Chapter 2

TEN CITIES' PROGRAMS TO MANAGE FLOOD HAZARD AREAS

The ten cities studied in this research illustrate the range of conditions under which local governments have formulated programs to combat existing and potential flood problems. They are dispersed geographically and set within different climatic and physiographic regions. Collectively, they represent many of the riverine flood hazards confronting cities and towns throughout the nation. Each community has responded to its flooding problem within the context of growth, age, size, and physical milieu by adopting a floodplain land use management program tailored to its needs and goals.

We begin by identifying four key dimensions of floodplain management programs, and by comparing the strength of each city's program on those dimensions. We then examine the ten communities to see how the characteristics of each city--physical, social and political--shaped its approach to flood problems. We describe in some detail the flood threat each was dealing with, the floodplain land use management program it had in place in 1976 at the start of our study period, and the evolution of the program over the following ten years.

Key Program Dimensions and Components

We noted in Chapter 1 that floodplain land use management programs may encompass a variety of ordinances and mechanisms to affect the *location* of development relative to the flood hazard and the *design* of buildings and infrastructure in the floodplain. In addition to those two dimensions, two other dimensions of floodplain land use management--*stringency of implementation* and *stringency of enforcement*--also may influence how programs affect the land market and the degree to which various groups expose themselves to flood hazards.

We constructed indices to measure the strength of location, construction, implementation and enforcement dimensions of floodplain land use management programs (see Appendix A for a description of the measurement of each index). To measure the overall strength of programs, we added each of those four 30-point indices together. Although the indices and composite scale are arbitrary to some extent (since we were selective in our choice of program components to include and we assumed each component and dimension contributed equally to overall program strength), they do capture the elements that are mentioned most frequently in the literature as contributing to effective floodplain land use management (see Burby and French et al., 1985; Mazmanian and Sabatier, 1983; Sheaffer and Roland, Inc., 1981; Hutton and Mileti, 1979; Sheaffer et al., 1976). The indices and composite scale provide a basis for the comparison of programs presented in this chapter and for subsequent analyses of the impacts of floodplain management.

Overall Strength of the Ten Programs

The strongest imaginable program to minimize the susceptibility of new development to flood damage in the ten cities would have had the following characteristics:

1) The floodplain would have been defined to include the area inundated by a storm exceeding the 100-year standard of the National Flood Insurance Program, reflecting concern for catastrophic events and potential errors in estimating the frequency and magnitude of flood events.

2) No new development would have been allowed in the floodway or floodway fringe, reflecting realization that the benefits of floodplain development may not exceed the sum of private and public costs and the fact that alternative, flood-free sites for community growth are available.

3) Owners of floodplain property would have been allowed to transfer development from the floodplain to flood-free sites, reflecting concern for equity in the application of floodplain regulations.

4) Steps would have been taken to acquire floodplain property (such as by requiring developers to dedicate land in the floodway to the public), reflecting realization that such property is not only very hazardous but also that it serves various public purposes (such as carrying flood waters, filtering pollutants in stormwater, and contributing to ground water recharge).

5) Public agencies would have adopted policies to restrict further construction of public facilities within the floodplain, reflecting realization that such facilities are subject to flood damage and that they tend to induce private development to locate in flood hazard areas.

6) Public agencies would have designated a lead department and staff person to administer the floodplain land use management program, reflecting realization that if someone is not accountable and in charge of the program, it is likely to falter.

7) Public agencies would have designated at least one person to manage the floodplain land use management program, reflecting realization that floodplain management requires adequate staff resources.

8) Variances to the floodplain regulations adopted would not have been allowed, reflecting realization that what seems to be a reasonable departure from the regulations at one point in time may not be reasonable in the long-term (for example, if watershed development leads to increases in the flood threat).

