June 18, 2001

No Adverse Impact:
A New Direction in Floodplain Management Policy

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Published in *Natural Hazards Review Nov. 2001, IAAN 1527-6988*

Abstract:
Annual flood losses in the United States continue to worsen in spite of 75 years of federal flood control and 30 years of the National Flood Insurance Program. This trend is unnecessary, and is primarily due to federal policies that have encouraged at-risk development, provided for insufficient consideration of the impact of that development on other properties and on future flood and erosion potentials, justified flood control projects based on a benefit-to-cost ratio that favors an intensification of land uses within the floodplain, and engendered an unhealthy reliance on federal resources by state and local governments. The authors propose a new "no adverse impact floodplain" approach that shifts the focus from the techniques and standards used for floodprone development to how adverse impact resulting from those land use changes can be planned for and mitigated. The proposed policy promotes fairness, responsibility, community involvement and planning, sustainable development, and local land use management, while not infringing on private property rights.

INTRODUCTION

Flood losses in the United States continue to escalate. This increase in the level of damage to public and private property, amounts spent on disaster relief, disruption in

that will significantly decrease the creation of

regional and socio-economic lines, then for one to agree with the Corps policy it would be necessary to have a view that development in floodplains is the ultimate expression of federal policy.

Induced flood damage. Because of our benefit-cost view of the world, once a structural project is built, there are apparent benefits to developing and intensifying land use within the "protected" zone. Yet to date we have not adequately addressed such issues as higher rates of runoff from developed watersheds or loss of stream storage that will lead to higher flood flows in the future. The net result is more damage from a catastrophic flood, and in all likelihood in a lower level of future protection than provided by the current structural project.

One category of induced flood damage is

buildings within a floodplain are constructed, yet remain silent about protecting the costly roadway and utility infrastructure required for that very development.

Current floodplain management standards have two essential components. The first is the concept of a two-district floodplain, known as the floodway and the flood fringe. The floodway is the central portion of the floodplain, presumably the area with the greatest water velocities and highest depths, which should be left open in order to avoid increases in flood levels. Under current national standards, however, flood levels can be increased up to 1 foot. The flood fringe comprises the outer areas on both sides of the floodway, and presumably is the area of lower depths and velocities and that stores water during a flood. Current standards allow development in the flood fringe regardless of depth and velocity, and restrict development in the floodway.

The second component is the establishment of the lowest floor of construction at the level of the 1% chance flood. (The discussion in this paper focuses on riverine examples, but there are similar standards for coastal areas.)

When establishing a floodway line, hydraulic engineers consider continuous floodplain encroachments until, on average, the flood levels increase 1 foot. Unfortunately, there is too little consideration given to the residual depths and velocities when the floodway line is established. When setting the floor elevation, the requirements are that the lowest floor of a building be no lower than the mapped 1% chance flood's water surface elevation. In general, no consideration is given to waves or to future increases in the level of the 1% chance flood. The increased future level is usually the result of more runoff from developing watersheds or is induced by floodplain encroachment allowable under the current regulations .

Induced flood damage. Due to the manner in which a floodway line is established, up to a 1-foot increase in flood water depth will result once the entire flood fringe is encroached upon. In many developing areas of the nation, the flood fringe areas are rapidly being filled, but there is no requirement to consider the impact this increase in water surface will have on existing buildings or property. Even worse, when a building is constructed in the floodplain, the lowest floor elevation may be set based upon data that is 15 years old or older and thus could well be below today's true 1% chance flood level. Further worsening this problem is the fact that the floodplain encroachments are displacing land area that the rivers naturally used to store floodwaters. If extensive filling of the floodplain occurs, flood stages are no longer attenuated in the floodplain but instead are passed downstream, further increasing flood levels. Finally, because of development within the watershed, more runoff will flow into the floodplains, but these future flows are not considered when establishing lowest floor elevations.

