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Whatcom County Farmland Property Values With and Without a Water Right

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Contents

Introduction

While watersheds in Whatcom County face a variety of issues, such as low in-stream flows in the summertime, a lack of healthy environment for salmon, and subsequently a low prey population for resident orcas, there is also a large amount of unpermitted water usage. In September 2017, Eric Hirst published a paper synthesizing his work with students Daniel Ashley, Ben Larson, and Rio Digby at Western Washington University on the prevalence of unpermitted irrigation in Whatcom County. That paper[1] identified 18,600 acres, roughly 38 percent of irrigated acreage, as unpermitted.

Whatcom County, outside of urban areas such as Bellingham and Ferndale and the Cherry Point industrial zone, is largely a rural, agrarian economy. Irrigation of agricultural land accounts for 70 percent of water use in the county during the summer months.[2] Irrigation over 5,000 gallons per day requires a water right, administered by the Washington State Department of Ecology. However, Ecology has noted that the Nooksack River Basin is over-appropriated,[3] and state law bars Ecology from issuing new water rights. In fact, it has been 30 years since new rights were issued. There has been no action from the State Legislature on this issue.

In the absence of this, and in the absence of true enforcement of water rights law, an informal network of irrigation has arisen in Whatcom County. While given the circumstances – lack of government action to rectify the situation – this is understandable, there are serious legal and environmental ramifications to the system that has arose.

The purposes of this paper are as follows:

1. To develop a methodology, using hedonic price analysis, to find the value of a water right for irrigated farmland in Whatcom County
2. To quantify the value to farmers of holding a water right through property values

To conduct this analysis, data on water rights and land-use patterns was used, alongside the GIS (Geographical Information Systems) methodology developed by Hirst, Ashley, Larson, and Digby, to identify parcels of irrigated land in Whatcom County and whether or not they had a right to their water usage. This data was cross-tabulated with property and sales data from the Whatcom County Assessor Database to create a database of parcels and their sales history. Finally, EViews, a statistical software package, was employed in a hedonic regression analysis to determine the effect that holding – or not holding – a water right had on agricultural property values.

No data is completely representative and assumptions are often necessary when conducting these analyses. The results must be understood through the limitations of the methods and data at the research team's disposal. Those are discussed in **Appendix C**.

Results, based on 463 property sales between 1984 and 2018, indicate that there could be significant potential economic and societal value attributable to both local farmers and Ecology if action is taken on this issue; however, concerns with existing data and lack of a complete dataset due to confidentiality

[1] Unpermitted Irrigation and Water Use in Whatcom County, Eric Hirst, September 2017
[2] A Comparison of Irrigation Water Rights and Crops Utilizing Irrigation in Whatcom County, Washington, Dan Ashley and Ben Larson, 2016
[3] Establishment of minimum water flows or levels-Authorized-Purposes. Wa. Stat. §§ 90.22.010, 1969

concerns make it difficult to present a definitive result. Simple analysis of the data, averaged over time, indicate that the value of a water right per acre may range from $4,150 to $7,100. If all acres currently lacking a legal water right were to obtain one, this would increase property values countywide by $77-132 million.

Regression analysis was less conclusive, with the provided variables unable to explain more than 24 percent of the variation in per-acre price. Noted issues with data quality (**Appendix C**) may explain some of this discrepancy, but as much data is held by government agencies and not directly available to the public (including data on sales of multiple agricultural parcels as part of one transaction), these issues could not be rectified in this report. The correlation coefficient on water rights in the analysis was 4485-4592 (depending on analyses), indicating that a water right may be worth nearly $4,500 per acre to sales value. This is a similar value to the simple averages analysis mentioned above, but may not be statistically significant due to the low explanatory power of the regression. Yet the closeness of the results (near ~$4,500) does corroborate their findings.

Methods

GIS Methodology

In order to join[4] our data, Geographic Information Systems software was used, specifically ESRI ArcGIS Pro. This software allowed the team to manipulate a spreadsheet, letting us join all farmland data based on location or through a shared attribute such as parcel ID.[5] The entire process is detailed in **Appendix A**.

Figure 1: GIS Analytical Process Flowchart

In summary, any Department of Agriculture Crop data outside of our study area (non-tribal farmland of Whatcom County) was eliminated from the region of analysis. The remaining area was then split by the Department of Ecology Water Right data, based on whether the crop field had or did not have a water right. Wetland areas were removed from acreage and farmland was combined back together based on parcel ID. Finally, the total acreage of farmable land was calculated using the area of the farmland GIS shapefile. This methodology was based on the work done in the 2017 Hirst paper.

Property Sales Methodology

Data from the GIS process was exported into an excel spreadsheet with parcel IDs and notable characteristics. This was fed into a computer script that searched the Whatcom County Assessor's Database by parcel ID and pulled all property sales data associated with the ID. Not all properties had sales data on the Assessor's website, while some properties had multiple sales throughout time.

In order to sort through this new data, the Center met with Nav Narwal and Rick Lindemulder, who are Pacific Northwestern realtors with experience in agricultural property sales. Through this, the Center learned that there are a variety of types of sales, some of which do not accurately represent the value of the property. For example, a special warranty deed sale is when a home is sold after foreclosure, meaning these properties are typically sold well below market value. The center decided to exclude sale types that would inaccurately represent the value of the property and focus only on sales that had no special circumstances. Information on sales included, excluded, and numbers of types of sales can be found in **Appendix B**.

After determining the type of sales data was most applicable and clearing unnecessary sales out of the database, land use codes were pulled from the Assessors website using a similar computer script to property sales. Once every parcel/transaction had been assigned a land use code, aerial imagery and parcel boundary data was used to confirm that each parcel was being used for agriculture. This was

[4] Join is a GIS term which means to combine two different datasets based on one shared value
[5] A explanation of the difference between crop fields and parcels can be found on page 6

done to account for possible errors due to combining so many disparate data sources. Aerial imagery was used to check properties that were zoned:

- 81 (agriculture (not classified under current law))
- 82 (agriculture related activities)
- 83 (agriculture classified under current use)
- 11 (household, single family units)
- 12 (household, 2-4 units)
- 13 (household, multiunit (5 or more))
- 14 (residential condominiums)
- 15 (mobile home parks or courts)

Four parcels that were zoned 83 were revealed by this method to be suburban homes, and were removed. There were also seven parcels zoned 11 that included irrigated agriculture which were included in the analysis.[6] Other parcels with assorted land use codes were cut later on in the analysis due to acreage restrictions, discussed below.

