FLOOD INSURANCE AS A COMPONENT OF LAND USE MANAGEMENT*

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Floods will continue to cause damage as long as development continues upon flood-prone lands. Inevitably, flooding occurs, damage ensues and there is personal suffering and loss. A burden of rescue and relief operations falls on all taxpayers.

Flood control projects cannot protect against all damage, and not all flood hazard areas are amenable to flood control projects. An alternative to continued construction of engineering works for flood protection is flood plain management. To be effective, this must be brought about through political and legal means. Its purposes are to minimize the consequences of flooding and to achieve, in the long run, an optimum use of the flood plains.

Since 1936, the national approach to flood problems has been generally for the federal government to assume a major obligation, in protecting developed areas from damaging floods. The government has invested over $9 billion in flood control projects since 1936, but damages have been escalating, annually costing $2 billion. Increasingly, federal funds were used to support projects justified on the basis of protection of land for future use. Individual beneficiaries from engineering works are not bearing an adequate share of the costs [2].

Individuals have a difficult time dealing with hazardous events such as floods. They neither show great concern about potential losses nor take steps to protect themselves. This response to uncertainty has led to increases in the toll of life and property. Disaster relief policies bailed out victims through low-interest loans and forgiveness grants as if disasters were a public responsibility. If victims of disasters bore more of the costs themselves, they would have a larger incentive to protect themselves against future catastrophies [8].

There is an urgent need to provide incentives to stop uneconomic development of flood plains. Urban expansion into flood plain in the United States lies between 1.5 and 2.5 percent annually, with much of the new development gaining no special benefits from flood plain location [10].

The flood damage hazard in the United States is highly concentrated. As few as two percent of all dwellings incur more than half of the annual flood damages. Less than ten percent of all dwellings have any significant flood hazard, hence 90 percent or more are free from any serious or measurable danger. Many people in high-flood risk areas are uninformed about the extent of risks of flood damage which they face [7].

The prime measure for reducing flood-damage hazard is to avoid unwarranted occupancy of flood-prone areas. Compulsory flood insurance is one important way of providing economic incentive to avoid development on highly flood-prone land. If the new occupant of such areas were to bear the full cost of flood insurance premiums, he would have to balance advantages and costs of such occupancy. In addition, potential damages can be reduced by careful site planning, land development, site preparation and by special flood-proofing measures. Flood-prone areas, both riverine and coastal, are often valuable in spite of the risk of flooding, because of recreational and locational value [7].

Flood plain regulations reduce future damages by requiring the flood plain be used for purposes that are not subject to flood damage or that suffer only

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*Technical Article No. 12226 of the Texas Agricultural Experiment Station.

minimal damage. Also, regulations provide for necessary floodway capacity, so that flows are not obstructed or flood heights increased significantly. Several devices are available to a community wishing to achieve flood plain management.

Zoning is a legal tool used to implement and enforce detailed plans resulting from land use planning programs. Designated floodways may be reserved by establishing encroachment lines that clearly define flooding zones. Used by local governments to specify the manner in which land may be divided, subdivision regulations may prescribe width of streets, curbs and gutters; lot sizes; elevations of land to avoid area flooding; size of floodways; and other requirements affecting the welfare and safety of the community. Building codes can contain provisions that assure structural soundness of buildings during flood periods. Flood-conscious governmental policies that limit the extension of public roads, utilities, and other services into flood-prone areas can play an important, if indirect, role in shaping overall development. Private development often follows the extension of public services. Continuing study and review of flood plain management considerations is important in maintaining long-range appropriate land use [4].

Federal action against flooding has been escalating since 1966. Executive Order No. 11296 of that year requires federal agencies to take the flood hazard into account when planning uses of flood plain lands. In 1968, Congress established a voluntary National Flood Insurance Program to provide limited coverage to victims of flood disasters. The Flood Disaster Protection Act of 1973 is an expanded flood insurance program, intended as a substitute and eventual replacement for federal disaster relief for flood occurrences. It combines subsidized flood insurance for existing development and manditory insurance, based on actuarial rates, for future development in flood-prone areas [9].

