52.5% of residents commute less than 30 minutes to work (30.82% commute less than fifteen minutes), specifying that a portion of residents derive income from local tourist based business. Because the city’s median and average household incomes are above average (see Table 4), it can be assumed that although many Wimberley residents are employed by businesses related to tourism, these salaries do not reflect the typical resident household earnings. Likely, the higher than averages wages and household incomes derive from residents in “white collar” jobs who commute to Austin, San Antonio and even Houston. According to the Census Bureau employment statistics, 81.3% of Wimberley’s residents are considered “white collar,” 5.8% higher than the Texas average. Additionally, a high proportion of Wimberley residents are retired with significant level of income.

Similarly, Industry Categories related to tourism mentioned above account for at least 30% of the businesses with employees in Wimberley (Retail Trade: 11.18%, Arts, Entertainment and Recreation: 2.35%, Accommodations and Food: 8.24% and Other Services: 8.24%).

The city of Woodcreek is almost entirely residential, with the exception of a golf course, meat market, liquor store and recreational camp. Woodcreek residents number approximately 1,457, with 748 single family homes and 18 multi-family units. 25% of residents work in some aspect of retail or service and the majority of residents travel less than 20 minutes each way to employment. This indicates that some residents likely are employed by tourist based businesses in the Wimberley area.

Table 4. Wimberley 2010 Household Income Statistics

| Wimberley and State of Texas Annual Household Income Estimates | | |
|--|-----------|----------|
| | Wimberley | Texas |
| Median Household Income | \$64,165 | \$54,591 |
| Average Household Income | \$80,420 | \$73,571 |
| Per Capita Household Income | \$35,120 | \$26,596 |

Economic Health in Wimberley Is Tied to Cypress Creek

Recent and historical data indicates that a significant portion of the City of Wimberley’s economy is reliant upon the natural resources that characterize the Hill Country and the Wimberley area. Premiums on land values and revenues from tourism and premiums are tied to Cypress Creek. This is echoed by Wimberley residents’ beliefs. The 2008 Economic Development Strategy Report for Wimberley made the following proclamation:

We believe our economic health and our potential for compatible development are dependent upon our natural assets, our small town ambiance and the reputation of Wimberley in the region... Our natural assets include the river, the creeks, the views, the open space (or the sense of it given by the terrain and vegetation), the hills, and the valleys.

Threats to the Watershed

The watershed and adjacent aquifer recharge and contributing zones of the lower Trinity Aquifer are particularly susceptible to numerous nonpoint source pollutants from development, septic systems, spray and subsurface effluent irrigation systems, fertilizer applications, and more direct public health threats from leaking petroleum storage tanks, all of which are exacerbated by reduced flow and drought conditions. Future development and prolonged drought will increase water quality impairments from pathogens, nutrients, sedimentation/siltation, organic enrichment and depressed oxygen levels, habitat alterations, and biological impairments (Cypress Creek Project 2010).



Figure 5. Jacob’s Well during normal flow conditions, 2009 (Vanessa Lavender)



Figure 6. Jacob's Well during low flow conditions, 2011 (<http://endangeredspace.blogspot.com>)

During dry conditions accompanying the drought in the summer of 2000, Jacob's Well ceased to flow for the first time in recorded history, degrading fish, wildlife, and water quality. During the drought of 2008-2009, the well stopped flowing again, for 167 days. This cessation of flow is partly attributed to a two to three foot drawdown of the aquifer. The current drought appears to be more severe and could potentially have more drastic effects on the local ecosystem and economy. A 30

foot drawdown of the Trinity Aquifer has been set by the regional groundwater authorities, Groundwater Management Area 9 and Hays Trinity Groundwater Conservation District. Regional experts and critics of the drawdown highlight the negative impacts to well owners, landowners, aquatic habitats and businesses dependent on the spring flow, which feeds the Cypress Creek and other creeks, rivers and streams in the Hill Country.

Due to drought conditions over the last several years, Jacob's Well and Cypress Creek have been subject to significantly reduced flows, resulting in a complete cessation of flow in some braids of the creek and even in certain reaches of the Blanco River, where the creek discharges. Figure 5 shows Jacob's Well during a normal flow period, while Figure 6 shows the effects of reduced discharge/rainfall.

Average area rainfall is approximately 26 inches per year (66 cm) with significant wet and dry cycles that span almost double the average in the wet years and nearly half the average rainfall in the dry years, as illustrated below in Figure 7 (D. Hillis, no date). In the immediate area of Cypress Creek, Jacob's Well discharge per cubic foot per second (cfs) according to the USGS data the drought years do show a statistical significance in cfs between the wet and dry years. As shown in Table 5, flow is significantly reduced during dry years. Chronic and repeating periods of drought, coupled with significantly increased aquifer withdrawals, pose serious threats to the flow of Cypress Creek, ultimately creating negative economic impacts from reduced property values and reduced tourism.

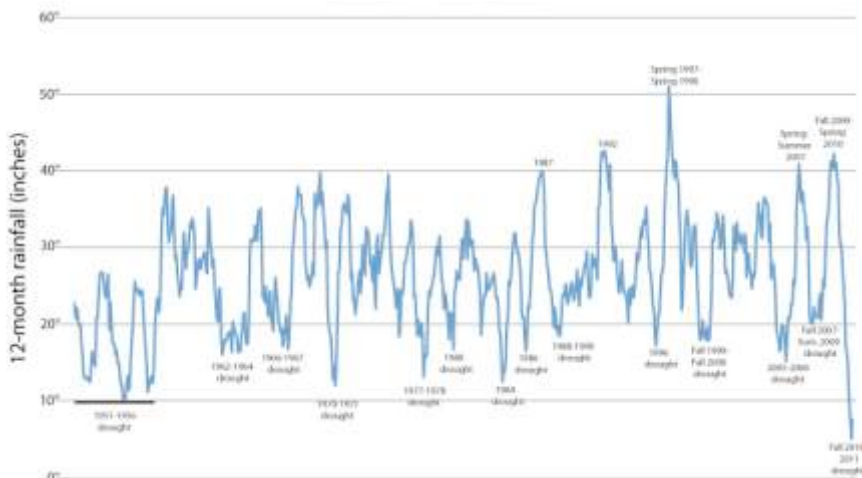


Figure 7. Rainfall 1950-2011 (D. Hillis)

Table 5. USGS Recorded Flow/Discharge for Jacob’s Well 2006-2011

| Hays County, TX Hydrologic Unit Code 12100203 USGS Gauge 08170990 – Jacob’s Well Spring | |
|---|--|
| Year (period of record average) | Discharge, cubic feet per second |
| 2006 (drought year) | 2.04 |
| 2007 (above average rainfall) | 18.0 |
| 2008 (partial drought year) | 3.7 |
| 2009 (drought year) | 0.670 |
| 2010 (above average rainfall) | 15.5 |
| 2011 (drought year) | 2.04 |
| 2012 (drought year) | 9.94 |

Economic Analyses of Cypress Creek

The following sections contain updated summaries of previous regional economic studies conducted by The Meadows Center for Water and the Environment and its partners, as well as a new analysis estimating the economic contributions of Cypress Creek to tourism related income.

Cypress Creek Project: Informal Land Value Study

The Cypress Creek Project’s Economic Subcommittee (Cypresscreekproject.org), composed of community business and landowners, assessed the potential land value changes associated with creek and watershed degradation. County appraisal data, real estate sales records, and anecdotal input from local business owners, real estate agents, and land owners within the watershed were used to develop a range of percentages of potential reductions in market values. The subcommittee estimated that prolonged reduced flow conditions could reduce market values in the portion of the watershed adjacent to the creek by as much as 25-45%. Further, long term decreases in water quality could result in a 20-30% decline in market values in creek side properties. Potential ranges for reduction in values were also reported for the “wet” portion of the watershed in general: 5-10% devaluation for prolonged reduced flow and up to 5% loss in value due to degraded water quality.

In this scenario, declines in market value driven by long term reductions in water quantity and quality could amount to nearly one half - from \$20,553,772 to \$11,304,575. Although these values have not been validated and are based primarily on informal investigation, they provide useful information regarding the potential costs of inefficient water use and prolonged drought. As with further regional economic evaluations, it is assumed that only the “wet” portion of the watershed would be deeply impacted, as property values in the “dry” portion of the watershed tend to correlate with features other than proximity to the flowing creek (described in greater detail in **Analysis of “Dry” Reach of Creek**). Figure 8 below shows the estimated range of values found by the Cypress Creek Economic Subcommittee.



Figure 8. Predicted Effects of Degradation on Cypress Creek Land Values (Cypress Creek Project)

The Meadows Center, Charles and Yoskowitz: Willingness to Pay to Protect Environmental Flow in Cypress Creek

This section was written in collaboration with, and contains information from reports authored by Dr. Joni Charles (Texas State University, McCoy College of Business Administration) and Dr. David Yoskowitz (Texas A&M University – Corpus Christie, Harte Research Institute). The submitted reports contain additional information and are included in Appendices A1 and A2.

This collaborative effort between The Meadows Center (formerly The River Systems Institute), Dr. Joni Charles and Dr. David Yoskowitz estimated the willingness of Wimberley and Cypress Creek area residents to fund or pay for conservation easements which would reduce the loss of groundwater and protect the creek. Determining value when no traditional market exists for that good or service can be exceedingly difficult. This is the challenge faced by those who wish to place a monetary value on environmental and ecological assets, such as Cypress Creek and its contribution to the community. Typically, the Contingent Valuation method (CV) is used to estimate the value of non-market goods, such as health or availability of environmental resources, using the collection of consumers’ responses to structured questions. Responses

indicate respondents' willingness-to-pay for a good or service or their perceived value of the good or service, which are *contingent* upon the configuration of the hypothetical market (Whitehead 2000).

On-site surveys of Wimberley and Cypress Creek area residents were administered in the Spring of 2010 at three survey sites: Wimberley Village Library, Wimberley Café on the Square and Juan Henry's Restaurant, all of which are frequented by local residents. Additional sites with heavier foot traffic were identified, but permission to conduct the survey on these sites was not granted. A total of 161 surveys were successfully administered and contained material asking survey respondents decide their willingness to pay for protection of the creek. If respondents answered that were willing to pay something, then the respondents were asked to decide if they were willing to pay specific amounts presented to them in order to protect freshwater inflow. (CV) method was used to transform residents' responses into average monetary values willing to be paid to maintain the health and flow of Cypress Creek. Statistical analyses were performed and are available in Appendix A.

Although results of the study were limited by sample size and technique, two important conclusions were garnered. Most notable, a significant number of individuals (91%) responded that they were willing to



Figure 9. Jacob's Well, circa 1926 (Wimberley Institute of Cultures)

donate a positive amount of money to protect environmental flows in Cypress Creek. In Dr. Charles and Dr. Yoskowitz's words, "a strong majority of those surveyed affirmed their willingness to donate some amount of money on an annual basis in order to protect groundwater that eventually impacts flow in Cypress Creek." By using contingent valuation, the study also concluded that residents are willing to pay an average of at least \$79 per person per year (possibly as high as \$94 per person per year).

These findings demonstrate that, in general, the residents of Wimberley and the Cypress Creek area consider it valuable to protect their water resources (groundwater and creek flow). The authors conclude that these results are a positive first step towards better understanding of the significance that water resources hold in the region's economy and way of life.

The Meadows Center for Water and the Environment and Mitchell Foundation: Estimation of Land Value Premiums from Proximity to Cypress Creek



Figure 10. Cypress Creek (Barry Armer, <http://barrysphotoblog.blogspot.com>)

To better understand the relationship between Texas Hill Country creeks and other natural resources and local economies, this study addressed Cypress Creek's economic benefits to the community of Wimberley through property valuation. Such information can be invaluable in the different approaches needed to improve the present and future conditions of groundwater-related systems in the Hill Country. Study goals were to determine available methods and data for valuing the contribution of Cypress Creek to the local economy.

Activities included the estimation of added economic value, in the form of property values and contingent potential tax income (should the city assess property taxes in the future) associated with Cypress Creek and the development of a methodology for applying this research to other Central Texas communities defined by their water resources. The analysis of Cypress Creek's economic impact on the community of Wimberley estimated benefits and financial value derived from the intrinsic character and proximity of the creek, and focused on the relationship of the creek and riparian areas to land values. Results include land value premiums attributed to proximity to Cypress Creek.

Methods

To establish a method for estimating economic contributions from Cypress Creek to its community in the forms of premium property values (and potential property tax revenue), literature and existing studies were first reviewed for complimentary approaches. This allowed us to identify potential methods and types of data necessary to complete modeling and calculation activities.

The basis used for approaching valuation of Cypress Creek included the economic and natural resources research conducted by John Crompton, Sarah Nicholls, and several of their colleagues. Crompton and Culpepper (2006) evaluated the economic impacts of state parks on nearby communities and depended on visitor numbers and expenditures data to estimate contributions to local income and jobs. Nicholls and Crompton (2005b) also used hedonic pricing methods to determine increased values of property rights attributed to regional parks in Bastrop County, Texas. Hedonic pricing models assume that multiple factors affect the price of a good or service and estimate the extent to which each factor affects the price. This is a common method for calculating housing prices.

Using similar methods, Crompton and Nicholls (2006) assessed tax revenues generated by homes near the Barton Creek Greenbelt in Austin, Texas. The authors calculated tax revenues that accrued from the value increments of land in proximity to the greenbelt. In 2005, the same authors performed an empirical assessment of the degree property values are impacted by the existence of nearby greenways. Their findings included statistically significant higher property values for homes that were nearby greenways and

greenbelts, compared to similar homes that were not in neighborhoods with green spaces (Nicholls and Crompton 2005 a).

Hedonic pricing methods utilized by these scholars use comparable properties in varying distances from a natural resource to estimate the economic value of that resource and the directly monetary effect on market prices. These methods are often employed to variations reflect the value of local environmental attributes on property values (King, Mazotta and Markowitz 2000). Further, Crompton (2001) states that residential property values capture at least a portion of the value of a particular amenity by being in proximity, known as the “proximate principle.”

Nicholls and Crompton (2005) found that “adjacency to a greenbelt produced significant property value premiums in two of three neighborhoods” assessed in Central Texas. The premium value, or increased price of a home or parcel of land, corresponds to a “capitalization” of the natural resource or amenity. Figure 11, below, illustrated the major categories used to calculate property values. To determine the value of environmental attributes, such as proximity to Cypress Creek, all other factors must be similar and held constant.

The regression model used to empirically estimate attribute prices may be expressed as:

$$P = \beta_1 + \beta_S X_S + \beta_N X_N + \beta_C X_C + \beta_L X_L + \beta_E X_E + \beta_T X_T + \mu \quad (1)$$

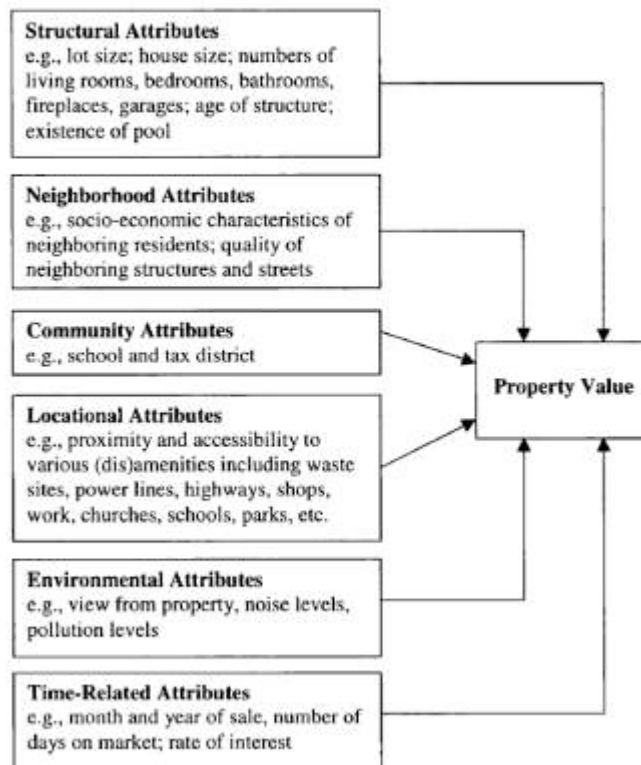


Figure 11. Diagrammatic Representation of Hedonic Property Value Model (Nicholls and Crompton 2005)

Ulibarri and Wellman (1997) reviewed several methodologies for valuing natural resources, including cost-benefit analysis of pollution abatement or resource replacement, utility models that estimate values for recreation and use of a natural resource, factor income approach that considers environmental and economic “services” of natural resources as part of their valuation, market pricing approaches for determining premium values derived from natural resources and hedonic pricing mechanisms employed by Crompton and Nicholls.

Based on the review of the above mentioned literature, models and calculation methodologies, data collection needs were identified. Also based on our extensive review and the availability of local and regional data, models and calculation methodologies were assessed for viability. Findings are reported in the section **Data Collection and Evaluation of Approaches**. Several methods were found to be well suited for estimating valuation of various features of Wimberley’s natural resources. However, data needed to execute these calculations was unavailable.

Therefore, a simple series of calculations was developed to estimate the premium that proximity to the creek afforded property values. These calculations can be used to estimate premium values added to property values for water resources in any community and are described below in **Calculating Cypress Creek’s Added Benefit to Property Values**. Two approaches were used to assess premiums added to land values with waterfront access. First, per unit (square feet and acre) values were identified and averaged for similar parcels in varying zones of distance from the creek. Agricultural and commercial land parcels, as well as very large undeveloped parcels were omitted. Second, specific subdivisions with similarly sized and characterized lots with varying distances from the waterfront were identified and land values were compared by distance or zone.

Analyses were also repeated for the “wet” and “dry” sections of the creek to further expound on the relationship between proximity to the creek and increase in land values. Interestingly, it was found that in the “dry” portions of the creek, other factors such as elevation and access to views play a larger role in determining value premiums. Summaries of this information are presented below in **Analysis of “Wet” Reach of Creek** and **Analysis of “Dry” Reach of Creek**. Results are expounded upon in the **Discussion and Implications** section). Table 6 below provides a summary of the study methodology and components which are discussed in the next sections of this report.

Table 6. Summary of Study Methodology and Activities

| Methodology | |
|--------------------|---|
| 1. | Literature review/model assessment (identification of data needs and potential methodologies). |
| 2. | Data collection and compilation. |
| 3. | Evaluation/Assessment of viability of modeling activities based on available data. Identification of data gaps. |
| 4. | Identification of possible economic modeling activities that could be performed based on available data. |
| 5. | Creation of methodology that could be replicated to assess economic value and contribution of creek to property values. |
| 6. | Efforts to link property values and proximity to creek to determine premium added to property values that could be attributed to creek. |
| 7. | Mapping of outcomes and analysis of results. |

Data Collection and Evaluation of Approaches

In order to perform hedonic pricing analyses, housing prices or land values must be available. Potential data on residential property sales or tax assessments in the region for a specific time period include:

- selling prices or tax appraisal values and locations of residential properties,
- property characteristics such as lot size and square footage,
- neighborhood and accessibility characteristics including average or median home prices, distance to town, number of lots, age and condition of streets and infrastructure, amenities and proximity to the creek, and
- environmental characteristics such as water quality in the creek, natural features and access to the creek and shore.

Much of this data was readily available for this study. Because Wimberley does not levy property taxes, and therefore does not conduct property value assessments, there were fewer sources of property valuation available. To gather data required to complete the hedonic proximal property valuation, online record reviews, phone discussions with city and county officials and visits were held with tax and property record agencies in Wimberley and Hays County. These efforts resulted in data files collected city and county records, as shown below in Table 7.

Hays CAD property data was sorted into residential components and merged with Hays County CAD shapefiles for lots. Texas Natural Resources Information System (TNRIS) shape files were added to County shapefiles to include city and county boundaries, roads, subdivisions and creeks.

Table 7. Data Collected for Hedonic Type Property Valuation

| Assessment | Data Collected | Years | Source |
|--|--|------------------------------|--|
| Identification and Valuation of Land Parcels | Hays County property values - Wimberley | 2006-2010 | Hays County CAD office |
| | City of Woodcreek property tax rolls | 2008-2012 | City of Woodcreek |
| | Land parcel location, size | 2002, 2007, 2010 | Hays County GIS data |
| | Land parcel proximity to creek and other features (including elevation land cover) | 2002, 2007, 2010; 2006, 2010 | Hays County GIS data; Texas Natural Resources Information System (TNRIS) |
| | US Census Data | 2010, 2005 – 2009 | US Census Bureau |

Table 8 presents the categories of data required for the valuation techniques (other than hedonic) reviewed by Ulibarri and Wellman. Pollution abatement and resource replacement techniques would require detailed data on degradation of Cypress Creek as well as cost estimates restore and maintain the creek before any economic analyses could be conducted (using existing property value information). The creek is not “degraded” at present but cost analyses are currently being performed as part of a preventative watershed protection plan. At present, the data required to estimate pollution abatement costs is not available. It is not likely that resource “replacement” could be evaluated, given the hydrologic nature and uses of Cypress Creek. Although the creek has great intrinsic value, it is not necessarily used as water supply source, fish nursery or other function with explicit economic value. Utility models are often used to quantify the recreational or use value of fisheries, but are not widely used for determining added value from proximity to natural resources. Cypress creek and its tributaries do not support substantial recreational fishing and little data on other recreational values is available. Potentially, known values for willingness to pay for access to water for recreation purposes could be used (such as park entrance fees or average distance traveled to water recreation areas) to determine the added value to properties close to Cypress Creek. However, this valuation technique would not account for the value of aesthetic appeal or any other environmental factor adding value to creek side properties.

