Environmental Hazards and Residential Property Values: Evidence from a Major Pipeline Event

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Acknowledgments

The authors wish to thank Keith Willnauer, Whatcom County Assessor, for providing the sales database used in this study. We would, also, like to thank Chris Behee, GIS Analyst, Planning Department, City of Bellingham, for generating our GIS variables.

I. Introduction

As is well known, willingness to pay for environmental goods such as air quality, water quality and distance from hazardous sites can be measured only indirectly. A common approach to estimation of marginal willingness to pay for such goods is the hedonic housing price methodology. When a consumer purchases a house, he or she is purchasing a bundle of characteristics, including environmental characteristics as well as house and neighborhood characteristics. The hedonic methodology involves statistical estimation of the monetary contribution of the environmental good to the sales price of a home.

A large literature employs the hedonic methodology to estimate the value of environmental amenities, including distance from potential environmental hazards such as toxic waste sites, nuclear power plants, chemical plants, incinerators, and landfills. With the exception of Simons (1999), no research has focused on potential hazards created by the extensive underground network of fuel pipelines in the U.S. According to a recent Transportation Research Board report (TRB, 2004), residential development along pipeline corridors has contributed to an increase in the number of pipeline "incidents" involving fatalities, injuries or significant property damage.

Following a recent accident in the Bay Area, the San Francisco Chronicle questioned whether "the risk of underground pipelines is higher than most suburbanites suspect" (Hall, 2004). The level of public awareness, even of the existence of nearly pipelines, appears to be low. An outstanding question is the degree to which a major pipeline event affects the level of perceived risk. A major accident occurring in a residential area of Bellingham, Washington, provides an opportunity to address this question. In the 1999 Bellingham accident, the rupture of a gasoline pipeline led to an explosion that killed three people, injured eight, and caused significant damage to the environment. Using housing market data for Bellingham, this study uses the hedonic methodology to estimate the marginal willingness-to-pay for distance from a pipeline, both before and after a high-profile accident. Empirical results presented here suggest that a major pipeline event leads to a significant increase in perceived risk.

The following section provides a review of the hedonic literature on the effect of adverse environmental events. Background information on pipelines and the Bellingham accident are provided in Section III, while Section IV describes the data used in the estimation. Sections V and VI present the specific models estimated and corresponding empirical results. A final section provides a summary and conclusions.

II. Previous Research

As indicated above, the hedonic methodology has been used to estimate the effect of a wide range of environmental hazards on property values. Both Boyle and Kiel (2001) and Jackson (2001) review the extensive literature. Most relevant here are those studies that examine the effect of an adverse environmental event. The standard expectation is that any change in the level of perceived risk due to an adverse event will be capitalized into home prices.

A number of studies focus on the 1979 Three Mile Island nuclear accident, arguably one of the most famous accidents of any kind in U.S. history. Nelson (1981) looks at 100 sales within five miles of the plant, and within eight to nine months of the accident, and finds no significant effect of the accident on home prices. The lack of capitalization, he suggests, may be explained by a perception that costs were short-term or by the expectation of financial compensation from federal and/or state government. Using a database of about 700 property sales around the plant, Gamble and Downing (1982) similarly find neither evidence of a price effect within nine months after the accident, nor any evidence of a negative effect on property values prior to the accident. It should be noted that a nuclear power plant differs from a pipeline in that local employment is created. This may create a positive offset to the perception of hazard. In a more recent paper, Clark et. al. (1997) also find no evidence that residential proximity to nuclear power plants, in this case two plants in California, has a negative effect on property values.

Another study focusing on an adverse event investigates the effect of an explosion at a chemical plant in Henderson, Nevada (Carroll et. al., 1996). The 1988 “PEPCON” explosion caused damage to surrounding residential property, but no deaths or injuries to local residents. Using a large database of sales two years before and two years after the event, the authors find that before the accident, properties within two miles of the plant sold for 6.3 percent less than those farther out. The effect becomes stronger following the accident, but not significantly so. Thus the authors do not find evidence of an increased in perceived risk.

In the only paper to focus on a pipeline hazard, Simons (1999) examines the impact of a 1993 pipeline rupture along the Colonial Pipeline in Virginia. In this case, no explosion occurred, and very few properties were directly affected. Simons finds a loss in home value in the range of 4 to 5.5 percent for homes with pipeline easements in a two mile area north of the rupture. He finds a 1 to 2 percent loss for homes with pipeline easements within ten miles of the rupture. Rogers (2000) identifies a potential specification error associated with Simons’ use of distance and time interaction terms in a pooled regression.

More recently, Bin and Polasky (2004) use a hedonic function to estimate the effect of a “major flooding event” -- Hurricane Floyd -- on the value of floodplain properties in North Carolina. Using a large sample of sales seven years prior and three years following the 1999 hurricane, they find a marginal effect on sales price of 3.8 percent prior to Hurricane Floyd, increasing to 8.4 percent following the hurricane. They conclude that recent experience with a hazard increases the perceived risk.