We contend that an effective compulsory flood insurance program will indeed result in maximum net benefits to the nation by causing rational economic flood plain use.[1] This is based on the premise that actuarial flood insurance premiums are a reliable measure of flooding risk and can be expressed as an annual cost to which the flood plain occupant can relate. Basically, if each new development were required to pay an annual charge (insurance premium) in proportion to its hazard, the following result would be expected:

(1) Society would be assured that occupants of new developments were assuming appropriate responsibility for locational decisions.
(2) New development in the flood plain would be precluded unless advantages were expected to equal or exceed the total social (public and private) cost.
(3) There would be incentive to undertake all those flood damage reduction measures, public and private, the costs of which are less than the consequent reduction in damage potential, since they would result in a greater reduction in occupancy charges (total social costs) than outlays for such measures. Moreover, if cost-of-occupancy charges were taken into account in the benefit-cost analysis of flood protection works, they would help determine the economics of any such undertaking and of any increment in scale of such undertaking.
(4) There would be support for appropriate regulation of flood plains to help, where possible, reduce the costs of flood plain occupance.
(5) In sum, the occupany charge indemnification fund or flood loss insurance can be used in lieu of an uneconomic structural or other type of measure, and to complement an economic flood protection measure [6].

The incentive to avoid locating new development in a flood plain when it is uneconomic can and will be provided by federal flood insurance. The annual flood insurance premium is an added buyer cost with impact on the marketability of a dwelling. Therefore, requirements to be covered by flood insurance provide economic incentives for improved land use management in flood plains [7]. In the five years since the Flood Insurance Act of 1969, more than $8 billion in property damages were written in 4,339 communities [10].

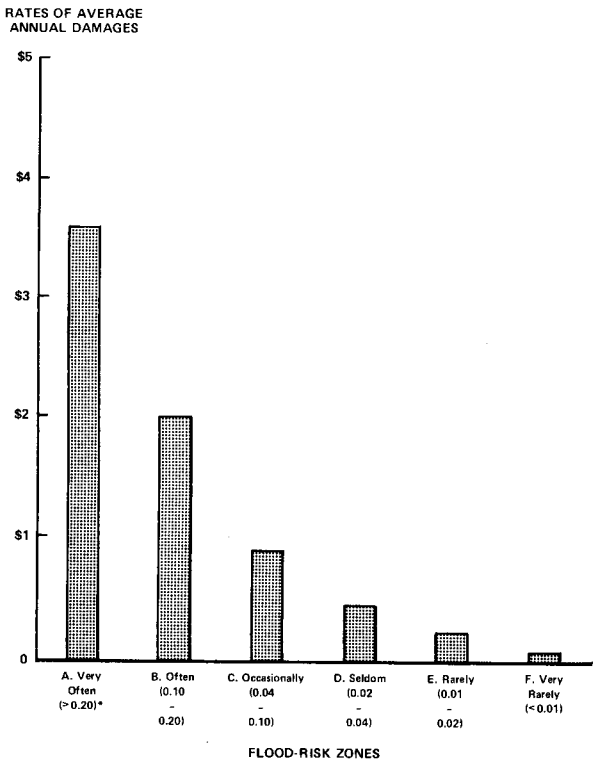
The actuarial base for the present flood insurance program is the likelihood of a 100-year flood. This is the size flood which would have a one percent chance of being equalled or exceeded in any one year. This has been selected as a flood hazard guideline which provides a reasonable level of freedom from damage or threat to life and health, but is not so high as to be unnecessarily restrictive.

A one percent chance of exceedence in any one year is equivalent to a 20 to 30 percent chance of exceedence in the common mortgage period. It is a

[1] This paper is part of a broad study on flooding, particularly in Texas. The source is: McNeely, John G. and Ronald D. Lacewell [5]. "Flood Plain Management," forthcoming Texas Agricultural Experiment Station Publication.

risk against which it seems rational to plan or insure. It is exceeded every year in some region of the country and often in several regions. In 1972 and 1973, over 80 presidential disaster declarations for public assistance were related to flooding. In over 20 of these disasters, flooding equal to or greater than the 100-year flood was experienced. In about ten of these cases, excessive flooding occurred over large areas [2].