Factor income valuation techniques essentially add up the values of all the known and estimated goods and services provided from a natural resource. These monetary benefits can range widely from fish production to recreational uses to pollutant removal to providing riparian habitat. This approach is commonly used to place values on entire natural resources, including rivers, streams, wetlands and forests. It requires an understanding of the goods and services provided by the resource as well as a means for quantifying them (pounds of fish, numbers of species, amount of oxygen produced, acres of habitat provided, pounds of pollutant removed, etc). This method provides valuable information for protecting and managing natural resources and it would be a very worthwhile endeavor to quantify the goods and services provided by

Cypress Creek. However, this is a very detailed process and requires many categories of data that are not currently available, including an inventory of ecosystem based good and services. Such an inventory is not impossible and could be conducted as additional research is completed. The method is limited to valuing those resources that can be used as inputs in production of marketed goods. Additionally, not all goods or services provided by Cypress Creek correlate with available marketed goods, making it difficult to accurately assign value. Such inferred values of ecosystem goods and services are often underestimated King, Mazotta and Markowitz 2000). Further, the value placed on ecosystem goods and services is not necessarily applicable to determining the role of Cypress Creek in the local economy, which was the ultimate goal of this study.

Unlike hedonic methodologies, market pricing approaches involve an in-depth analysis of market trends, including willingness to pay from “target” markets and changes in prices over time. Market pricing methods estimate value of ecosystem based products or services as part of a commercial market, requiring similar to data inputs as factor income and recreation utility approaches.

Table 8. Data Collected Requirements for Various Environmental Valuation Techniques

| Valuation Technique | Data Categories | Potential Data Sources |
|---|--|---|
| Pollution abatement or resource replacement | Historical water quality and quantity | Water quality and flow monitoring |
| | Cost of abating pollution, maintaining flow (cost of prescriptive best management practices or potential “clean up” costs) | Existing literature with pollution abatement cost information, Cypress Creek Project’s Watershed Protection Plan |
| Utility models to estimate recreation and use values | Willingness to pay for creek access or proxy for recreational use value | Willingness to pay surveys, cost of accessing similar resources (Blue Hole entrance fees, park entrance fees, average cost of travel for access to similar water recreation areas. |
| Factor income approach for valuing environmental and economic “services” of natural resources | Value of each specific good or service provided by the creek; alternate supply and demand for goods and services | Inventory of goods and services potentially provided by the creek; existing literature with monetary values for similar ecosystem goods and services (|
| Market pricing approaches for premium values derived from natural resources | Proxies or valuations from other studies to determine “cost” of environmental services or amenities. | Existing economic literature denoting costs and pricing of specific natural resource types, willingness to pay surveys or valuations from recreation and use utility models or factor income methods. |
| | Market data on cost, pricing, supply levels and demand for services or amenity | Federal consumer pricing data |

Calculating Cypress Creek's Added Benefit to Property Values

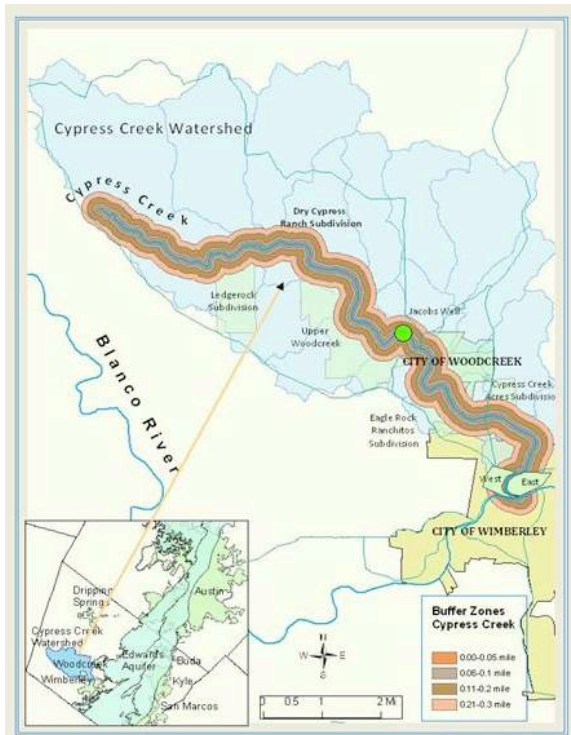


Figure 12. Concentric Zones and Selected Subdivisions for Analysis of Property Values in Cypress Creek.

2010 shape files were used to create maps of the Cypress Creek Watershed and concentric zones were identified in increasing distances from the center of the creek, as shown in Figure 12. Zone 1 included riparian areas directly adjacent to the creek (0.0 miles) to 0.05 miles from the center of the creek, Zone 2 was limited to 0.06 to 0.10 miles from the center of the creek, Zone 3 encompassed the areas between .11-.20 miles from the center of the creek, and .21-.30 miles from creek was designated as Zone 4. A slight gap was left between each zone to prevent potential overlap of lots between multiple zones. Any lot that fell into more than one zone was only counted in the zone closest to the creek.

The creek was further divided into two sections to represent the “wet” creek and “dry” creek. The dry portion of the creek is located west of Jacobs Well and is not fed by groundwater, typically only flowing after rain events. The wet creek begins east of Jacobs Well and is fed by spring flows. It was assumed that property values would be higher in the wet portion of the creek (as it flows year

round). Figure 13 illustrates the division of the two portions of the creek.

Properties within each zone were grouped by size and lot characteristics (similar land cover and slope). Land values were reported per unit (dollar per square feet and acre) and did not include housing values as age, size, building materials and other housing characteristics could complicate the valuation process. Statistical measures of central tendency were calculated (mean, median, minimum, and maximum values) for similar parcels in each of the zones. Agricultural and commercial land parcels, as well as very large undeveloped parcels were omitted to minimize skewing of property. Properties with very high and very low values were effectively omitted by using median values. Figure 14 illustrates all parcels used in the analysis (2010 data). Maps utilizing 2006-2009 data can be found in Appendix B.



Figure 13. Concentric Zones and Wet/Dry Creek Delineation for Analysis of Property Values in Cypress Creek.

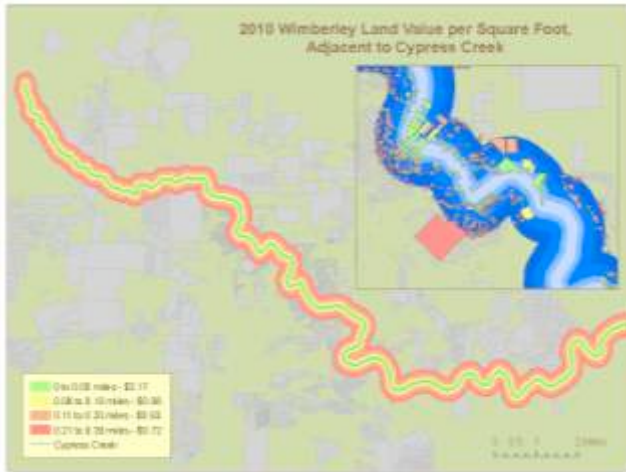


Figure 14. Location and Median Square Foot Value of Land Parcels by Zone of Distance Used for Analysis of Property Values in Cypress Creek.

Figure 15 shows the calculated median values for each of the four Zones in both the Wet and Dry portions of the creek. Specific subdivisions with similarly sized and characterized lots with varying distances from the waterfront were also identified using 2010 property value data and land values were compared by distance or zone using the same methods described above. It was assumed that variation in lot characteristics would be minimal within the same subdivision and housing units were more likely to be comparable. Four subdivisions in both the wet and dry creek sections were identified, with each subdivision or location having four randomly selected homes in each of the four zones. All selected properties selected were similar in size (no more than 25% difference in total lot area) and lot

characteristics and were used to ground truth the median lot values calculated. The values of improvements or houses on the properties were included in the valuation assessments. Maps of these subdivisions and selected properties are available in Appendix C and Figure 12 above outlines the locations of the subdivisions within the watershed.

The following sections, **Analysis of “Wet” Reach of Creek, Analysis of “Dry” Reach of Creek and Discussion and Implications** contain more detailed maps and analyses of the results.

Analysis of “Wet” Reach of Creek

Both mean and median per square foot lot prices increase in value the closer in proximity the properties are to Cypress Creek (Table 9a). Median land values of \$0.85 were found in Zone 4 (.21-.30 miles from the creek) for the 214 properties assessed. The percent change in price per square foot between Zone 4 and Zone 3 is 68%. The median value of 210 properties in Zone 3 increased by \$0.40 to \$1.25 per square foot (.11-.20 miles from the creek). Values in Zone 3 were 32% higher than Zone 2 land prices. An additional \$0.20 per square foot premium was seen for 123 properties assessed in Zone 2 (.06-.10 miles from the creek). Per square foot prices increased 58% between Zones 2 and 1. 187 properties were assessed in Zone 1 (0-.05 miles from the creek) with a median value of \$3.47 per square foot.

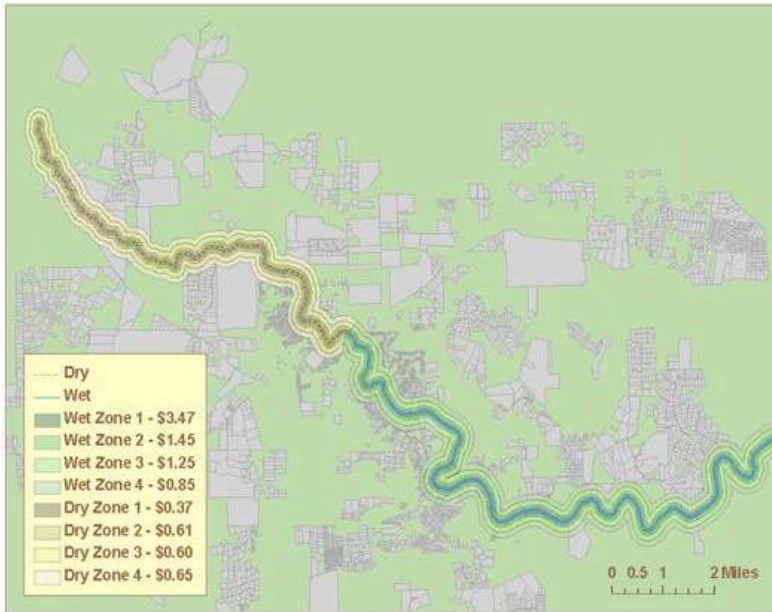


Figure 15. Median Square Foot Pricing by Zone (Distance from Cypress Creek)

Minimum values may have been skewed by rounding of very small values and because lot sizes tend to increase slightly as proximity to riparian areas and the creek decrease. The maximum per square foot price of \$1748 in Zone 1 is significantly higher than other lots in the same Zone (mean value of \$13.04). This deviation can be explained by the very small size and creek access of one property. However, despite the extreme maximum value in Zone 1, the maximum values for properties in each of the concentric zones follow the pattern of higher values as proximity to the creek increases. These values clearly indicate that, holding all other land parcel characteristics constant, proximity to the wet portion of Cypress Creek adds a price premium to lot values. These premiums increase land values in the Wimberley area and are important to the City if property taxes are adopted in the future. Where property taxes are collected in Woodcreek, it can be assumed that some portion of the tax revenues generated is attributed to these land premiums. This tax potential is reported below in **Discussion and Implications**.

Table 9a. Results for Square Foot Land Values in Wet Creek Zones 1-4

| Wet Creek Reach Zones | # Properties Assessed in Zone | Mean (\$/ft ²) | Median (\$/ft ²) | Percentage Change from Zone Above | Minimum/Maximum |
|-----------------------|-------------------------------|----------------------------|------------------------------|-----------------------------------|------------------|
| Zone 1 | 187 | \$13.04 | \$3.47 | - | \$0.07/\$1748.47 |
| Zone 2 | 123 | \$3.66 | \$1.45 | 58% | \$0.05/\$26.95 |
| Zone 3 | 210 | \$1.62 | \$1.25 | 14% | \$0.01/\$9.94 |
| Zone 4 | 214 | \$1.16 | \$0.85 | 32% | \$0.11/\$7.59 |

This analysis was repeated for randomly selected properties in four subdivisions in the wet portion of the creek in Wimberley and Woodcreek. The subdivisions contained similar properties in all four zones, with four properties in each of the four zones. All properties selected had no more than 25% difference in total lot area. Mean values were calculated for each zone (average of the four properties in each of the four subdivisions, totaling sixteen lots). The results of this analysis included home and lot improvement values, as it was assumed that neighboring lots in a subdivision would have similarly constructed and valued homes, although the houses constructed in Zone 1 may have more square footage, more flood prevention features and other characteristics that could increase total value. Table 10b shows that the results of the subdivision scale analysis is very similar to the watershed scale results. The ranking of zones by value follows the same pattern with properties increasing in value as proximity to the creek increases. The mean value of properties in Zone 4 is more than four times less than the average property value in Zone 1.

Table 9b. Results for Square Foot Land Values in Selected Lots and Subdivisions in Wet Creek Zones 1-4

| Wet Creek Reach Zones | # Properties Assessed in Zone | Mean (\$/acre) * including improvements | Mean (\$/ ft ²) * including improvements |
|-----------------------|-------------------------------|---|--|
| Zone 1 | 16 | \$841,104 | \$19.43 |
| Zone 2 | 16 | \$377,139 | \$6.59 |
| Zone 3 | 16 | \$201,291 | \$4.57 |
| Zone 4 | 16 | \$180,718 | \$4.15 |

Analysis of “Dry” Reach of Creek

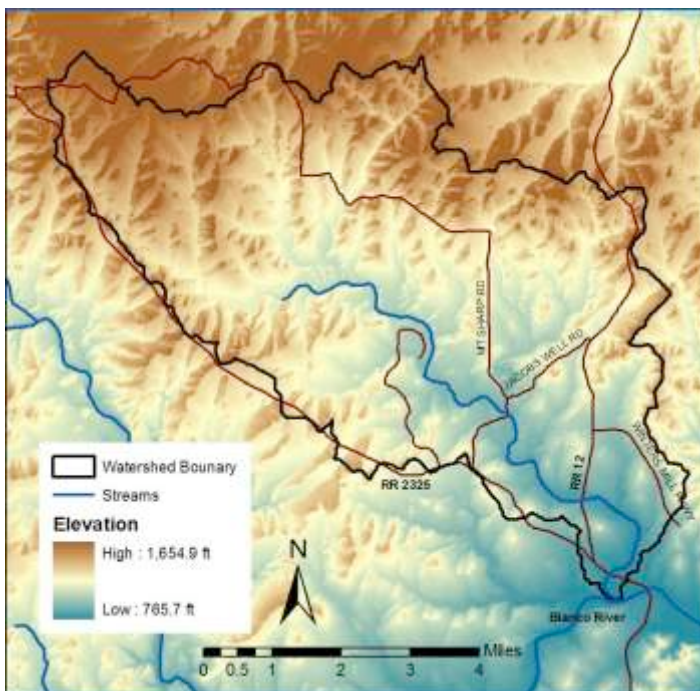


Figure 16. Elevation in the Cypress Creek Watershed

A point to consider before analyzing results is that the dry portion of the watershed is not as extensively developed as the wet portion and has historically been more rural, with larger tracts of land. Smaller lots in developed areas tend to have a higher per square foot prices than larger more rural parcels. As development in this area increases, mean and median land values, as well as lot size may change. Current developments in the dry portion of Cypress Creek may not be in the most desirable locations. Properties with the best views and terrain may still be privately held as large tracts of land.

Before conducting any analysis it is clear that mean, median and maximum values for lots in all Zones in the dry reach of the creek are valued lower than their counterparts in the wet reach of the creek. This is not unexpected, as the wet portion of the creek flows year round with clean, clear water while the dry portion of the creek typically only flows after rainfall events and carries sediment rich overland flow, or muddy, debris filled water.

Additionally, the topography is very different in the two portions of the watershed (see Figure 16). The Southeastern, wet portion is characterized by lower levels of elevation and areas near the creek are relatively flat or have gently rolling terrain. In the dry portion of the watershed to the Northwest, the landscape is dominated by areas of high elevation and rougher, steeper terrain. In the dry portion of the watershed the closer the proximity to the creek, the lower the elevation is likely to be. Properties with vistas or views are often found set back from the creek. Along most of the dry reach of the creek, the most desirable lots are likely to be found in Zones 2, 3 and 4 (.6-.1, .11-.2 and .21-.3 miles from the center of the creek).

It is also interesting to note that 188 properties in Zone 4 met the criteria for assessment, while 159 met the criteria in Zone 3, and only 99 and 82 properties were able to be assessed in Zones 2 and 1, respectively (see Table 10a). This may indicate that fewer properties are developed in closer proximities to the dry reach of the creek.

Unlike the wet portion of the creek, mean and median per square foot lot prices are highest in Zone 4, farthest from the creek. Median land values of \$0.65 per square foot were found in Zone 4 (.21-.30 miles from the creek). Also, unlike the wet reach of the creek, the difference in values between the zones is very small and not significant. The median value of properties in Zone 3 decreased by \$0.05 to \$0.60 per square foot (.11-.20 miles from the creek). Median per square foot values for lots in Zone 2 (.06-.10 miles from the creek) are \$0.01 greater than those in Zone 3 but have the same mean value as lots in Zone 4. Median values in Zone 1 (0-.05 miles from the creek) were the lowest, at \$0.37 per square foot.

Minimum values for all zones are very similar and not significant, shown in Table 10a; however the maximum values do not follow any expected patterns. The maximum per square foot prices in Zones 1, 3 are not significantly different. The maximum per square foot values in Zone 2 are more than twice the maximum values in Zone 4 and at least 74% greater than maximum prices in Zones 1 and 3. This particular property is in the Upper Woodcreek subdivision and is the same size as several other nearby lots. There is some discrepancy between the City of Woodcreek and Hays County records as to whether this lot may actually be 3 combined lots. If the parcel is, in fact, three times larger than the recorded acreage, then the recorded per square foot value would be drastically overestimated. This inconsistency would explain the departure in value. The next highest value in Zone 2 is \$1.36 per square foot, which is in line with the maximum values for the other zones.

Mean values for all Zones 2-4 in the dry portion of Cypress Creek are nearly identical with a total variation of only \$0.03. As expected, based on elevation and topography of properties in Zone 1, its mean value is 25-29% lower than mean property values in other Zones.

The numbers of properties meeting criteria for assessment, as well as mean and median values, indicate that in the dry portion of the creek, Zones 2-4 have higher land values than properties in Zone 1. Because there is so much land characteristic variation in the dry portion of the creek, it is difficult to say that proximity to the creek has any effect on property values. Instead, it appears that elevation and topography play a much greater role in price premiums, holding land parcel characteristics such as size and location constant. In this case, safety from flooding, suitable topography and views afforded by elevation are the determinants of desirable properties and price premiums.

Table 10a. Results for Square Foot Land Values in Dry Creek Zones 1-4

| Dry Creek Reach Zones | # Properties Assessed in Zone | Mean (\$/ft ²) | Median (\$/ft ²) | Minimum/Maximum |
|-----------------------|-------------------------------|----------------------------|------------------------------|------------------------|
| Zone 1 | 82 | \$0.47 | \$0.37 | \$0.04/\$1.62 |
| Zone 2 | 99 | \$0.63 | \$0.61 | \$0.10/\$2.57 (\$1.36) |
| Zone 3 | 159 | \$0.66 | \$0.60 | \$0.08/\$1.91 |
| Zone 4 | 188 | \$0.63 | \$0.65 | \$0.07/\$1.22 |

To validate this analysis, it was repeated for randomly selected properties in four subdivisions. The subdivisions identified contained four properties in each of the four zones and all properties available for selection had no more than 25% difference in total lot area. Mean values were calculated for each zone (average of the four properties in each of the four subdivisions, totaling 16 lots). The results of this analysis included home and lot improvement values, as it was assumed that neighboring lots in a subdivision would have similarly constructed and valued homes. As shown in Table 10b. The ranking of zones by value is exactly the same as the watershed level analysis: Zone 4 had the highest value, followed by Zone 2, then Zones 3 and 1, although none of the differences between zones is statistically significant.