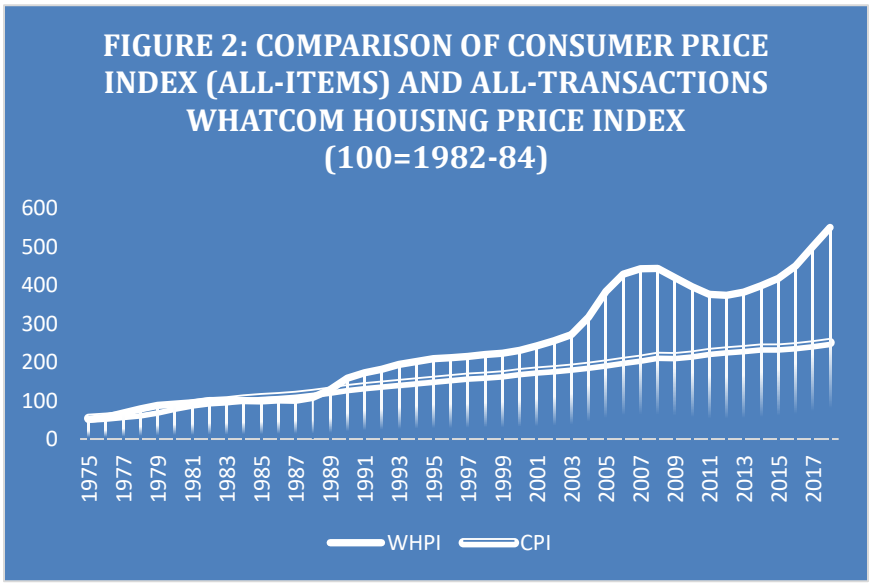


FIGURE 2: COMPARISON OF CONSUMER PRICE INDEX (ALL-ITEMS) AND ALL-TRANSACTIONS WHATCOM HOUSING PRICE INDEX (100=1982-84)

Once confident that the parcels in the database were being used for agriculture, the next step was to adjust their sales value for inflation using both the Consumer Price Index (CPI) for the nation and Whatcom's Housing Price Index (HPI) from 2017. Using the deflated values the sale price was divided by the total irrigated acreage in order the get the price per irrigated acre under each scenario (CPI and HPI). There were a total of 463 transactions gathered between 1984 and 2018 after all of this adjustment; 302 of these occurred since the year 2000.[7]

In calculating acreage, the Center noticed some discrepancies in parcel acreage between our data sources: Department of Agriculture Crop Distribution, and the Whatcom County Assessor, and the parcels shapefile. They differed by significant amounts in some instances. These discrepancies were found to be the result of differing methodology.

[6] There were large discrepancies between the GIS shapefile and Assessor's database about the size of these parcels, but aerial photography clearly revealed them to be larger farms, ranging from ~40-90 acres.
[7] For comparison, the 2017 Census of Agriculture showed a total of about 1,700 farms in Whatcom County.

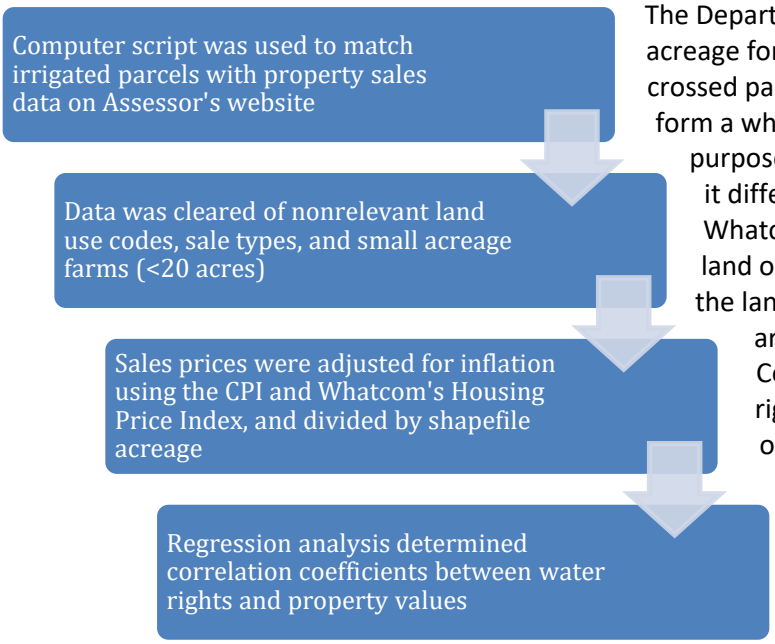


Figure 3: Sale Price Analytical Process

The Department of Agriculture data defined their acreage for whole *fields of farmland*, which often crossed parcel lines or combined with other fields to form a whole parcel. Although this is accurate for their purposes, measuring the total amount of farmland, it differs from how the land is sold – as *parcels*. The Whatcom County Assessor's Database included all land on a parcel, including non-farm land, such as the land occupied by houses. Although these homes are being purchased along with the land, the Center was looking for the value of a water right per acre of irrigated land and therefore only needed the size of all irrigated acreage per parcel. Our water right (WR) and non-water right (NWR) shapefiles, generated through GIS using crop field and parcel data, were the most accurate to show the acreage of irrigated farmland by parcel.

Finally, data on inflation adjusted, per-acre sales price, acreage, date of sale, and whether or not a parcel had a water right were entered into the statistical package EViews. This was used to build a regression to determine the impact a water right had on sale value of agricultural land. The variables considered (both utilized and not utilized) are listed on the next page in **Table 1**.

A brief overview of all data sources used in this analysis is included in **Appendix E**.

Table 1: Explanatory Variables in Hedonic Price Model		
Variable	**Description**	**Used / Not Used Due to Statistical Insignificance**
ACRE	The acres of irrigated agriculture on the parcel, to assess effects of economies of scale	Used
DAY	The oldest sale in the database was marked as day 0, with subsequent sales marked with a number equal to the days since sale 0, to account for any other time-related effects	Not Used
DUMWATER	A dummy variable assigned to properties with a water right (1 = water right, 0 = no water right)	Used
PPIR	The producer price index for raspberries	Not Used
PPIB	The producer price index for blueberries	Used
PPIM	The producer price index for raw milk	Not Used
WHPI	The Federal Housing Finance Agency's All-Transactions home price index for Whatcom County, to account for the different and faster inflation homes experience	Used
SQFT	The square footage of a house on the property, to better approximate home value separate from land value	Not Used
FULLB	The number of full bathrooms in the house on the property, to better approximate home value separate from land value	Not Used
HALFB	The number of half bathrooms in the house on the property, to better approximate home value separate from land value	Not Used
BDRM	The number of bedrooms in the house on the property, to better approximate home value separate from land value	Not Used
REALCONTRACT	A dummy variable that indicates if a sale is a real estate contract or not, which may contain other unlisted properties in the sale	Not Used

A number of assumptions and limitations were involved in the methodology of this paper and are detailed in **Appendix C**.

Results

Scenario 1 (CPI)

All results below were inflation-adjusted by the Consumer Price Index to be in 2017 dollars.[8] Analysis found that over the time period of 1984-2018, properties with a water right indicated a consistent price boost per-acre compared to properties without a water right. In earlier years, namely 1984-1998, the price differential is small enough that drawing conclusions about a statistically significant difference between the two property types (water right and no water right) is difficult. However, beginning in 1999 and culminating in the period from 2009-2013, the value of an acre holding a water right increased much faster than the value of non-water right acres, although both property types increase at rates above those seen in the prior decades. It appears that since 2014 the value of an acre holding a water right began to converge again with non-water right acres. These data are found in **Table 2** and **Figures 4 and 5**.