Flood insurance premiums provide economic guidelines to optimum use of the flood plain. This is due to the great variation in average annual flood damages (insurance premium) from one flood risk zone to another which reflect the cost of living on the flood plain [8]. Figure 1 indicates estimated average annual flood damages by flood risk zones. In Zone A, where a flood is expected once every five years (20 percent chance of flooding annually), average annual flood damages per $100 of value are about $3.60, compared to $2.00 in the five to ten year expected occurrence interval. Expected flood damages continue to decline as the threat of flooding becomes less frequent.



SOURCE: U.S. Congress, Senate, 1966 (4).

*Probability of flooding in any year.

FIGURE 1. AVERAGE ANNUAL RESIDENTIAL FLOOD DAMAGES, PER $100 PROPERTY VALUE, STRUCTURE AND CONTENTS, BY RISK ZONES, MEDIAN OF STUDY AREAS

EFFECT OF FLOOD INSURANCE

Texas ranks fifth nationally in the number of communities with identified and mapped flood hazard areas, according to the Texas Water Development Board. In these areas, flood insurance premiums indicate the flood risk to the potential buyer or builder. The annual flood insurance premium impacts directly on flood plain property values. For the examples below, it is assumed that a flood insurance premium is set at the average annual flood damages per $100 of building and contents.[2] In actuality, a flood insurance premium will exceed average annual flood damages, since those damages and all overhead costs of the program must be included in the premium. Hence, the effect of flood insurance on property values is greater than that of the actual flooding risk.

The value of property in a flood plain considering flooding risk can be estimated using the following equation:

$$V = L+B+F - \frac{A\left(\frac{B+F}{100}\right)}{i} \qquad (1)$$

where

V = value of land, buildings and contents considering flooding
L = land value with no flooding risk
B = building value in absence of flooding
F = furnishings or building contents value in absence of flooding
A = average annual flood damages per $100 building and contents value
i = interest or discount rate.

Basically, the calculation takes property value in the absence of flooding and subtracts the expected present value of all future flooding damages.

Effect on Developed Flood Plain

Assume a development in the flood plain which has a land value of $10,000 and flood damageable property in building and furnishings of $40,000. This

[2] A method for establishing average annual flood damages for agricultural crops produced in flood plains was developed by Eidman and Lacewell [3]. Agriculture is not critical to the arguments set forth in this paper nor is insurance as badly needed to guide use of the flood plain in agriculture as in urban areas.

would give a total value of $50,000 for land, building and furnishings if the development were not subject to flooding. However, location in a flood plain means a flood risk is assumed. This risk can be reflected in reduced property value.

The magnitude of the reduction in property value is directly related to the flood risk; i.e., the greater the flood risk, the greater the loss in property value. In the example, if average annual flood damages were $1.00 per $100 flood damageable property value, the total property value would be reduced $4,000, calculated as ($1.00X400/10%). This leaves a $46,000 property value rather than $50,000, calculated using a ten percent discount rate.[3] At $5.00 average annual flood damages per $100 property value, the reduction in property value due to flooding risk would be $20,000, or the $50,000 value would be reduced to $30,000.

Figure 2 shows percent reduction in flood damageable property value that is associated with alternative flooding risks (average annual flood damages). A ten percent discount rate is used to develop the graph. With average annual flood damages of $10 per $100 of building and contents, value of the building and contents is zero, due to the serious magnitude of flooding risk. This would logically mean the land value would also be zero for new construction; i.e., land use would have to be something other than homesites to have any value.