Table 10b. Results for Square Foot Land Values in Selected Lots and Subdivisions in Dry Creek Zones 1-4

| Dry Creek Reach Zones | # Properties Assessed in Zone | Mean (\$/acre) * including improvements | Mean (\$/ft ²) * including improvements |
|-----------------------|-------------------------------|--|--|
| Zone 1 | 16 | \$85,836 | \$1.99 |
| Zone 2 | 16 | \$106,619 | \$2.47 |
| Zone 3 | 16 | \$93,603 | \$2.14 |
| Zone 4 | 16 | \$101,966 | \$2.62 |

Results, Discussion and Implications

Valuation of land premiums attributed to lots in proximity to Cypress Creek was intended to provide some measure of potential economic contributions of the creek to the local community. Possible contributions

include higher than average property values and income from property taxes that may be assessed in the future.

Figure 15 above presents the median per square foot land values in each concentric zone of the Wet and Dry sections of the creek. Figure 17 is an enlarged insert of this map, correlating with the values presented below in Table 11. As expected, in the wet portion of the creek, proximity to the creek significantly increases the per square foot value of land in four concentric zones around the creek.

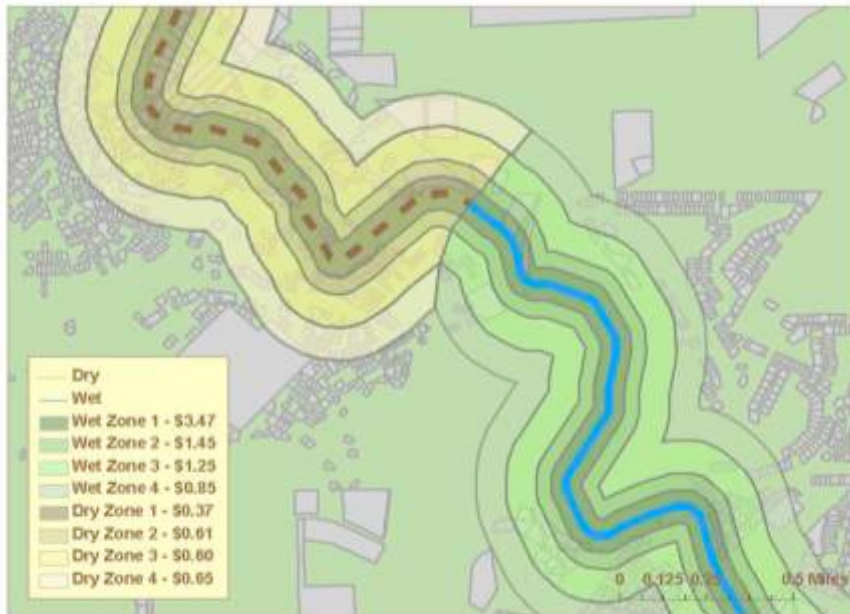


Figure 17. Enlarged View of Median Square Foot Pricing by Zone (Distance from Cypress Creek)

Table 11. 2010 Calculated Median Land Values by Zone of Distance from the Wet and Dry Reaches of Cypress Creek

| Zone (miles) | Dry Cypress Creek Median land values (Avg \$/AF, 2010) | Wet Cypress Creek Median land values (Avg \$/AF, 2010) |
|----------------|--|--|
| 1 (0 – 0.05) | \$0.37 | \$3.47 |
| 2 (0.06 – 0.1) | \$0.61 | \$1.45 |
| 3 (0.11 – 0.2) | \$0.60 | \$1.25 |
| 4 (0.21 – 0.3) | \$0.65 | \$0.85 |

However, due to different levels of elevation and topographical features, the dry portion of Cypress Creek does not follow the same valuation pattern. Instead, it appears that while less significant, there is a land

value premium for properties with appropriate topography for building and high enough elevation for panoramic views, which are most likely to be located in Zones 2, 3 and 4. Conversely, property in direct proximity to the dry portion of the creek is not attributed with any price premium. There are several other factors that may also have influenced this assessment. The dry portion of the creek is not as picturesque as the wet reach of the creek and only flows after rain storms.

Because there is less development in the dry portion of the basin, there were fewer parcels of land available to compare and assess. Further, parcels of land in this more rural portion of the Cypress Creek Watershed tend to be larger and valued differently. Larger parcels are often valued at agricultural rates, instead of residential prices which tend to have higher square footage values. Even if appraised at residential value, larger parcels of land tend to have a lower per square foot value than smaller “in town” lots. Many parcels in proximity to the dry reach of the creek are characterized by flood plain, rough terrain and varying elevation. A more in depth analysis of factors affecting property values in the dry reach of the creek is warranted, but is not likely to divulge major economic contributions to the local economy. For this reason, remaining discussions focus on the wet or spring fed reach of the Cypress Creek.

Crompton (2001b) reports that the monetary value of a natural resource or amenity provided by that resource, is at least “partially captured” by the prices of residential properties near the resource, also known as the proximate principle. It can be assumed that the premium, or increased price attributed to properties proximate to natural resources, such as a greenbelt or creek correspond to a “capitalization” of the resource value. Increased property tax revenues typically result from a rise in per unit value of proximate properties, and Crompton asserts that the calculated sum of additional taxes levied from premium proximate property values can be more than sufficient to maintain the resource. Nicholls and Crompton (2005) found that the “enhancements” to the tax base from properties near the greenbelt in Austin constituted a “net gain” to the city, even after management costs associated with the greenbelt. This is important to consider, as the collection of property taxes in Wimberley, especially on properties with premium values derived from proximity to Cypress Creek in would provide funds to manage and protect the creek as well as increase the City’s revenues.

Although not all properties in Wimberley are located on or near Cypress Creek, those in proximity to the creek increase the collective property values in the area. From the data collected and analyzed in this study, it is concluded that a land value premium of at least \$2.62 per square foot can be attributed to properties in the riparian area and very close proximity to the creek (0-0.05 miles from the center of the creek). This value was derived from the subtraction of the Zone 4 median value from the Zone 1 median value. This premium amounts to approximately \$28,531.80 per quarter acre lot. For property in Zone 2 (0.06-0.1 miles from the center of the creek), a premium of \$0.60 per square foot can be attributed to land values, equating to \$6,534 per quarter acre lot. Land 0.11-0.2 miles from the creek, in Zone 3, still



Figure 18. Cypress Creek, Wimberley, TX (<http://www.mccrocklin.com>)

receives a value premium, although smaller, \$0.40 per square foot or \$4,356 per quarter acre lot.

Correll et al (1978) examined property values in varying distances from greenbelts (up to 3,200 ft or 0.59 miles) in Boulder, CO and found that property values were reduced by an average of \$4.20 for each foot removed from the greenbelt. On average, mean prices for properties adjacent to greenbelts in Boulder were 32% higher than comparable properties 0.59 miles from the greenbelts and 9% higher than properties 0.2 miles away. Our results found that each 0.05-0.10 mile (264-528 ft) increase in distance from the creek reduced the median per square foot property value by approximately 50%, conversely translating to creek side properties priced 36% higher than properties 0.2 miles away. Because this study included different parameters for assessing properties (inclusion of home values, different lot size criteria, etc), is reported in 1978 dollars and was performed in an area where property values are higher than in Wimberley, it is not appropriate to make direct comparisons by dollar values, except to say that the trend of property values rising as proximity to a natural amenity increases holds true in both cases.

Nicholls and Crompton (2005) used a comparable hedonic pricing method and presented similar results in their assessment of property values premiums attributed to proximity to a greenbelt in Central Texas. They concluded that “adjacency to the greenbelt produced significant property value premiums in two of three neighborhoods.” Similarly, the authors found that properties not in direct proximity, but with a “view” of the greenbelt, were not valued significantly higher than those in proximity and were subject different valuation characteristics, such as “dramatic topography and dense vegetation.”

Nicholls and Crompton also analyzed the impacts of these price premiums on property sales prices and property tax rates. Their findings demonstrate that in Austin, TX proximity to the greenbelt significantly increased sales prices and revenues generated from property taxes. Although their study areas and natural resource were different, Nicholls and Crompton’s findings support the conclusion that direct proximity to the wet reach of Cypress Creek increases the value of property, while land with views of the dry portion of the creek may provide a slight price premium.

The city of Woodcreek collected \$189,764 and at least some of this revenue can be tied directly to creek side land premiums. There were only twelve properties located in Woodcreek that fell within the boundaries of Zone 1 (0-0.05 miles from the creek). Their average assessed value (land and improvements or homes) in 2010 was \$1,995,200. The median real estate property taxes paid for housing units with mortgages in 2011 was \$3,589, at an average rate of 1.7%. \$2,874 was the median property tax paid for homes with no mortgages at an average rate of 1.5%. To protect the privacy of landowners, we did not identify which of the twelve properties in Zone 1 carry a mortgage. If it is assumed that approximately half of the properties carry a mortgage, that would make an effective tax rate of 1.6% (the average of 1.5 and 1.7%). At a 1.6% rate, the twelve properties valued at \$1,995,200 contributed approximately \$31,923 in 2011 in property taxes. Further, if there is a premium of \$2.62 per square foot for properties in Zone 1, with a median property size of 1.07 acres (12.84 total acres, equivalent to 559,310.4 square feet), then as much as \$1,465,393 of the nearly \$2 million total assessed value of the 12 properties is “capitalized” value from proximity to Cypress Creek. Thus, \$24,911 of the total taxes levied in 2011 (\$31,923) were attributable to Cypress Creek.

Wimberley does not currently collect property taxes, but if levied in the future, properties in proximity to the wet portion of the creek could provide substantial revenues. Without knowing the potential tax rates that could be adopted in Wimberley, it is difficult to assign a dollar amount to tax revenues that could be generated from premium property values. However, using only the properties assessed in this study and Woodcreek's average property tax rate of 1.6%, potential annual property tax revenues can be estimated. 175 properties in Wimberley were located in Zone 1 (0-0.05 miles from the creek), with a 2010 total assessed value of \$60,461,173. \$967,379 in property taxes could have been levied from these properties. Assuming a premium of \$2.62 per square foot for properties in Zone 1, with a median property size of 1.07 acres (187.25 total acres, equivalent to 8,156,610 square feet), then the portion of potential tax revenues attributed to value premiums related to the creek could be as much as \$21,370,318 of the total assessed value. \$341,925 of the potential tax revenue, \$967,379, could be tied directly to Cypress Creek. Additional revenues would certainly be generated from properties in Zones 2 and 3 as well.

In summary, home and land prices in the wet portion of the creek have price premiums associated with proximity to the creek. These enhanced values provide increased opportunities for property tax revenues, some of which could be used to help protect the creek and riparian areas. Although not many similar studies exist, analyses determining property value premiums associated with proximity to natural resource amenities in Central Texas and Colorado have comparable findings – the closer properties are to natural resources like creeks, the higher the average price and potential property tax income.

Estimation of Cypress Creek's Contribution to Tourism Revenues

Based on reviewed studies and assessment of the region's need for comprehensive economic information to assist in decision-making and management related to water resources, it was determined that an important activity would be to estimate the value of Cypress creek's contribution to the economy in the form of tourism and the related hospitality sector's revenue, taxes generated and community services (chiefly, employment), or to determine the value of Cypress Creek's "natural capital."

This portion of the study explored additional methods for valuing the creek's contribution to the local economy in the form of tourism and the related hospitality sector's revenue, taxes and community services. Tourism in Wimberley and surrounding areas is primarily driven by the local water resources, including Cypress Creek, Jacob's Well and Blue Hole. These natural features draw visitors to Wimberley, whose expenditures ultimately impact the local economy, including revenues and employment. Additionally, a portion of money spent by tourists supports local businesses that are not directly related to tourism. Some percentage of each dollar spent by tourists is re-spent in the local economy, known as "the multiplier effect." Studies show that residents experience an improved quality of life resulting from the presence of tourist related businesses in their communities. A 2009 study in New Braunfels reports "as a result of visitor spending, residents enjoy a vibrant community composed of a wide variety of restaurants and entertainment establishments right in their backyard" (Impact Data Source 2009).

Although the creek is not heavily used for tubing or paddling, it winds through downtown Wimberley, creating a setting for shopping and dining, and Jacob's Well and Blue Hole draw thousands of visitors each

year. No comprehensive counts of visitors are recorded, but collected and compiled data suggests that at least 250,000 tourists visited Wimberley in 2010.

Major Industry Categories (defined by the North American Industry Classification System - NAICS) in the Wimberley area include included Retail, Accommodation and Food Services, and Arts, Entertainment and Recreation, all heavily dependent on tourism. The section above on page 6, **Background Information** provides statistics on tourism, sales tax revenues, hotel revenues and tourism related employment in Wimberley.

Data Collection and Evaluation of Tourism Valuation Approaches

Data expected to be collected included number of tourists visiting the area, tourist activities, average expenditures, length of stay, and similar information. Additional desired data consisted of local business inventories, including commercial use of property near waterfront areas, employee and salary expenditures, sales revenues, and tax contributions. These types of data are consistent with common methods and models for valuing other types of natural resources.

Because much of this data was not available, actual data collection and compilation included information from sources such as the local chamber of commerce, state, county, and city financial and demographic information, tax records, and relevant stakeholder knowledge. To estimate the effects of tourism related to the creek, data were collected on the number of visitors to specific attractions in the Wimberley area, including Blue Hole, Wimberley Market Days, Emily Ann Theater, and Chamber of Commerce logs. Several years' worth of employee salary expenditures, sales revenues, and tax contributions also were collected. Data sources and types are shown in Table 12 and a more comprehensive list is provided in Appendix D. Several potential methods for determining the relationship between natural resources and tourism revenues were assessed, including data collection needs.

Table 12. Data Collected for Tourism Analyses

| Data Assessment | Data Records | Years | Source |
|---|--|-------------------|---|
| Wimberley, Woodcreek population and employment statistics | Number of local residents, resident income, resident employment categories, commute time | 2008-2011 | US Census Bureau US Bureau of Labor Statistics |
| Sales Tax Revenue | Audited City Financials | 2001-2010 | Cities of Wimberley and Woodcreek |
| | Revenue by NAICS category | 2005-2010 | US Bureau of Labor Statistics |
| Tourist and visitor counts/estimates | Blue Hole visitor counts | 2008 - 2011 | Interview with City of Wimberley staff |
| | Theatre activities, events and attendees | 2008 – 2011 | Emily Ann Theatre |
| | Attendance at Market Days | 2010 | Annette Harrington, Annual Leasing Staff, Lion Club |
| | Hotel receipts, revenues | 2010-2012 | Texas Comptroller |
| | General visitor estimates | 2004-2011 | Chamber of Commerce |
| Demographics, Business Data and Employment Income | Business Economic Census | 1997, 2002, 2007 | US Census Bureau |
| | Employment Income Economic Census | 1997, 2002, 2007 | US Census Bureau |
| | US Census Data | 2005 – 2009, 2012 | US Census Bureau |

Common methods used to determine economic impacts of tourism were compiled and an assessment of appropriate approaches for valuation of the financial contribution of a natural resource to a small community was performed. The basis for approaching this valuation initially included the economic and natural resources research in Texas through the Houston Advanced Research Center’s Valuing Nature in Texas Program (Mathis et al. 2003).

Mathis et al. (2003) extensively reviewed methodologies used to determine non-market values of natural resources. Their review focused on several categories or types of valuation, including estimating the economic contribution of services provided by natural resources, known as ecosystem services. These types of valuations are described in more detail above in **Data Collection and Evaluation of Approaches** (pg 22) and unfortunately are not relevant for determining potential relationships between tourism revenues and natural resources associated with Cypress Creek. Contingent valuation methods, also reviewed by Mathis and colleagues, were found to be effective in determining the public’s “willingness to pay” for access to natural resources for recreation value. Contingent valuation was used to determine the amount Wimberley area residents were willing to pay to help preserve Cypress Creek. This study is summarized above in **The Meadows Center, Charles and Yoskowitz: Willingness to Pay to Protect Environmental Flow in Cypress**

Creek (pg 17). However, in order to determine the perceived value of Cypress Creek to visiting tourists, intensive surveys would have to be administered to those vacationing in Wimberley, an unrealistic activity at this point in time.

According to Mathis et al (2003), the simplest Travel Cost method is to measure the cost of travel to a location and use it as a proxy for the value of the tourism destination. This approach requires intensive surveys and data collection, which was not feasible for this study. If undertaken in the future, it is important to include questions about distance traveled, duration of stay, perception of environmental quality, money spent during the trip, and demographic information. An alternative method includes collecting regional travel cost data and known economic values for similar nearby tourism spots driven by water resources. The known economic revenues generated from alternative tourist destinations can be used as a proxy or substitute to value Cypress Creek and Wimberley. Additionally, the difference in travel costs for regional tourists to visit alternative locations can be compared. The city of New Braunfels, City of Boerne and Hamilton Pool in Dripping Springs, TX are potential alternate locations. However, the necessary economic data for Dripping Springs and Boerne were not readily available or able to be compared. Further, no data regarding regional travel time to tourist destinations or revenues resulting from regional travel could be obtained. As more data becomes available, a methodology for contingent and travel cost valuation surveys and analyses could be tailored from the studies listed below in Table 13, although none of the methodologies reviewed provide the exact information required to accurately estimate the economic contribution of Cypress Creek to the local economy. These techniques could be used to capture perceived tourist values of having access to Cypress Creek, as well as a cost estimate or willingness to travel to Cypress Creek compared with other nearby attractions.

Table 13. Contingent and Travel Cost Valuation Methodologies Reviewed for Assessing Recreation and Tourism Values

| Authors | Study | Summary, Notes |
|-----------------------------------|---|---|
| Walsh, Aukerman and Milton (1980) | Measuring the Benefits and Economic Value of Water in High Country Reservoirs. Colorado Water Resources Institute. B-175, Colorado State University, Ft. Collins, CO. | 200 people were interviewed at 14 locations to determine the benefits from expanding recreation opportunities. Marginal benefits per unit of water were determined, resulting in an assigned value at different levels of "draw down" or categories of access. * This study focused efforts on access to water resources and loss of perceived benefit from crowding but does provide a method for calculating user's perceived value of the resources. |
| Walsh, Sanders and McKean (1990) | The Consumptive Value of Travel Time on Recreation Trips. Journal of Travel Leisure 29(1) p 17-24. | This study outlines a statistical procedure to estimate demand for the recreation activity of pleasure driving or sightseeing by car on scenic river highways in the Rocky Mountains. |
| Sanders, Walsh and McKean (1991) | Comparable Estimates of the Recreational Value of Rivers. Water Resources Research 27(7) p 1387-1394. | Contingent valuation study and travel cost study to measure the recreation values of rivers in the Colorado Rocky Mountains. * This study provides methodologies for calculating and validating travel costs and willingness to pay to access a river for recreation. |
| | | |

Mathis et al also reviewed Hedonic pricing mechanisms, which were used in the property valuation activity, and are described in detail in **Collection and Evaluation of Approaches** (pg 22). A common hedonic methodology is known as “hedonic wage theory/analysis” but because a majority of Wimberley residents’ employment income is not related to tourism, this approach would not be beneficial.

Studies on community impacts of state parks and green spaces have shown the relationship between tourism and local economies (Crompton & Culpepper 2006; Crompton et al 2001; Crompton & Lee 2000). Methodologies used in these efforts were reviewed for applicability to Cypress Creek. Crompton and Culpepper (2006) evaluated the economic impact of 79 Texas parks on their communities. Data was collected from surveys, similar to the contingent valuation approaches described above. Total park attendance was also collected from Texas Parks and Wildlife, as well as standard demographic data for the communities studied. The contribution of tourism generated by the parks was used to estimate direct expenditures by visitors, total sales generated by the parks and related businesses, employment and personal income was assessed using modeling software which creates separate models of the economic structure of each county in Texas, known as IMPLAN. This approach could be applied to Wimberley if accurate visitor counts could be obtained and the model could be restructured to include only information for the Wimberley area, instead of the county level. IMPLAN software uses specifically developed county level data sets and can be purchased for \$350, along with a minimum charge of \$1400 to assist with the restructuring of the inputs to exclude the rest of the county.

Crompton et al. (2001) created a guide for estimating the economic impact of events that draw tourists to a particular area, using Springfest in Ocean City, Maryland as an example and also utilized surveys and IMPLAN. The authors specifically mentioned that it was difficult, yet very important to obtain attendance data. This is a critical issue and lack of visitor counts limited the types of analyses that could be used in Wimberley. Crompton and colleagues used employment statistics instead of sales revenues. Unlike Wimberley, Ocean City is nearly completely dependent on tourism for revenues and employment. Most of Wimberley’s residents are employed in industries outside of Wimberley, not associated with tourism, so the approaches discussed in this paper are not applicable to Wimberley and Cypress Creek, except for the case of special events like Market Days. An interesting principle discussed in Crompton et al.’s work, however is the exclusion of revenues from local residents. This is an important concept to consider.