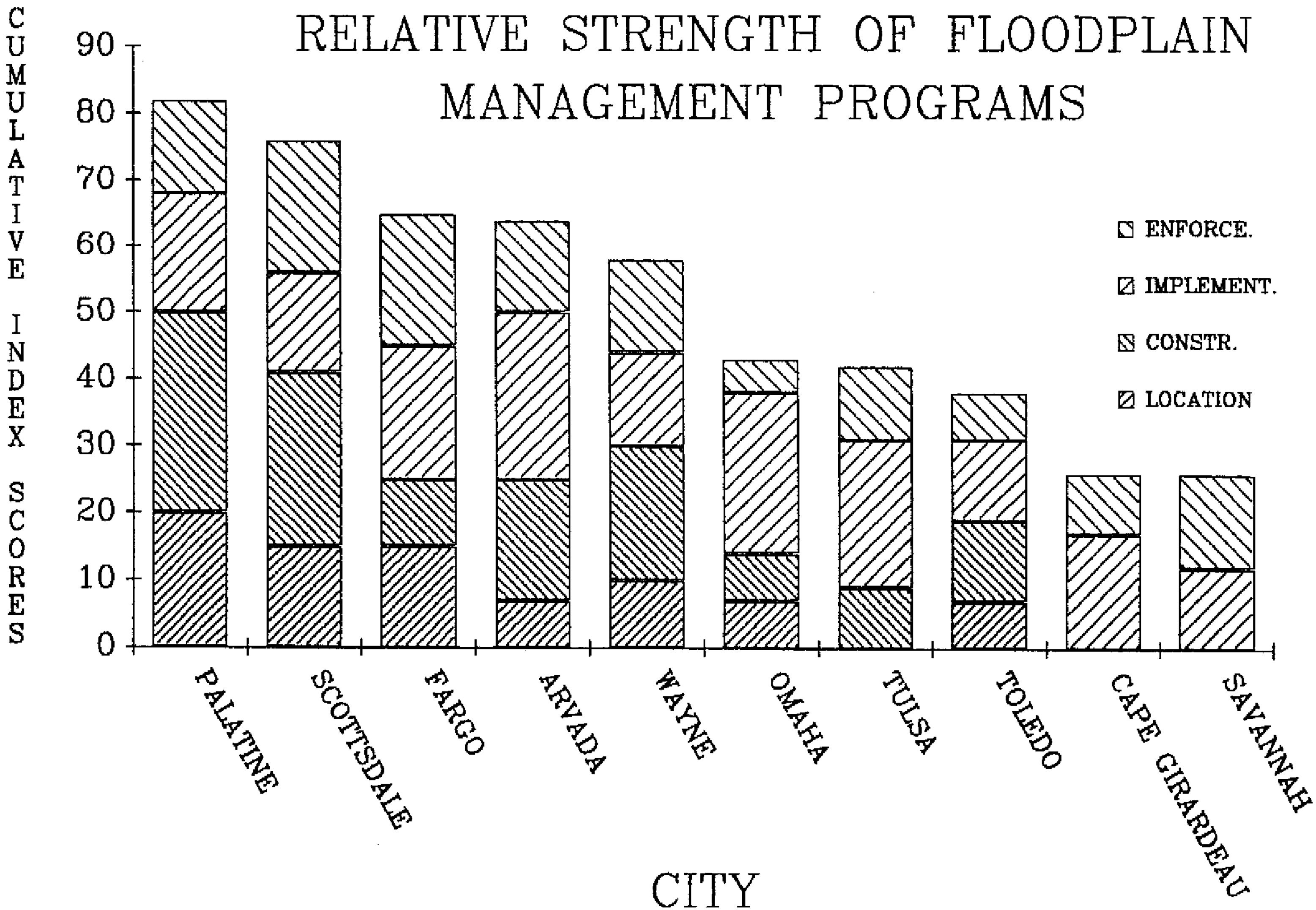
9) Floodplain ordinances would have contained strict penalties for violations, including provisions for injunctive remedies, fines, and criminal penalties, reflecting realization that strong deterrence to violations, such as filling in the floodway, may be needed.

10) Public agencies would have undertaken systematic surveillance of activities in the floodplain in order to detect violations of floodplain management regulations, reflecting realization that if property owners believe that they can violate the law without being detected, they may be more likely to engage in illegal activities that are harmful to public health and safety.

The strongest floodplain land use management program would not necessarily have been an optimal program in a specific community when all program costs and benefits are taken into account. In many communities, for example, the public and private costs of eliminating all floodplain development may not exceed the social benefits obtained. For that reason, it should not be too surprising that none of the cities we studied had as strong a floodplain management program as was theoretically possible (a city with a program such as that outlined above would have received 120 points on our program strength index). Palatine, the city with the strongest program, had a program strength index of 82, which is only 68% of the maximum index points possible.

The strength of each city's floodplain management program is compared in Figure 2-1, which illustrates how programs differed on each of the components we examined. As noted above, Palatine had the strongest program. It was

FIGURE 2-1


RELATIVE STRENGTH OF FLOODPLAIN
MANAGEMENT PROGRAMS
CUMULATIVE INDEX SCORES
90
80
70
60
50
40
30
20
10
0
ENFORCE.
IMPLEMENT.
CONSTR.
LOCATION
PALATINE
SCOTTSDALE
FARGO
ARVADA
WAYNE
OMAHA
TULSA
TOLEDO
CAPE GIRARDEAU
SAVANNAH
CITY

followed closely by Scottsdale, Fargo, Arvada and Wayne. The programs in the five other cities studied were substantially weaker. The strong programs tended to score well on each of the program dimensions we measured. The two weakest programs--Cape Girardeau and Savannah--rated very poorly on the location and construction dimensions of floodplain management, but they were implementing and enforcing the minimum regulations required for participation in the Regular Phase of the National Flood Insurance Program.

Below we take a closer look at each community to see how floodplain management programs were developed to address a variety of flood hazards and how local leaders' perceptions of the hazard and the role of the floodplain in community life affected their choices among program dimensions and components. Following that, we identify some of the factors that produced the wide disparity in program composition and strength illustrated in Figure 2-1. We begin with the weakest programs, Savannah and Cape Girardeau, and proceed through succeedingly stronger programs to conclude with Palatine. Readers who are not interested in a detailed description of each community and its program may want to turn to the end of the chapter, where we discuss some of the factors that account for differences in the approaches the communities took to dealing with flood problems.