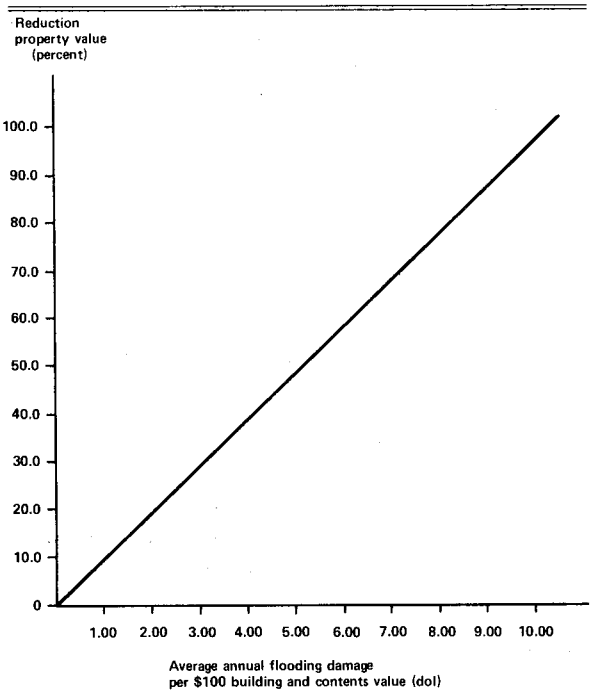


FIGURE 2. PERCENT REDUCTION IN VALUE OF BUILDING AND CONTENTS BY LEVEL OF FLOODING RISK

Viewing the same type analysis somewhat differently, assume a family buys a new house and lot for $32,000, paying ten percent down, and puts $8,000 worth of furniture in it. The land may have been worth $8,000. Building cost, including builder's profit, is $24,000. Under usual home financing terms, monthly payments, including taxes and amortization of the loan, are about $300. Such houses have been found in some cities in zone A, most frequent flood hazard. The average annual flood damage in such areas might easily reach to $10 per $100 property value (building and contents). This is $4,000 (or $333 monthly), or more than the whole home financing cost in the absence of a flood risk. Putting aside the question of the occupant's willingness to pay such a cost, it is not economic for him to do so, or for the public that he should be in a place where flooding costs are so high.

In the short run, with investment in present buildings already made, and subsidized flood insurance available, continued use of existing dwellings makes economic sense from a public policy viewpoint. Although the owner with a high mortgage may not be willing or able to pay actuarial flood insurance rates, the nation is better off for him or someone else to use the dwelling than to abandon it. The subsidy, to owner and lender as well, may be necessary and desirable until the present buildings are no longer readily habitable. If exposed to heavy flood losses, houses will age quickly.

This analysis is based on the presumption that the flood insurance premium is reasonably equivalent to average annual flood damages. With heavily subsidized flood insurance, some of the property value loss attributable to flood risk is assumed by the federal government. Property value can be expected to be reduced in relation to the flood insurance premium.

Effect on New Development

The above discussion related to a development in the flood plain. Turning to bare flood plain land, the effect of flooding risk on land value where development is planned can also be calculated with Equation 1.

One important difference is that development has *not* occurred. This means that the value of

[3]These results, as in any analysis where a stream of costs or benefits are evaluated on a present value basis, are dependent upon the interest rate. A reduced interest rate would yield a larger property value loss due to expected average annual flooding and vice versa.

buildings and contents that are planned for the flood plain cannot reasonably be decreased due to flooding risk. A homeowner would not rationally expend money on land, building, and contents in a flood plain when, upon completion of construction, the property would be worth thousands of dollars less. Therefore, all loss in value to undeveloped flood plain property attributable to flood risk must be applied to the land. Further, flood insurance is not subsidized for new developments in the flood plain, hence property owner rate is actuarial rate or a close approximation of actual flood risk.

To illustrate, consider a home that is planned in the flood plain where the land is valued at $10,000 in the absence of flooding and a $38,000 building and contents structure is contemplated. If average annual flood damages after construction are $1.00 per $100 building and contents value, the loss in property value would be $3,800. This $3,800 loss in value due to flood risk would reasonably be deleted from the $10,000 land value leaving a $6,200 land value. For greater flood risks, the land value is further reduced to zero and beyond, for this type of development. The value for recreation or water storage purposes is not considered in this problem.