Crompton and Lee (2000) reviewed thirty economic impact studies in seven US cities, including sports tournaments, festivals and spectator events. Of specific interest, authors estimated economic contributions to communities of arts festivals, golf tournaments, a river festival and a fourth of July celebration, all of which occur in the Wimberley area. The methodology employed is very similar to other studies performed by Crompton and his colleagues, utilizing surveys and IMPLAN modeling, as well as employment data in lieu of sales revenues. It is important to note, however, that their data collection and general approach are of value and could be tailored to determine potential economic impacts of specific events held in Wimberley. This would require altering the analysis methodology to use sales revenue data and utilizing surveys that capture visitors’ average expenditures by category (retail, art, food, services, etc).

Although developed for valuing coastal tourism and recreation impacts upon communities, research conducted by World Resources Institute (2009) developed a helpful tool that could be modified in order to estimate tourism and recreation impacts associated with Cypress Creek and its features, including Jacob's Well and Blue Hole. The World Resources Institute specifically assessed economic contributions associated with coral reefs in the Caribbean, focused on tourism and recreation values. Their methodology included an "economic impact analysis" to quantify tourism related revenues, wages, taxes and other spending. Direct economic impact was calculated by summing gross revenues for each tourist attraction or activity. Financial analysis estimated the "economic activity generated by use of an ecosystem good or service" by calculating revenues and income less operating costs.

The excel based tool developed by The World Resources Institute has inputs for population data, land and geographic data, economic data (GDP, etc), as well as data for hotel and accommodations, specific recreation use, number of visitors and revenues generated from individual attractions or sectors. All of these inputs could be revised to represent Wimberley's circumstances. The tool also uses coral reef and coastal features data in its calculations. These equations would require more in-depth review and modification to accurately account for Cypress Creek and other natural water features.

The IMPLAN and Coral Reef Valuation Tool are well developed resources for assessing economic contributions of natural resource based tourism. It must be noted, however that all studies using the IMPLAN require the collection of intensive surveys, and in order to capture the total contribution associated with Cypress Creek and its features, multiple analyses would need to be performed. Likewise, the Coral Reef Valuation Tool requires restructuring of some of its built in calculations. Each of the approaches described above has benefits and limitations, outlined in Table 14 below. Unlike the methods outlined in Table 13, most of the data required to utilize the approaches in Table 14 is available.

Table 14. Models and Tools Reviewed for Assessing Economic Contribution of Natural Resource Based Tourism

| Authors | Model/ Tool | Data Needs | Summary of Methodology, Notes | Revision Required * All methods require proxy for visitor counts |
|----------------------------------|----------------------------------|---|--|---|
| Crompton & Culpepper (2006) | IMPLAN | <ul style="list-style-type: none"> Data from intensive surveys Total visitor counts Standard demographic data Data supplied by IMPLAN | Assessed county-wide economic impact of 79 Texas parks | IMPLAN assesses at county level; would require technical support to include only Wimberley area or expand analysis to county level |
| Crompton et al (2001) | IMPLAN | <ul style="list-style-type: none"> Data from intensive surveys Total visitor counts Standard demographic data Data supplied by IMPLAN | Assessed county-wide economic impact of a festival, focused on community effects; Beneficial only for events such as Market Days, but not total contributions from CC | IMPLAN assesses at county level; would require technical support to include only Wimberley area or expand analysis to county level |
| Crompton & Lee (2000) | IMPLAN | <ul style="list-style-type: none"> Data from intensive surveys Total visitor counts Standard demographic data Data supplied by IMPLAN | Reviewed 30 economic impact studies of festivals, spectator events; Beneficial only for events inc Market Days, 4 th of July, etc. Does not value total contributions from CC | IMPLAN assesses at county level; would require technical support to include only Wimberley area or expand analysis to county level |
| World Resources Institute (2009) | Coral Reef Valuation Tool (V2.0) | <ul style="list-style-type: none"> Population/Demographic data Land, geographic data Economic data Hotel data Specific recreation use Total visitor counts Revenues generated from individual attractions or sectors | Assessed tourism/recreation economic contributions associated with coral reefs in the Caribbean, including economic costs; excel based model includes calculations developed specifically for coral reef/coastal features. | Excel model would require revision of calculations, coefficients and multipliers generated for coral reef/coastal features to apply to Wimberley area; also requires small revision of inputs for economic data |
| | | | | |

Measurement of the value of “natural capital” in regard to tourism has been studied by Thomas-Hope & Jardine-Comrie (2004) in Jamaica. The authors attempted to attribute value to a selection of natural resources and ecosystem services related to tourism, finding that “any attempt to value ecosystem services will encounter many conceptual and empirical challenges.” In this case, as with Wimberley and Cypress Creek, a lack of comprehensive data (average visitor expenditures, visitor counts and values for specific natural resource services provided) was the limiting factor. Stabler et al.’s *The Economics of Tourism*, Second Edition, suggests that using simple value statistics in the form of sales revenues or expenditures can be an effective way to estimate tourism’s contributions to overall revenues, thus bypassing Thomas-Hope & Jardine-Comrie concerns. While the actual value of ecosystem services is not counted toward an estimation

of valuation in this case, realistic assessments can still provide important information about local economic contribution tied to natural resources.

A recent study titled “The Economic Impact of New Braunfels’ Hospitality Industry,” conducted by Impact Data Source (2009) followed the simple approach suggested by Stabler et al. This effort presented methods for valuing the hospitality industry’s contribution to the New Braunfels’ areas economy, including sales, service and tax revenues, as well as direct and indirect employee wages. Study results included an estimation of the economic contribution of New Braunfels’ hospitality industry through sales revenues, employment and taxes.

The impact of tourism (defined in this study as “hospitality industry”) is presented in two categories: direct revenues and employment income from businesses that cater to tourists and indirect revenues and employment income that exist, in part, to support tourism related employees and businesses. Examples of indirect benefits include revenues and salaries from maintenance companies, gas stations, banks and retail stores.

Data collected for this analysis included sales and revenue data, sales tax records, employment statistics, demographic information, hotel revenues, details and characteristics about local businesses (utilizing NAICS codes), tourist counts and city revenues. With the exception of accurate tourist counts, the same data was collected for Wimberley (and Woodcreek). The authors of this study make the assumption that most of the tourism in New Braunfels is tied to the area’s natural features and do not differentiate tourism income that may be generated independent of the city’s rivers, lake and other natural features. The study, unlike Crompton and colleagues’ body of work does not discount the portion of revenues that may be generated by local residents, but does segregate it as indirect impacts. Unlike Wimberley, the City of New Braunfels collects substantial income from property, hotel occupancy and alcoholic beverage taxes, as well as a higher rate of sales tax. Income allocated to the County, local independent school district’s and road maintenance are also included as revenues in this evaluation.

New Braunfels, also located in the Central Texas Hill Country, is located approximately 25 miles South of Wimberley and although much larger, possesses many of the same attributes (distance from the interstate, proximity to San Marcos, Austin and San Antonio, configuration downtown area, similar composition of businesses, similar proportion of economic contribution of residential and tourist components). This methodology is attractive, as it can easily be applied to Wimberley and much of the data required is readily available.

Methodology

Visitor counts were obtained from all possible sources, but none were comprehensive and many were measured over different time periods. All counts obtained for 2010 were checked against previous years’ data for anomalies and averaged monthly, when possible. It was assumed that many tourists would visit multiple locations in one day, therefore counts were not summed, but estimated based on highest counts for Market Days and other annual events, combined with visitor counts of attractions that are likely to be visited separately. Total retail based revenues were reviewed by category and compared with percentages of estimated visitors and resident expenses to determine the percentages of retail revenues generated from tourist activities.

Sales tax data was collected from audited city financials and the Bureau of Labor Statistics (see Table 12 for details) detailing percentages levied specifically for Wimberley and Woodcreek in 2010. Taxable sales were derived from this data (as not all sales are taxable) and then summarized by industry, using NAICS industry category codes related to retail sales and tourism related services. To the extent possible, estimated spending contributed by local residents was removed from the analyses.

Employment and earnings were compiled by industry category (relating to tourism) from the Bureau of Labor Statistics provided for Wimberley and Woodcreek in 2010 and were summed. Estimates based on known average employment were applied to businesses to validate employment rates and income related to tourism. City wide income statistics (mean, median, total per capita income and household income) were reviewed, along with median travel times to work to determine how much of Wimberley's total personal income is dependent on tourist related activities. Median and average home prices also were compared with personal income to validate higher than average incomes (derived from non-tourism industries outside of Wimberley and Woodcreek).

The findings for sales revenues are presented above in **Tourism in Wimberley** (p 11) and employment information is detailed **Employment in Wimberley** (p 13). These two computations were summed to determine to total direct contributions of tourism to the Wimberley and Woodcreek economy.

An assessment of indirect and induced economic impact of the industry was not performed because it employment data established that only a small portion of employment and household income are tied to tourism in Wimberley.

Results, Discussion and Implications

Accounting of Tourists

Unfortunately, there is no available single or comprehensive measure of the number of people who visit Wimberley. Figure 19 summarizes all available visitor counts in 2010. Many of the valuation approaches rely on this data to provide effective results. An estimated 120,000 visitors attended Market Days in 2010. It is likely that many of these visitors also attended other attractions in Wimberley, including Blue Hole, Jacob's Well or other retailers in the downtown area. 21,000 visitors attended the Holiday Lights Attraction in November and December. It is assumed that these tourists also attended other attractions. However, because the markets only occur one Saturday per month and The Lights Festival lasts for one month, these counts may be misleading. The Chamber of Commerce logged 22,538 visitors in 2010 (on days other than Market Days and the Holiday Lights Festival) and 27,768 people visited the Emily Ann Theatre throughout the year. Theatre staff reported that the majority of these visitors were from out of town. Using these counts alone, more than 191,000 people visited Wimberley in 2010. Another 15,500 attended Blue Hole and the Butterfly Festival. Casual tourists who visit the downtown area, Jacob's Well, Cypress Creek or any one of the number of art galleries in town are not included in these counts. City staff, local business owners and

residents conservatively agree that at least 250,000 tourists visited Wimberley in 2010 and, although expected to grow, this may be a reasonable estimate for annual visitors

2010 Bureau of Retail Statistics total sales for Wimberley are shown below in Figure 20 and are described in detail in the **Tourism in Wimberley** section of this report (p 11). Reviewing the percentages for each of the sale categories, a pattern emerges for sales that are predominantly encumbered by residents. The majority of Building Materials and Garden Store, General Merchandise, Health and Personal Care, Motor Vehicle Related and Sporting Goods sales are likely purchased by local residents and account for approximately 8% of total sales revenues. Local residents' expenditures account for some portion of Food and Beverage, Food Service, Gasoline Station and Home Furnishings, as well. Reviewing the remaining categories strengthens the assumption that the majority of total retail sales are driven by out of town guests. For example, more than 52% of total sales are attributed to Nonstore Purchase sales, which include items from Market Days, as well as locally produced art, jewelry and other artisan products. Wimberley's approximately 2,700 residents total less than 1% of the estimated 250,000 annual visitors and their total retail purchases are expected to comprise less than 25% of total annual retail sales, with the exception of the Other Services category defined below.

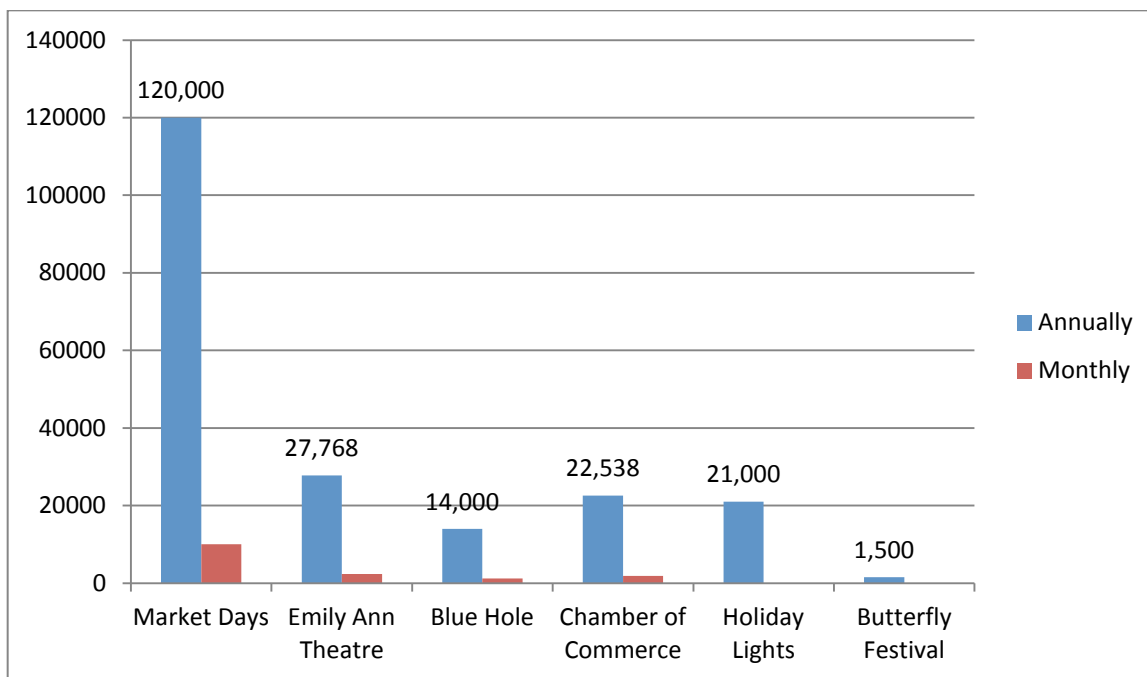


Figure 19. 2010 Visitors Counts, Wimberley, TX

Table 15. 2010 Wimberley Retail Sales

| 2010 Bureau Retail Sales Statistics for Wimberley, TX | | |
|---|--------------|--------|
| Total Retail Sales | \$91,932,000 | |
| Building Materials and Garden Store Sales | \$3,508,000 | 3.82% |
| Clothing and Accessories Store Sales | \$134,000 | 0.15% |
| Food and Beverage Store Sales | \$17,554,000 | 19.09% |
| Food Services | \$4,526,000 | 4.92% |
| Gasoline Stations Store Sales | \$10,266,000 | 11.17% |
| General Merchandise Store Sales | \$1,050,000 | 1.14% |
| Health and Personal Care Store Sales | \$383,000 | 0.42% |
| Home Furnishings Store Sales | \$1,866,000 | 2.03% |
| Miscellaneous Store Sales | \$2,692,000 | 2.93% |
| Motor Vehicles Related Sales | \$1,709,000 | 1.86% |
| Nonstore Purchases Sales | \$48,086,000 | 52.31% |
| Sporting Goods Store Sales | \$158,000 | 0.17% |

Contribution of Tourist Driven Retail Sales

Total gross taxable revenue generated from tourism related businesses in Wimberley (and Woodcreek) was \$81,464,130 in 2010. Based on visitor counts and information collected about local residents, it is assumed that 75% of Retail, Accommodation and Food Services, as well as Arts, Entertainment and Recreation can be attributed to tourists and visitors. Other Services, such as home improvement services, personal care, health and beauty services, non-mechanical automobile services, as well as tour guide services, tube and boat rentals, etc. are likely to be utilized by local residents at a higher rate, therefore only 50% of Other Services are ascribed to tourism. Total revenues generated from tourism are estimated to be \$60,455,681 in 2010, equivalent to 63% of Wimberley’s total revenues generated. At first glance, this value seems very high, but only amounts to a little more than \$240 per tourist. These values indicate that the impact of tourism is significant to Wimberley’s local economy. Figure 21 details the total revenues generated from Retail and Services sectors in Wimberley in 2010 and Figure 22 illustrates the economic contribution from tourism by sub-category.

Additionally, the city collected \$220,799 in franchise taxes in 2010. Using the same assumptions for tourism attributed retail sales, 75% of franchise businesses would be driven by tourist activity, attributing \$165,599 of the total levied franchise taxes to tourism.

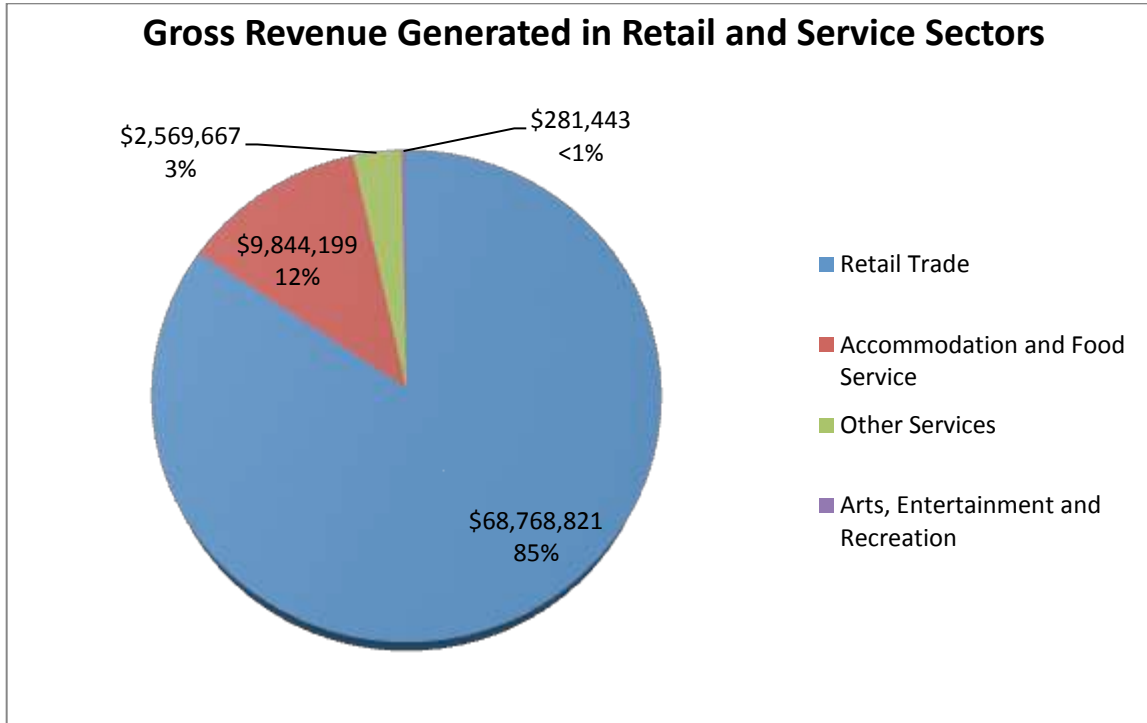


Figure 20. 2010 Gross Revenues from Retail and Service Sectors in Wimberley, TX

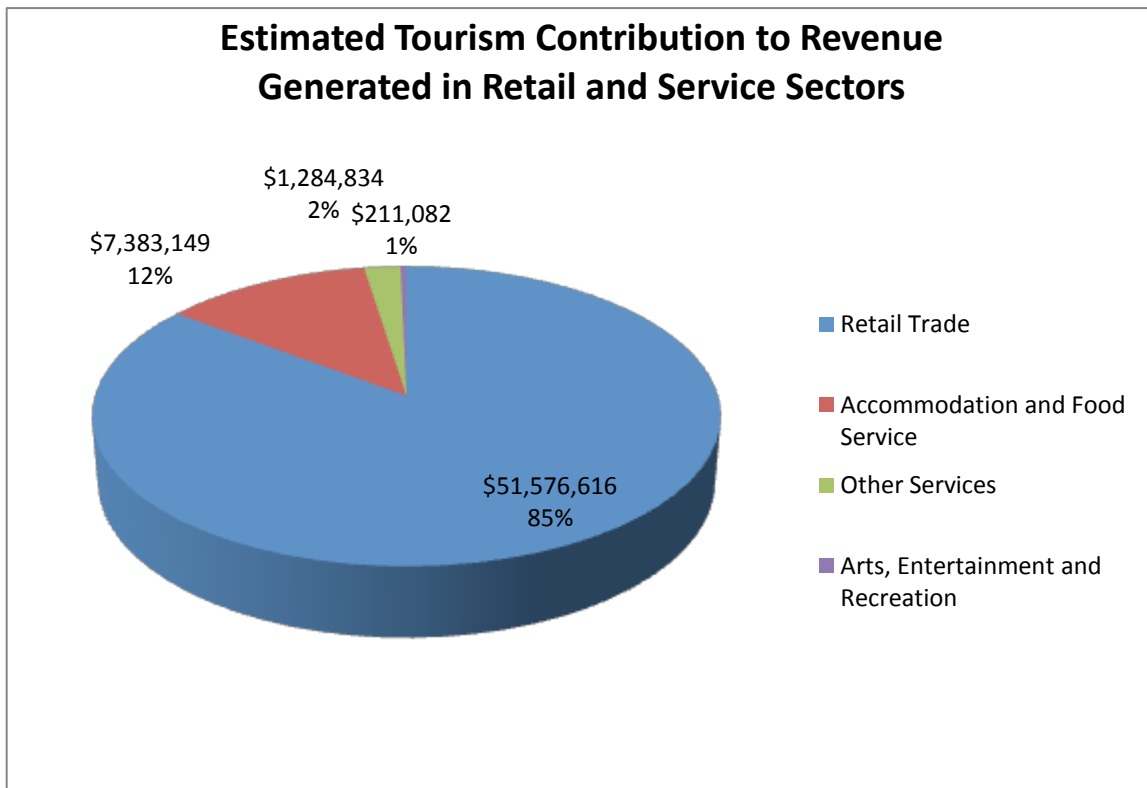


Figure 21. 2010 Tourism Contribution to Gross Revenues from Retail and Service Sectors in Wimberley, TX

Contribution of Hotel and Lodging Sales

Despite its name, the NAICS industry category Accommodation and Food Service does not include hotels, bed and breakfasts or inns. Total revenues generated from overnight lodging in Wimberley in 2010 totaled \$4,844,085, accounting for just over 5% of total revenues for the city (Figure 23). It is assumed that the majority of these revenues can be attributed to tourism. Because Woodcreek is primarily residential, it is likely that most overnight visitors in Woodcreek dine, shop and visit attractions in Wimberley. Gross revenues generated from overnight lodging in Woodcreek were only \$16,147 in 2010, but increased substantially to \$66,289 in 2012. These revenues were not considered in the total economic impact of tourism in Wimberley, but illuminate the importance of tourism in the area.