III. Background on Pipelines and the Bellingham Accident

A. Pipeline Statistics

A pipeline construction boom in the 1950s and 1960s contributed to the current network of about 360,000 miles of liquid and gas transmission pipelines in the U.S. Over 160,000 miles of hazardous liquids transmission pipelines transport crude oil and refined petroleum products, primarily, but also toxic chemicals, and highly volatile liquids. Another 300,000 miles of transmission pipelines transport natural gas.[1] Many lines that serve major cities were constructed in what at the time were sparsely populated rural areas. In recent years, however, suburban encroachment on the existing pipeline network, along with growth in the volume of products transported through the network, has contributed to an increase in the number of pipeline incidents involving fatalities, injuries or significant property damage. According to a recent Transportation Research Board report, the number of such incidents per 10,000 miles of pipeline rose 2.2% annually from 1989 to 2000 (TRB, 2004).

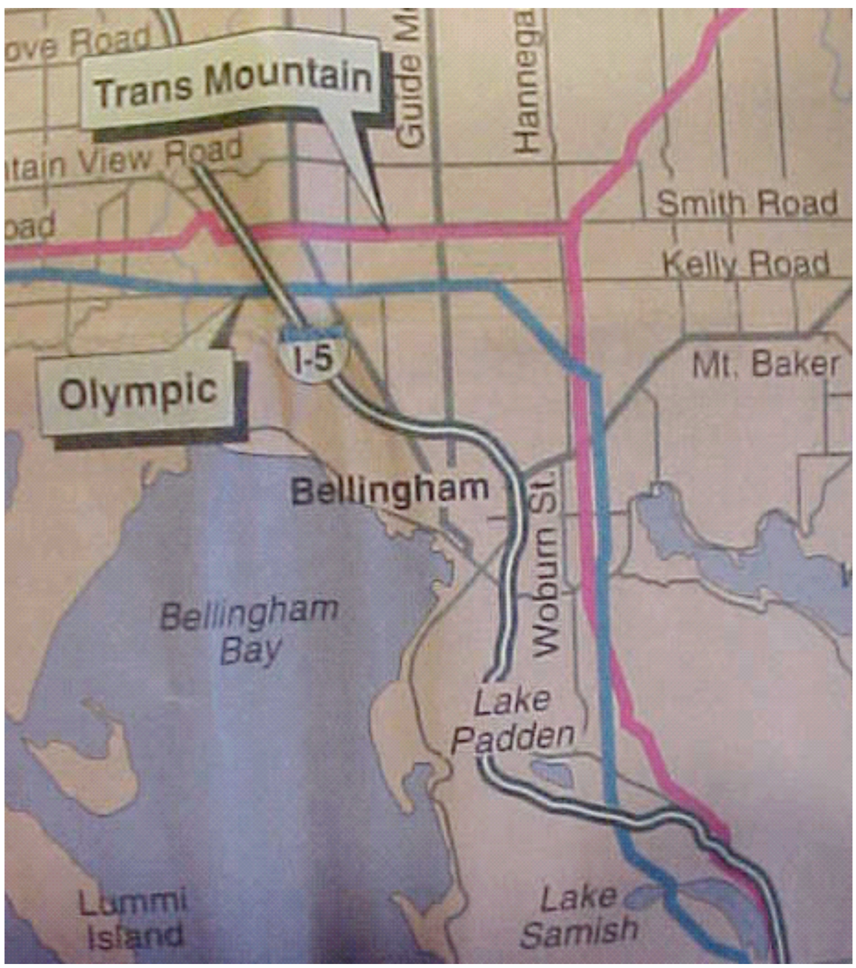
Evidence from a number of sources points to a low level of public awareness of pipeline hazards, or even of the existence of nearby pipelines. A recent public opinion poll conducted by the Washington Utilities and Transportation Commission surveyed 400 residents known to live near transmission pipelines (gas or liquid). Of these residents, only 40 percent indicated awareness of living near a major pipeline, and 55 percent "flatly denied" living near a major pipeline (WUTC, 2005). While Washington state law requires that sellers disclose to buyers whether a pipeline crosses the property itself (and the required easement would show up on the title report in any case), regulations don't require notification that a property being sold is "near" a pipeline.

[1] Office of Pipeline Safety, 2003 statistics.

B. Profile of a Major Accident

In Bellingham, Washington, two major transmission pipelines run north/south through residential areas of the city – the Olympic pipeline and the Trans Mountain pipeline (see Exhibit 1 below). As they run through Bellingham, the two pipelines are no more than 1500 feet apart. The 718-mile Trans Mountain Pipeline transports crude oil from East Edmonton, Alberta to U.S. refineries at Cherry Point, and then through Bellingham to refineries in Anacortes, 45 miles southwest of Bellingham.