SCENARIO 1
Water Right Value

- *$4,150-$7,100 per acre*
- *$77-132 million countywide*

Table 2: Avg. Market Value Per Acre of Irrigable Farm Land in Whatcom County								
Water Right				No Water Right				
Year	Average property value	Number of properties (n=279)	Annual Percent Change	Year	Average property value	Number of properties (n=184)	Annual Percent Change	Difference
84-88	$10,035	15		84-88	$8,170	13		$1,865
89-93	$10,520	30	0.9%	89-93	$9,829	16	3.8%	$691
94-98	$12,111	41	2.9%	94-98	$11,372	27	3%	$738
99-03	$12,758	30	1.0%	99-03	$9,753	23	-3.0%	$3,005
04-08	$25,895	63	15.2%	04-08	$18,776	29	14%	$7,119
09-13	$30,352	55	3.2%	09-13	$20,045	30	1.3%	$10,307
14-18	$27,296	45	-2.1%	14-18	$26,227	46	6%	$1,069
						Weighted[9] Avg. Difference		**$4,151**

Figure 4 indicates the average difference between water right and non-water right properties over the time period of the study. As can be seen in **Figures 4 and 5**, the largest difference occurs in the period from 2009-2013. Using a weighted average of sales over the whole time period, the average difference between properties with and without a water right is $4,151 (2017 dollars). Assuming that no other variables differentiate the properties in our sample besides whether or not they have a water right, the above number can be considered a reasonable approximation of the value of a water right in Whatcom County. Multiplying this value by the number of acres without a water right in Whatcom County (18,600 acres) reveals that the total market value for water rights in Whatcom is approximately $77 million.

Calculating the value of a water right using just the past decade of data, when the water right began taking on a greater value, give a per-acre value for a water right at $7,100. Multiplying this by the 18,600 acres of unpermitted irrigation gives an overall value of $132 million. This data can be seen in **Appendix D**.

[8] U.S. Bureau of Labor Statistics, *Consumer Price Index for All Urban Consumers: All Items (seasonally adjusted)*
[9] Weighted by number of sales

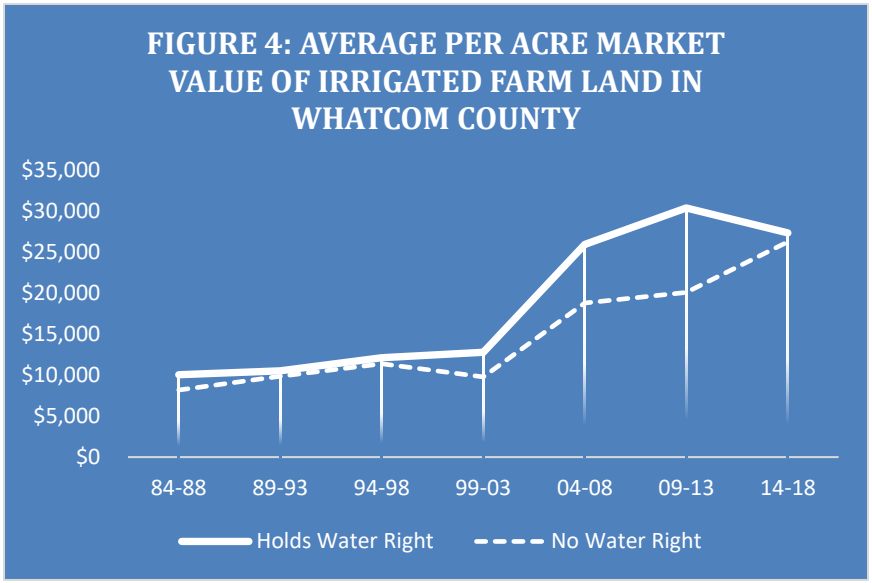


FIGURE 4: AVERAGE PER ACRE MARKET VALUE OF IRRIGATED FARM LAND IN WHATCOM COUNTY
$35,000
$30,000
$25,000
$20,000
$15,000
$10,000
$5,000
$0
84-88
89-93
94-98
99-03
04-08
09-13
14-18
Holds Water Right
No Water Right

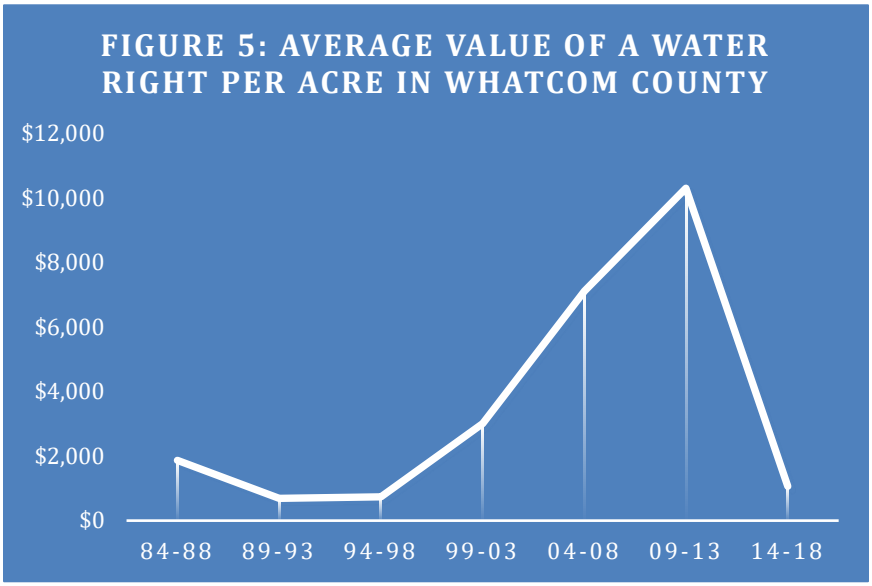


FIGURE 5: AVERAGE VALUE OF A WATER RIGHT PER ACRE IN WHATCOM COUNTY
$12,000
$10,000
$8,000
$6,000
$4,000
$2,000
$0
84-88
89-93
94-98
99-03
04-08
09-13
14-18

Scenario 2 (WHPI)

All results below were inflation-adjusted by the All-Transactions House Price Index for Whatcom County, WA to be in 2017 dollars.[10] Analysis found that over the time period of 1984-2018, properties with a water right indicated a consistent price boost compared to properties without a water right. In earlier years, namely 1984-1998, the price differential and/or sample sizes are small enough that drawing conclusions about a statistically significant difference between the two property types (water right and no water right) is difficult. However, beginning in 1999 and culminating in the period from 2009-2013, the value of a water right property increased much faster than the value of non-water right properties, although both property types increase at rates above those seen in the prior decades. It appears that since 2014 the value of an acre holding a water right began to converge again with non-water right acres. These data are found in **Table 3** and **Figures 6 and 7**.