Savannah, Georgia (Program Strength Index: 26)

Profile

	1975	1985	% Change
Population	144,809*	144,709	- 0.1
Dwelling units	53,437*	58,666	+10.9

*Includes area annexed in 1979

Flood hazard source	Three canals (Springfield, Casey and Placentia); Savannah River
Floodplain use	
Total acreage of floodplains, 1975	2,210 acres
Developed, 1975	1,040 acres
Residential	530 acres
Nonresidential	510 acres

Flood history	Post-World War II: Relatively minor floods along the canals have occurred in 1947, 1960, 1963, 1964, 1966, 1969, 1970, 1971, 1972, 1973, 1975, 1976, 1980, and 1985
Average annual flood damage potential, 1975	$3,300,000
Population at risk, 1975	7,084

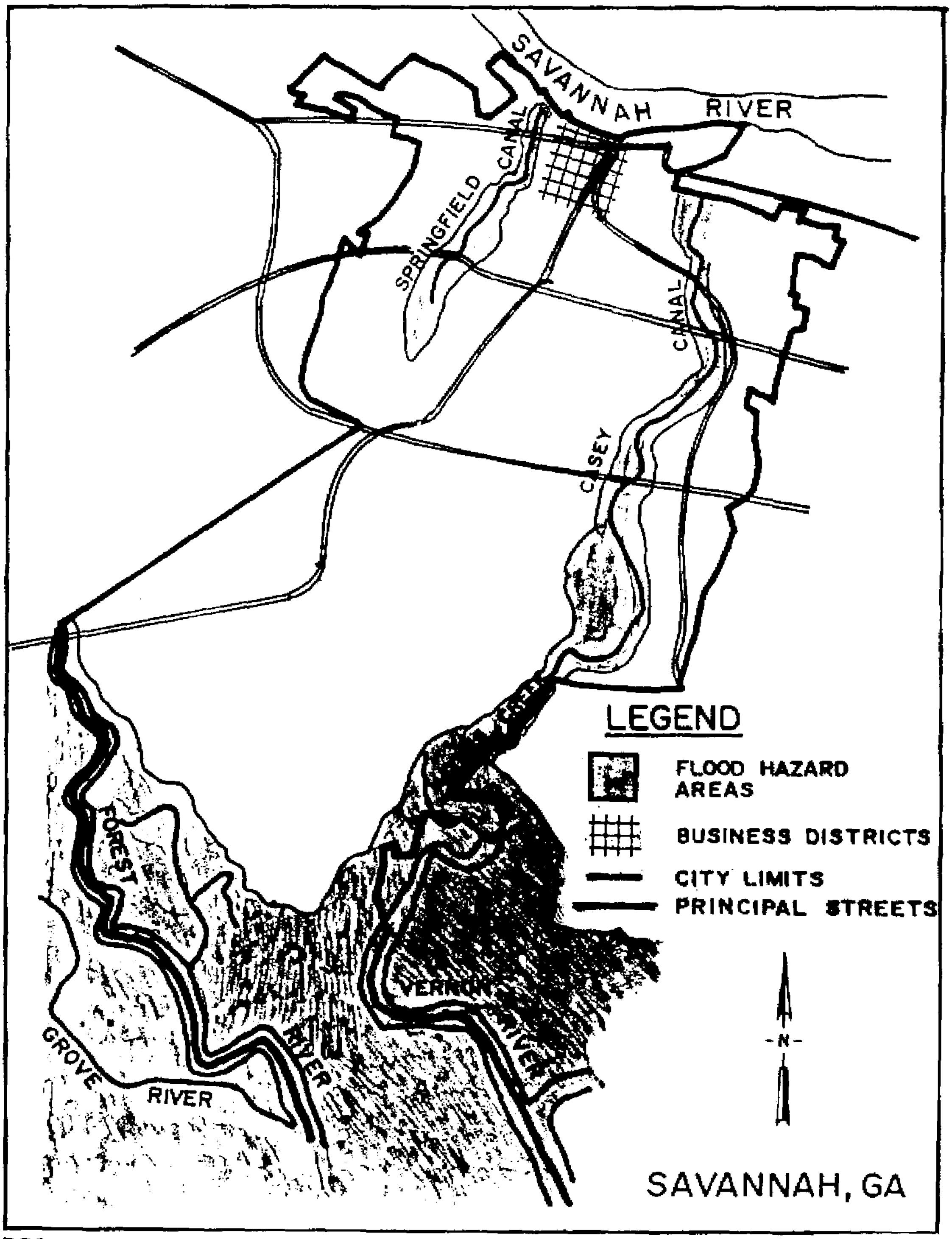
The Community and Its Flood Hazard

Founded in 1773 on a bluff overlooking the Savannah River, growth in Savannah soon spread over the surrounding poorly drained marshlands, creating a flood problem that has been with the city ever since (see Figure 2-2). The flood threat came from a number of sources. The Savannah River caused flooding when peak flows from heavy rainfall over the river basin moved downstream and the river left its banks, and also when tidal floods moved upstream from the Atlantic Ocean. In addition, heavy rainfall locally caused flooding due to poor drainage. During the 19th century, the city coped with those problems by building drainage canals and tide gates. During the 20th century, flooding caused by storms over the Savannah River Basin was mostly eliminated by the Corps of Engineers through the construction of several large dams and reservoirs upstream.

During the period we studied (1976 through 1985), the principal flood problems stemmed from ponding in various areas because of inadequate stormwater drainage and flooding from three canals (Springfield, Casey and Placentia), which frequently caused minor flooding when heavy rainfall coincided with high tides. During a high tide, tide gates were closed, and the canals could not discharge their flow, so that produced frequent backwater flooding over the adjacent broad floodplains. Extremely serious flooding would currently result if high tides and hurricane-produced tidal surges coincided, overtopped the tide gates, and added saltwater to the rain-swollen flows of the canals.

In part because of periodic nuisance flooding, Savannah's floodplains were partially vacant (53% of the acreage was undeveloped) in 1976, while little vacant land remained within the city limits outside of the floodplains. The floodplains contained over 7,000 dwellings, however, and those structures accounted for 72% of the estimated potential average annual flood damages of $3.3 million. In 1979, during the period studied, Savannah annexed 20,000

FIGURE 2-2



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persons in a large area south of the city, which encompassed a significant amount of floodplain property on the Vernon River.