Exhibit 1



The 400-mile 19-inch steel pipeline owned by the Olympic Pipe Line Company carries refined petroleum products from refineries north of Bellingham to Seattle, and ultimately to Portland, Oregon. When the pipeline was completed in 1965, there was little residential development along its route through Bellingham. By the late 1990's, however, significant development had occurred; the pipeline runs under suburban yards, streets, under easements along the back of many residential lots, through city parks, and within 30 feet of a middle school. The pipeline right-of-way averages 35 feet. Along the right-of-way, signs warn of its presence.

On June 10, 1999, the Olympic pipeline ruptured in a suburban Bellingham park, spilling 229,000 gallons of gasoline into Whatcom Creek. Leaked gasoline ignited in a series of explosions which sent a smoke cloud six miles upward and burned approximately 1.5 miles along the creek. Three people died as a result of the explosion and eight people were injured. Two of the deaths were the result of severe burns inflicted on ten-year old boys playing in the park. An 18-year old man drowned as he fished in the creek. One home and a water treatment plant were damaged, and extensive environmental damage occurred to the creek and park.[2]

As might be expected, this event received heavy coverage in the local media. Subsequent to the accident, the section of pipeline through Bellingham was shut down for a period of 1 ½ years. The Olympic Pipe Line Company was faced with civil lawsuits, a federal criminal investigation and an inquiry by the National Transportation Safety Board. According to the final report by the NTSB, the rupture was likely caused by excavation-related damage to the pipeline by IMCO General Construction and by the failure of Olympic to adequately inspect the pipeline. The attention focused on pipeline safety by this accident, as well as by a 2000 natural gas pipeline accident that killed 12 people at a campground in New Mexico, led Congress to strengthen pipeline safety law, with the passage of the Pipeline Safety Improvement Act of 2002.

[2] Property damage caused by the incident was estimated to be at least $45 million.

IV. Data

The sample of Bellingham properties used in this study is drawn from a computer data file provided by the Whatcom County Assessor's Office in Bellingham, Washington. The original file contained all single-family home sales in Bellingham for a five ½ year period prior to the June 1999 accident, and another five year period following the accident. For each transaction, the file provides the sales price and date of sale, and a set of variables describing each property's current characteristics, such as year built, year remodeled, square footage, condition of the structure, and type of sale. To estimate the impact of proximity to the pipeline, both before and after the accident, the data file containing all Bellingham single-family sales was merged with a second file (obtained from the City of Bellingham Planning Department) containing all single-family homes located within one mile of either the Olympic pipeline or Trans Mountain pipeline, along with GIS variables measuring the distance in feet of each home from each of the two pipelines. The sampling of properties within one mile of either pipeline yields a sufficient number of observations, while keeping the sample relatively homogeneous in terms of neighborhood quality. (Bellingham neighborhoods beyond one mile from either pipeline, and thus excluded from the sample, include both the most prestigious neighborhood and the least prestigious.)

The resulting data set contained 4,969 sales, including a number of extraneous sales (listed more than once in the data base), sales of raw land, sales consisting of non arms-length transactions, etc.[3] After removing such transactions, the data set was reduced to 3,765 single-family residential property sales.

[3] Omitted transactions include those in which a) the transaction price was identified as one that did not represent a true "market" price because the sales were between family members, the sales were through a trust or estate, the sale was to a real estate relocation service, the sale represented a partial interest, or it was a transaction with HUD or FNMA at well below the market value, b) the sale was listed more than once in the data set, c) data for a transaction were incomplete or in error and complete or corrected data could not be found, d) the property was remodeled after the date of sale, causing the current list of descriptive variables to be different from what they were at the time of sale, and e) the transactions appeared to be for raw land.

Previous research shows that the existence of a water view is an important determinant of sales price in this coastal market (Benson et. al., 1998). The absence of view information in the county assessor's records was thought to be a potential problem for this study, given that the Olympic pipeline runs along the western side of "Alabama Hill", not far from the crest, in an area in which view potential drops off rapidly as distance from the pipeline increases. To avoid potential bias in estimated pipeline effects resulting from omission of view data, the authors collected these data through personal inspection. Benson et. al. (1998) describes the inspection methodology in detail. Based on the type of view – ocean, lake, mountain or territorial, and based on view quality (determined primarily by the degree of obstruction by trees and buildings), each property was classified into one of nine view categories, or into the no-view category. It should be noted that the view category was assigned to each property by the authors without knowledge of the actual selling price of the home--i.e. judgments about view quality were independent of value considerations.