SCENARIO 2
Water Right Value

- *$4,456-$6,824 per acre*
- *$83-127 million countywide*

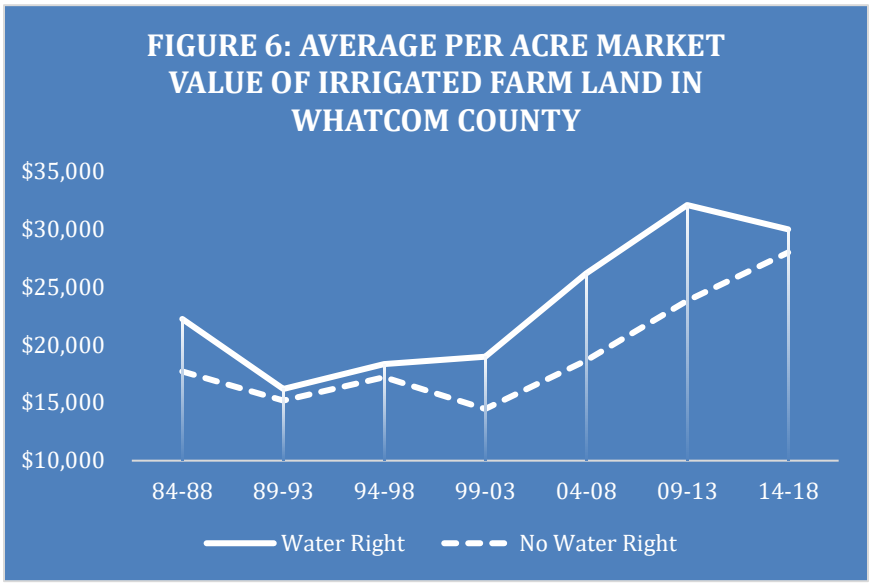
Table 3: Avg. Market Value of Irrigable Farm Land in Whatcom County								
Water Right				No Water Right				
Year	Average	Number of properties	Annual Percent Change	**Year**	Average	Number of properties	Annual Percent Change	**Difference**
84-88	$22,243	15		**84-88**	$17,698	13		$4,546
89-93	$16,190	30	-6.2%	**89-93**	$15,178	16	-3.0%	$1,012
94-98	$18,335	41	2.5%	**94-98**	$17,212	27	3%	$1,122
99-03	$18,965	30	0.7%	**99-03**	$14,466	23	-3.4%	$4,498
04-08	$26,157	63	6.6%	**04-08**	$18,650	29	5%	$7,507
09-13	$32,065	55	4.2%	**09-13**	$23,795	30	5.0%	$8,270
14-18	$29,961	45	-1.3%	**14-18**	$27,970	46	3%	$1,991
							Weighted Avg. Difference	**$4,456**

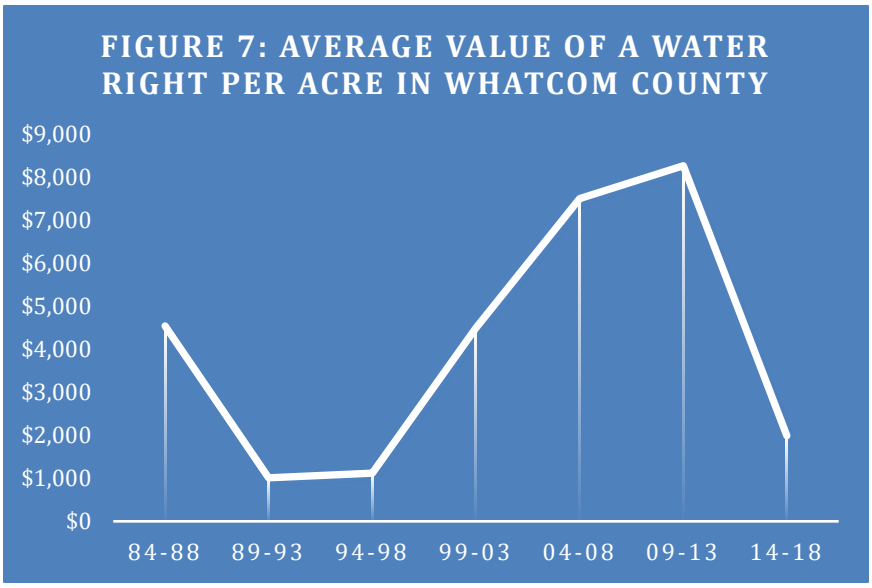
Figure 6 indicates the average difference between water right and non-water right properties over the time period of the study. As can be seen in **Figures 6 and 7**, the largest difference occurs in the period from 2009-2013. Using a weighted average of sales over the whole time period, the average difference between properties with and without a water right is $4,456 (2017 dollars). Assuming that no other variables differentiate the properties in our sample besides whether or not they have a water right, the above number can be considered a reasonable approximation of the value of a water right in Whatcom County. Multiplying this value by the number of acres without a water right in Whatcom County (18,600 acres) reveals that the total market value for water rights in Whatcom is approximately $83 million. While the value of a water right seems to vary considerably over time, and therefore so does the value of the market, this is a reasonable average.

Calculating the value of a water right using just the past decade of data, when the water right began taking on a greater value, give a per-acre value for a water right at $6,824. Multiplying this by the 18,600

[10] U.S. Federal Housing Finance Agency, *All-Transactions House Price Index for Whatcom County, WA*

acres of unpermitted irrigation gives an overall value of $127 million. This data can be seen in **Appendix D**. Interestingly, even when substituting the CPI for the WHPI as an inflation adjustment measure, the results are similar. This indicates that the method of inflation adjustment does not consequently affect the results of the analysis.





Weighted by Acreage

This report also analyzed the sales value by acreage, to determine if the size of a farm had any impact on the per-acre value of a water right. **Table 4** contains the results of the analysis. Properties with and without a water right were separated and then bundled into four different acreage categories. A mean per-acre sales price was calculated, and the difference between the water right and non-water right properties in each acreage category was found. Then, an overall weighted average was calculated at the bottom of the table. This resulted in an average per-acre sales price of $3,961. The average value of the water right seems partially but not consistently dependent on size, with larger farms receiving a greater per-acre value for a water right. More robust is the finding that per-acre prices in general decline as acreage increases, which held true for both water right and non-water right properties.

Table 4: Average Per-Acre Sales Price (CPI Adjusted) Weighted by Acreage			
Acreage	**No Water Right**	**Water Right**	**Difference**
20-29.9	$22,075	$25,195	$3,120
30-39.9	$16,817	$19,275	$2,458
40-59.9	$12,591	$18,934	$6,342
60+	$11,594	$17,839	$6,245
		Weighted[11] Avg Difference	**$3,961**

[11] Weighted by acreage

Regression Analysis

To conduct the above analysis in a more rigorous fashion, EViews statistical software was used to run least squares regression analysis on the data to determine if there was a statistically significant relationship between water right and per-acre sales price. The results of the regression are below in **Table 5**.

