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SPATIAL AND TEMPORAL VARIABILITY IN RESIDENTIAL LAND VALUES FOLLOWING CATASTROPHIC FLOODING

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INTRODUCTION:

Research into natural hazards and the impact on the human landscape has been an area of continued study in an attempt to explain the relationship between the physical and human environments (Burton et al. 1978; Palm, 1982; White and Haas, 1975). The natural hazards literature has often adopted a case study approach and in this way has provided valuable baseline data for disaster mitigation (Burby and French, 1985; Montz, In Press; Muckleston, 1983). At the same time, urban oriented work has frequently incorporated accepted economic models and ideas into the research design, thereby allowing for replication. Usually, however, a simplistic physical environment has been assumed (Ohls et al. 1974; Scawthorn et al. 1982; Shilling et al. 1985). In both cases it would seem, a sound conceptual framework is lacking around which more integrated studies might be undertaken; an appropriate theoretical base, therefore, is needed. It is argued that a greater integration of the two literatures should help provide this element and facilitate the development and testing of such a framework.

In this research, we examine the impact of one natural hazard, flooding, on one aspect of the human environment, the residential land market. Preliminary work in this area has suggested that damage accruing from flooding results in a reduction in the utility derived from the particular land parcels inundated (Tobin and Newton, 1986). Further, it has been hypothesized that the subsequent recovery of the land market from this impact will be contingent upon the various socio-economic characteristics of the community flooded, as well as prevailing physical and hydrological factors. Thus the negative impacts of the flood event are capitalized into the selling price of the residential property. If this premise is true, then we need to establish what the initial impact of the flood is on the residential land market and how long it takes the land market to recover to levels at or near those existing prior to the flood.

The long term goals of this research, therefore, are to establish and test a predictive model of the behavior of the residential land market in a flood prone environment, based on this notion of utility/disutility. Clearly many factors are involved here, requiring research into a range of communities under different flood conditions. The principal objective of this paper is to answer the preliminary questions concerning how low-probability, major flood events interact with the human environment. Specifically, we have examined the extent to which a catastrophic flood depressed property values in a California community, and how, given similar socio-economic conditions, the market gradually recovered. In this way, some of the extremes of the theoretical framework might be considered.

RELATED WORK:

The basic premise of the hazards literature is that natural hazards and subsequent policy intervention will have an impact on the human environment which will manifest itself in terms of the market value of houses and the spatial location of property. Simply stated, hazards will tend to have a negative effect, thus depressing the housing market, while conversely alleviation programs will benefit the community and lead to elevated land values. Scawthorn, et al. (1982) examined such relationships from a theoretical perspective and suggested, not surprisingly, that there would be movement of housing locations towards lower damage areas in earthquake prone environments especially where investment was highest. In essence, house values will fall in the high risk areas and probably increase in the low risk.

Studies of the flood hazard have tended to adopt a similar position (Babcock and Mitchell, 1980; Burby and French 1981; Changnon et al. 1983; and Penning-Rowsell and Chatterton, 1980). However, the results of such research are tentative at best with most studies suggesting that flooding or flood mitigation programs have little or no effect (Sheaffer and Greenberg, 1981; Zimmerman, 1979). Some results have even been contradictory. For instance, Dowall (1979) found that environmental and other land use regulations led to inflationary values for the land, while Ohls et al. (1974) found the opposite trend; they identified lower land values in association with land use zoning. Given these findings, it is apparent that a sound and explicit theoretical framework, through which each of these studies might be reinterpreted is lacking. It is our opinion that these previous studies have failed to account for the capitalization of the flood hazard into the housing price.

These apparently contradictory results can be explained more easily through a research framework which integrates basic concepts from economics with the natural hazards literature, as shown by Damianos (1975) and Foster (1976). Damianos employed land rent theory to evaluate the impact of several flood hazard reduction policies upon residential property values. He found a difference between protected and unprotected properties but recognized the limitations of the study, notably that other locational and hydrological factors could be affecting property values. The attempt to incorporate a theoretical base, however, is commendable. Foster also considered the benefits and costs associated with floodplain management. Several scenarios were presented concerning the potential economic impacts of different alleviation strategies on floodplain land values, with a view toward reducing socially suboptimal decisions.