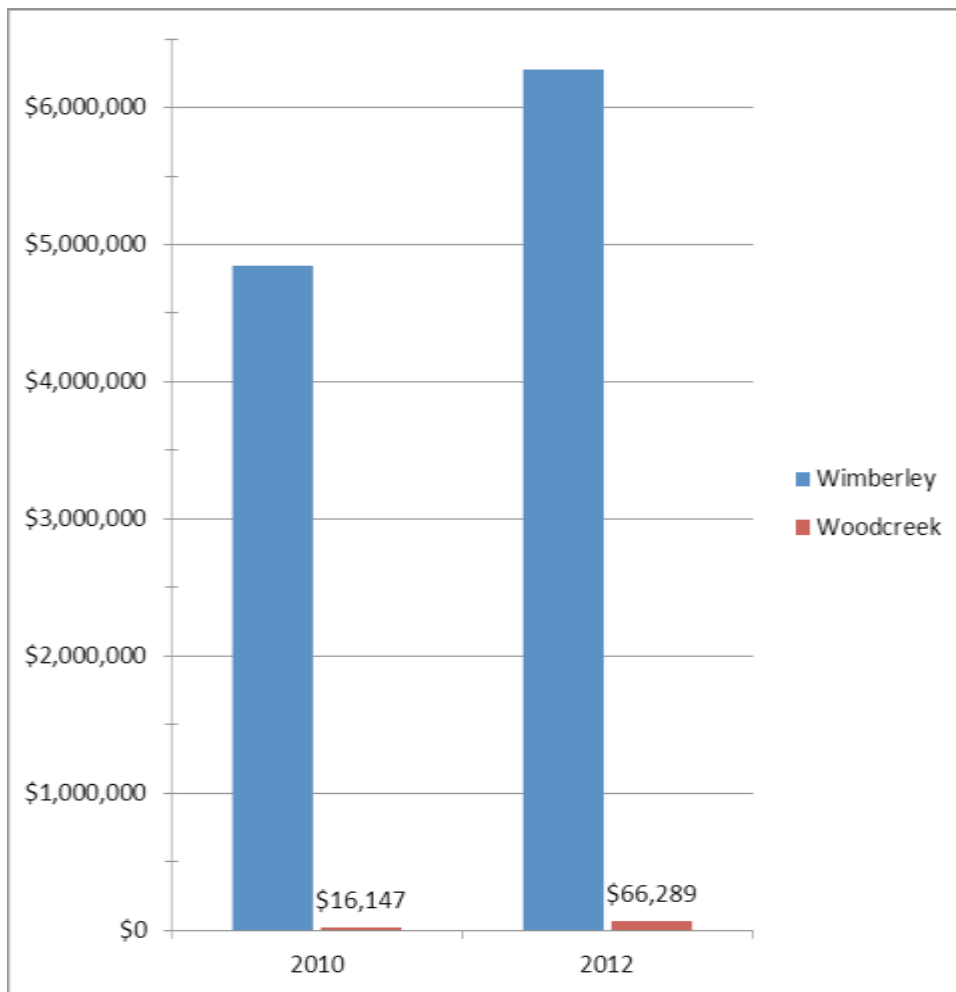


Figure 22. 2010 and 2012 Hotel Revenues for Wimberley and Woodcreek

Contribution of Tourism Related Employment

Wimberley is home to approximately 2,700 residents. More than 40% of Wimberley residents works in some type of retail or service job, but not all of these jobs are in Wimberley. Only 31% of residents commute less than 15 minutes to work. This indicates that a portion of residents derive income from local tourist based business, and it can be assumed that if 1,080 (40%) of residents work in retail or service jobs and 31% of those are employed in Wimberley, then approximately 335 local residents work in Wimberley's tourist based economy. Although the total number of locally employed residents working in tourism related jobs is small, the impact of salary dollars is still significant. Industry Categories related to tourism account for at least 30% of the businesses with employees in Wimberley (Retail Trade: 11.18%, Arts, Entertainment and Recreation: 2.35%, Accommodations and Food: 8.24% and Other Services: 8.24%).

The city of Woodcreek is almost entirely residential – 25% of residents work in some aspect of retail or service and the majority of residents travel less than 20 minutes each way to employment. This indicates that some residents likely are employed by tourist based businesses in the Wimberley area. Assuming that at least half of Woodcreek residents are employed by tourist related retail and service industries, as many as 182 residents (12.5% of 1,457) may receive income from tourism.

Per capita annual income (based on median household income) for Wimberley in 2010 was \$35,120 and the state per capita income was \$26,596. More than 80% of Wimberley residents work in “white collar” jobs with annual income significantly higher than the state averages. Further, average number of people per household in Wimberley is lower than the state average. Typically, individuals employed in retail and tourism service positions are not paid high wages. Therefore, the state per capita income estimate of \$26,596 is likely to be higher than the average annual income paid to tourism related retail and service employees in Wimberley. Reported hourly rates for retail and service employees in Wimberley ranged between \$9 and \$18 per hour, equivalent to annual salaries of \$18,000 to \$36,000 per year, indicating that the state per capita reported rate is the best metric to use for calculating tourism's impact on employment wages in Wimberley (PayScale Human Capital).

The 335 Wimberley residents employed in the tourism sector (including lodging) were paid an estimated \$8.9 million in 2010 and the 182 Woodcreek residents thought to be employed in Wimberley's tourism industry were paid \$4.8 million, totaling \$13.75 million in tourist based incomes. Some of these dollars are spent in the local economy creating indirect benefits.

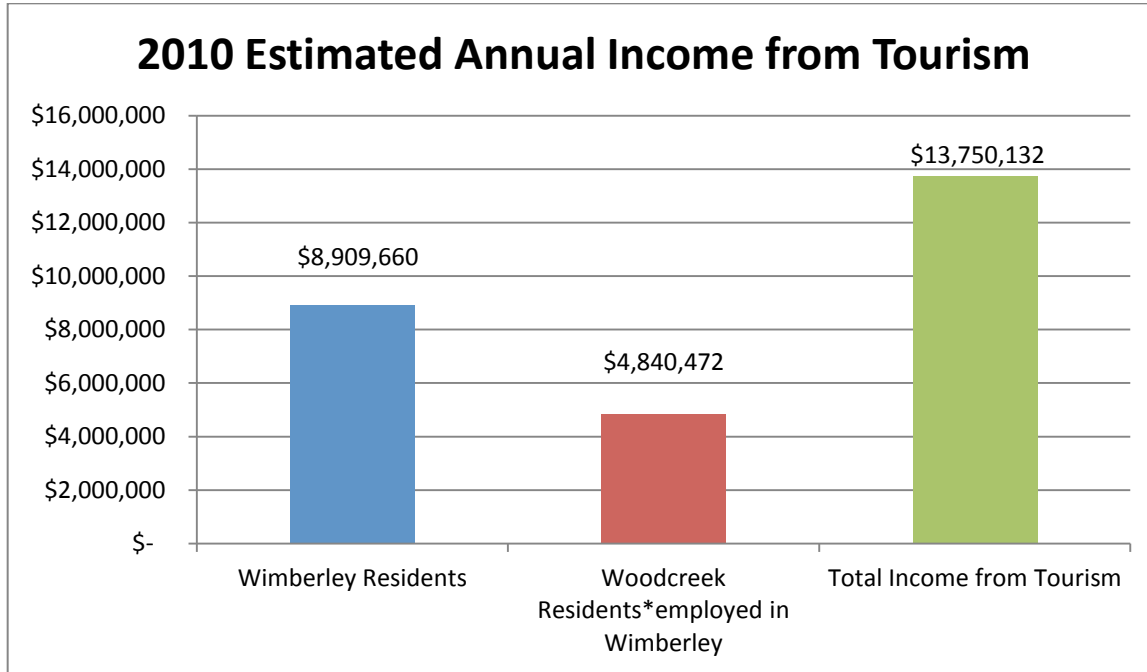


Figure 23. 2010 Tourism Contribution to Wimberley and Woodcreek Resident Income

Total Contribution of Tourism Related Revenues to Wimberley’s Economy

In 2010, an estimated 250,000 out of town visitors spent \$60,455,681, equivalent to 63% of Wimberley’s total revenues generated for the year. Overnight lodging in Wimberley in 2010 totaled \$4,844,085, accounting for just over 5% of total revenues for the city. Additionally, Woodcreek collected \$34,271 (1% local) in local sales tax revenues from its few businesses and vacation rentals. 2010 sales taxes levied from these revenues for the City of Wimberley equaled approximately \$391,799, 70% of total tax revenues collected. Local residents employed by tourism related businesses in Wimberley earned \$13.75 million in 2010. These values are summarized below in Table 16.

Table 16. Total Contribution of Tourism to Wimberley’s Economy, 2010

| 2010 Total Contributions of Tourism to Wimberley’s Economy | |
|---|---------------------|
| Tourism Generated Sales Revenue (gross) | \$60,455,681 |
| Overnight Lodging revenue (gross) | \$4,844,085 |
| Gross Revenue Total | \$65,299,766 |
| Tourism Generated Sales Tax Total | \$391,799 |
| Tourism Generated Franchise Tax Total | \$165,599 |
| Tourism Generated Income (Local Residents) | \$13,750,132 |

If, like many neighboring cities, the City of Wimberley collected additional taxes or fees for hotel occupancy, mixed beverages and solid waste or river management, additional income would be generated from tourism. Because these taxes and fees are not currently collected, and surveys of number and types of local businesses were not available, the methodology set forth in Impact Data Source’s 2009 report could only be partially utilized. Additionally, with more accurate visitor counts, other approaches assessed in this effort, including use Contingent and Travel Cost Valuation methodologies, as well as use of the IMPLAN model, and revised World Resources Institute’s Valuation Tool would provide improved values for tourism’s linkages to Cypress Creek and the resulting economic values. However, this simple assessment shows that these linkages exist, are important to the local economy and warrant further investigation.

Results from this study show that economic impact of Wimberley’s tourism industry is significant, valued at millions of dollars annually. In 2010, the total direct impact of tourism in Wimberley’s economy highlights the role the creek plays in the local economy as well as the need to protect and preserve the creek.

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Appendix A1: The Value of Environmental Flow in Cypress Creek: Willingness to Pay by Wimberley Residents to Protect Groundwater and Preserve Flow in Cypress Creek

The Value of Environmental Flow in Cypress Creek

Willingness to Pay by Wimberley Residents to Protect Groundwater and Preserve Flow in Cypress Creek

by

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Preface

Study Background

The Cypress Creek watershed is a part of the Edwards Plateau region of the Texas Hill Country and is located in northern Hays County in and around Wimberley, Texas. Much of the terrain in the area is characterized by thin topsoil layers, steep slopes, predominant karstic limestone features, and relatively sparse vegetation (Cypress Creek Project, 2010). The Cypress Creek watershed encompasses approximately 24.27 square miles, most of which is undeveloped, except for the dense residential development in Woodcreek and commercial/residential development in the City of Wimberley. Numerous cliffs and deep valleys typify the topography of the watershed. There is approximately 565 feet of topographic relief across the study area with elevations ranging between approximately 835 and 1400 feet above mean sea level (Hays-Trinity, 2008).

Cypress Creek is commonly divided into two segments (Figure 12). The 9.5-mile segment above Jacob's Well is usually dry, except during major rainfall events, and is referred to as Dry Cypress Creek. The 4.9-mile long stream segment below Jacob's Well is fed by the spring and consistently contains flowing water. The downstream segment is referred to as Cypress Creek. The stream gradient of the lower part of the creek is approximately 20 feet per mile. The Dry Cypress watershed accompanies approximately twice the area of the wet Cypress Creek watershed (Hays-Trinity, 2008).

Jacob's Well

Jacob's Well is a natural flowing artesian spring located in the bed of Cypress Creek. During low flow conditions, Jacob's Well forms the headwaters for Cypress Creek. Water from Jacob's Well flows into Cypress Creek, which runs through downtown Wimberley and provides inflows to the Blanco River several miles downstream. The Blanco River provides recharge to both the Trinity and Edwards Aquifers. During the dry conditions of July 2000, Jacob's Well ceased to flow for the first time in recorded history, degrading fish, wildlife, and water quality (Cypress Creek Project, 2010).

Funding

This study was funded by the River Systems Institute (RSI) of Texas State University – San Marcos and was fully supported by Mr. Andrew Sansom, Executive Director.

Acknowledgements

The principal investigators were Dr. Joni Charles of Texas State University and Dr. David W. Yoskowitz of the Harte Research Institute for Gulf of Mexico Studies, Texas A&M University – Corpus Christi. Dr. Yoskowitz was responsible for the statistical analysis, survey design and background. Dr. Charles was responsible for the pilot surveys and administration of the main survey. Data collection and data entry was provided by students in the Environmental Economics class in the Department of Finance and Economics at Texas State University during Spring 2010. Dr. Susan Roberts, Groundwater Scientist served as internal peer reviewer of the final report and provided invaluable support for the closure of the study. Ms. Sharla Gutierrez and Ms. Sara Wardlow provided logistical and administrative support. Mr. Ricardo Videtta helped with final editing work.

Executive Summary

This report estimates the willingness to pay of residents in the Wimberley and Cypress Creek area for conservation easements which would reduce the loss of groundwater and provides an analysis of the results. Data from residents were collected from an on-site survey administered by students of environmental economics during Spring 2010.

Questionnaire Design

Sample Design

Interviewers conducted surveys at three different sites in Wimberley – a local convenience store/gas station, a popular restaurant used by local residents and the local library. The survey sites were chosen based on locations in the city where there was the most customer traffic. The survey was administered at three times during the day in the work week, over a two week period – early in the morning, mid-day and late afternoon. Every third person was interviewed¹ as a systematic approach to generating a random sample – the target number of participants was 300. Although this approach is generally acceptable as a means of generating a random sample, the number of survey respondents was reduced by a number of factors using this approach: (1) other times of the day and days of the week were not possible due to scheduling constraints (2) many Wimberley residents commuted to work in surrounding cities, and so were not available during the day in the work week and (3) some business owners with heavy foot traffic chose not to give permission for the survey to be conducted on their premises and (4) funding constraints. Details of the response rate and the implications of the economic and demographic characteristics of the respondents are given in the Data Section of the statistical analysis by Dr. Yoskowitz.(Yoskowitz 2011).

Survey Pre-test and Administration

Questions for the questionnaire were based on a contingent valuation questionnaire which was developed to estimate willingness to pay for freshwater inflow into the San Antonio Bay. The questionnaire was administered by Harte Research Institute for Gulf of Mexico Studies – TAMUCC. Access and permission to use the questionnaire was provided by Dr. David Yoskowitz. Each of 38 interviewers practiced the flow of the questions during class sections and did a pilot test of the survey to five individuals. Any modifications to the questions and design of the survey reflected feedback from the pilot test.

¹ In some instances, it was not always possible to adhere to this approach.

Data Collection and Entry

Interviewers were divided into two groups; those who would conduct the onsite survey and those who would stay in the classroom and enter the data from the surveys administered by those who were onsite in Wimberley. The number of interviewers in each of the two groups was determined by their availability at the time the surveys were to be continued.

Data Collection

Survey Sites

Wimberley is a small village of just under 4000 residents (2000 Census) in the Hill Country of Texas. Most activity is around the Wimberley Square. This 'Square' attracts many visitors for its eclectic shops, which include art, antiques and souvenirs. Cypress Creek, which runs through the city, Jacob's Well and Blue Hole are natural sources of water which enhance the village as a place to visit and add to its aesthetic value. There were three survey sites chosen within the village: Wimberley Village Library, Wimberley Café on the Square and Juan Henry's. These sites are frequented by Wimberley residents and were chosen to maximize the number of survey respondents. Other sites with heavier foot traffic would have been preferred, but permission to conduct the survey on these sites was not granted. Interviewers were instructed to approach every third person, whenever possible, but the difficulty of obtaining a random sample may limit the generalization of the results. Three groups of three interviewers (except for unforeseen circumstances) each traveled to Wimberley in the morning, and during early and late afternoon, two times a week. Interviewers carpoled or provided their own transportation.

Survey Administration

A pilot test of the survey was conducted by interviewers approximately two weeks before the onsite survey was administered. During the week of the actual survey, interviewers were provided with a clipboard, writing instruments, respondent incentives, a stack of numbered surveys, a laminated map of the watershed area and a respondent version of the survey. During the pilot test, the respondent version of the survey and the laminated map were found to make it easier for respondents to follow along and to respond to the surveyor's questions.

Data Entry

A separate group entered the data and was provided a code version of the survey. As onsite interviewers returned their completed surveys, the responses on each survey were coded and then entered on an Excel spreadsheet. All respondent survey data was then transferred to a master Excel spreadsheet. A total of

161 surveys were returned. A recent survey commissioned by the City of Wimberley in 2008 (A Window to the Future) had a response of 500 residents.

(<http://www.vil.wimberley.tx.us/vertical/Sites/%7B140989A8-309D-4E90-A37A-F257BF123B26%7D/uploads/%7B42CACB08-4C20-46AB-A2E3-1CFE14C0082F%7D.Pdf>).

Statistical Analysis

The Contingent Valuation (CV) technique was used for transforming resident responses into average monetary values for keeping water flowing in Cypress Creek. A technical presentation of the theory behind the CV technique can be found in the statistical analysis.

Results

Results of the data show that a majority and significant number of individuals willing to donate a positive amount in order to protect environmental flow to the spring at Jacob's Well and the downstream segment of Cypress Creek. Economic, demographic variables and owning land or a home did not seem to be significant in helping to explain whether or not an individual respondent will choose to make a donation, but the amount of the donation did vary depending on these variables.

Conclusion

The report acknowledges the limitations of the study, namely, that the number of survey respondents does not allow for a robust result for the average amounts residents are willing to pay and that a different sample group would yield a different average donation value. Caution is urged when interpreting or applying the results of this study.

Yoskowitz, D. (2011). Statistical Analysis of Willingness to Pay to Protect Environmental Flow in Cypress Creek. R. S. Institute. Corpus Christi, Harte Research Institute for Gulf of Mexico Studies.

**Appendix A2: Statistical Analysis of Willingness to Pay to Protect
Environmental Flow in Cypress Creek**

**Statistical Analysis of Willingness to Pay to Protect
Environmental Flow in Cypress Creek**

By

David W. Yoskowitz, Ph.D

October 2011



1. Introduction

What is the value of water flowing in Cypress Creek? How do you value something when there is no traditional market that exists for it? This is the challenge faced by those who wish to place a monetary value on many environmental and ecological assets.¹ For policymakers it is necessary to place a value on alternatives states of being especially when the costs and benefits of a particular decision are being weighed.

Water has value in its many different uses, such as drinking, irrigation, cooling, etc. What is the value of water when it is not used at all, but remains in its body or course for what is referred to as “environmental flow”? More specifically, what is the value of environmental flow in Cypress Creek? There might be as many different answers as there are individuals whom you ask. An angler’s perspective would most likely differ from swimmers, who would most likely differ from water resource managers, who would most likely differ from someone who does not use the resource at all.