Table 1 provides descriptive statistics for all variables. Statistics are provided both for a pre-event sample (sales recorded Jan. 1999-June 1999) and a post-event sample (sales recorded July 1999-June 2004). Definitions of variables are found in Appendix A. To remove the effect of housing price inflation, sales prices are deflated with a Bellingham housing price index, constructed from median sales price in each year. The resulting real price is expressed in 2003 dollars. In the pre-event sub-sample, the average property is approximately 16 years old at the time of sale, and the mean square footage is 1641, excluding finished and unfinished basement, while in the post-event sample the average property is 22 years old with a square footage of 1618. Distance from each pipeline, measured as feet from the center of the property to the pipeline, ranges as low as 16 feet from the Olympic pipeline, and 3 feet from the Trans Mountain pipeline. Not shown in the table, the number of sales within 500 feet of the Olympic pipeline is 145 prior to the explosion and 233 after the explosion. The equivalent numbers for the Trans Mountain pipeline are 163 and 181.

V. Hedonic Modeling: The Effect of a Pipeline Event

We hypothesize that in the absence of a pipeline "event", i.e. a highly publicized accident, proximity to a pipeline has no significant effect on sales price. Two tests of this hypothesis are conducted. First, we include a variable measuring distance from the pipeline experiencing the event – the Olympic pipeline -- in a hedonic model, and estimate the model for each of our sub-samples, the pre-event sample and the post-event sample. Second, we include in the same model a variable measuring distance from an event-free pipeline – the Trans Mountain pipeline. If our hypothesis is valid, the variable measuring distance from the Olympic pipeline will be significant in the post-event period, but not before, and the variable measuring distance from the Trans Mountain pipeline will insignificant in both time periods. The second test is considerably weaker than the first, however, since the second pipeline differs not only in that it did not experience an accident, but also in that it transports crude oil, which is much less volatile than gasoline, and thus poses a lower level of risk.

It is likely that any effect of a pipeline event on sales price is highly localized, and will decay rapidly as distance from the pipeline increases. With sufficient distance from the pipeline, the effect should go to zero. Thus we further hypothesize that in the case of the pipeline experiencing an event, the effect on price will vary inversely with distance from the pipeline.

The specification for our hedonic model is as follows:

$$\ln(P_i) = \alpha + \sum_{j=1}^{n} \beta_j X_{ji} + \sum_{k=1}^{m} \gamma_k Z_{ki} + \sum_{p=1}^{2} \delta_p D_{pi}^{-1} + e_i$$

where ln(*P*) is the natural log of price of property i, *X* is a vector of j property characteristics such as age and square footage, *Z* is a vector of k year dummy variables, and *D* is a vector of two variables, one measuring distance in feet from the Olympic pipeline and the other measuring distance in feet from the Trans Mountain pipeline.

Since the distance variables are in inverse form, a pipeline effect will be indicated by a negative coefficient. As the number of feet from the pipeline increases, the inverse distance from the pipeline becomes smaller. The variable can thus be viewed as a measure of "closeness in distance" to the pipeline. If, as closeness to the pipeline increases, the sales price falls, *ceteris paribus*, the coefficient on the distance variable will be negative.

The model is estimated for each sub-sample, using ordinary least squares with White's procedure for obtaining covariance matrices and standard errors corrected for potential heteroskedasticity. The estimated models are shown in Table 2.

Most of the variables describing property characteristics are significant, with the expected sign, and stable across the two samples. Sales prices are higher, the newer the house, the better the condition, the greater the number of baths, and the greater the above grade square footage, as well as the greater the basement square footage, garage square footage, etc. Most of the view variables are significant as well.

Neither of the inverse distance variables is significant for the pre-event sample. For the post-event sample, the coefficient on inverse distance is significant only for the Olympic pipeline. As expected, the coefficient is negative, indicating that as inverse distance (or "closeness") increases, sales price falls, ceteris paribus. Figure 1 shows the mean price, and the mean price minus the estimated discount due to proximity to the pipeline, as a function of distance in feet from the pipeline. For a property located 50 feet from the pipeline (but which otherwise has the characteristics of the mean property), the estimated discount is $9,613, which falls to $4,863 at a distance of 100 feet, $2,446 at a distance of 200 feet, and $491 at a distance of 1000 feet from the pipeline.