These two studies incorporate the economic assumption of a real estate market, in which changes in the utility derived from a land parcel are manifested as changes in land value. This assumption has been developed in the urban-economic literature to explain some of the dynamics of the residential real estate market (Bish and Nourse, 1975; Grether and Mieszkowski, 1974; Li and Brown, 1980; Rowels and Scott, 1981). Clawson (1971) pointed out that, at the aggregate level, land values will be determined to some extent by externalities and in particular by what is happening in adjacent land units. Working on flooding, Shilling et al. (1985) tried to demonstrate that the selling prices for houses located in the floodplain were indeed lower than for properties located outside the flood prone area. However, methodological problems with this particular study may restrict any general application of these results.

In terms of flooding, therefore, if urban development has encroached into flood prone areas, then land values may also be adversely impacted by factors associated with the physical characteristics of the flood, that is externalities to the housing market. More specifically, land values will decline to the extent that flooding reduces the utility of the land. This decline is an instance of the capitalization of an environmental externality, namely the flood event.

THEORETICAL CONCEPTUALIZATION:

Given the economic assumption of an urban land market in which changes in the utility derived from a land parcel are reflected as changes in land values, this paper looks at the relationship between the flood hazard and residential land values. The focus is on the capitalization of the flood event into land values. See Tobin and Newton (1986) for a more detailed discussion of these ideas.

From a theoretical perspective, if one assumes that other aspects of the metropolitan residential real estate market remain constant during the post-flood period under study, the occurrence of a flood event will reduce land values through damage to structures on and land in the floodplain. These damages represent reductions in the utility the owners derive from the flooded land parcels and the extent of this reduction in utility is dependent upon the temporal, spatial and hydrologic features of the flood hazard.

In this context, one temporal influence on residential land values will be the frequency of flooding or recurrence interval. Residential land values in areas of repeated flooding will reflect the degree of risk and remain low relative to non-flooded areas. The land values of those areas which experience only rare events will initially decline due to the flood and then return to levels at or near those prevailing prior to the event. This occurs because a temporal component of the hazard, frequency, is incorporated into the capitalization process as a factor of disutility. Thus different flood frequencies would have different impacts on residential land values.

This temporal influence may in part explain why some studies have found little difference in property values before and after a flood event (see for example Sheaffer and Greenberg, 1981). The frequency of flooding may have been sufficiently high at the study sites, such that major reductions in utility had already been capitalized into land values and were not reflected in the serial comparisons of recent property values. A dynamic equilibrium price level, in which the house values fluctuated only nominally, therefore, may have already been set as a result of the high probability of flooding.

Residential land values and subsequent recovery will also be influenced by the severity of flooding. In essence, it is suggested that the more severe the flood experience (in terms of greater depth, longer durations or higher velocities) the more apparent the capitalization process because of the greater damage. The subsequent recovery period from the hazard, therefore, will in part be directly related to the degree of damage.

It is recognized that residential market values are influenced by a variety of factors including the elasticity of the local market and whether or not the flood hazard has already been capitalized into market values. These factors can ultimately be incorporated into the conceptual framework of this research once baseline relationships regarding capitalization under different flood hazard

scenarios have been developed.

It is the specific effects of capitalization which have not been explicitly accounted for in many studies cited at the beginning of this proposal, although it should be added that the work of Muckleston et al. (1981) broaches this aspect of hazards research. Therefore, the rather negative and sometimes contradictory results described in earlier studies may be the result of inadequate attention to two aspects of the flood hazard: (i) the site specific differences in the intensity of the flood experience, and (ii) the temporal variation in land value appreciation and depreciation. This project is designed to address these issues and incorporate them into the theoretical foundation.

RESEARCH OBJECTIVES:

It is the purpose of this research to establish the baseline for one flood situation - that of a rare event causing sufficient damage to be declared, at least locally, a catastrophe. The specific questions to be researched are: what is the immediate impact of such a flood on the local residential land market, and how long will it take the market to recover from the flooding?

It is hypothesized that in the case of a catastrophic flood, the actual surge of water would most likely destroy many structural improvements made to the land, which in turn will significantly reduce the value of that land. Further, it is assumed that in a catastrophic event, the full effect of the flooding will not already be capitalized in the local land values, because there will be no recent history of flooding in the area. In essence, the flood hazard will not be recognized as a negative externality and hence is not seen to contribute to the disutility of property in this location. However, this still needs to be confirmed by examining property values both before and after the flooding. In addition, we need to know the degree of impact of the flooding on the housing market, that is to what extent, if any, do prices fall? Finally, we are interested in the rate of recovery of the residential land market. It is suggested that, following this shock to the land market, the recovery of land values to a new stable price level will be contingent upon the actual extent of damage, given that other socio-economic factors remain the same. Also, because of the spatial variability of flooding within the floodplain, in some parts of the community damage could be so great as to preclude any noticeable recovery in land values, at least in the short term, while other areas affected to a lesser extent will recover more rapidly. Thus it is hypothesized that the spatial and temporal impacts of the catastrophic flooding will be reflected in the changing values of floodplain property.