There are a number of non-market valuation techniques that have been developed to quantify the value that individuals place on environmental goods and each has its strengths and weaknesses. Surprisingly, very little has been done to evaluate the value of environmental flow using these techniques.

A number of studies have focused on valuing water quality improvement. These studies have focused on maintaining improved water quality (Harris, 1984), protecting swimming water quality (Sutherland and Walsh, 1985), and willingness to pay to protect water quality in England (Green and Tunstall, 1991) and improve it in the Monongahela River (Desvousges, Smith, and Fisher, 1987).

¹ The term *ecological asset*, as it is used in this report, refers to ecological goods and services. While there is continuing debate about how to define ecosystem services, we feel the term *ecological assets* is encompassing enough to account for both goods and services.

Protecting in-stream flow for various recreational and environmental activities has also been researched. Daubert and Young (1981) measured willingness to pay to protect in-stream flow for recreational fishing and Loomis (1987) measured the willingness to pay for environmental flow in order to protect the ecosystem of Mono Lake in California. Studies have also dealt with protecting in-stream flow as an alternative to dam building (Gonzalez-Caban and Loomis, 1997) and the impact on ecosystem services as a result, in part, of increasing in-stream flow. Loomis et al., (2000), and Berrens, et al. (2000) use contingent valuation to investigate the non-market benefits of protecting minimum in-stream flows in New Mexico.

An extension of valuing instream flows are freshwater inflows into estuaries. Hosking and du Preez (2004) utilize a contingent valuation method for valuing inflow into the Keurbooms Estuary near Plettenberg Bay, South Africa. Focusing on recreational users, they found that this group's valuation was less than what farmers were willing to pay for the water as an input into crop production. Freshwater inflow has also been valued in Texas (Yoskowitz and Montagna, 2009) for the Rio Grande where the results suggested that a majority of "users" of the resource

2. Methodological Approach

There are a number of approaches to valuing non-market ecological assets. The appropriate technique depends upon many factors including: type of resource to be valued, budget, time frame, and use of the results. Table 1 categorizes the various approaches based upon the techniques used to generate values. Economic agents engage in real, market activities and the values they place on goods and services are *revealed* through their actual behavior.

Table 1. Methods for Estimating Values for Non-Market Ecological Goods and Services

| | Observed Behavior (Revealed Preferences) | Hypothetical (Stated Preferences) |
|-----------------|---|--|
| Direct | <p><i>Direct Observed</i></p> <p>Market Prices Simulated Markets (experimental economics)</p> | <p><i>Direct Hypothetical</i></p> <p>Bidding Games Contingent Valuation (willingness to pay/accept questions)</p> |
| Indirect | <p><i>Indirect Observed</i></p> <p>Travel cost analysis (surrogate expenditures) Hedonic pricing Avoidance expenditures Referendum voting</p> | <p><i>Indirect Hypothetical</i></p> <p>Contingent Ranking Contingent Activity Contingent referendum</p> |

Source: Mathis et al., (2003).

If markets do not exist for the goods or services, then hypothetical scenarios are created to elicit the values that individuals would place on the non-marketed good and this value preference is *stated*.

The technique employed for this study is the contingent valuation (CV) method. In general the CV method estimates the value of the non-market goods through questions in a survey format. The respondents state their preferences in terms of willingness-to-pay (WTP) for a good or service or willingness-to-accept (WTA) if they cannot use the good or service. The values placed on the good or services are *contingent* upon the structure of the hypothetical market (Brookshire and Eubanks, 1978, Brookshire and Randall, 1978, Whitehead, 2000).

Earlier in its development and use, this method was not without controversy. The basic argument against was "...that real transactions are much more reliable indicators of value than self-reported behavioral intentions" (Randall, 1997). The debate came to a head as a result of

the *Exxon Valdez* spill in 1989 and the use of CV in assessing damages. Both sides argued aggressively for the merits and perceived shortcomings of the technique.

In order to settle many of the ongoing issues, the general counsel of NOAA formed a panel of experts, chaired by two Nobel laureates in economics, to provide a recommendation on the use of CV for estimating non-use values. Their report concluded, “CV studies can produce estimates reliable enough to be a starting point for a judicial or administrative determination of natural resource damages—including passive use values” (Arrow et al., 1993).

While there continues to be some detractors of the CV method, its lengthy history and continued use show it to be well vetted. Mathis et al. (2003) sum it up nicely “...CV is the only economic method available for measuring non-use values associated with nature”.

2.1 Technical Presentation

What follows is the very concise and tractable explanation developed by Mathis et al. (2003) of the theory behind the CV technique. Consider an individual utility function:²

$$u(x,z) \tag{2.1}$$

where x is a vector of market goods and z is a vector of non-market environmental goods, characterized as public goods.³ The individual maximizes utility by choosing which quantities of

² A utility function is a mathematical representation of the satisfaction that an individual receives from consuming goods and services. These goods and services can range from dining out, shoes, and education to leisure activities and enjoying nature, whether actively or passively. All else held constant, the more one consumes the more satisfaction they receive.

³ Non-market environmental goods are typically characterized as public goods, that is, exclusion is not possible and the enjoyment or use of the good by one individual does not diminish the enjoyment or use by another. These characteristics lead to well-known problems regarding the provision of the public good due to “free riding” behavior. Moreover, because non-paying consumers cannot be excluded from consuming the public good, it is difficult to charge a price for consumption. Furthermore perhaps the most counter-intuitive insight yielded by the theory of public goods is that, even if it were possible for firms to charge a price for public goods, the economically efficient price for the consumption of a public good (once it has been provided) is zero, since the opportunity cost for additional consumers is zero. Thus, the price of the consumption of public goods faced by consumers is typically assumed to be zero.

the available market goods to consume. Expenditures for these consumption choices are constrained by available income, y , where p is a vector of market prices at which the market goods are purchased. Thus, the basic model of consumption can be expressed as

$$\max u(x,z) \text{ s.t. } px = y. \quad (2.2)$$

Implicit in this simple characterization of consumer behavior is the important distinction between private and public goods. Individuals can choose different quantities of *private* goods for consumption, but must use exactly the same quantity of the *public* good. In other words, whatever quantity in which the public good is available is the amount the individual must use. Given the public good nature of the environment goods, the individual does not choose the quantity of environmental goods to enjoy. Moreover, because the environmental goods do not have a corresponding market price, no income must be expended to enjoy the benefits of these goods.

Constrained optimization (maximizing utility subject to the budget constraint as described above) yields the following demand function for market goods:

$$x_i = h_i(p,z,y) \quad i = 1, \dots, n \quad (2.3)$$

where i indexes the i th market good. Here, the demand for a market good depends on its price and the price of all other market goods, the vector of environmental goods, and the individual's level of income. From the demand curve, the indirect utility function is derived:

$$v(p, z, y) = u[h(p, z, y), z] \quad (2.4)$$

where utility is represented as a function of prices for the market goods, income, and the environmental goods.

Now suppose that, within the vector of environmental goods z , one particular environmental good, z_i is increased *ceteris paribus*, where the superscripts 0 and 1 indicate states before and after the increase, respectively. Then,

$$z^1 > z^0 \quad (2.5)$$

and

$$u^1 = v(p, z^1, y) > u^0 = v(p, z^0, y). \quad (2.6)$$

The WTP that a CV survey attempts to elicit from a respondent is based on the difference between utility before and after the increase in z_i . One method of measuring this difference is the “compensating variation,” that is, the amount of income (money) that the individual would need to give up *after* the change from z^0 to z^1 , to leave her just as well off as before the change. The compensating variation measure of change in utility can be written as:

$$u^1 = v(p, z^1, y-c) = u^0 = v(p, z^0, y), \quad (2.7)$$

where the compensating variation is represented by c . The reduction in income by c exactly

offsets the benefits of the increased environmental amenity, leaving the individual indifferent between u^1 and u^0 . Consequently, c can be viewed as the maximum amount the individual would be willing to pay for the increase in the environmental good, z_i . Thus, it is the compensating variation, c , that most contingent valuation questions attempt to elicit. Since we have defined the environmental good as a public good, the *total* WTP for the increase in z_i is given by aggregating (summing) the compensating variations of all n individuals.⁴

3. Valuation Methods and Empirical Results

3.1 Technique

For the purposes of valuing freshwater inflow we utilize the stated preference approach of the CV method. This approach uses hypothetical choice data to estimate the ex-ante willingness to pay for various non-market commodities (Brown, 2003). This approach can be used to construct realistic policy options, through hypothetical choices, in order to gain information about the policy (Whitehead, et al, 2006). The major weakness of the stated preference approach is the hypothetical nature of the exercise. The respondent is placed in a situation that they are not completely familiar with and information about the commodity or program might be incomplete.

The hypothetical situation in the freshwater inflows survey involves two decisions, following Whitehead et al. (2006). First, the survey respondents decide if they are willing to pay

⁴The non rival and non-excludability of public goods is closely associated with a “non-divisibility” of consumption characteristic, that is, the public good must be consumed by everyone at whatever level it is supplied. However, individual willingness to can vary for a given quantity of a public good. Thus, to find the total willingness to pay for a public good requires adding up individual willingness to pay for a given quantity (vertical summation). In contrast, in the case of private goods, individuals can choose the amount to consume at a given price, and total willingness to pay is found by horizontal summation of individual demand curves.

something. If they are willing to pay something, then the respondents decide if they are willing to pay the specific amounts presented to them in order to protect freshwater inflow. Specifically, we employ a double-bounded dichotomous choice (DBDC) format to elicit the respondent's willingness to pay. The response sequences are: *yes-yes*, *yes-no*, *no-yes*, *no-no*. The probabilities of each are as follows:

$$\Pr(\text{yes, yes}) = \Pr(WTP_{1j} \geq BID^1, WTP_{2j} \geq BID^2) \quad (3.1)$$

$$\Pr(\text{yes, no}) = \Pr(WTP_{1j} \geq BID^1, WTP_{2j} < BID^2) \quad (3.2)$$

$$\Pr(\text{no, yes}) = \Pr(WTP_{1j} < BID^1, WTP_{2j} \geq BID^2) \quad (3.3)$$

$$\Pr(\text{no, no}) = \Pr(WTP_{1j} < BID^1, WTP_{2j} < BID^2) \quad (3.4)$$

Where BID is the bid amount for the first and second bids faced by the j^{th} respondent.

If $y_{1j} = 1$ the response to the first question is yes, and 0 otherwise, $y_{2j} = 1$ if the response to the second question is yes, and 0 otherwise. Following Alberini et al. (1997) the j^{th} contribution to the bivariate probit log likelihood function becomes:

$$\begin{aligned} \log L_{BP} = \prod_{j=1}^n & (1 - y_{1j}) * (1 - y_{2j}) * \square_j^{NN} + (1 - y_{1j}) * y_{2j} * \square_j^{NY} \\ & + y_{1j} * (1 - y_{2j}) * \square_j^{YN} + y_{1j} * y_{2j} * \square_j^{YY} \end{aligned} \quad (3.5)$$

Where $\square_j^{NN}, \square_j^{YN}, \square_j^{NY}, \square_j^{YY}$ are the probabilities of each pair of responses that are calculated

from the bivariate normal cumulative distribution function. Mean willingness to pay is calculated as:

$$WTP = \frac{\alpha}{\hat{\beta}_{BID}} + \sum_{z=1}^n \frac{\hat{\beta}_z}{\hat{\beta}_{BID}} z \quad (3.6)$$

Where α is the constant, $\hat{\beta}$ is the estimate of the coefficient, and z is the vector of variables that are arguments in the estimation. Therefore the mean WTP is the constant, from the estimation results, divided by the estimated coefficient of the BID variable $\left\{ \hat{\beta}_{BID} \right\}$, plus the sum of the remaining explanatory variables multiplied by their mean values, except BID, divided by $\hat{\beta}_{BID}$.

3.2 Results

The dependent variable in assessing willingness to pay is whether or not the respondent is willing to pay the requested donation to be made to protect groundwater. As suggested by Groothuis and Whitehead (2002) the “don’t know” responses are recoded to “no” for the most conservative estimate.

The independent variables were selected in order to generate a more complete estimate that takes into account by economic and demographic factors. As the bid (BID) amount increases the probability of responding “yes” and therefore the willingness to pay, should decrease. Income and education should be positively related with the probability of willingness to pay. In addition, we ask whether the respondent is a landowner/resident. We hypothesize that being a resident would improve the probability of saying “yes”.

Table 2 presents the results from three estimations: Model 1 where the bid amount (BID) is the only explanatory variable; Model 2 where a more complete model includes both economic and demographic variables including education level, income, and age; Model 3 includes whether the respondent owns a home or land in the immediate region, along with education and income levels. The bid amount is included in all models.

Table 2. Probit Estimation Results for Cypress Creek

| | <u>Model 1</u> | | <u>Model 2</u> | | <u>Model 3</u> | |
|------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|
| | <u>coefficient</u> | <u>t-statistic</u> | <u>coefficient</u> | <u>t-statistic</u> | <u>coefficient</u> | <u>t-statistic</u> |
| Constant | 0.376 | 2.347 | -0.348 | -0.653 | 0.517 | 0.842 |
| BID | -0.004 | -1.694 | -0.007 | -2.478 | -0.006 | -2.271 |
| Landowner | | | | | -0.271 | -0.633 |
| Education | | | 0.1 | 0.898 | -0.006 | -0.057 |
| Income | | | 0.192 | 1.183 | 0.104 | 0.672 |
| Age | | | 0.002 | 0.741 | | |
| 2*LL Ratio | 2.892 | | 11.344 | | 5.906 | |
| p-value | 0.089 | | 0.023 | | 0.206 | |
| WTP | \$94 | | \$79 | | \$81 | |

In all models the bid amount is significant and negatively related to the probability of saying yes to that bid amount. So, as the bid amount increase it is more likely that a respondent will say “no” to that amount. For models 2 and 3, the remaining variables are not significant in helping explain whether or not an individual respondent will chose to make a donation. When BID is the only explanatory variable mean WTP = \$94. Inclusion of the additional variables tempers the WTP estimates at \$79 for Model 2 and \$81 for Model 3.

While we generate WTP values through our statistical analysis it needs to be noted that there are some important shortcomings. The first is the sample size. For Model 1 there were only 74 respondents and 148 observations available for analysis.⁵ This is significantly less than the 300-400 that would normally be required for a survey of randomly sampled respondents. Therefore, given the small sample size, caution should be used when interpreting or applying

⁵ The other two models had less than this number available for analysis.

these results. Second, these results are not generalizable beyond the group that was surveyed. This is a usual caveat in non-random drawn samples.

3.3 A Context for the Value

Values for anything are fluid, dynamic, constantly changing whether it is for apples, umbrellas, or a fishing trip and these values are dependent upon the circumstances that individuals find themselves in. Many different factors influence these values including taste and preferences and income. When these change, then most likely values will change.

While the same survey, in the same locations, at a different point in time would most likely generate a different value for environmental flow protection, the most noteworthy result was that there were a **significant number of individuals** (91%) that were willing to **donate a positive amount** in order to protect environmental flow.⁶ That, in and of itself, is a very telling result. From the perspective of trying to drive policy, NGOs should be encouraged by this.

4. Conclusions

This study takes an initial look at the value that residents of Wimberley and the Cypress Creek region place on protecting groundwater and ultimately freshwater flow in the creek. Using contingent valuation we have estimated the mean willingness to pay (WTP) values. A conservative estimate of the mean WTP is \$79 per individual per year for the appropriate population.

A strong majority of those surveyed affirmed their willingness to donate some amount of money on an annual basis in order to protect groundwater that eventually impacts flow in Cypress Creek. This is encouraging as it demonstrates at basic level the importance of

⁶ Ninety-one percent of the survey respondents said they would be willing to make an annual donation in order to protect environmental flow for cypress creek. This is not saying that 91% would donate the mean WTP calculated above.

protecting groundwater resources in the region. While this survey lacked the number of survey respondents to produce robust results, it is a first step towards a fuller understanding of the significance that water plays in this region.

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Appendix B: Parcel Value Maps, 2006-2009

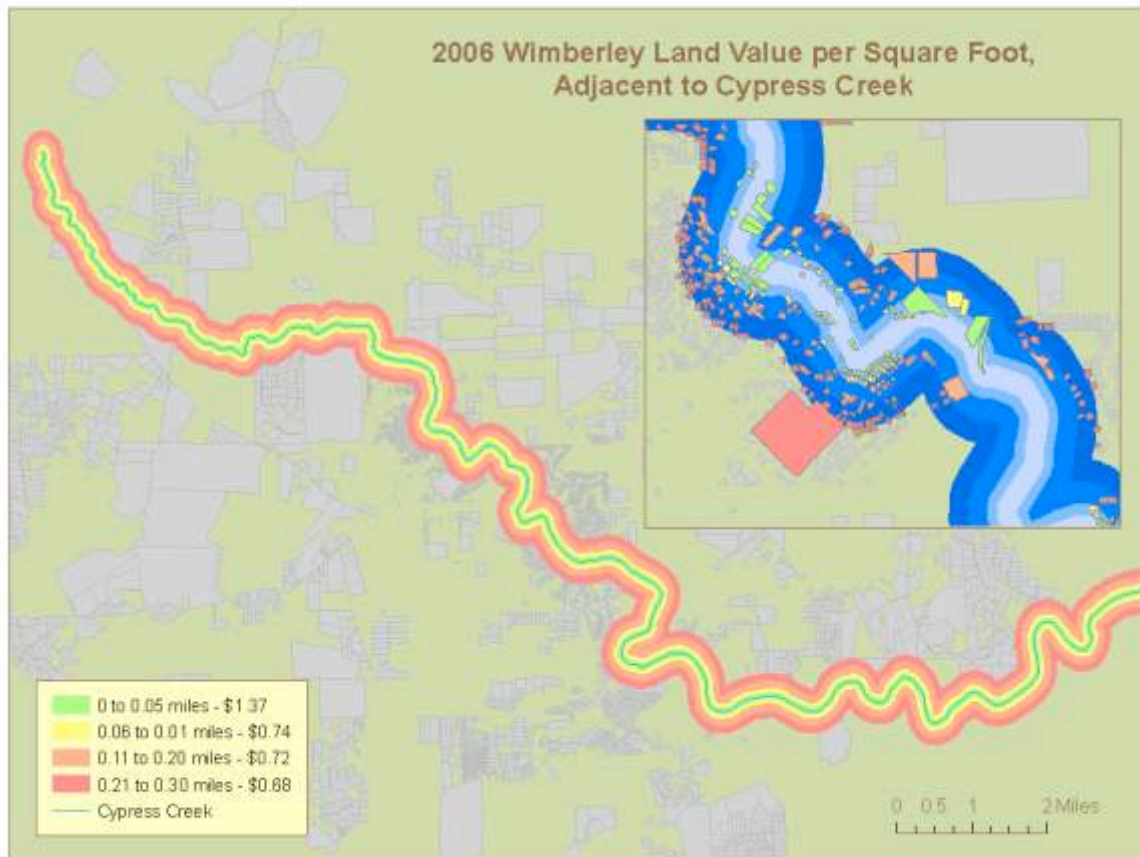


Figure B1. 2006 Land Value per Square Foot, Adjacent to Cypress Creek.