VI. The Effect of Elapsed Time from a Pipeline Event

The above results are consistent with the hypothesis that in the absence of a pipeline event, there is no effect of proximity to a major transmission pipeline. Following an event, proximity to the pipeline that experienced the event has a significant negative effect on price. Given that the negative effect is triggered by the pipeline event, it is reasonable to expect the effect to diminish, as the event becomes more distant in time. We hypothesize that an event-induced effect on prices will, for a given distance from the pipeline, vary inversely with the amount of time elapsed since the event. To test this hypothesis, we interact our distance variable with a variable measuring elapsed time. The following model is estimated:

$$\ln(P_i) = \alpha + \sum_{j=1}^{n} \beta_j X_{ji} + \sum_{k=1}^{m} \gamma_k Z_{ki} + \delta D_i^{-1} + \lambda (D_i T_i)^{-1} + e_i$$

where again, ln(*P*) is the natural log of price of property i, *X* is a vector of j property characteristics such as age and square footage, and *Z* is a vector of k year dummy variables. In this model, *D* is the distance in feet from the Olympic pipeline and T is number of months between the pipeline explosion and the sale. Combining terms, the model can be re-written as:

$$\ln(P_i) = \alpha + \sum_{j=1}^{n} \beta_j X_{ji} + \sum_{k=1}^{m} \gamma_k Z_{ki} + (\delta + \lambda T_i^{-1}) D_i^{-1} + e_i$$

where the coefficient $(\delta + \lambda T_i^{-1})$ measures the marginal effect of inverse distance from the pipeline, which with this specification varies as a function of time. When modeled without a time interaction term, the coefficient on inverse distance from the Olympic pipeline was expected, and found, to be negative. Given that the specification includes the inverse of time, the coefficient on the distance-time interaction term is expected to be negative as well.[4]

[4] For a given distance, as the number of elapsed months from the pipeline event increases, the inverse of elapsed months becomes smaller. Inverse elapsed time can thus be viewed as a measure of "closeness in time" to the pipeline event. If, as closeness in time to the event increases, the price discount at a given distance becomes larger, then the coefficient on the inverse time variable will be negative.

This model is estimated for the post-event sample only. As seen in Table 3, the coefficients on both the inverse distance variable and the inverse distance-time interaction variable are negative and significant. This supports our hypothesis that for a given distance from the pipeline, the effect of the explosion diminishes over time. Figure 2 shows the mean sales price minus the estimated discount due to elapsed time from the explosion, as a function of months from the event, for properties at four distances. For a property 100 feet from the pipeline, the estimated discount is \$5,813 at 6 months, which falls to \$4,784 at 12 months, \$4,267 at 24 months, and \$4,008 for a property selling 48 months after the pipeline explosion.

VII. Summary and Conclusions

Little research has focused on the impact of pipelines and major pipeline accidents on the value of single-family residential properties. This study uses housing market data for Bellingham, Washington to test a number of hypotheses relating to pipelines and property values. Market data for Bellingham are particularly well-suited for this purpose, as there are two major transmission pipelines running through residential neighborhoods in the city, a pipeline that experienced a major accident in 1999 (the Olympic pipeline) and another that has remained accident-free (the Trans Mountain pipeline). Both pipelines are classified as "hazardous liquids" pipelines. The Olympic pipeline transports refined petroleum products and the Trans Mountain pipeline transports crude oil.

Results suggest that in the absence of a highly-publicized event, location near a pipeline is not viewed as a significant environmental risk. Hedonic estimation for a 5 ½ year time period prior to Olympic pipeline explosion yields no evidence that either of the two pipelines had an effect on sales price of properties located nearby. Estimating the same model for a 5-year time period following the event, we find a significant, negative effect of proximity to the Olympic pipeline. Proximity to the accident-free pipeline (the Trans Mountain pipeline) remains insignificant. As mentioned above, however, this pipeline transports crude oil, which is much less volatile than gasoline, and thus poses fewer risks. It is likely that it is this lower risk--combined with the absence of an event--which explains the lack of a measurable effect on prices for this pipeline.

To measure proximity to the Olympic pipeline, we find that an inverse distance specification works well. As distance from the pipeline increases, there is a rapid decay in the estimated price effect. For example, in the case of a property with the characteristics of the mean, the estimated discount relative to the mean sales price is $9,613, or 4.6 percent, for a property located 50 feet from the pipeline. It then falls to $4,863 dollars for a property 100 feet from the pipeline, $2,446 dollars for a property 200 feet from the pipeline, and $491 dollars for a property 1000 feet from the pipeline. Modeling the impact of a pipeline event is further improved by adding a variable that interacts distance from the pipeline with time elapsed since the event. At a given distance from the Olympic pipeline, we find that the negative effect on price following the June 1999 accident has diminished over time.