METHODOLOGY:

An attempt was made to answer these research questions and to test the hypotheses outlined above through empirically based work. The field research for the paper was undertaken in the towns of Linda and Olivehurst, California. These two communities are situated in the Central California Valley in Yuba County, approximately sixty miles north of Sacramento (Figure, 1). They have resident populations of 10225 and 8929 respectively, according to the last census. These two communities proved ideal field work sites. The flood data showed that they both suffered considerable losses from the catastrophic flood of February 1986, but until then had experienced nothing more than localized storm damage for a

number of years. It was anticipated, then, that any flood problems would not have been capitalized in the local housing values prior to this event and that values had either been maintained or possibly even raised by the presence of a major levee system along the Yuba and Feather Rivers. Furthermore, once the levees have been repaired, the probability of the similar floods recurring are relatively low and hence land values were expected to fall initially and then recover at least to some extent.

Data were collected from various sources to establish details on the severity of the flood hazard throughout the floodplain, the socio-economic conditions of the two communities, and characteristics of the residential housing market before and for some time after the flood event. Primary field work was undertaken two weeks after the initial flooding and contacts were made with the important "actors" in the communities and the real estate market, including the President of the Board of Realtors, various real estate agents, the County Assessor and county planners. Background information on the historical flood record, descriptions of the actual 1986 event and its initial impact, and perceptions of the long-term implications were obtained from these individuals. Additional flood data were gathered from personal observations and in consultation with the State Department of Water Resources. Socio-economic traits of the two communities were collected from census records and direct field work.

The data on the residential housing market were obtained from the local Board of Realtors through the Multiple Listing Service (MLS) records. In this area, current house listings and subsequent property sales are all coordinated through a regularly updated computerized system, which, according to the President of the Board, accounts for 95 percent of the local property transactions. The MLS records list details on the asking price, the selling price, the size of the house, the specific location of the dwelling and the days the property remained on the market. These data were used to characterize the residential land market in and around the two communities. The data were examined for the period several years before the flood, then again a few weeks after the event to establish the immediate impact of the flood. The longer term impacts and subsequent recovery were based on similar data collected six months after the flooding. It is anticipated that further work will will continue along these lines for the next few years.

A recognized advantage of examining these particular communities were several large residential tract developments which had been constructed on the floodplain since the last flooding. These subdivisions consist of relatively uniform dwellings in terms of structures, size of buildings and other important characteristics. Generally, each house has three bedrooms and two bathrooms, and an area of of 1275 square feet. Given this homogeneity of property, it was possible to identify trends and patterns in land market prices easily without worrying excessively about additional externalities associated with differences between individual properties. Pre-flood data on property transactions confirmed that these houses reflected this homogeneity, since selling prices were very nearly identical. Flood data also indicated that within tract flood experience, in terms of depth, duration and velocity of water, were very similar, so individual units experienced the same degree of damage and loss. Between tract experience varied, however, which provides some basis for comparison. Thus we had a well controlled study through which we could establish some base-line data associated with catastrophic flooding.

FINDINGS:

(1) Flood Characteristics:

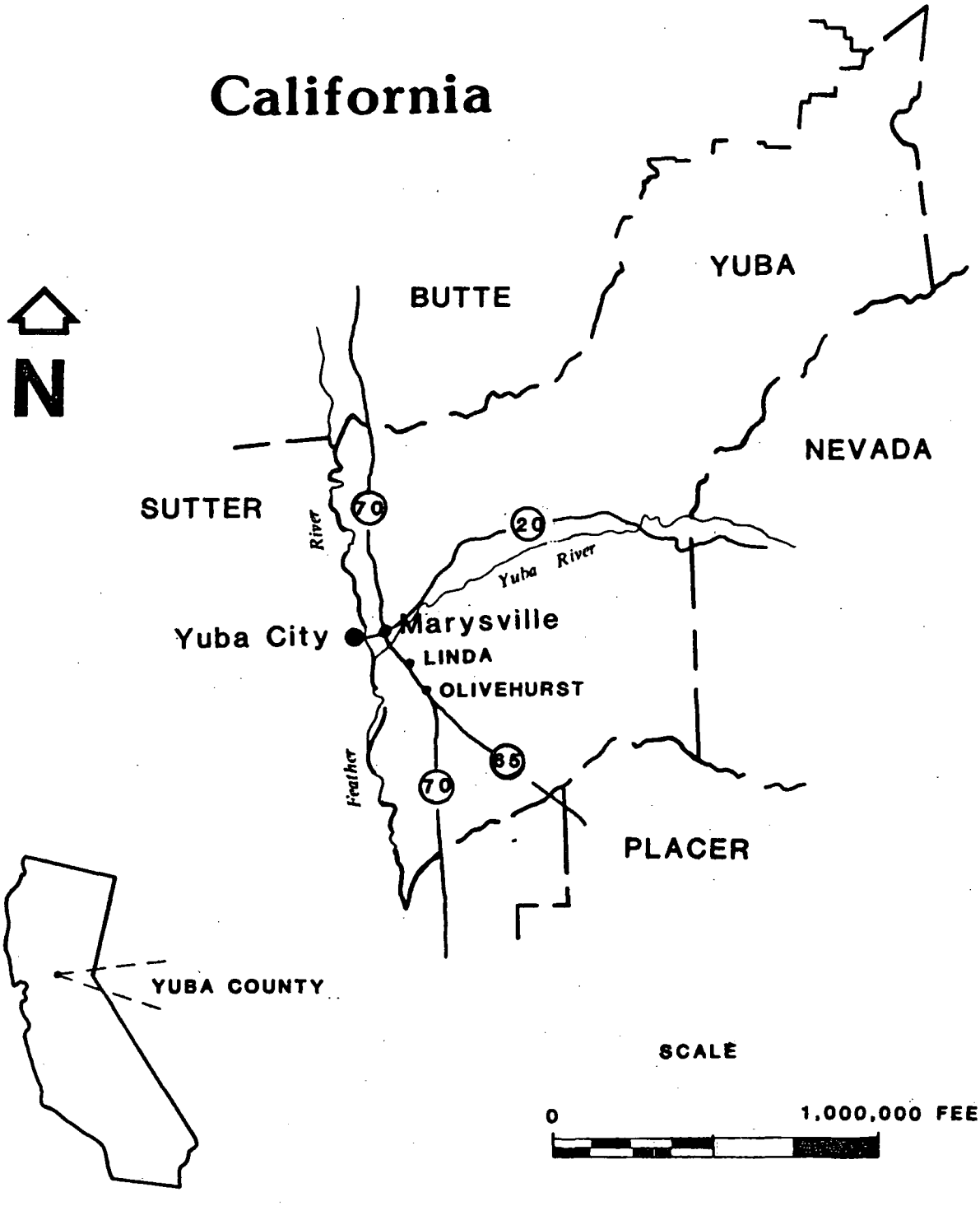
The Historical Record: The historical record of flooding within the Sacramento drainage basin is fairly lengthy, although there has not been a flood of any significance in this part for over thirty years. The construction of a large levee system, initially implemented in the 1930s, has drastically reduced such events. The last catastrophic flood along the Feather and Yuba Rivers occurred in 1955 when one of the levees broke discharging water through the adjacent community of Yuba City (Figure 1). Linda and Olivehurst were not affected directly on this occasion. This flood inundated over 100,000 acres, killed 46 people and injured over 3,000 (Friesema, et al. 1979). In addition, 280 buildings were destroyed, 1,500 suffered major damage and another 4,500 needed some form of repair. At the time, the community was severely criticized for ineffectual leadership during a natural disaster (Friesema, et al. 1979). It was made abundantly clear from this flood that there was the potential for other catastrophic events should any of the levees fail again. The subsequent development of floodplain land, especially on the other side of the river, totally ignored these early warning signs.

Flooding 1986: The flooding of February 1986 was essentially a repeat of the earlier event. In this instance, the levee broke on the south side of the Feather River sending water through Linda and Olivehurst. The weather preceding the flood had been similar to that in 1955 although the storm tracks were located somewhat further south. A series of intense storms saturated the area between the 4th and 19th of February, filling lakes and reservoirs to their maximum and raising rivers to record levels. One part of the Feather River drainage basin received nearly 50 inches of rain at this time. These storms caused damage to much of northern central California such that 39 counties were eventually declared state emergency areas by the governor (Department of Water Resources, 1986).