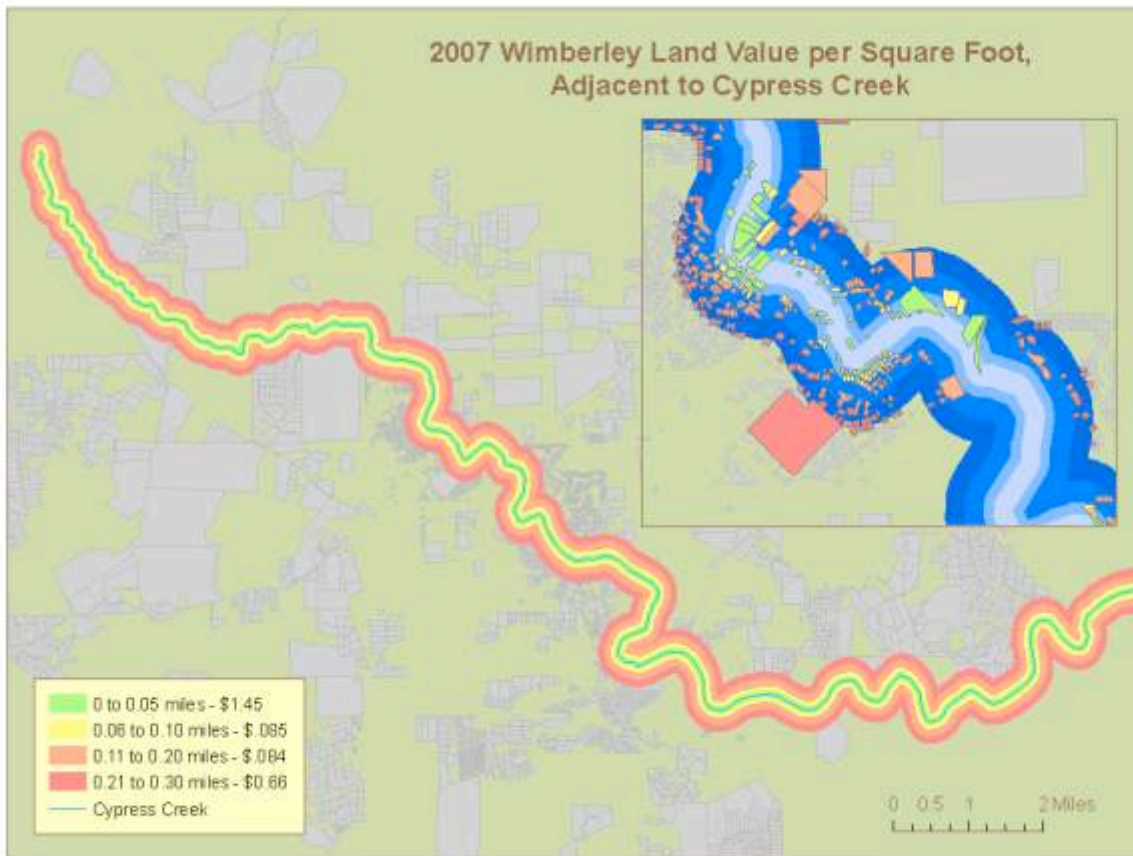
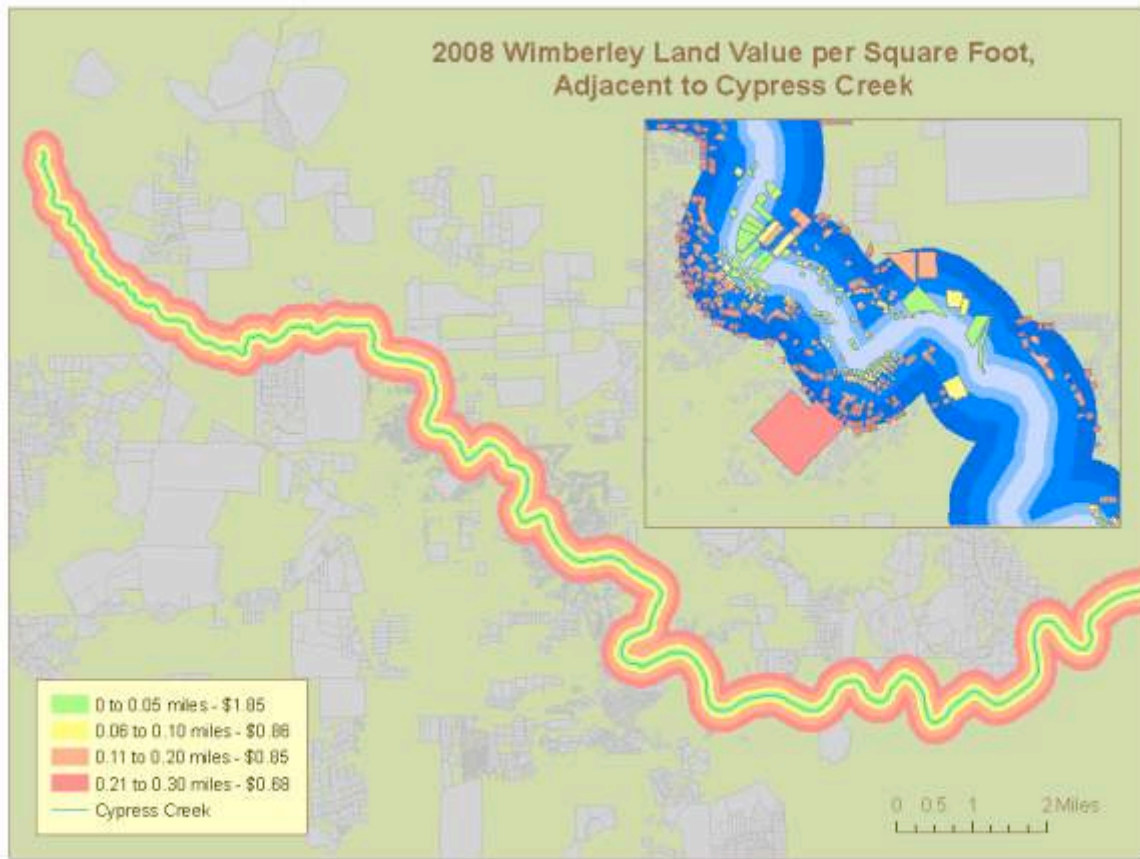
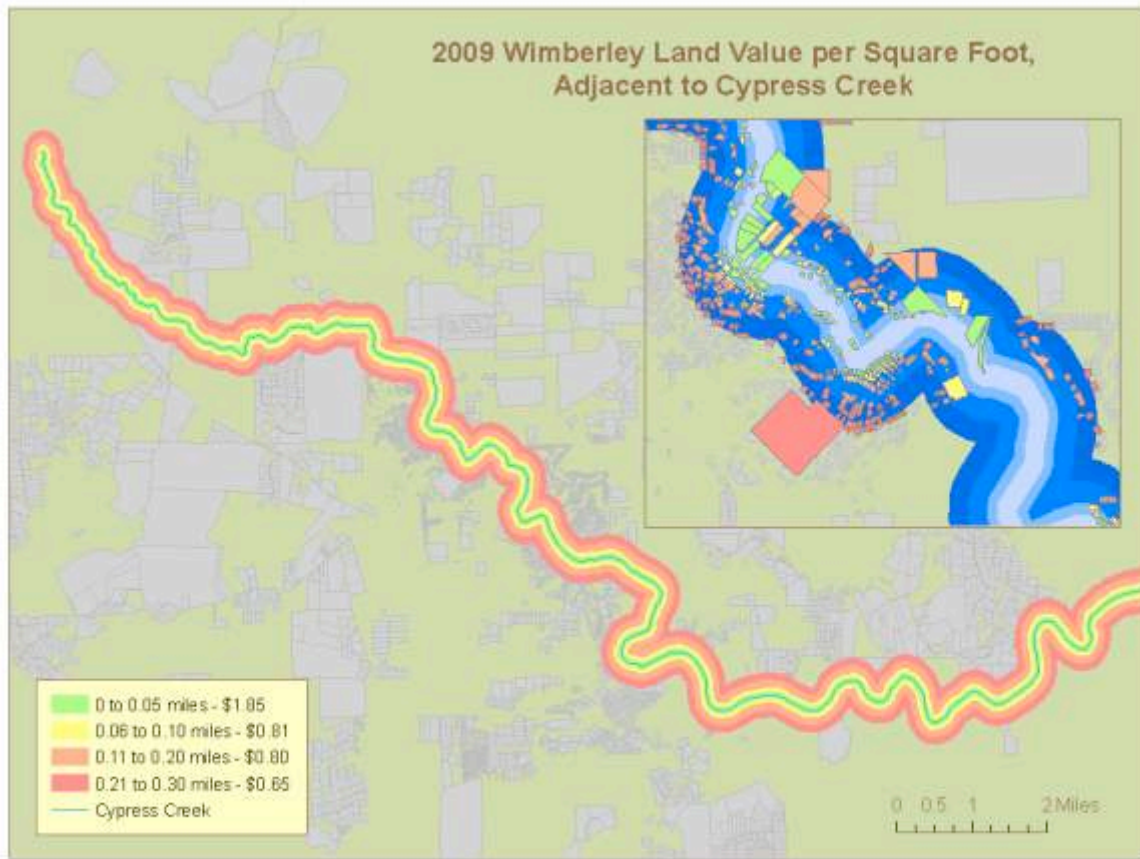


Figure B2. 2007 Land Value per Square Foot, Adjacent to Cypress Creek.



Appendix B3. 2008 Land Value per Square Foot, Adjacent to Cypress Creek.



Appendix B4. 2009 Land Value per Square Foot, Adjacent to Cypress Creek.



Appendix C: Selected Subdivision Maps

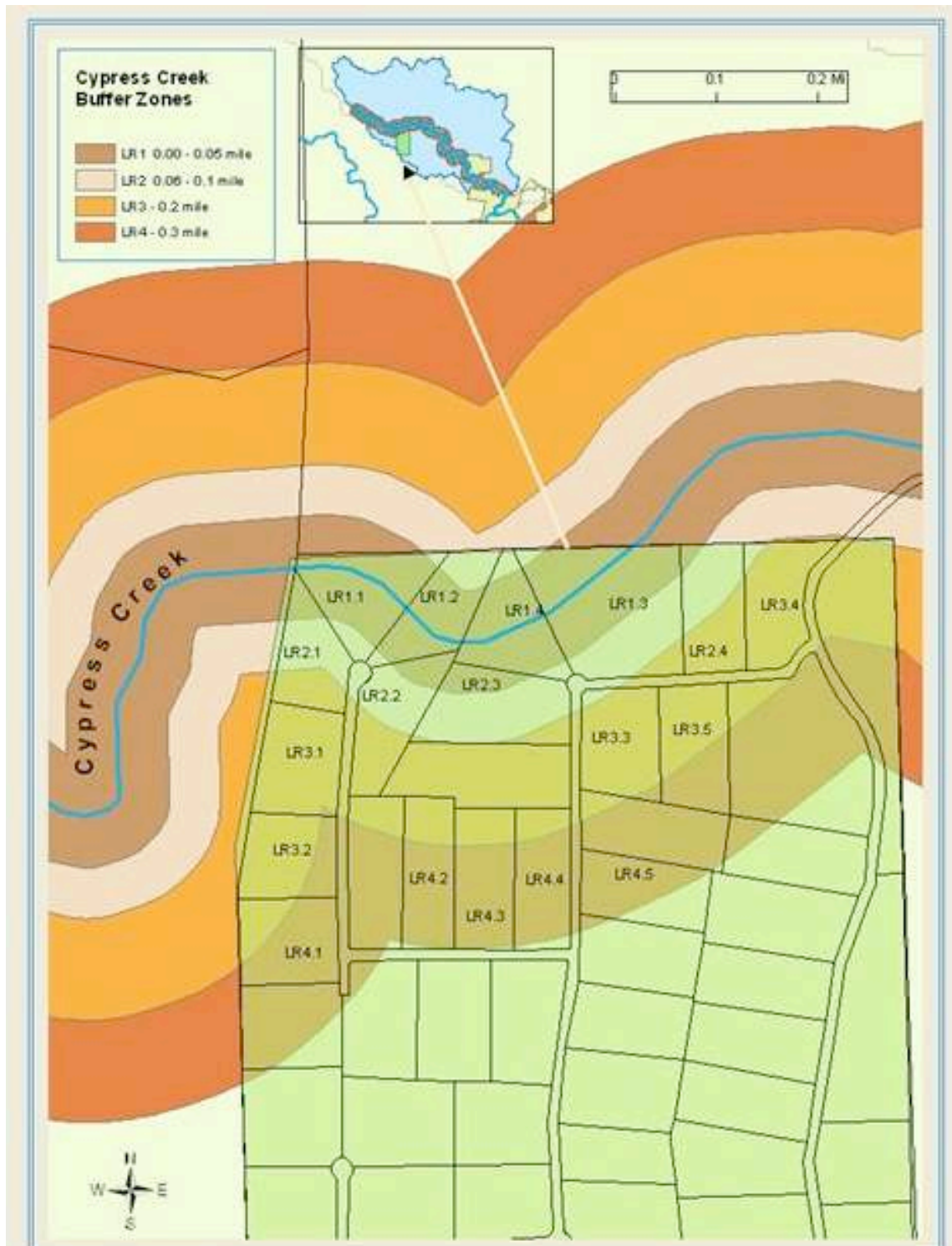


Figure C 1. Ledgerrock Subdivision, Dry Creek.

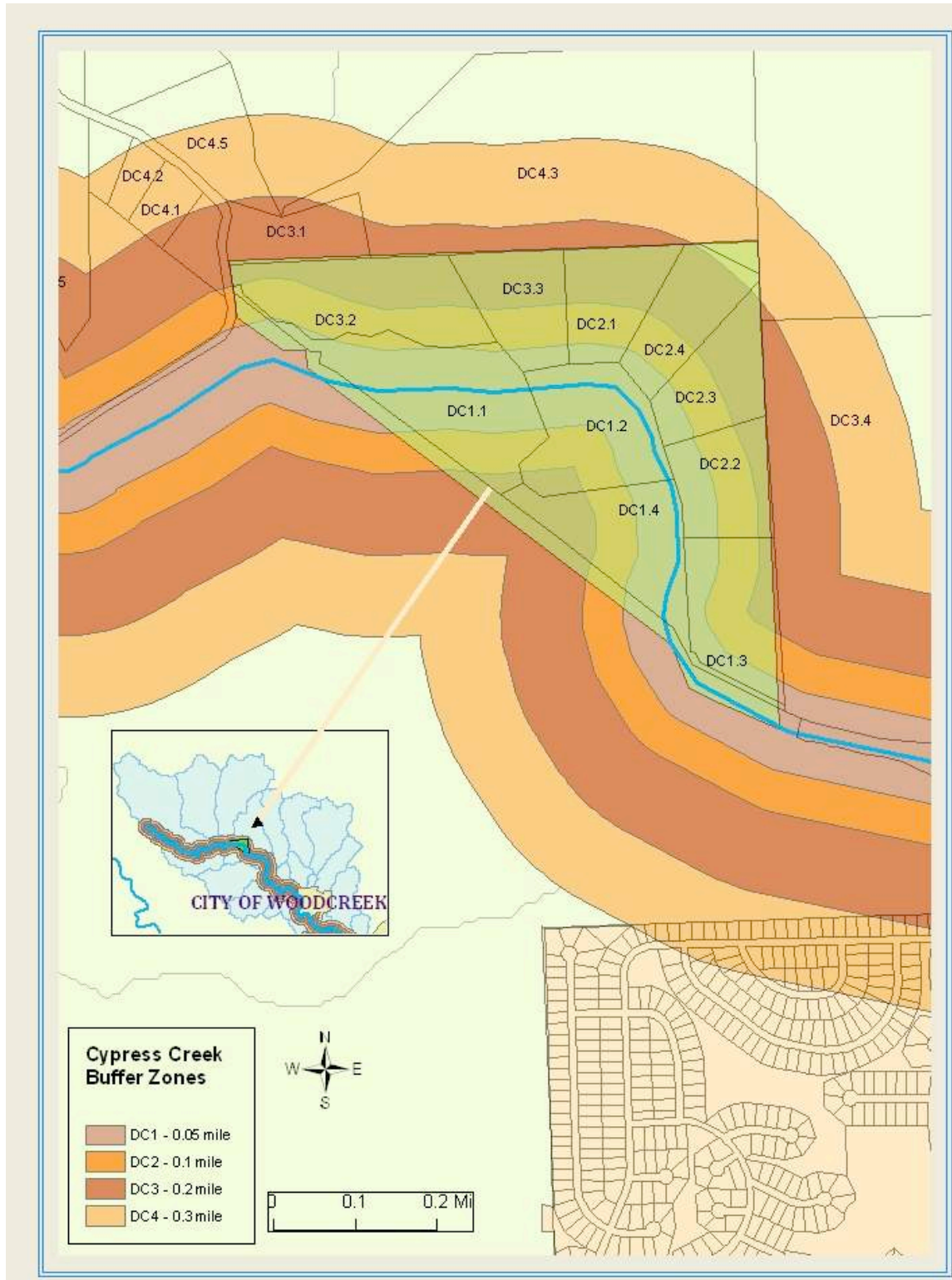


Figure C 2. Dry Cypress Ranch Subdivision, Dry Creek.

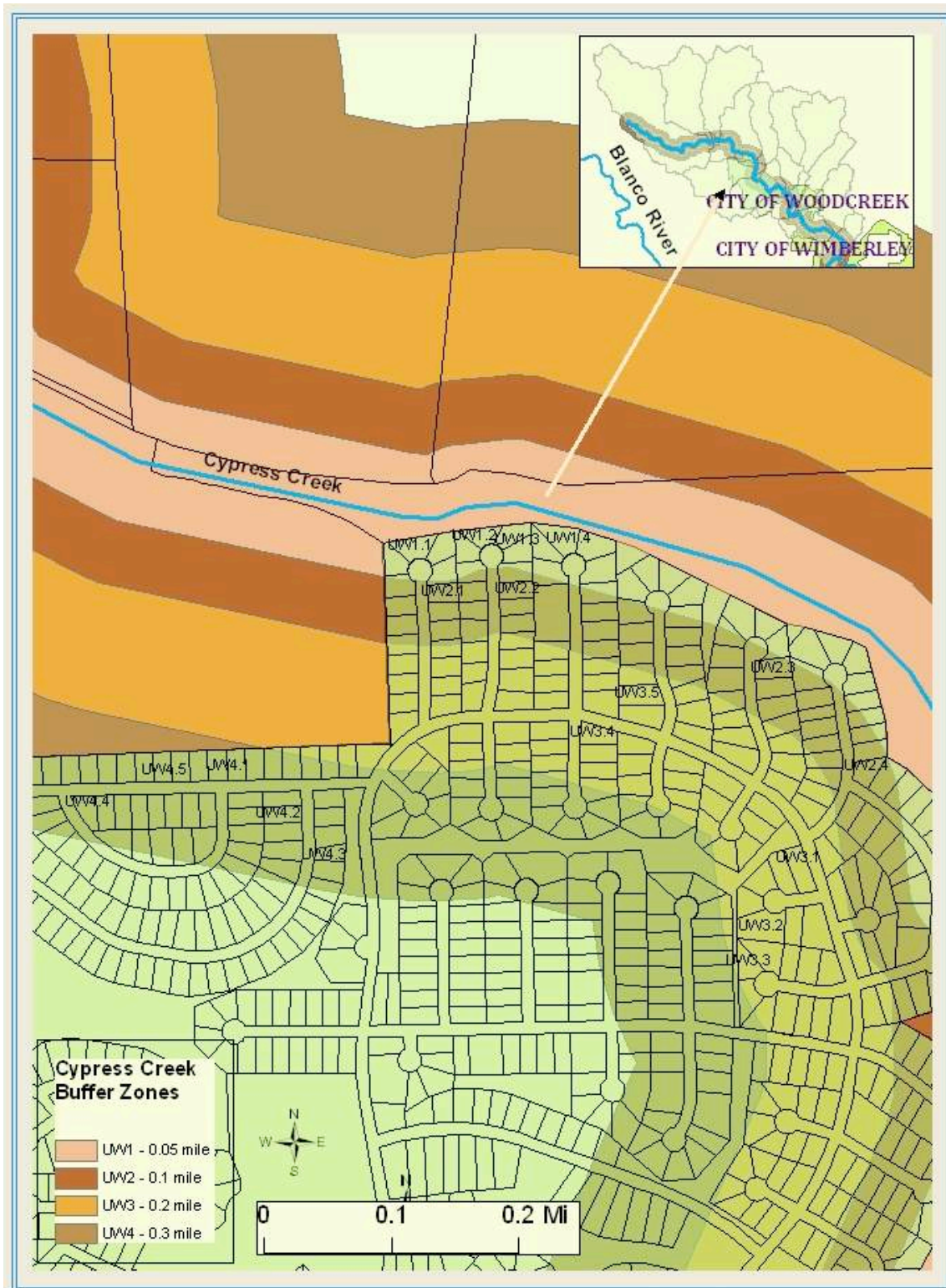


Figure C 3. Upper Woodcreek Subdivision, Dry Creek.