The Floodplain Management Program

Savannah joined the National Flood Insurance Program in 1971 and entered the program's regular phase in 1973. In those years, floodplain regulation drew vigorous protests from citizens who feared that the requirements to elevate structures would raise construction costs and lead to aesthetic blight when elevated buildings were placed next to existing structures built at grade. As a result of those concerns, Savannah did not begin formally implementing its floodplain regulations until 1978. The city's program complied with minimal federal standards for communities in the regular phase of the NFIP (for example, the regulations require finished floor elevations at or above the 100-year base flood elevation) and no variances were granted between 1976 and 1985. Although it did not discourage floodplain development within the pre-1979 city boundaries, Savannah enacted an ordinance to preserve the marshlands along the Vernon River floodplain that were annexed in 1979.

The building inspections department, which checked new building permits for location in the floodplain, and the engineering department, which established minimum first-floor elevations and also reviewed subdivision plats, administered the program, but no one had specific responsibility for overall program supervision. Instead, it was handled as a routine part of city business and was given relatively little priority or attention by the staff.

Rather than focus on preventive measures and vacant land, the main attention to floodplain management in Savannah centered on resolving existing drainage problems. During the decade prior to 1976, the city had invested over $5 million in improvements to rectify flooding attributable to inadequate storm drainage and over $1 million to reduce flooding along the canals. During the study period, and in response to strong pressure from neighborhood groups, it invested almost $9 million in further improvements to the drainage system. Nearly $11 million more was programmed for the five-year period 1986 through 1990. In addition to those investments to solve existing problems, the city also tried to minimize drainage problems in new development. To achieve that end, it established regulations requiring developers to provide compensatory flood storage, as well as easements and land dedications to accommodate stormwater.

Cape Girardeau, Missouri (Program Strength Index: 26)

Profile

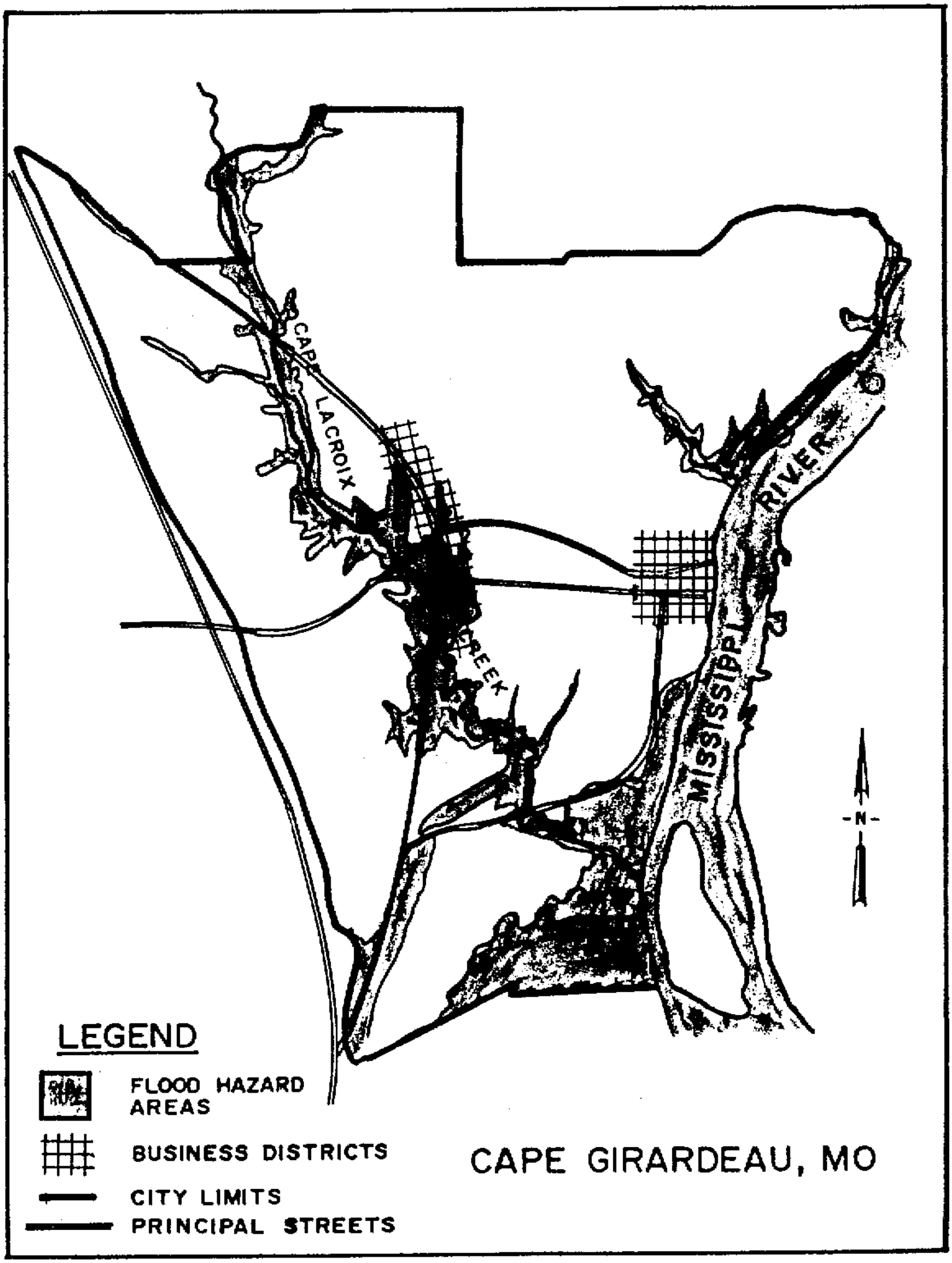
	1975	1985	% Change
Population	32,822	40,000	+22
Dwelling units	11,200	14,675	+31