The levee north of Linda and Olivehurst broke during the early evening on February 20th. It is interesting to note that the Feather River had already receded by over one foot from a peak discharge level of 76.3 feet, recorded on the previous day. The break quickly expanded from 40 to over 180 feet wide and water covered nearly 20,000 acres of farmland as well as the two communities. The characteristics of the flooding and subsequent damage were clearly influenced by the nature of this break. The initial onset of water was very rapid leading to considerable structural damage as houses were moved from their foundations and vehicles were swept away. However, as the flood waters spread out over the extensive flat terrain, the velocity slowed and flood depths rose significantly. The duration of flooding was variable throughout the floodplain. In most of Linda and Olivehurst, the water remained for less than two days. However, for extensive agricultural areas and for portions of the two communities (including over 600 houses) flood water was still a problem several weeks later. In fact, pumping of water out of some low lying areas was not complete until the end of March (Department of Water Resources, 1986). Flood depths were also variable, ranging from a few inches and little more than an inconvenience to greater than 10 or 12 feet.

Flood Damage: The long duration and the great depths of the flood exacerbated the losses from the flooding. The longer water remained inside houses the more water damage was recorded. Also, houses inundated in excess of 18 inches

YUBA COUNTY



Wendy Silcox

Map Source: U.S. Dept. of the Interior-Geological Survey September 16, 1986

experienced considerable problems with internal walls. These tended to rot away and hence needed completely replacing. Even greater water depths, meant that no personal property was protected since most of the dwellings in this area are single story. Even if there had been time to take remedial action there would have been nowhere to store valuables. Additional problems were associated with vast quantities of mud deposited in the area and the failure of the sewer system.

An estimated 6,500 buildings were inundated in Yuba County (Bluett, 1986), and preliminary data suggested that 3 people died in the flood (Smith, 1986), although subsequent reports did not confirm these figures (Department of Water Resources, 1986). Table 1, shows the estimated damages to property in the area in comparison with the losses throughout the declared disaster area. It is apparent from this that Yuba County suffered a significant proportion of the total losses recorded from the flooding. The business losses may be particularly devastating to the two communities, since a substantial portion of their tax base may be permanently lost. At the present time it is not known if the Peach Tree Mall, flooded to an estimated 10 feet, will reopen. This mall contained 41 businesses including two major anchor stores. The total losses for Linda and Olivehurst were estimated by a city assessor at the time of the flood to be in the region of $50 to $100 million (Department of Water Resources, 1986; Smith, 1986). However, since total losses for the California flooding have been estimated at $500 million, this may be somewhat of an under estimate. Neither Yuba nor Sutter Counties were participants in the National Flood Insurance Program.

Table 1: Estimated Damage in California Flooding, February 1986.

	PEOPLE		HOUSES		BUSINESSES	
	Deaths	Injuries	Damaged	Destroyed	Damaged	Destroyed
YUBA COUNTY.	(3)	30	3000	895	150	150
ALL LOSSES.*	12	67	12447	1382	967	185

* Totals for 39 counties declared emergency areas.

Sources: Department of Water Resources, 1986; Bluett, 1986; Smith, 1986.

Community Response: On the occasion of this flood, the communities along the Yuba and Feather Rivers appeared well prepared for the flooding. Certainly the criticism from last time cannot be directed at the local authorities who, both before and after, demonstrated concern for the local population. The rapid evacuation of persons from the hazardous area most probably saved many lives and clearly reduced the number of injuries. The wet conditions preceding the levee break, combined with exceptionally high river levels and several smaller levee breaks in the region, alerted many locals as well as the responsible authorities to the possibility of flooding. As a result, when the levee did fail most people were successfully evacuated from the floodplain. A few individuals remained in their houses by choice and were rescued the following day. Local organizations further checked every house for persons left behind. In all 24,000 people were safely removed from the flood and over 13,000 were housed in prepared evacuation centers (Smith, 1986).

(2) Impact of Flooding on The Economy and Residential Property Values:

Linda and Olivehurst are not wealthy communities and it is questionable how well they will recover economically from this flood. Table 2 shows the socio-economic characteristics of the two communities. As can be seen, the communities are predominantly low to middle income groups, with a fairly large proportion of the population receiving public assistance. Both communities are somewhat poorer than the county as a whole, which reports a per capita income of $8899 per year. Unemployment is high, averaging 20 percent. Both communities are dependent upon agricultural activities.

Table 2. Socio-Economic Characteristics of Linda and Olivehurst, California.

		LINDA		OLIVEHURST	
Population		10225		8929	
Median Income	($)	9453		11719	
Per Capita Income	($)	4475		4686	
Households with Public Assistance		945	(26%)	618	(19%)
Families Below Poverty Level	(%)	26.7		15.6	

Source: US Census, 1980.