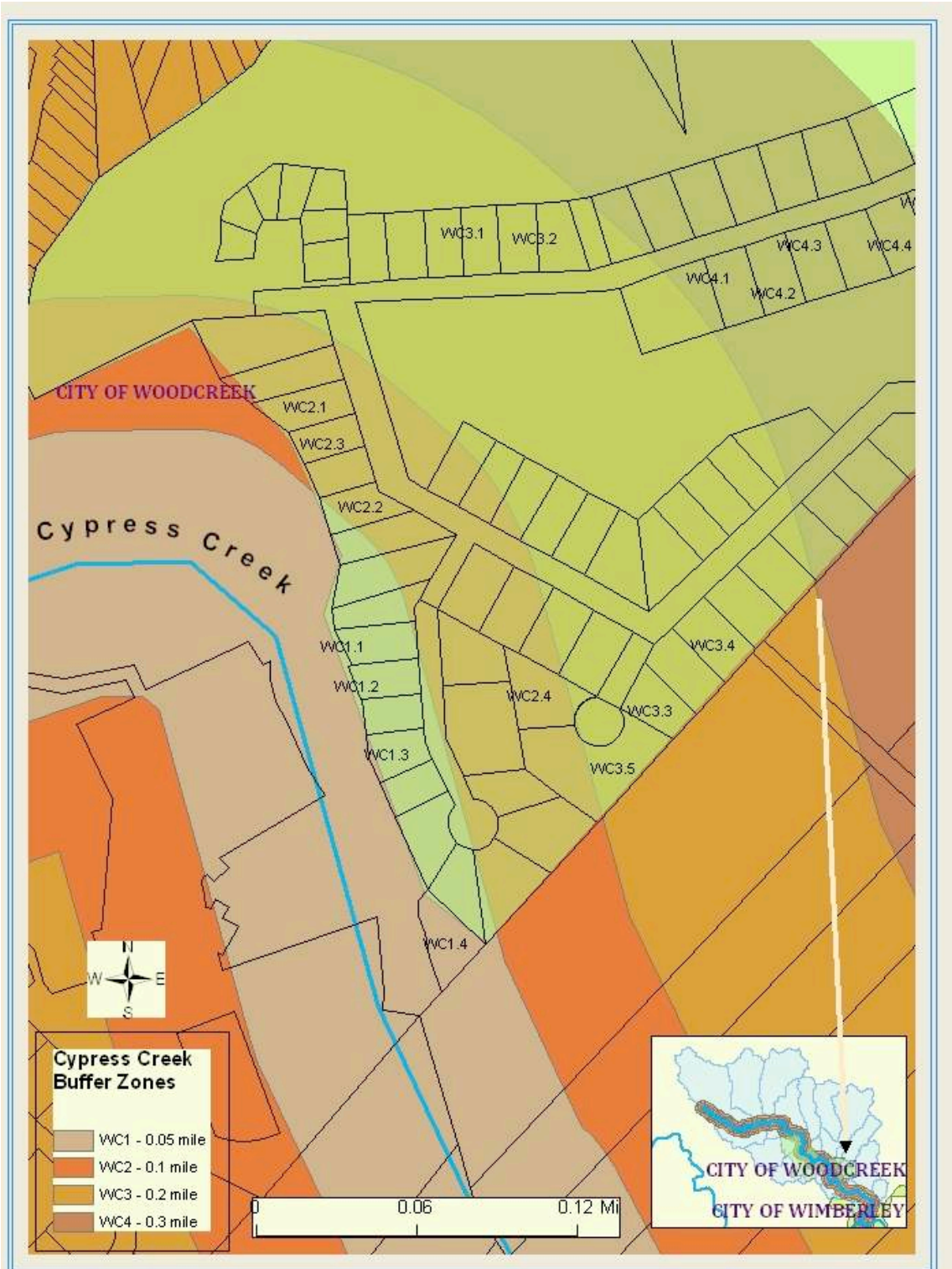


Figure C 4. Woodcreek Subdivision, Dry Creek.

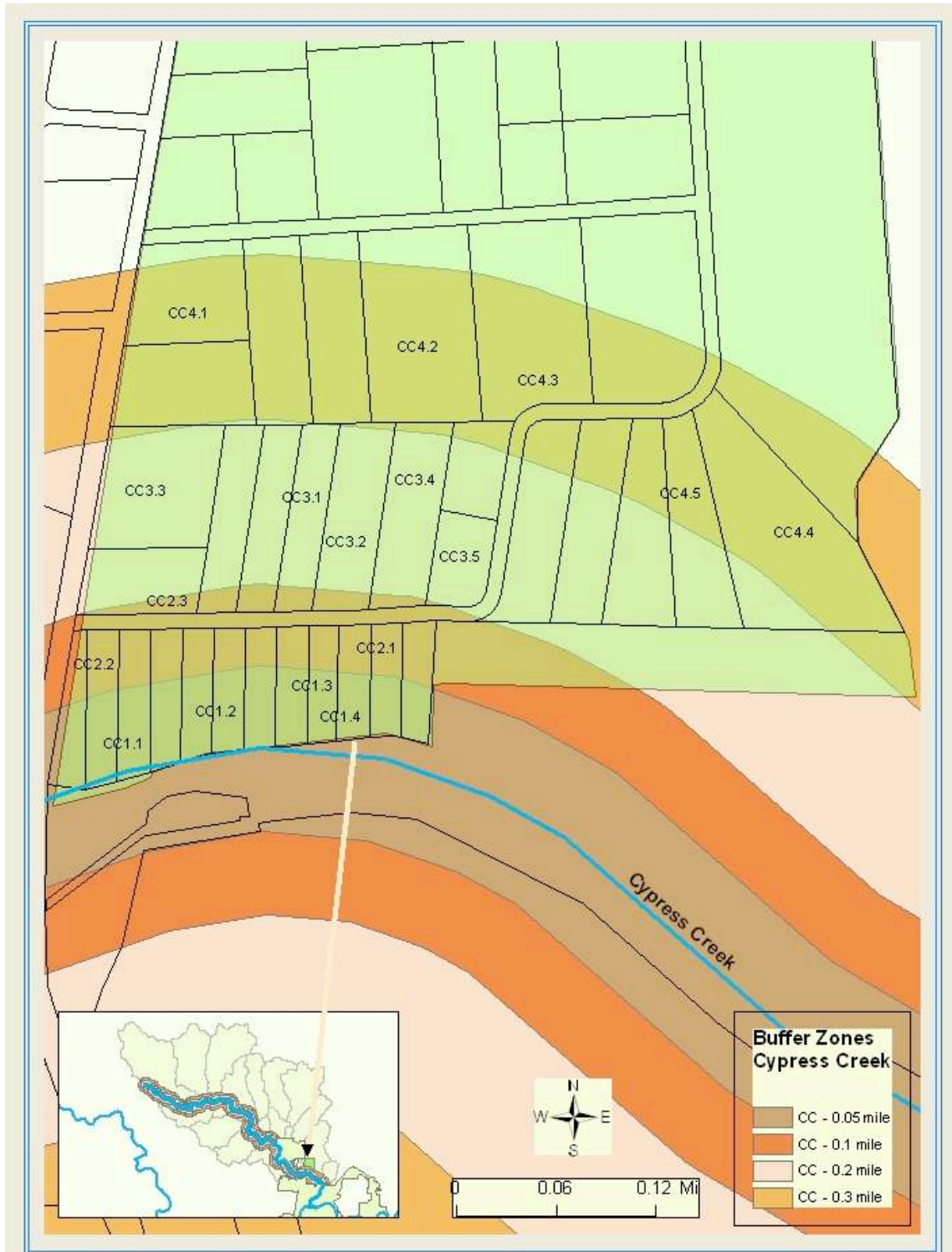


Figure C 5. Cypress Creek Acres Subdivision, Wet Creek.

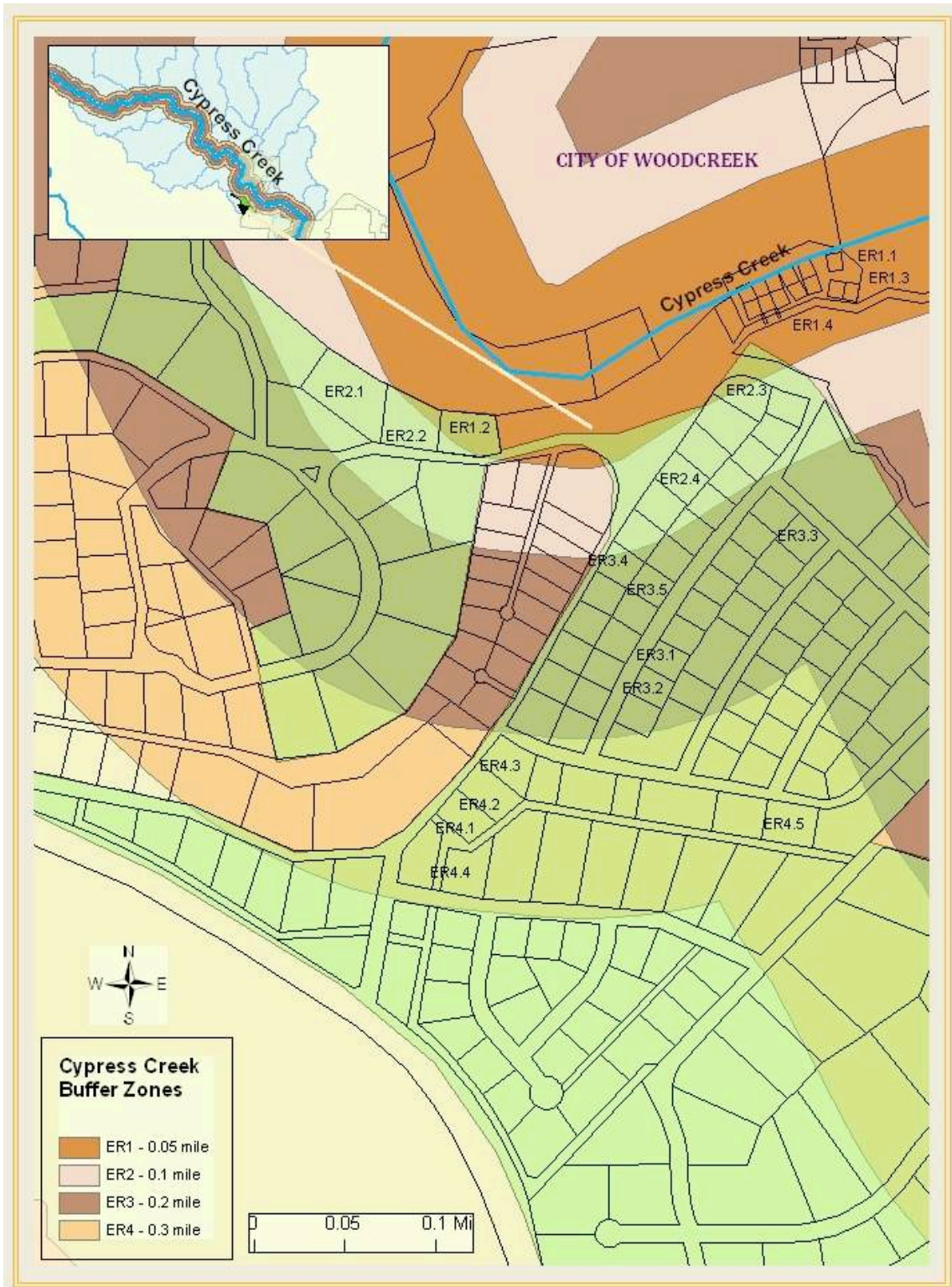


Figure C 6. Eagle Rock Ranchitos Subdivision, Wet Creek.

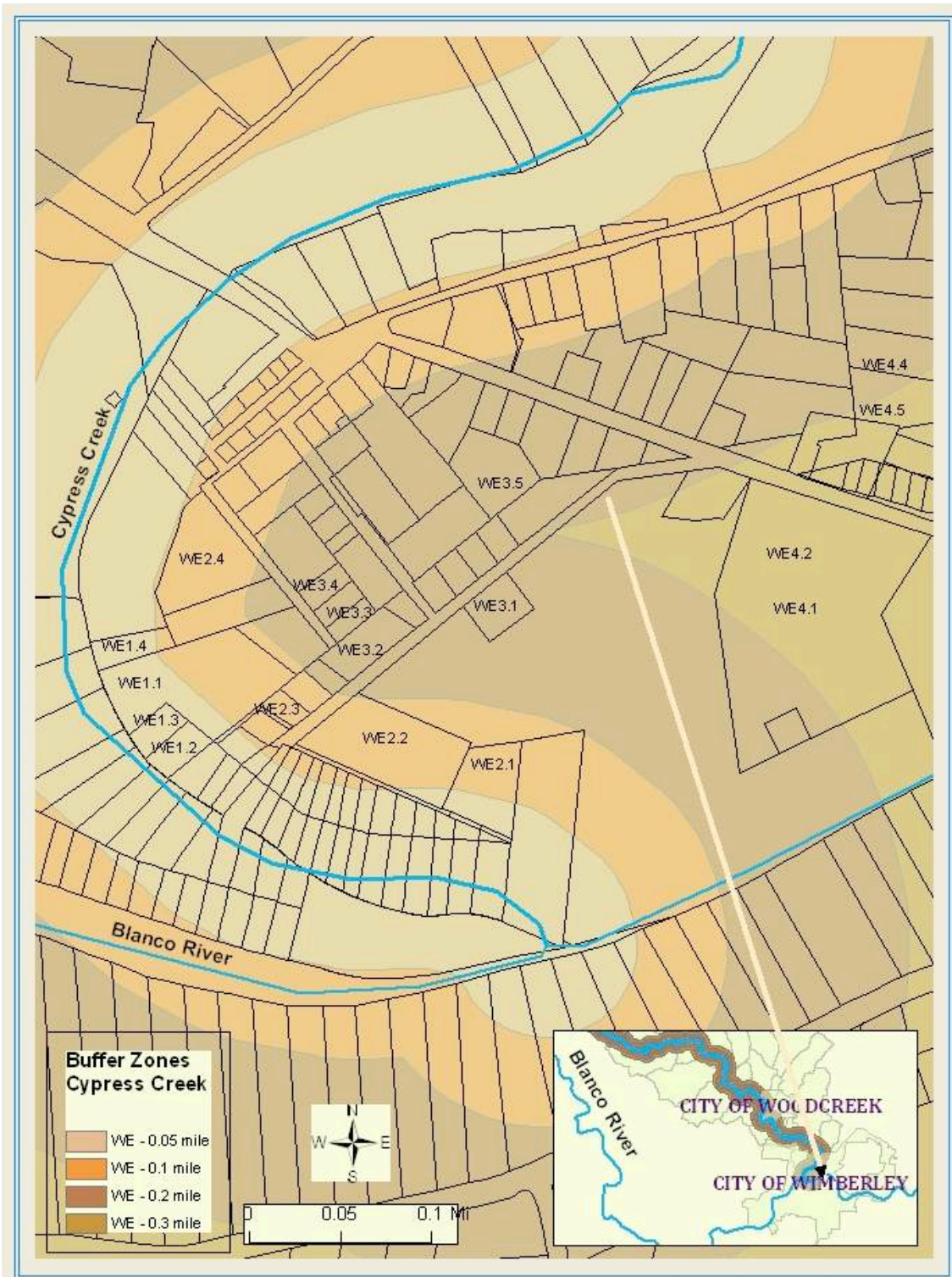


Figure C 7. Wimberley East, Wet Creek.

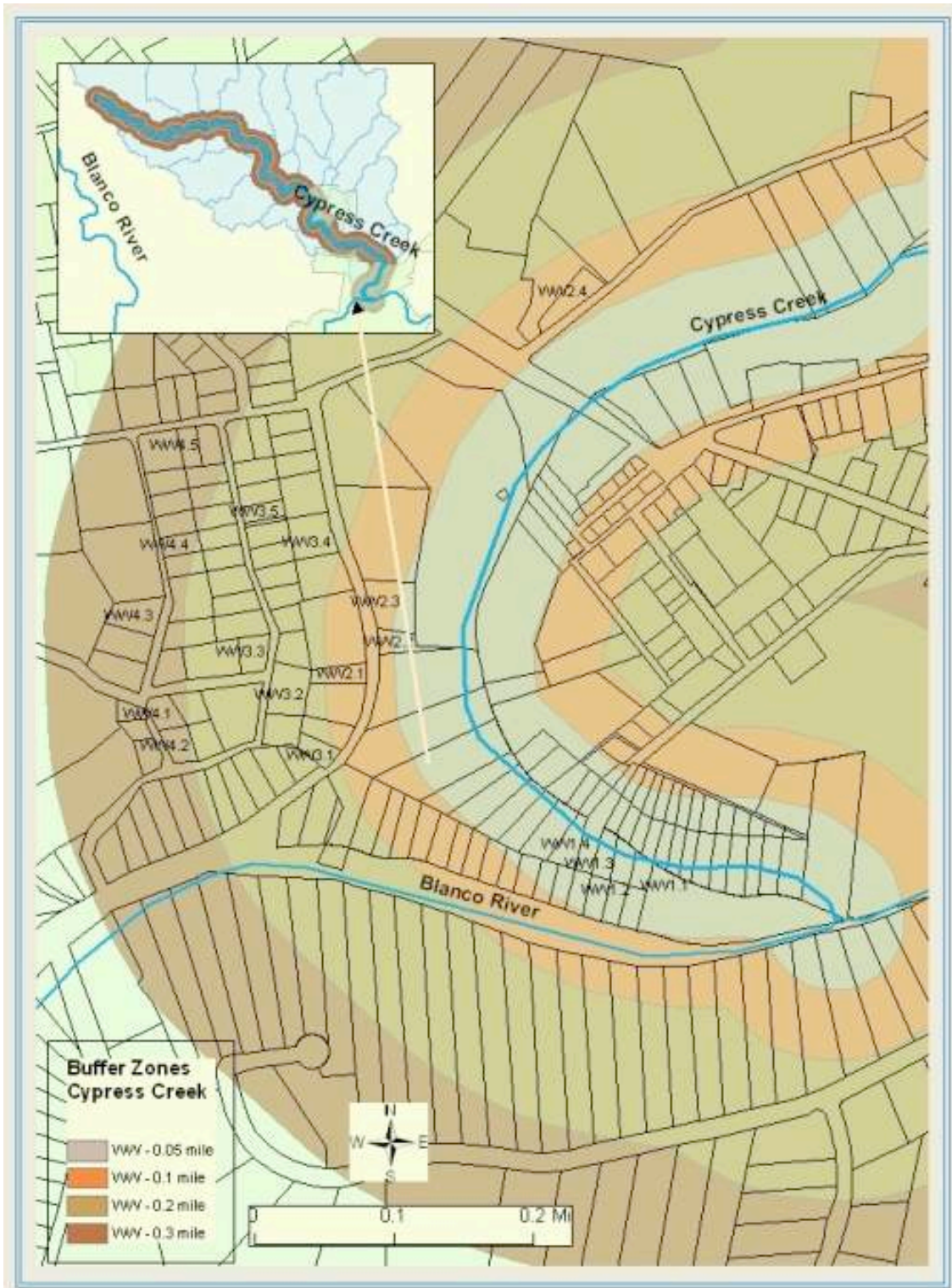


Figure C 8. Wimberley West, Wet Creek.



Appendix D: Data Collection Sources

Data Collected via Internet

- Population – Census data online
- Activities attracting visitors – shops/local businesses; Blue Hole Park opened last year. All other parks do not count visitors nor do the shops
- Local business data – US Census
- Sales revenues – City has budget and other financials listed on the website for approximately four years. Additional years can be obtained from City Archives
- Tax contribution – City has budget and other financials listed on the website for approximately four years. Additional years can be obtained from City Archives
- Employment income and salary expenditures – US Census
- US Census – Economic Forecasts contain some employment numbers. Quantity and salary range can be historically searched.

Interview with Don Ferguson – City Manager, Wimberley

- Bed & Breakfast Industry – on the comptroller's site or office
- Financial Impact from Market Days – City keeps info on this but not sure how accurate the numbers will be for our use
- Sales Tax – historical numbers are on the City's financials section of website and additional years can be obtained from City archives/offices
- Business Tax – on the comptroller's site or office
- Lodging – limited information obtained through Chamber of Commerce
- Comptroller's website – hotel tax receipts and sales tax information
- The Cypress Creek Study – information regarding home valuation information was given to Cypress Creek staff
- Number of tourists per month – No way to count this at the city level
- City Expenditures to support tourism – the City's financials will indicate expenditures for infrastructure but not sure if we know if it is for tourism or maintenance. We know direct expenditures Blue Hole can be attributed to tourism.
- Local business data – limited information obtained through Chamber of Commerce



- Employment income and salary expenditures – City does not have this info

Visitors

- Wimberley Chamber of Commerce – WHAT IS DATA? spread sheet via email
- Lions Club – WHAT IS DATA? spread sheet via email
- Emily Ann Theater (events throughout the year) – WHAT IS DATA? spread sheet via email
- Blue Hole – Number of visitors to the park, online the Wimberley website/city records
- Economic Impact from Market Days – City maintains financial records, but unsure of accuracy for our use

Comptroller

- Comptroller's office provided an excel spread sheet per public records request that included 10 years sales tax data
- Length of stay – Comptroller's website or office
- B&B Industry – on the comptroller's site or office
- Lodging Impact – not sure how to determine this one
- Comptrollers website – hotel tax receipts and sales tax information

Hays County Tax Assessor

- Home values – gathered five years data for Wimberley Independent School District
- Land values – gathered five years data in the Wimberley Independent School District
- CAD GIS shapefiles – shapefiles for GIS land lot boundaries
- CAD excel spread sheets – Hays CAD office built the excel spread sheets used for GIS