Table 5: Hedonic Regression Results Dependent Variable: CSALEPRICE (CPI-adjusted per-acre sale price) (n = 463, R^2 = 0.24)					
Variables	**Coefficient**	**Standard Error**	**P>t**	**95% CI[12] (Low)**	**95% CI (High)**
CONSTANT	-13057.75	8172.07	0.11	-29118.09	3002.60
ACRE	-161.23	46.67	0.00	-252.95	-69.51
DAY	-0.76	0.83	0.36	-2.38	0.87
DUMWATER	4484.75	1507.18	0.00	1522.74	7446.77
PPIR	319.26	280.97	0.26	-232.92	871.44
PPIB	499.62	231.27	0.03	45.10	954.13
PPIM	23.07	46.51	0.62	-68.33	114.48
WHPI	121.68	43.82	0.01	35.56	207.81
SQFT	1.10	1.91	0.57	-2.65	4.85
FULLB	-115.21	1889.45	0.95	-3828.50	3598.07
HALFB	2779.80	2337.76	0.24	-1814.54	7374.15
BDRM	-209.51	1084.45	0.85	-2340.74	1921.73
REALCONTRACT	2207.81	1915.24	0.25	-1556.17	5971.78

The coefficient for water rights was found to be 4484.75, indicating a nearly $4,500 value per-acre to a property with permitted irrigation.

As can be seen above, many variables considered were not found to have any statistically significant explanatory power. This can be found in the column **P>t**, where values roughly larger than 0.04 are statistically insignificant (excluding the constant). These include variables on the day of the sale, the producer price indexes for raspberries and milk (significant agricultural products in Whatcom County), various housing variables (such as square footage and the number of bathrooms/bedrooms), and sale type. The overall regression resulted in relatively low R^2 value, at 0.241. This indicates that the variables in the equation only explained 24 percent of the variation in per-acre sales price seen in the data.

Rerunning the analysis and using only statistically significant results returns the results in **Table 6**.

[12] Confidence Interval: this means that we can state with 95% confidence that the mean value of the correlation coefficient exists between the high and low bounds of the confidence interval. Of course, this is dependent on the predictive power of the overall regression (a regression can have a 95% confidence interval no matter how strong its predictive power).

Table 6: Hedonic Regression Results Dependent Variable: CSALEPRICE (CPI-adjusted per-acre sale price) (n = 463, R^2 = 0.23)					
Variables	Coefficient	Standard Error	P>t	95% CI[13] (Low)	95% CI (High)
CONSTANT	-1661.58	3665.89	0.65	-8865.63	5542.47
DUMWATER	4592.21	1472.34	0.00	1698.84	7485.58
ACRE	-158.39	43.62	0.00	-244.10	-72.67
WHPI	110.14	21.07	0.00	68.72	151.55
PPIB	396.08	191.05	0.04	20.64	771.51

Notice that the coefficient on water rights (DUMWATER) increased slightly to 4,592, indicating that $4,592 of each per-acre sale value is attributable to the presence of a water right. This exists within a 95 percent confidence interval of $1,699-$7,485. The R^2 value is slightly lower for this regression, at 0.23, indicating it is marginally less explanatory of the existing data than the previous regression.

Conclusions and Further Research

Numerous questions arose during this research that were either outside the scope of this study or lacked quality data but would help inform and expand upon these results. For example, future research could examine the relationship between crop type and the value of a water right. For example, berry farming is more water intensive than hay farming. Unfortunately, there is a lack of data on different crops farmed by parcel over time. Soil type was considered as a proxy for crop type; however, most of Whatcom County has the same type of soil.

One unanswered question behind this research is the reason behind the price bump that occurs from 1999-2018 in both water right and non-water right properties. One possible explanation is that farmers were more worried about Ecology's enforcement of legal water rights during that time period, but that does not explain the growth in non-water right property value as well. The most likely reason that would cause landowners to worry about water right enforcement was the Hirst Decision, but that decision occurred years after the time period featuring the jump in prices. Overall land scarcity or the price of certain farm products, such as raspberries, offer promising leads but were not explored by this paper. Furthermore, the decline in value seen in the most recent time period also offers avenues for further research.

Overall, the analyses presented here show remarkable convergence: the incremental value of farmland with a water right is about $4,500 relative to farmland without a water right. Applied to the roughly 18,600 acres of irrigated land that lack a water right suggests an aggregate implicit value of $84 million. In other words, if Ecology and the farmers (along with the two Native American tribes) worked together, farmers would be able to "unlock" $84 million of value in their property. Surely this is a large enough incentive to stimulate some serious problem solving in Whatcom County.

[13] Confidence Interval: this means that we can state with 95% confidence that the mean value of the correlation coefficient exists between the high and low bounds of the confidence interval. Of course, this is dependent on the predictive power of the overall regression (a regression can have a 95% confidence interval no matter how strong its predictive power).

Appendix A: GIS Processing

GIS Data

Finding the value of a water right per irrigable acre first required finding the total farmable land belonging to each parcel. WSDOA keeps track of registered farm fields, monitoring their crop type, irrigation, and total acreage. Their data is presented as a shapefile; polygons showing the land within each WSDOA-recognized farm field for the entirety of the state. These fields often extend throughout several parcels under a single owner. Identifying whether a field does or does not have a water right required the WSDOE Water Rights database, accessible as a spreadsheet, again for the entire state.

Our study area includes all of Whatcom County, excluding tribal land due to different jurisdictions. While watersheds often cross tribal (and international) boundaries, we limited this report to the aforementioned geography, in line with the analysis of the 2017 Hirst report. Therefore, the WSDOA Cropland and Water Rights Data had to be restricted down to just the county.

A shapefile for Whatcom County, accessed from Western Washington University Huxley College's GIS data, was used to remove any data outside the study area. Additionally, tribal land data was removed because each tribal land has water rights built into the treaties that define their land. The WSDOE Tribal Lands shapefile was used to remove this land from our dataset. Finally, because these WSDOA cropland data included some land registered as a wetland according to Whatcom County, and these areas are restricted, and not practical for agricultural use, these areas were removed based on the "Whatcom County Critical Area Wetlands" shapefile.

All data used is listed below:

1. WSDOA "Agricultural Land Use" (2015)[14]
2. WSDOE "Geographic Water Information System" (2015)[15]
3. WSDOE "Tribal Lands of Washington" (2015)[16]
4. Whatcom County "County Boundary" (2015)[17]
5. Whatcom County "Parcels" (2018)[18]
6. Whatcom County "Wetlands" (2018)[19]

Process

Done through previous iteration of the CEBR project in 2015-16:

1. All input datasets were projected into NAD 1983, NSRS 2007, State Plane Washington North FIPS 4601 (US Foot) – *(Project Tool)*
2. The datasets for Crop Distribution and Water Rights were clipped to the extent of Whatcom County, then all tribal lands areas within the datasets were removed *(Clip, Erase Tools)*
3. Crop Distribution datasets were joined to the Water Rights Data by location *(Spatial Join Tool)*

[14]Washington State Department of Ecology, "Agricultural Land Use", 2015.
[15] Washington State Department of Ecology, "Geographic Water Information System", 2015.
[16] Washington State Department of Ecology, "Tribal Lands of Washington", 2015.
[17] Whatcom County, "County Boundary", 2015.
[18] WWU Huxley Spatial Analysis Lab Data,"Parcels", 2018.
[19] Whatcom County, "Wetlands", 2018. Retrieved from https://www.whatcomcounty.us/716/Data.