As expected, the flooding has had a major impact on the economy of these two communities, although the full implications are still being assessed. It is still unclear whether the Peach Tree Mall will return to its former importance. Prior to the flood, this shopping center provided over 80 percent of the sales tax revenue for Linda and Olivehurst. If one or the other of the anchor stores does not reopen then serious problems could ensue and possibly lead to even higher unemployment rates. Similarly, the long term losses to agriculture have not been accounted for fully, especially regarding any permanent damage to orchards in the area.

The extensive flooding of the two communities also has had repercussions on the residential areas since over one third of all dwellings were inundated. The degree of damage suffered was clearly related to the extent of the flooding experienced. For instance, some residences are to be torn down rather than repaired. These comprise primarily older dwellings, which may not have met local building codes prior to the flooding, and other properties which experienced the most serious flooding (Bluett, 1986). In particular, this included homes inundated to the greatest depths, often to the eaves, and those flooded for over two weeks. In some cases, the costs of the repairs would greatly exceed the market value of the property (Overton, 1986).

One gauge of the impact of the flood on the real estate market is how real estate companies handled the situation. A preliminary survey of realtors showed that the response was very similar. All companies stopped showing houses in the flooded area for at least two weeks after the flooding, which essentially meant that the housing market for this period had fallen to zero. One company immediately cancelled all its listings in the flooded area, while others were waiting to hear from the owners on how to proceed with the sale once the situation returned to "normal." It was anticipated that repairs and cleaning

would be complete a few weeks after the flood. Later evidence suggested that housing returned to the market fairly rapidly, once repairs had been completed.

This is not to say that all houses were flooded to the same degree. Indeed, one of the housing tracts sustained relatively minor damage with estimated flood depths of less than one foot. Some of the housing here is designated as low income and more than half is owner occupied. The area benefited from the fact that the buildings were raised above the level of the roads. In addition, the houses were constructed with slab concrete floors which did not sustain damage and there were no basements in which valuables could have been stored.

Realtors generally agreed that the flood will make sales in the flood area much more difficult in the immediate future. Projected decreases in the selling prices ranged from 50 percent without repair to 15 percent once repairs had been completed. Typically, it was estimated that an owner of a $55,000 house would have to spend approximately $5,000 to $10,000 to bring property back to conditions existing prior to the flood (Overton, 1986). It was thought by most that the full effects of the flood would last at least two years, although one realtor thought that the market would be back to normal within one year.

An additional problem in this area is the large number of rental units. In fact, in the area which received the worst flooding and subsequently the highest proportion of losses (Alicia Avenue) over 90 percent of the housing is rental, most of which is low income. It is, therefore, not a matter of the residents deciding if and how to rebuild, but of the landlords, many of whom do not live in the area, making these decisions.

A factor which may help with the recovery process is the reassessment of flooded properties. Under this process, which was recently completed, a structure which experienced more than $5,000 damage will have the assessed value reduced. The taxes in California are based on assessed value and these will be reduced proportionally, then gradually increased over subsequent years. It was anticipated that houses with major losses would have the tax halved for at least one year (Bluett, 1986). This reassessment should enhance the recovery period.

Six months later housing data demonstrated that the market was beginning to return to levels at or near those existing prior to the flood. Before the flood the average asking price for houses in the flood zone had been $52,768, by September 1986 the figure for a similar house was $45,767, a decline of only 13.3 percent. It would appear that the list price for property has been rising gradually since the flood. For instance, the average list price for property sold since February was $37,333, while for those houses still on the market in September the average was $49,733. Most of these unsold properties were placed on the market after those which had sold; two in June and the rest since the third week in July. There was no physical difference in the characteristics of sold and unsold houses, each had a similar number of bathrooms and bedrooms and an average floor area of 1275 square feet. If the increase in average list price is indicative of market conditions (ie. if list and selling prices are close to one another) then the trend is towards higher prices in the floodplain housing. This may indicate a quick recovery period and/or optimism regarding a floodplain location. However, it should be noted that very little property has changed hands, although some additional dwellings have been transferred in ownership without going through the MLS service (Overton, 1986). Table 3 shows the average and range of data for property located in the flooded areas, both before and after flooding.

Table 3: Housing Values in Flooded Areas, Linda and Olivehurst, California.