Flood hazard source	Mississippi River (slow-rise flood) and Cape La Croix Creek (flash flood)
Floodplain use	
Total acreage of floodplains, 1975	3,500 acres
Developed, 1975	1,450 acres
Residential	190 acres
Nonresidential	1,260 acres
Flood history	Mississippi River: 1944, 1947, 1951, 1973 (post-World War II floods) Cape La Croix Creek (1952, 1957, 1958, 1964, 1973, 1977, and 1986)
Average annual flood damage potential, 1975	$552,000
Population at risk, 1975	1,582

The Community and Its Flood Hazard

Cape Girardeau, located on the Mississippi River in southeastern Missouri, is typical of small cities located on major rivers and prone to both deep, slow-rise floods and flash floods on smaller creeks and drainageways. Originally subject to devastating floods from the Mississippi River, as the town grew north and west it expanded into the floodplain of Cape La Croix Creek, which also posed a serious flood threat (see Figure 2-3). In 1973, three years prior to the start of the study period, flooding occurred on both the Mississippi River and the creek. When the Mississippi went over its banks, 53,200 acres were under water and 1,000 persons evacuated their homes. Estimated flood damages to 140 homes and 20 businesses were $15.3 million. That same year, a flash flood on Cape La Croix Creek caused damages of about $3 million to 100 homes and 50 business firms. In May of 1986, just after the study period,

FIGURE 2-3



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Cape La Croix Creek flooded once again, resulting in an estimated $80 million in property damages and the loss of two lives.

The Floodplain Management Program

Because of the concentration of its economic base in flood hazard areas (90% of industrial acreage and 40% of commercial acreage), officials in Cape Girardeau feared that building and land use regulations required by the National Flood Insurance Program would stifle economic development. They actively opposed passage of the National Flood Insurance Act in 1968, and in 1975 they testified against the program at Congressional oversight hearings, which subsequently led to passage of amendments which weakened the NFIP. The city's skepticism about floodplain management was reflected in the measures it adopted to deal with the flood threat.

With millions of dollars in property located in the floodplain, however, late in December of 1971 local officials decided to ignore their misgivings and enroll in the flood insurance program. They neglected to adopt the required floodplain management regulations, though, and eight days later, on January 1, 1972, the city's participation was suspended by the Federal Insurance Administration. Cape Girardeau re-entered the emergency phase of the NFIP on March 14, 1974, after citizens, reacting to the ravages and losses from the 1973 floods, pressured the city administration to enact the required floodplain management ordinance. A flood hazard boundary map was prepared that same month. In 1980, Cape Girardeau advanced from the emergency to the regular phase of the National Flood Insurance Program, and it strengthened floodplain management to comply with the stricter standards of the regular program, including elevation of new structures to or above the base flood level.

While it complied with NFIP requirements for floodplain regulation, and the city staff of five professionals administered the required permits faithfully, Cape Girardeau's preferred approach to solving its flood problems centered on flood control works to keep flood waters away from developed and potentially developable property. In 1964, the Corps of Engineers completed levees and a flood wall on the Mississippi River. As the city expanded into the Cape La Croix Creek floodplain and the threat of flooding increased there, it again sought help from the Corps, which completed a flood control plan for the Cape La Croix Creek watershed at the city's request. That project, if constructed (costs were estimated to be $29.2 million in 1981), would eliminate most of the flood threat to residences and businesses in the Cape La Croix Creek floodplain.

Toledo, Ohio (Program Strength Index: 38)