The net result is that, due to land use actions within and outside the floodplain, existing and future development very likely will experience flood depths of 1 foot or more above the mapped levels, inducing significant new damage. From a broad policy standpoint a 1-foot increase sounds trivial. Consider, however, that the difference in flood depth between a 1% chance (100-year) flood and a 2% chance (50-year) flood is often only 1 or 2 feet. Likewise, the difference between a 1% chance flood and a 10% chance (10-year) flood may only be from 2 to 4 feet. Based on recent evaluations in the Charlotte-Mecklenburg region of North Carolina, planners and engineers are estimating that between improved mapping techniques, accounting for future-conditions runoff from the watershed, and the impact of floodplain encroachment, future 1% chance flood levels will be on average 5.7 feet higher than current mapped elevations. Of the 5.7-fo

What this means is that today's 1% (100-year) standard, which allows encroachments into the floodplain, in actuality may be tomorrow's 50-year standard, and may only be a 10-year standard once the watershed is fully developed. These trends do not bode well for controlling the escalation of flood damage, and left unchecked could become significantly worse than anticipated by the founders of the flood insurance program. Gilbert F. White has long called for a full-fledged assessment of the effectiveness of the NFIP, and based on these trends, the need for this evaluation is self-evident.

Disaster Assistance Mission

Congress and the citizens of the United States are typically quite compassionate when it comes to assisting those affected by natural disasters. Unfortunately, our need and desire to help those victims has become viewed as a federal responsibility, and only recently has the idea of actually mitigating some of these losses begun to seriously shape disaster recovery programs.

Unhealthy state and local government reliance. The perception among elected officials and, to a lesser degree, professional staff is that when a natural disaster strikes, the federal government will fly to the scene with trucks full of money to solve the problems. In some cases this perception may be true, but in most it is far from the truth. Unfortunately, this perception (coupled with readily available federal flood control projects from the 1950s through the 1970s) has led to a belief that flood mitigation is a federal issue, and is a lesser responsibility of the non-federal entities. Because of this mindset and competing needs for local funding, most communities do little more than comply with the minimal standards of the NFIP, leading to the creation of increased future flood losses as described above.

Induced flood damage. For many years the sole focus of disaster assistance was rapid recovery with little concern for mitigation. The result was that communities were the recipients of repaired or replacement systems of infrastructure that made floodprone areas attractive locations for development. Only if buildings were substantially damaged (more than 50% damaged in one event) were they rebuilt to be compliant with NFIP standards. The net result is that damage-prone infrastructure was replaced, and buildings that were heavily damaged or destroyed were replaced by buildings only marginally protected by virtue of being elevated to the level established when the flood mapping was done (in most cases many years before the disaster). Only recently (in the 1988 and 1994 amendments to the disaster relief acts) has mitigation become an important element of the recovery process. But it will take years for mitigation to catch up with the backlog of communities that were rebuilt only to be destroyed again.

Summary of the Problem

To visualize how ludicrous the prevailing approach to flood loss reduction in the United States is, imagine a situation in which someone decides to build a house next to a landfill (from most perspectives not a good decision, yet it is within the purview of that citizen to do so). Over a weekend the owners of one property build a home next to the landfill, using government-supported studies that suggest there are no serious problems associated with noise and dust (the study was 20 years old). On Monday, the new homeowners call their favorite politician to complain about the noise and dust from the landfill, at which time publicly funded studies of and projects for sound barriers and dust abatement are approved and ge

amend a master plan that will double the town's population but will not provide any more landfill space. On Friday, six new homes are built on the properties behind the new sound barrier, and everything is wonderful until the following Tuesday, when people come home to find overflow trash dumped in their front yards.

For too long, our national policies have ignored growth-related impact in the floodplain and have allowed construction and paving on the watershed to have "free dumping" prerogatives—increased runoff being "temporarily stored" on downstream properties. At the same time we are taking actions that encourage at-risk behavior. Property owners would not tolerate trash dumped on their lawns, but they do not seem to understand that floodwater "dumped" on their property could easily be avoided.