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Table 1. Summary Statistics of Sample Variables

	Pre-event sample (n=1753)				*Post-event sample (n=2012)*			
Continuous vars:	**Mean**	**Std. Dev.**	**Min.**	**Max.**	**Mean**	**Std. Dev.**	**Min.**	**Max.**
PRICE (2003$)	207563	65026	62143	726593	209374	75761	57597	710037
AGE	16	24	0	99	22	27	0	106
TOTSF	1641	496	552	4483	1618	521	504	4483
FBASEMSF	139	366	0	2730	173	411	0	2730
UFBASESF	61	231	0	2272	78	262	0	2182
GARSF	435	201	0	1392	427	211	0	1500
CARPSF	16	77	0	624	19	88	0	840
STORGSF	19	96	0	1700	21	103	0	1872
SHOPSF	5	65	0	1680	4	50	0	1040
DECKSF	152	184	0	1410	152	195	0	1690
PATIOSF	89	188	0	1880	92	74	0	1688
BEDRMS	3.1	0.6	0	6	3.1	0.6	1	6
BATHS	2.1	0.6	1	4	2.1	0.7	0	5.5
D olympic	2649	1658	21	6585	2857	1923	16	6580
D transmtn	2689	1440	3	7251	2854	1556	35	7246

Dummy vars:	**Mean**	**n**	**Mean**	**n**
REMODEL	0.035	61	0.039	78
COND2	0.040	69	0.047	95
COND4	0.306	536	0.266	535
COND5	0.448	785	0.478	961
CONDM	0.057	99	0.063	126
CONDP	0.113	198	0.108	217
VIEWOV	0.037	64	0.047	94
VIEWPOV1	0.037	66	0.041	82
VIEWPOV2	0.046	81	0.052	104
VIEWPOV3	0.086	151	0.095	191
VIEWLF	0.004	7	0.006	12
VIEWLV	0.008	14	0.008	17
VIEWPLV	0.040	70	0.042	84
VIEWMV	0.022	38	0.018	37
VIEWTG	0.022	38	0.033	66
VIEWTP	0.039	68	0.064	128

Table 2. Hedonic Model 1

Dependent variable is ln(P)

Variable	Pre-event: (Sale prior to Olympic pipeline explosion) Coeff.	T-Stat.	Post-event: (Sale after Olympic pipeline explosion) Coeff.	T-Stat.
C	11.47190	430.21	11.41769	437.59
AGE	-0.00152	-5.43	-0.00079	-3.11
REMODEL	0.05766	2.57	0.01316	0.61
TOTSF	0.00030	24.56	0.00027	22.24
FBASEMSF	0.00019	15.45	0.00019	17.48
UFBASESF	0.00007	4.11	0.00013	9.81
GARSF	0.00031	13.50	0.00027	11.50
CARPSF	0.00013	3.34	0.00006	1.38
STORGSF	0.00006	1.57	0.00017	4.93
SHOPSF	0.00013	3.04	0.00020	2.68
DECKSF	0.00013	5.33	0.00006	3.23
PATIOSF	0.00004	2.20	0.00002	1.24
BEDRMS	-0.00664	-0.92	0.00092	0.13
BATHS	0.01690	1.93	0.02630	3.04
COND2	-0.04762	-2.05	-0.13913	-5.21
COND4	0.08273	7.67	0.08970	8.74
COND5	0.10449	8.52	0.14591	11.47
CONDM	-0.04902	-2.32	-0.04089	-2.65
CONDP	0.03573	3.25	0.04300	3.44
VIEWOV	0.13153	6.63	0.24957	12.46
VIEWPOV1	0.10710	5.74	0.15999	9.14
VIEWPOV2	0.03611	1.69	0.11757	7.09
VIEWPOV3	0.07211	5.48	0.07800	6.34
VIEWLF	0.43259	1.92	0.79777	14.97
VIEWLV	0.04919	0.75	0.18613	4.45
VIEWPLV	0.05642	3.27	0.09093	5.51
VIEWMV	0.01131	0.66	0.01324	0.75
VIEWTG	0.05010	4.71	0.06949	4.17
VIEWTP	0.01299	1.24	0.01350	1.07
D^{-1}olympic	**-0.38617**	**-0.30**	**-2.35013**	**-3.34**
D^{-1} transmtn	**0.15168**	**1.58**	**-0.06631**	**-0.07**
Y1995/Y2000	-0.00920	-0.80	-0.01954	-1.85
Y1996/Y2001	-0.02796	-2.41	-0.02832	-2.57
Y1997/Y2002	-0.05651	-4.84	-0.02709	-2.63
Y1998/Y2003	-0.05345	-4.45	0.02948	2.65
Y1999/Y2004	-0.05993	-4.70	0.07603	5.13
R-squared	0.8107		0.8318	
Adj. R-squared	0.8069		0.8289	
S.E. of regr.	0.1297		0.1400	
n	1753		2012	

Table 3. Hedonic Model 2 (Post-event)

Dependent variable is ln(P)