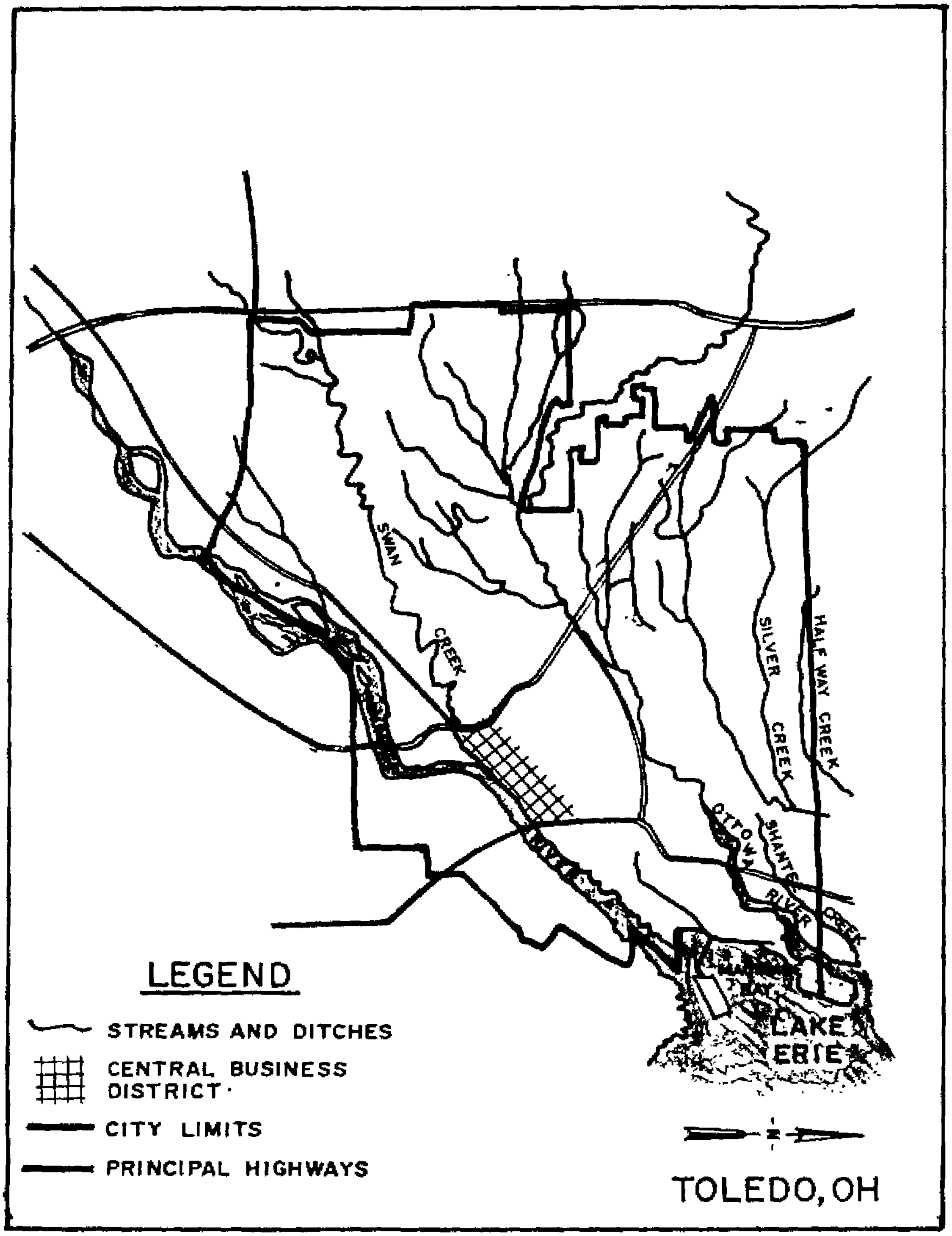
Profile

	1975	1985	% Change
Population	368,849	343,700	-7
Dwelling units	136,806	145,206	+6
Flood hazard source	Lake Erie (seiches exacerbated by storm events); Maumee River; Ottawa River; Swan Creek		
Floodplain use			
Total acreage of floodplains, 1975	3,352 acres		
Developed, 1975	1,125 acres		
Residential	572 acres		
Nonresidential	553 acres		
Flood history	Serious flooding in 1973		
Average annual flood damage potential, 1975	$1,281,000		
Population at risk, 1975	14,200		

The Community and Its Flood Hazard

The 34th largest city in the U.S. in 1975, Toledo faced flood threats from a number of sources (see Figure 2-4). Seiches on Lake Erie could inundate low-lying lake shore properties at Point Place, which is a heavily developed residential area on a peninsula in Lake Erie formed by the Maumee and Ottowa Rivers. A large storm over Lake Erie on March 17, 1983, for example, caused $2.5 million in damages to Point Place. In addition, a rise in the Maumee and Ottowa Rivers could cause extensive interior backwater flooding. Located on a flat, glacial outwash plain, Toledo was also prone to flooding caused by poor natural drainage systems and flows that exceeded the capacity of stormwater ditches constructed by the city and private developers. Following a heavy rainfall or spring snowmelt, the capacity of the drainage system was frequently exceeded, resulting in excessive runoff, downstream flooding, and extensive shallow street and basement flooding.

FIGURE 2-4



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Because of frequent nuisance flooding, development of flood hazard areas lagged behind that of the rest of the city (by 1976, one third of Toledo's floodplains had been converted to urban use, compared to 69% of the available land in the city not subject to flooding). Nevertheless, over 5,000 dwellings and numerous commercial establishments had occupied flood hazard areas and were at risk. The average annual flood damage potential was over $1 million at the start of the study period.

The Floodplain Management Program

Toledo adopted floodplain management regulations in compliance with the minimum standards for participation in the emergency phase of the National Flood Insurance Program in 1970, which made it one of the earlier entrants into the program. The city joined the regular phase of the NFIP in 1978. Struggling to overcome the adverse consequences of its declining economic base, Toledo designed its 1978 floodplain ordinance so that new buildings would be less susceptible to flood damage than in the past, but it did not seek to discourage continued development of the floodplain (city leaders viewed any development, even development in hazardous areas, as beneficial). Although the city did not discourage floodplain development during the study period, in previous years it had acquired a large amount of parkland in areas subject to flooding, particularly along Swan Creek.

The 1978 floodplain ordinance required that buildings be elevated one foot above the base flood elevation. To prevent the worsening of problems from shallow sheet flooding, the city prohibited fill that increased flooding over the entire floodplain and required that fill be obtained from the same site where it was placed, thus ensuring that compensatory flood storage would be provided. Those requirements were administered by a large professional staff of 114 in the planning, zoning, engineering, and building inspection departments. Few variances to the regulations were granted over the study period.

Toledo adopted a master drainage plan in 1971; however, because of financial constraints, only one major project was undertaken. The city took steps to resolve the flood problem in the Point Place area (where 690 homes housing 2,100 people were at risk) by investing $6.1 million in dikes and flood walls along the Maumee and Ottowa Rivers.