It is clear that the nation has followed a course that has encouraged at-risk behavior, silently allowed practices that increase flooding potential, and done little to encourage local government innovation—all of which has led to significant increases in flood losses. Trends in flood damage data substantiate that losses are escalating significantly. It also appears that if current practices are left unabated, the potential for a more rapid escalation in losses exists.

To remedy the unintended effects of several decades of flood reduction policies, it will be necessary not only to avoid creating new hazards but also to actively mitigate existing ones. The guiding principle of "no adverse impact" floodplain management described below would significantly assist the nation in meeting this goal.

DESCRIPTION OF NO ADVERSE IMPACT FLOODPLAINS

A "no adverse impact floodplain" is one in which *the action of one property owner or community does not adversely affect the flood risks for other properties or communities as measured by increased flood stages, increased flood velocity, increased flows, or the increased potential for erosion and sedimentation, unless the impact is mitigated as provided for in a community or watershed based plan.*

flood problems. Adverse impact caused by implementation of the plan would be confined to the local or regional planning boundary of the plan. If

Table 1. Some adverse impacts of development on floodprone lands, remedy options to mitigate them, and benefits/limitations of those options.

ADVERSE IMPACT	CONTRIBUTING CONDITION	REMEDY	COMMENT
INCREASED FLOOD STAGES			
INCREASED VELOCITY			

INCREASED FLOWS

EROSION & SEDIMENTATION

the first floor of a structure must be elevated above the regulatory flood height) is an essential strategy for minimizing the potential of flooding to new construction, it does little to address the potential for induced flood damage to existing structures in or near the floodplain.

Other tools that some are using include developing local regulatory floodplain maps premised on a fully developed or "future condition" watershed condition, utilizing local and regional basins to store excess runoff such that flood peaks are not increased; or some are exploring the concept of permanent easements that allows future overflow. Each of these techniques lend themselves towards either a regulatory or project based implementation, and are only some of the tools that could be considered.

In recent years a limited number of communities have begun dealing with the issue of not increasing flood elevations caused by floodplain encroachments. The response by the development community has often been to channel the river with concrete to increase velocity, which gets rid of the water more quickly but also leads to the loss of storage in the floodplain. In some cases this has led to the increased severity of downstream flooding.

Increased velocity. Whenever the discharge in a stream is increased without an offsetting increase in cross-sectional flow area, or when the cross-sectional flow area is decreased due to fill or development in the floodplain, velocities will increase. Increased velocity also commonly occurs when levees are installed, pinching in the river. The impact of these actions can be erosion from increased velocity and/or increased flooding or damage downstream. Approaches that limit or result in reduced floodplain encroachment that would increase velocities will prevent this problem. Retention or regional storage options that limit runoff from new development to the amount of discharge that existed before development will also prevent increased velocities. When existing levees are to blame, setting back the levee and restoring natural flow areas to the future condition floodplain of the stream will support a no adverse impact standard. At times, with regional plans, velocity increases may be necessary. However, under a no adverse approach this increase would be identified and mitigated as appropriate in the plan.

Increased flow. A third area of concern is the management of increased flow. These increases are generally the result of paving of watersheds or the loss of in-stream storage due to filling or development. Communities continue to implement and evaluate retention and detention basins so that new development does not increase flow. If properly designed, retention/detention can limit downstream flood damage, and be readily blended into the developed landscape. In some regions retention and detention measures have gained a bad reputation either due to poor design or because they fail due to poor standards. In most cases where these measures fail, the standards appear to be focused on making sure that post-development flows do not exceed pre-development flow rates. However, lacking very specialized bu,nstre[aprment.6(o64 e. Hnd eval.s4 Tc-0.001 9(it

is analogous to not providing enough landfill space for new growth. Channelization and bank stabilization designs generally are measured for site-specific performance, but their impacts on channel geomorphology are often overlooked. In some cases this has led to the creation of instabilities, causing channel downcutting and bank erosion. In many cases channels have been "bank protected" with little consideration of how the channel will respond. Often streams and rivers respond with accelerated erosion of other sections of the floodplain to compensate for the loss of sediment supply from the protected reach. Each stream has a certain sediment need, and if its source is cut off by armoring in one area, it will get it from another portion of the stream.