Before Flood:	List Price	Selling Price	Days on Mkt	Area(ft2)
Average	$52,768	$49,871	117	1200
Range - High	$59,900	$59,900	300	1420
Low	$46,000	$37,000	6	1080
After Flood:				
Average	$45,767	$31,167*	125	1275
Range - High	$62,000	$37,000	303	1400
Low	$30,000	$27,500	8	924

* Selling price includes only the sales which have been reported through the MLS service, although many more houses in the flood zone are now listed and are included in the list price data.

Source: Multiple Listing Service, Yuba-Sutter Counties, California.

A further indication of the impact of the flood on the housing market has been the changing differential between selling price and the original list price. For the three years before the flood, from 1983 through 1985, the average selling price was 3.3, 5.18 and 6.9 percent respectively below the asking price. For the actual sales since the flood the percentage reduction has been 16.5. These data would appear to indicate that sellers are trying to raise the market to pre-flood levels with high list prices and/or are attempting to recover their investments in property since the flood, but are failing to achieve this because memories of the the flood are still fresh in the minds of people in the area. Thus landowners are experiencing the negative externalities of their location and, it could be argued, that the flood is being capitalized in the house value. A direct comparison of property on the market from the same streets, both before and after the flood, tends to confirm this.

CONCLUSIONS:

In keeping with the theoretical structure upon which this research is based, there has been a change in the utility of flooded residential property in Yuba County, California and this has been reflected in the real estate market. Immediately following the flood, no market existed at all. Within a few months, houses were again put on the market but with a lower list price than for comparable homes before the flood. This suggests that the market has recovered from the initial shock but, at this juncture, has failed to return to pre-flood levels. The diffence between list price and selling price has also increased to nearly 17 percent during the post-flood period. More specifically, the substantial decline in the actual money received for floodplain property, from about $50,000 to just over $31,000, is further evidence of the capitalization process.

It appears that the recovery process is occurring quite rapidly and perhaps faster than might have been expected given the extent of the damage to the two communities. However, in spite of the catastrophic nature of the flooding, this was an unusual event with a low probability of recurrence, which may help

explain why land values did not remain low for an extended period. Once the initial impact was absorbed by the communities and the levee system repaired, then the chance for further or similar events in the near future must seem rather remote. Certainly, the probability of future flooding of similar magnitude will be quite low.

There are other factors that come into play here, which are likely to influence the housing market. First, the occupancy rates for housing in these two communities in 1980 was 91 percent, indicating few available units. The flood only exacerbated the situation because flood induced losses to the housing stock. As a result, recovery may be relatively quick because these losses are likely to influence the market by driving prices up. Thus increased prices over time may be the result of factors associated with demand and supply conditions of the housing market.

A second influence on increased housing prices is the extent of repair or refurbishment. Although many houses were inundated, this occurred only because of a rare situation. Where damage was slight, repairs may serve to increase the value of the property rather than merely return prices to pre-flood levels. This could occur only if the prevailing attitude is that flooding will not recur. Given the characteristics of this flood, this perception may be widespread.

We see, then, two factors that serve to increase the market value of housing, such that recovery to pre-flood levels occurs relatively quickly. However, this can happen only where the socio-economic conditions can bear it. It is not clear that this is necessarily the case in Yuba County. Indeed, the area was economically depressed prior to the flood. The loss of a large portion of the sales tax revenue from the flooding of the Mall may serve to dampen any recovery process.

In the final analysis, the results from Yuba County illustrate the reductions in utility that result from a flood event. Indeed, housing prices dropped following the flood and have not yet recovered to pre-flood levels. The fact that this is seen to be a rare, although catastrophic event, supports the premise that flood frequency affects the capitalization process. That is, the flood initially is capitalized into housing values, but because of the infrequent nature of the hazard, values can rise over some period of time. While recovery is evident in both these communities, the exact extent of this period remains to be determined. These properties will be tracked over time, however, and compared with non-flooded houses until some degree of equilibrium is reached. This is part of the on-going research program into floodplain land values under different flood conditions as outlined in the theoretical discussion.

REFERENCES:

Babcock, M. and Mitchell, B., 1980. Impact of Flood Hazard on Residential Property Values in Galt (Cambridge), Ontario. Water Resources Bulletin, 16(2): 532-537.

Bish, R. and Nourse, H., 1975. Urban Economics and Policy Analysis. McGraw Hill, Inc., New York.

Bluett, P., 1986. Personal Communication. County Assessor, Marysville, Yuba County, California.

Burby, R.J. and French, S.P., 1981. Coping with Floods: The Land Use Management Paradox. Journal of the American Planning Association 47: 289-300.