Tulsa, Oklahoma (Program Strength Index: 42)

Profile

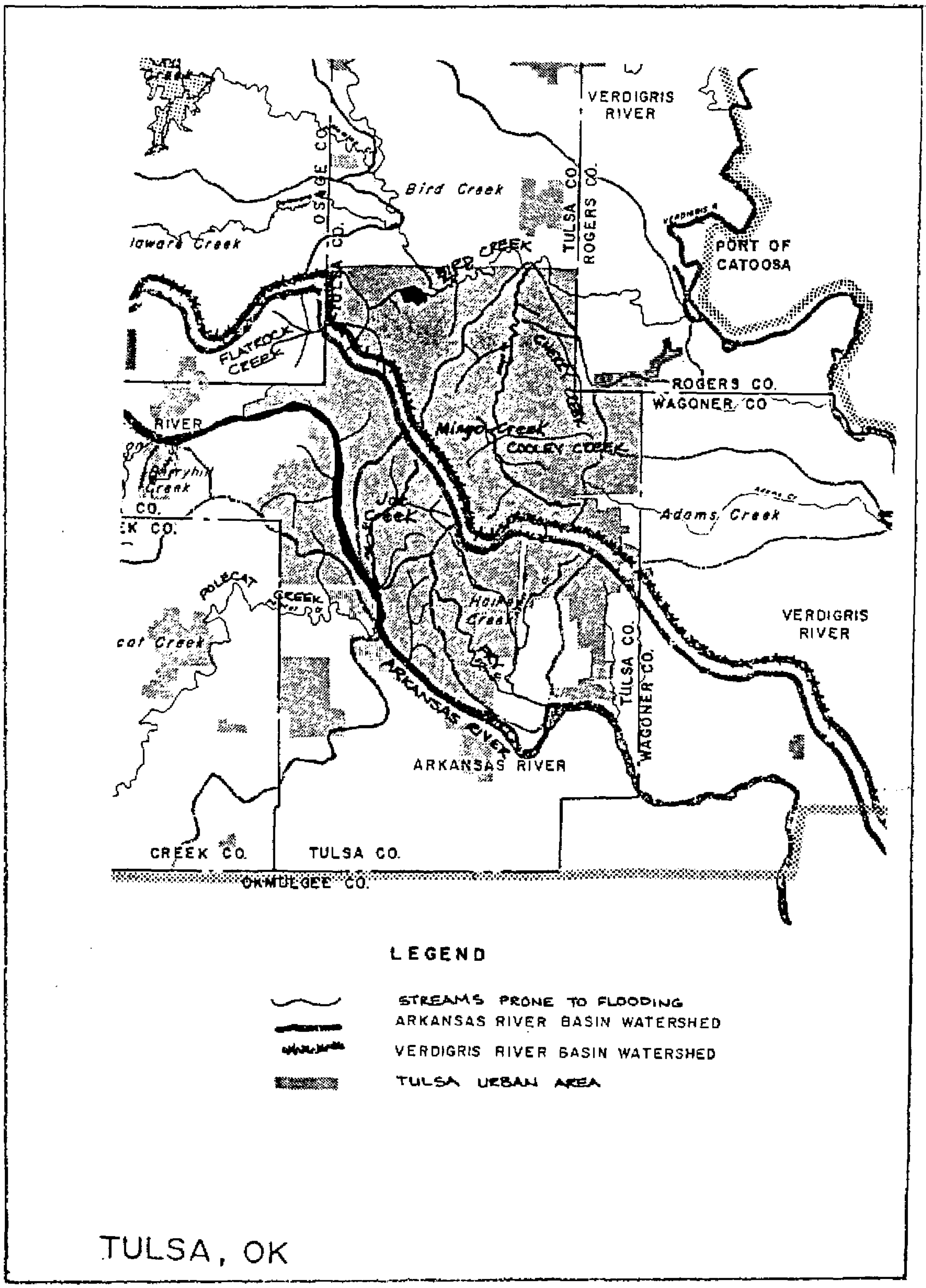
	1975	1985	% Change
Population	345,635	377,700	+ 9
Dwelling units	134,589	181,277	+34

Flood hazard source	Arkansas River; Joe Creek; Mingo Creek; and, to a lesser degree: Haikey, Crow, Broken Arrow, Butler, Spunky, Adams, and Berryhill creeks
Floodplain use (Joe and Mingo Creek floodplains)	
Total acreage of floodplains, 1975	6,100 acres
Developed, 1975	3,530 acres
Residential	1,840 acres
Nonresidential	510 acres
Flood history	Serious floods occurred in 1959, 1961 (2), 1968, 1970 (2), 1974 (5), 1976 (2), 1984, and 1986
Average annual flood damage potential, 1975	$3,166,000
Population at risk, 1975	14,850

The Community and Its Flood Hazard

Tulsa exemplifies the flood hazards of cities in the southern Great Plains. Once subject to serious riverine flooding from the Arkansas River, no sooner had flood control works been completed to solve that problem than frequent floods began to damage structures that had been built in the floodplains of Mingo Creek, Joe Creek and other small streams in the metropolitan area (see Figure 2-5). Twice during the ten-year study period disastrous floods resulted from intense rain storms over the city--first in May, 1976 and then again in May, 1984. Those storms led to rapid rises in the creeks, and residents had little time--just 30 minutes in the 1976 flood--to evacuate their homes and flee to safety. In addition to the overbank flooding, many areas of Tulsa were subject to sheet runoff and localized ponding. The average annual flood