4. All the Crop Distribution datasets that were also within Water Rights Dataset were saved as their own file. Those that weren't within the Water Rights Dataset were saved separately *(Select by Attribute and Export Feature)*

Done in this iteration of the CEBR project in 2018-19:

5. Both Water Rights (WR) and Non-Water Right (No WR) Agriculture Land were joined spatially and split into parcels using the parcel shapefile *(Identify Tool)*
6. Wetland areas were removed from both WR and No WR features *(Erase Tool)*
7. Because the identify tool in some cases split the land in the same parcels into two or more different shapes these had to be joined back together based on parcel ID *(Dissolve Tool)*
8. Acreage was calculated for all features in WR and No WR *(Calculate Geometry)*
9. Both WR and No WR features were exported to Excel to allow for sales data to be joined (Table to Excel)

The farmland with and without water rights are shown in the following figure (**Figure 7**) to further identify how these parcels are distributed spatially in Whatcom County, Washington.

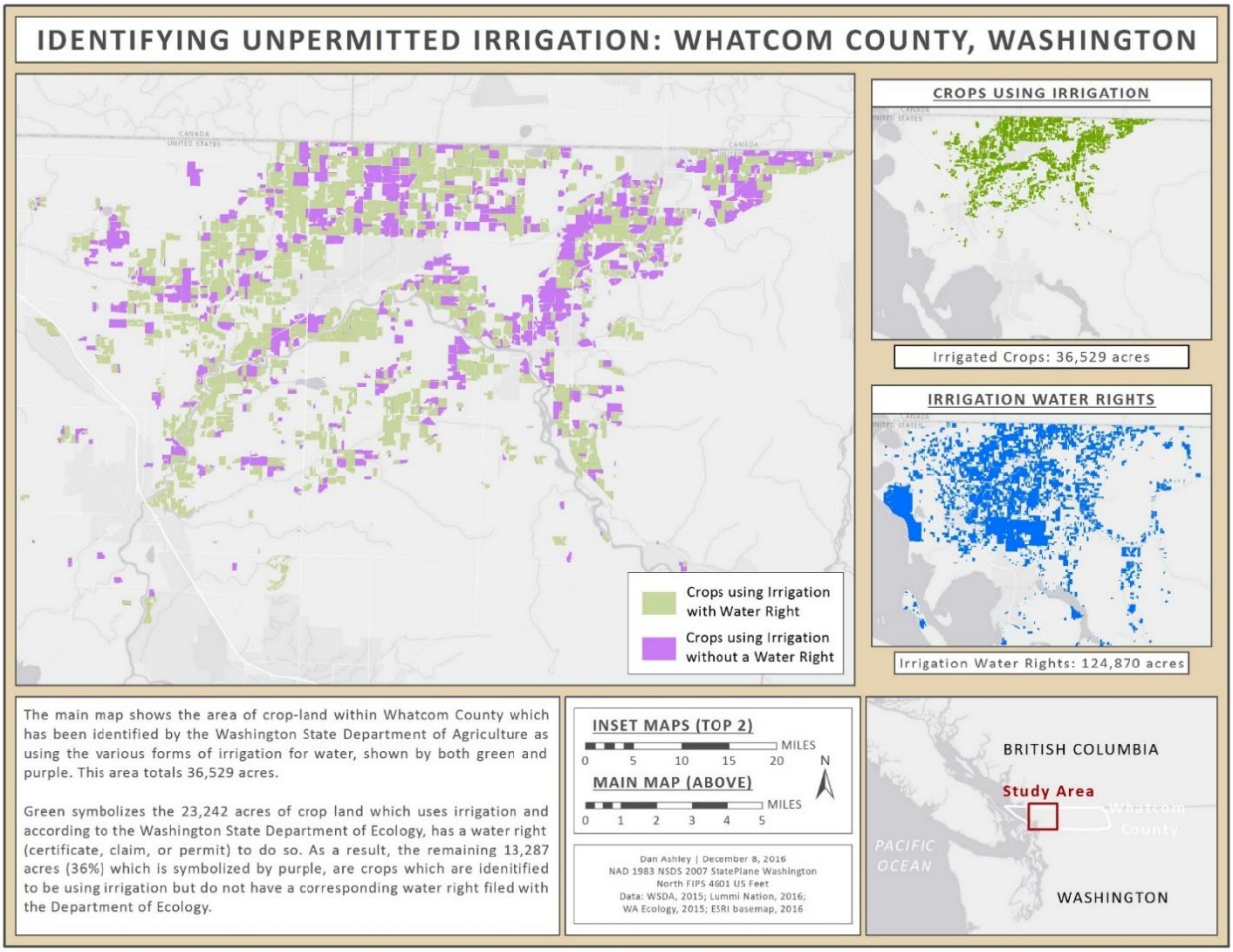


Figure 7: Identifying Unpermitted Irrigation: Whatcom County, Washington (Ashley and Larson, 2016)

Appendix B: Property Sales Definitions

Table A: Sale Types Used in Analysis		
Sale Type	**Explanation**	**Number of sales**
Personal Representative's Deed	Estate or personal representative sells the parcel	9
Warranty Deed	Standard way to transfer land	212
SWD	Same as warranty deed	142
Real Estate Contract	The bank owns the property until the loan is paid off	100
	Total	463

Table B: Sale Types Removed From Analysis	
Sale Type	**Explanation**
Grant Deed	Same as warranty deed
Quit Claim Deed	Transferring the interest to a kid, in a divorce, etc.
Excise Tax Affidavit	Sales tax
WD/Mobile Dual Document Trans	Sale of mobile home
Purchaser's Assign of Contract	An offer was made but the sale did not go through
Easement	A right to crop the land, among other misc. rights
Dept. of Licensing/Mobile Trans	Mobile home title transfer
Trustee's Deed	Property goes into bankruptcy and is sold by the bank The property is usually sold at a lower price
Executor Deed	Estate that is willed to someone
Bill of Sale	Personal property is sold along with the agricultural land
Boundary Line Agreement	Moving property line
Treasurer's Deed	Tax foreclosure that the county owns. The property is usually sold at a lower price
Right of Way Deed	Similar to an easement
Bargain &Amp; Sale Deed	Similar to a treasurers deed
M/H Title Elimination	Removal of a mobile or making it a permanent structure
Special Warranty Deed	Foreclosure sale The property is usually sold at a lower price
Seller's Assign of Contract	Transferring the loan to another company
Sheriff's Deed	Tax closure and seized by law enforcement. The property is usually sold at a lower price
Community Property Agreement	Adding someone to the deed (usually between a married couple)