Variable	Coeff.	T-Stat.
C	11.42002	440.04
AGE	-0.00079	-3.10
REMODEL	0.01329	0.61
TOTSF	0.00027	22.19
FBASEMSF	0.00019	17.48
UFBASESF	0.00013	9.75
GARSF	0.00027	11.50
CARPSF	0.00006	1.38
STORGSF	0.00017	4.94
SHOPSF	0.00020	2.68
DECKSF	0.00006	3.19
PATIOSF	0.00002	1.21
BEDRMS	0.00129	0.18
BATHS	0.02647	3.06
COND2	-0.13882	-5.20
COND4	0.08986	8.76
COND5	0.14581	11.53
CONDM	-0.04099	-2.67
CONDP	0.04283	3.44
VIEWOV	0.25226	12.65
VIEWPOV1	0.16127	9.16
VIEWPOV2	0.11809	7.13
VIEWPOV3	0.07801	6.34
VIEWLF	0.79851	14.98
VIEWLV	0.18663	4.47
VIEWPLV	0.09148	5.56
VIEWMV	0.01359	0.77
VIEWTG	0.06990	4.20
VIEWTP	0.01349	1.07
D^{-1}olympic	**-1.80694**	**-2.61**
$(DT)^{-1}$ olympic	**-6.05296**	**-1.84**
Y2000	-0.02256	-2.15
Y2001	-0.03173	-2.88
Y2002	-0.03060	-2.97
Y2003	0.02596	2.32
Y2004	0.07262	4.89
R-squared	0.8321	
Adj. R-squared	0.8291	
S.E. of regr.	0.1399	
n	2012	

Figure 1
Effect of Distance on Price

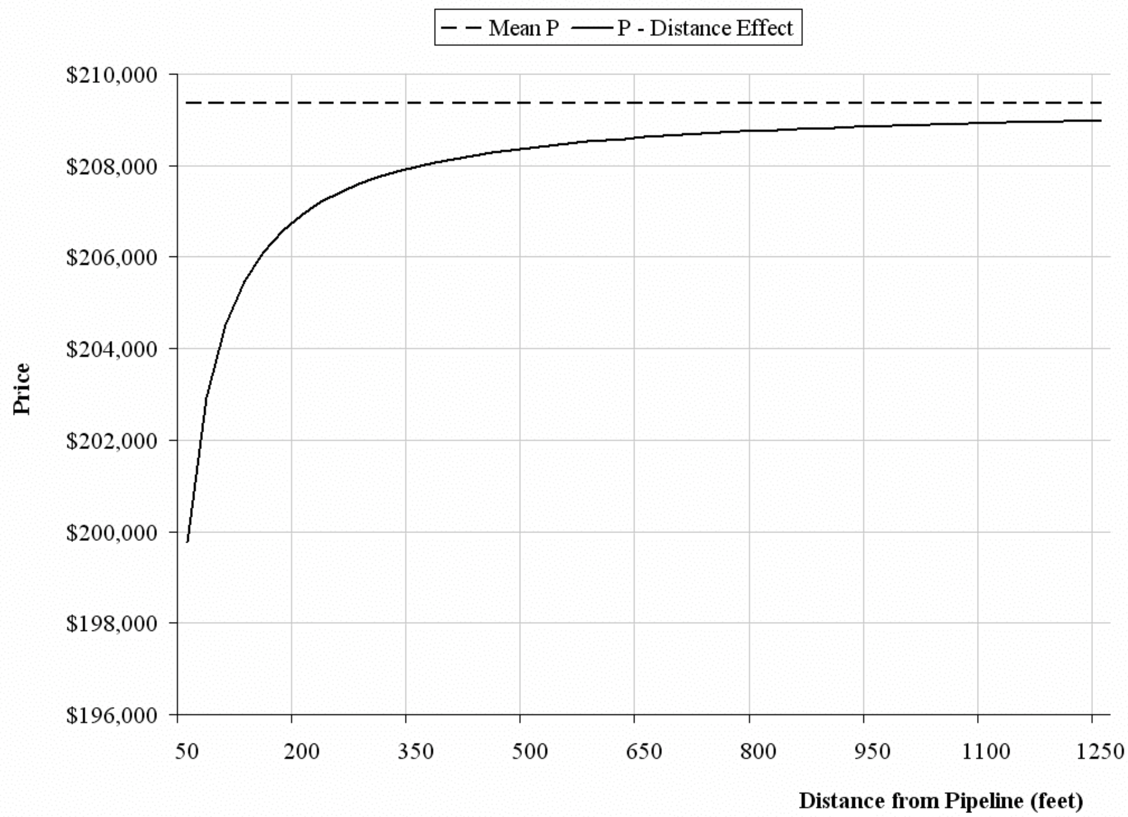
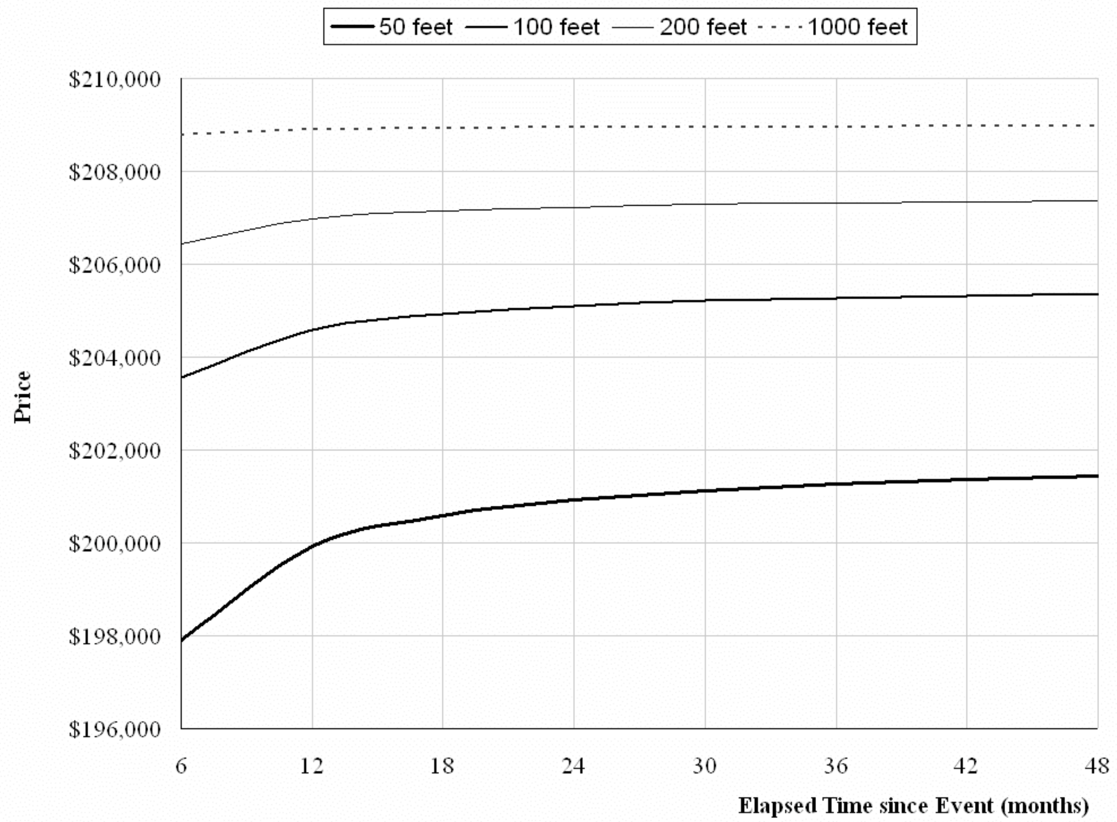