Burby, R.J. and French, S.P., 1985. Flood Plain Land Use Management. Studies in Water Policy and Management, No. 5. Westview Press, Boulder.

Burton, I., Kates, R.W. and White, G.F., 1978. The Environment as Hazard. Oxford University Press, New York.

Changnon, S.A., Schicht, R.J. and Semonin, R.G., 1983. A Plan for Research on Floods and Their Mitigation in the United States. In: Final Report to National Science Foundation (NSF-PAG-81- 17027). Illinois State Water Survey Division, Department of Energy and Natural Resources.

Clawson, M., 1971. Suburban Land Conversion in the United States: An Economic and Governmental Process. Resources For the Future, Johns Hopkins Press, Baltimore.

Damianos, D., 1975. The Influence of Flood Hazards upon Residential Property Values. Unpublished Ph.D. Dissertation. Agricultural Economics, Virginia Polytechnic Institute.

Department of Water Resources, 1986. The Floods of February 1986. California Department of Water Resources: Public Information Office. 29pp.

Dowall, D.E., 1979. The Effect of Land Use and Environmental Regulations on Housing Costs. Policy Studies Journal 8: 277-288.

Foster, J.H., 1976. Flood Management: Who Benefits and Who Pays. Water Resources Bulletin, 12 (5): 1029-1039.

Friesema, H.P., Caporaso, J., Goldstein, G., Lineberry, R. and McCleary, R., 1979. Aftermath: Communities After Natural Disasters. Sage Publications, Beverly Hills.

Grether, D.M. and Mieszkowski, P., 1974. Determinants of Real Estate Values. Journal of Urban Economics 1: 127-146.

Li, M.M. and Brown, H.J., 1980. Micro-Neighborhood Externalities and Hedonic Housing Prices. Land Economics 56(2): 125-141.

Montz, B.E., (In Press). Floodplain Delineation and Housing Submarkets. The Professional Geographer.

Muckleston, K.W., 1983. The Impact of Floodplain Regulations on Residential Land Values in Oregon. Water Resources Bulletin 19: 1-7.

Muckleston, K.W., Turner, M.F. and Brainerd, R.T., 1981. Floodplain Regulations and Residential Land Values in Oregon. Office of Water Resources Technology (No. A-054-ORE) and Water Resources Research Institute, Oregon State University.

Ohls, J.C., Weisberg, R.C. and White, M.J., 1974. The Effect of Zoning on Land Value. Journal of Urban Economics 1: 428-444.

Overton, J., 1986. Personal Communications. President of the Sutter-Yuba Board of Realtors, Yuba City.

Palm, R., 1982. Earthquake Hazards Information: The Experience of Mandated Disclosure. In D.T. Herbert and R.J. Johnston (Eds.) Geography and the Urban Environment: Progress in Research and Applications 5: 241-277. Wiley, Chichester.

Penning-Rowsell, E.C. and Chatterton, J.B., 1980. Assessing the Benefits of Flood Alleviation and Land Drainage. Proceedings of the Institution of Civil Engineers (Part 2), 69: 295-315.

Rowels, S.T. and Scott, A.J., 1981. The Urban Land Question. In M. Dear and A. Scott (Eds.) Urbanization and Urban Planning in Capitalist Society. Methuen, New York.

Scawthorn, C., Iemura, H. and Yamada, Y., 1982. The Influence of Natural Hazards on Urban Housing Location. Journal of Urban Economics 11: 242-251.

Sheaffer, J.R. and Greenberg, L.S., 1981. Evaluation of the Economic, Social and Environmental Effects of Floodplain Regulations. Report for the U.S. Department of Housing and Urban Development and the Federal Emergency Management Agency.

Shilling, J.D., Benjamin, J.D. and Sirmans, C.F., 1985. Adjusting Comparable Sales for Floodplain Location. The Appraisal Journal July: 429-436.

Smith, C., 1986. The Flood of '86. Special Edition: Yuba-Sutter Appeal-Democrat, The Flood of 1986. 24pp.

Tobin, G.A. and Newton, T.G., 1986. A Theoretical Framework of Flood Induced Changes in Urban Land Values. Water Resources Bulletin 22: 67-71.

White, G.F. and Haas, E.J., 1975. Assessment of Research on Natural Hazards. MIT Press, Cambridge, Massachusetts.

Zimmerman, R., 1979. The Effect of Flood Plain Location on Property Values: Three Towns in Northeastern New Jersey. Water Resources Bulletin, 15(6): 1653-1665.