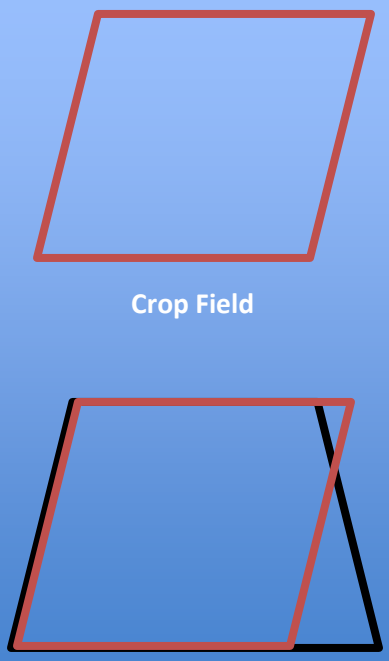
Appendix C: Assumptions and Limitations

Assumptions in the Methodology

When building any model, some necessary assumptions need to be made. During the model-building process, the Center discovered that a water right is assigned to a crop field rather than a specific parcel, meaning that a parcel could have both water right and non-water right crop fields within it.

The Center also discovered that there were geographical differences in the GIS data, which created a margin of error in the fields. Essentially, the parcels were drawn in ways that differed slightly from the crop fields, so that even shared boundaries were slightly off (see **Figure A**). In order to account for this margin of error, the Center determined what percentage of each parcel's acreage had a water right and defined a "water right parcel" as any parcel whose acreage was 90-100 percent covered by fields with a water right. We then defined any parcel that had 0-10 percent water rights acreage as a "non-water right parcel." 161 transactions with 11-89 percent of their acreage containing a field with a water right were removed from the analysis, totaling 34 percent of the final total sample size. These percentages (below 10 percent and above 90 percent) were based off of GIS analysis in Ashley and Larson's study.

Figure A: Example of Overlay Issues in GIS



The Center wanted to control for the value of any structures in a parcel. In order to do this we removed 497 transactions that involved a property smaller than 20 acres. This was done under the assumption that in properties smaller than 20 acres the structure would be a larger percentage of the land value, with the opposite true for properties over 20 acres. Data under 20 acres was extremely volatile, due to the undue influence of the home value on sales price.

Table C: Summary of Assumptions

Assumptions	Reasons
Parcels are completely water right or non-water right	The majority of the parcels were mostly water right or not
	Account for the margin of error in the GIS data
Removed parcels with less than 20 acres	The structure on properties larger than 20 acres would be a smaller percentage of the land value
	Data under 20 acres was extremely volatile, due to the undue influence of the home value on sales price.

Model Limitations

Due to the various necessary assumptions made in the model, there are limited application opportunities. For example, all properties smaller than twenty acres were removed in order to account for the value of any structures on the parcel, which has the potential to exclude smaller hobby farms. Naturally, land values increase over time as land becomes scarce relative to demand and general prices rise due to inflation. Since there is no agricultural property index that could be used to put all sales values across the time period of our analysis (1984-2018) in equivalent dollars, the Center utilized the national-level Consumer Price Index (CPI). The CPI includes a housing component which serves as a reasonable deflator to control for the effect of inflation on agricultural land values. To explore the effects of inflation-adjustment on the data, analysis was also conducted by adjusting the data using the All-Transactions Whatcom County Home Price Index. There is no literature to suggest whether one inflation adjustment measure is better than another for this specific instance – both contain data on changes in property values over time – but the similar results indicate that inflation adjustment is not a significant factor in the end results.

Another thing discovered during the analysis of the data was that certain properties were bought as a bundle. This caused the bundled sale value to be assigned to each parcel, which resulted in an inaccurately higher price per acre, due to the price being repeated across the parcels and not divided fairly amongst the whole sale of land. In order to determine the true cost of an individual parcel, the total cost was divided between the bundled parcels based off of the acreage of each parcel.

This bundling was sometimes explicit in the data, and sometimes not. For example, a parcel with a per-acre sales price of $164,000 (CPI-adjusted) was removed after it was determined that it was bundled with another, larger parcel with an unknown water right designation. This extra parcel in the sale was not explicitly listed in public databases; this information was provided by the Assessor's office. It is unknown how many other parcels were affected by this, although all sales before 2010 were transferred from an older database. Due to issues in transferring the data, these bundled purchases are not accurately represented in the data, as they are post-2010. This may present significant and unknown data issues affecting the per-acre sales value used in the analysis.

Appendix D: Changes in the Past Two Decades

Modern Table and Graph: Sales from 2000-2018 (CPI and WHPI adjusted)

This appendix is included to take a closer look at the period (2000-2018) in which the difference between the per-acre sales price of properties with and without a water right diverged most significantly. Coincidentally, this was also a time period in which most (65%) of the property transactions in the database occurred. While not every two-year period in **Table D** contains enough sales to do significant analysis, this provides a different perspective, indicating how contextual market variables may shape the value of a water right.

The results below indicate that the value of a water right, expressed through differences in per-acre sales values, grew nonlinearly from roughly $204 in 2000-01 to $19,514 in 2010-11. The value then fell through 2017, culminating in another spike up to $25,011 in 2018. It is unclear what changed about the agricultural property market in the first two decades of the 21st century to create such large per-acre values for properties with water rights.

Table D: Avg. Market Value Per Acre of Irrigable Farm Land in Whatcom County (CPI)						
Water Right			No Water Right			
Year	Average Property Value Per-Acre	Number of sales (n=178)	Year	Average	Number of sales (n=124)	Difference
2000-2001	$8,157.04	7	2000-2001	$7,953.15	8	$204
2002-2003	$17,746.89	9	2002-2003	$11,557.90	10	$6,189
2004-2005	$14,442.24	27	2004-2005	$9,912.28	9	$4,530
2006-2007	$28,375.41	17	2006-2007	$22,023.46	10	$6,352
2008-2009	$33,633.51	30	2008-2009	$23,989.58	17	$9,644
2010-2011	$35,031.14	24	2010-2011	$15,517.41	7	$19,514
2012-2013	$28,934.64	20	2012-2013	$20,287.93	17	$8,647
2014-2015	$23,010.26	26	2014-2015	$21,900.40	15	$1,110
2016-2017	$30,592.34	15	2016-2017	$28,919.64	26	$1,673
2018	$50,217.43	3	2018	$25,206.92	5	$25,011
				Weighted Avg. Difference		**$7,111**