Sediment transport and sedimentation are perhaps the least-understood functions of a floodplain, yet the consequences of disrupting them can be significant. Some communities are beginning to evaluate the use of erosion haza

- Sufficient detention storage to allow a post-development 100-year release rate of 0.1 cubic feet per second per acre of development.
- Compensatory storage equal to at least 1.5 times the volume of floodplain or depressional storage displaced; and provided at the same incremental flood frequency elevation as the flood storage displaced.

watercourses termed “washes,” are ephemeral, and are characterized by fast runoff response, high velocities, and potentially high sediment loads.

setback is that bank stabilization can only be used ifnk ezation can onlybanpart ofnk ezmaster plan, or

· Dedication of over $1 million in local funds to re-map the floodplains in Charlotte-

Using future development conditions in floodplain mapping–How does it save flood damage and community disaster costs? As part of the strategy to determine what impact development in the watershed and the impact filling in the floodplain have on flood heights and flood damage, a pilot study was initiated by Mecklenburg County. The goal is to manage new development so flood problems are not increased. The findings of that study are:

- By updating the FEMA map computer models to 2000 land use conditions, flood heights increased 2-3 feet. However, when the ultimate land use in the watershed was loaded into the models, flood height increased another 2-3 feet. Therefore, if the County continues to rely on FEMA for floodplain mapping, the maps will not be keeping up with the impact of development. There is a possibility that new development would be permitted that will ultimately be as much as 2-3 feet below future flood heights.
- To determine the relative impact of development in the floodplain, an encroachment analysis was performed looking at the cumulative impact of 1.0-, 0.5-, and 0.1-foot encroachment on flood heights. This is very different from the FEMA mapping standard, which removes flood storage area on a per cross-section basis and does not account for the cumulative impact of floodplain storage area removal in the watershed. A much more informed decision on the appropriate freeboard requirement can be made if a community knows the cumulative impact of filling in the floodplain for specific watersheds.

The largest impact of development in the floodplain is the FEMA minimum standards, which allow a 1.0 foot encroachment. Even though this has a dramatic cumulative impact on flood heights (2.3 feet), it does not exceed the impact of ultimate development in the watershed (4.3 feet). Therefore, a total prohibition of development in the floodplain was not approved. However, there is still significant impact when there is development in the floodplain due to storage removal and there has been recent development elevated only to the old FEMA flood elevations. To increase the

RECOMMENDATIONS

The authors propose a new policy that is based on the premise of managing floodplains and the watershed so that there is no adverse impact on adjacent properties. “No adverse impact floodplains” is a management principle that is easy to communicate, and from a policy perspective,

4. The Federal Interagency Task Force on Floodplain Management, chaired by FEMA, should initiate an update of the Congressionally mandated Unified National Program on Floodplain Management. It should focus specifically on flood damage and how a no adverse impact approach would work nationally.
5. FEMA should consider expanding its Cooperative Technical Partner (Community/State)

CONCLUSION

Current management approaches for reducing flood losses too often allow development to occur without considering its adverse impact on other properties within the watershed or on future flooding potential. This has contributed to steadily rising flood losses and is increasing the potential for future flood damage.

A "no adverse impact floodplains strategy," adopted as a national default standard, would require that consideration be given to the effect that proposed development activity anywhere within a watershed could have on flood stages, velocity, flows, and erosion or sedimentation anywhere within that watershed. It would ensure that future development activity both in and out of the floodplain be part of a locally adopted management plan. It is an approach that will lead to reducing flood losses within the nation while promoting and rewarding strong management, planning, and mitigation actions at the local level.

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