The level of average annual flood damages per $100 building and contents where land value becomes zero is important. Average annual flood damages where land value is zero can be calculated as

$$L = \frac{A\left(\frac{B+F}{100}\right)}{i} \qquad (2)$$

or

$$A = \frac{100L\,i}{B+F} \qquad (3)$$

In the example where land value was $10,000 in absence of flooding, and a $38,000 building and contents structure is contemplated, with average annual flood damages of $2.632 per $100 building and contents value, the value of the land would be zero.

The level of average annual flood damages where land value is zero is especially important in evaluating new developments in a flood plain. Table 1 indicates average annual flood damages where land value would be zero, given alternative building and contents values for a planned development and land values in the absence of flooding. A ten percent discount rate was used in the calculations. As the value of building and contents increases relative to land value, the average annual flood damages value, where land value is reduced to zero, becomes smaller.

For example, if the value of building and contents were going to be $20,000, and land value in the absence of flooding was $10,000, average annual flood damages would have to be $5.00 per $100

TABLE 1. AVERAGE ANNUAL FLOOD DAMAGES WHERE LAND VALUE IS ZERO[a]

Value of building and contents ($)	Land Value in absence of flooding ($)								
	1,000	2,000	3,000	4,000	5,000	10,000	20,000	50,000	100,000
1,000	10.00	20.00	30.00	40.00	50.00	100.00	200.00	500.00	1,000.00
2,000	5.00	10.00	15.00	20.00	25.00	50.00	100.00	250.00	500.00
5,000	2.00	4.00	6.00	8.00	10.00	20.00	40.00	100.00	200.00
10,000	1.00	2.00	3.00	4.00	5.00	10.00	20.00	50.00	100.00
15,000	.67	1.33	2.00	2.67	3.33	6.67	13.33	33.33	66.67
20,000	.50	1.00	1.50	2.00	2.50	5.00	10.00	25.00	50.00
25,000	.40	.80	1.20	1.60	2.00	4.00	8.00	20.00	40.00
30,000	.33	.67	1.00	1.33	1.67	3.33	6.67	16.67	33.33
40,000	.25	.50	.75	1.00	1.25	2.50	5.00	12.50	25.00
50,000	.20	.40	.60	.80	1.00	2.00	4.00	10.00	20.00
100,000	.10	.20	.30	.40	.50	1.00	2.00	5.00	10.00
200,000	.05	.10	.15	.20	.25	.50	1.00	2.50	5.00
250,000	.04	.08	.12	.16	.20	.40	.80	2.00	4.00

[a]Average annual flood damages per $100 building and contents value. Calculations are based on a 10 percent discount rate. The calculation is: Average annual flood damages=land value/(building and contents value) • 0.1

building and contents value—for actual land value to be zero for building purposes. However, if building and contents value were increased to $50,000, average annual flood damages, where a $10,000 land value would be reduced to zero, occurs at $2.00 per $100 property value.

With compulsory flood insurance set at the approximately flood risk rate, flood plain development is expected to be guided to more socially desirable ends. However, flood insurance is not the only flood plain land use planning technique that should be used in guiding development of bare flood plain or shifting uses in developed flood plain.

INTEGRATED FLOOD PLAIN MANAGEMENT

The best management program for a particular flood-prone area may be a system of flood protection works, but the limit to their rational cost is suggested by the difference in insurance premiums with and without them. If flood damage is unavoidable, then insurance is a means of protecting against such losses. Where the unavoidable loss is high, the best long run solution may well be a shift in land use from residential to recreational uses, or simply as overflow land to help contain floods. If a city has long-range economic and land use plans, and if it takes actions to implement these plans over a period of years, substantial impacts on land use can be expected over time without severe hardship to anyone. Zoning, building permits, extension of public services and other public actions can gradually guide growth into appropriate areas.

Management of flood-prone areas, in this broad sense, goes beyond flood insurance alone. Flood insurance should be viewed as a facilitating force toward long-range land use management. When flood disasters occur, all agencies concerned with land use in flood-prone areas should restrict future public and private investment in such areas. This takes advantage of opportunities afforded by disasters to channel resulting new investments to other geographic areas.

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