Note: Cells marked red indicate low sample size

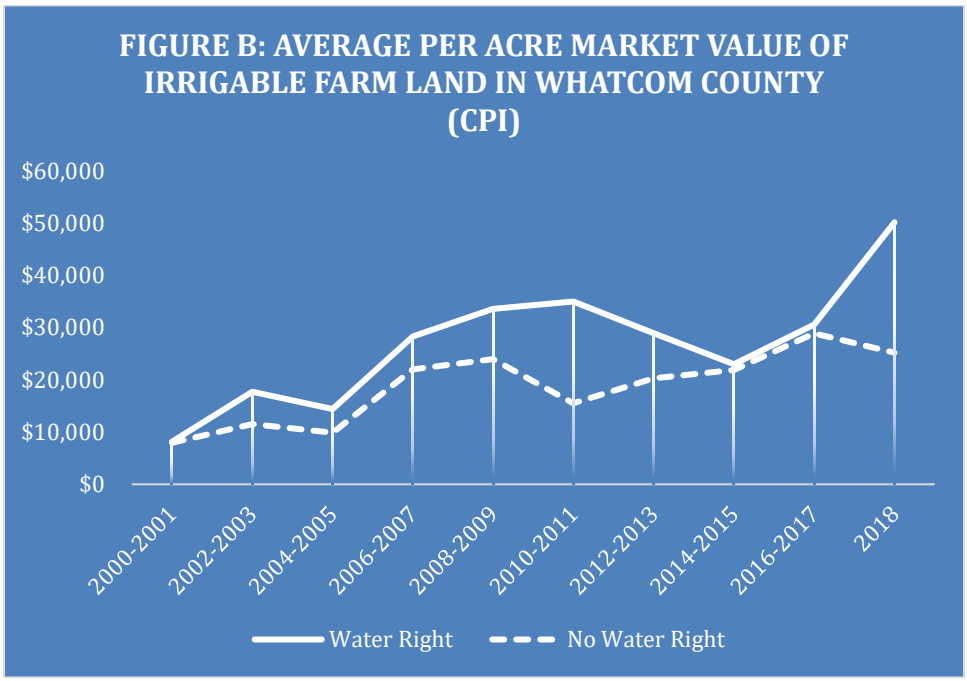
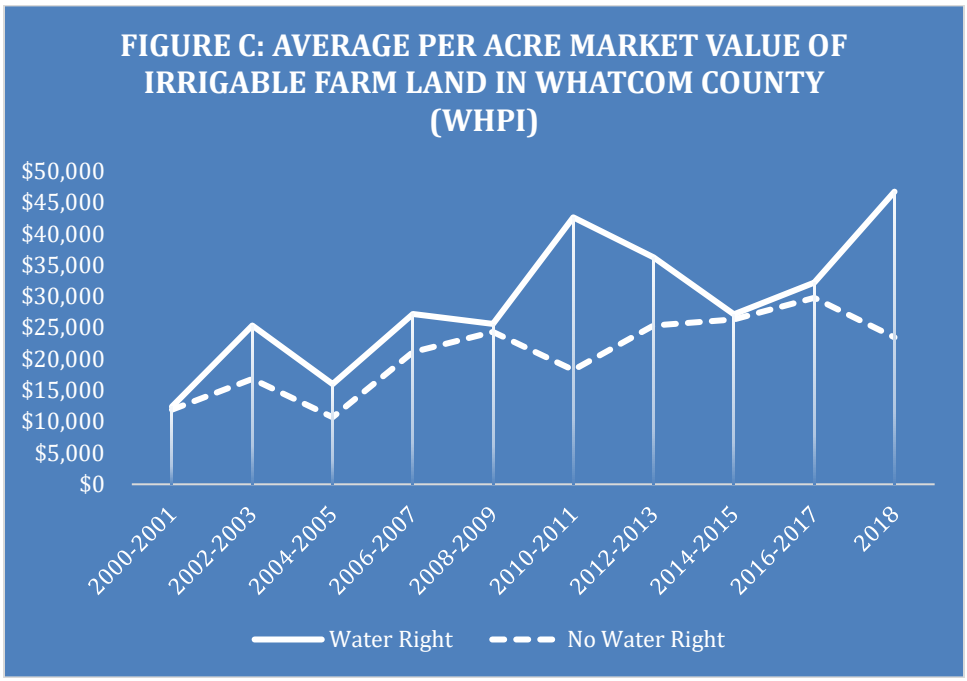


Table E: Avg. Market Value Per Acre of Irrigable Farm Land in Whatcom County (WHPI)						
Water Right			No Water Right			
Year	Average Property Value Per-Acre	Number of properties (n=178)	Year	Average	Number of properties (n=124)	Difference
2000-2001	$12,399.18	7	2000-2001	$11,941.55	8	$458
2002-2003	$25,376.90	9	2002-2003	$16,818.84	10	$8,558
2004-2005	$16,016.83	27	2004-2005	$10,715.51	9	$5,301
2006-2007	$27,224.88	17	2006-2007	$21,135.53	10	$6,089
2008-2009	$25,595.10	30	2008-2009	$24,326.78	17	$1,268
2010-2011	$42,656.76	24	2010-2011	$18,272.53	7	$24,384
2012-2013	$36,228.44	20	2012-2013	$25,381.76	17	$10,847
2014-2015	$27,146.30	26	2014-2015	$26,324.93	15	$821
2016-2017	$32,205.83	15	2016-2017	$29,785.73	26	$2,420
2018	$46,746.17	3	2018	$23,464.50	5	$23,282
					Weighted Avg. Difference	**$6,823.61**

Note: Cells marked red indicate low sample size



Regression Analysis

Results were less conclusive when running regression analysis on only the "modern" data. As indicated by the R squared value, only 15% of variability in per-acre sales prices was explained by the included variables. The coefficient for a water right was 7354, indicating that a water right is worth roughly $7,300 per acre. Full results are below in **Table F**.

Table F: Hedonic Regression Results
Dependent Variable: CSALEPRICE (CPI-adjusted per-acre sale price)
(n = 302, R^2 = 0.15)

Variables	Coefficient	Standard Error	P>t	95% CI (Low)	95% CI (High)
CONSTANT	-7149.69	7336.44	0.33	-21587.69	7288.31
DUMWATER	7354.99	2159.27	0.00	3105.59	11604.39
ACRE	-180.79	61.44	0.00	-301.71	-59.87
WHPI	104.43	45.92	0.02	14.06	194.79
PPIB	628.06	260.63	0.02	115.15	1140.97

Appendix E: Original Data Sources

Three main data sources were used to build the database necessary for this analysis. They are detailed below:

1. WSDOE hosts "Water Resources Explorer", a web tool allowing data on water rights to be stored and queried. Information for each permit includes the claim number, recipient, permit type, and parcels within the water right claim.
2. WSDOA annually releases a data set titled “Agricultural Land Use” to manage data for every piece of agricultural land in the state. This data set stores field identification information, spatial location, crop group and type, and irrigation method. Principal to this analysis was the location these agricultural lands.

Whatcom County Assessors "Property Search" stores information about property/parcels including address, acres, land use codes, tax valuations, and sales transactions for Whatcom County. Specific to our analysis was sales values and dates linked to individual parcels.