Figure 2
Effect of Elapsed Time on Price
(for properties of a given distance)



Appendix A
Variable Definitions

AGE = the year of sale minus the year built,
REMODEL = a dummy variable equal to 1 for houses that were remodeled since 1960, otherwise 0.

TOTSF = total above grade square footage in the dwelling
FBASESF = square footage of finished basement,
UFBASESF = square footage of unfinished basement,
GARSF = square footage of garage space,
DECKSF = square footage of deck,
PATIOSF = square footage of patio,
STORSF = square footage of external storage buildings
SHOPSF = square footage of external shop buildings

BEDRMS = the number of bedrooms in the dwelling,
BATHS = the number of baths in the dwelling,

COND = a vector of two binary variables based on the assessor's classification value of 1, 2, 3, 4, 5, or 6 depending on the condition of the dwelling, with 1 being the lowest condition and 3 being average condition; defined as:
COND2 = if the condition classification is a 1 or 2,
COND4 = if the condition classification is a 4,
COND5 = if the condition classification is a 5 or 6,
and the omitted category includes "average" condition, coded 3.

CONDPM = a vector of two binary variables based on the assessor's additional condition classification of a plus or minus to refine the 1 through 6 classifications given in COND above, defined as:
CONDM = if the additional classification is a minus,
CONDP = if the additional classification is a plus,
and the omitted category includes properties with no plus or minus,

VIEW = a vector of nine binary variables defined as:
VIEWOV = 1 if the dwelling has an unobstructed ocean view, else 0,
VIEWPOV1 = 1 if the dwelling has a superior partial ocean view (partial ocean view means there is some obstruction such as trees or buildings), else 0,
VIEWPOV2 = 1 if the dwelling has a good partial ocean view, else 0,
VIEWPOV3 = 1 if the dwelling has a poor partial ocean view, else 0,
VIEWLF = 1 if the dwelling is on lakefront property (on Lake Whatcom, a 9.5 mile long, 4,899 acre lake), else 0,
VIEWLV = 1 if the dwelling has an lake view from non-lakefront property, else 0,
VIEWMV = 1 if the dwelling has an unobstructed view of snow-covered mountains, else 0,
VIEWTG = 1 if the dwelling has a good territorial view, else 0,
VIEWTP = 1 if the dwelling has a poor territorial view, else 0,
and the omitted category includes properties with no view.