FIGURE 2-5


VERDIGRIS RIVER
Bird Creek
OSAGE CO.
TULSA CO.
ROGERS CO.
PORT OF CATOOSA
FLATROCK CREEK
Mingo Creek
COOLEY CREEK
ROGERS CO.
WAGONER CO.
Adams Creek
Joe Creek
VERDIGRIS RIVER
ARKANSAS RIVER
WAGONER CO.
CREEK CO.
TULSA CO.
OKMULGEE CO.
LEGEND
STREAMS PRONE TO FLOODING
ARKANSAS RIVER BASIN WATERSHED
VERDIGRIS RIVER BASIN WATERSHED
TULSA URBAN AREA
TULSA, OK

damage potential was $3.2 million at the start of the study period, but losses far exceeded that amount in the 1976 ($34.9 million) and 1984 ($181.8 million) floods.

In 1975, the intensity of development (developed acres as a percent of total acreage) in the Mingo Creek and Joe Creek floodplains exceeded that of areas of the city outside of the floodplain (58% vs. 41% developed). Eighty percent of the Joe Creek floodplain was in urban use, while in the case of Mingo Creek, which is located farther from the center of the city, urbanization had engulfed 50% of the floodplain. Both floodplains were used for industrial purposes and, in fact, those uses accounted for 10% of Tulsa's industrial acreage. They were attractive sites for residential development as well. Homes in the floodplains in 1975 tended to exceed citywide average values and to be occupied by households with above-average incomes. Residential areas were not uniformly affluent, however, since 17% of the dwellings in the floodplains were mobile homes.

The Floodplain Management Program

The 1976 flood catalyzed Tulsa's leadership to attend to flood problems that had reached crisis proportions. Shortly after the flood, the city commissioners enacted a six-month moratorium on floodplain development (subsequently extended to two years) to allow time to formulate new policies and programs, appointed a full-time floodplain management adviser, and established a hydrology section in the engineering department. In 1977, it adopted a new floodplain ordinance and joined the regular phase of the National Flood Insurance Program.

The following year, however, prodevelopment interests won a majority of the seats on the city commission. The commission rescinded the moratorium on floodplain development and reduced the floodplain management staff. With little political support, the regulatory program adopted in 1977 was not vigorously pursued.

After five years of lax floodplain management, the catastrophic flood losses of 1984 again spurred the city's leadership to take the flood problem seriously. In 1985, Tulsa enacted more stringent floodplain regulations, and formal procedures to enforce the regulations were also put in place. The city organized a stormwater management department and charged the department with formulating a master drainage plan for the city. The commission also had the department escalate construction of drainage improvements (some $33 million in flood control and drainage projects were completed over the period 1976 through 1985; additional expenditures of $75 million were anticipated). Tulsa financed the drainage master plan through a $2 levy on all water bills. It financed specific improvements using proceeds from a one cent sales tax levied specifically for capital improvements. Finally, the city launched an effort to acquire 300 single-family detached homes and 200 multi-family dwelling units in flood hazard areas; some of that property would be left as open space and some was needed for flood control projects. The steps Tulsa took to strengthen its stormwater management program in 1985 should lessen the threat of flooding in the future, but those steps came too late to have any affect on floodplain development during the period we studied.

Omaha, Nebraska (Program Strength Index: 43)

Profile

	1975	1985	% Change
Population	330,792	333,477	+1
Dwelling units	121,651	132,789	+9

Flood hazard source	Missouri River; Big Papillion Creek, Papillion Creek; West Branch Creek
Floodplain use (Papillion Basin floodplains)	
Total acreage of floodplains, 1975	7,600 acres
Developed, 1975	1,100 acres
Residential	380 acres
Nonresidential	730 acres
Flood history	16 major floods between 1929 and 1966 (most serious in June 1964); most recent major floods in June 1974 and September 1975
Average annual flood damage potential, 1975	$2,800,000
Population at risk, 1975	4,350

The Community and Its Flood Hazard

Omaha was the first city among those we studied to adopt floodplain management regulations. Floods in 1958, 1960, and 1964 led the city council to adopt restrictive zoning for floodplain property in 1964. In 1967, the State of Nebraska passed even more stringent restrictions. Thus, for almost a decade before the beginning of the period we studied, Omaha had policies in place that were designed to limit the development of floodplain property.

The flood hazard in Omaha came from two sources: the Missouri River and small suburban streams in the Papillion River Basin (see Figure 2-6). Major floods over the Missouri River Basin in 1952 and earlier years led to large federal investments in upstream flood control structures and, in the Omaha area, a levee system along the Missouri River. Those measures largely eliminated the threat of flooding from that source. The Papillion floodplains, however, were still a source of concern in 1975. In the Papillion basin, high-intensity rainfall between April and September, falling on steeply sloping hills with low permeability, could cause serious flooding. The 1964 flood destroyed 11 homes and 24 trailers, while causing damages to 219 additional homes and trailers. Floods in June of 1974 and September of 1975 caused the loss of eight lives and led to more than $5 million in property damages. During the period studied, however, there were no major floods in the Omaha area. Average annual flood damages in 1975 were $2.8 million, with some 1,600 households and 350 businesses (including several regional shopping centers) at risk.

The Floodplain Management Program

Omaha's floodplain management program was designed to keep floodways in open space land uses and discourage residential uses in the floodway fringe, but to allow commercial and industrial use of flood hazard areas. That approach to floodplain management began in 1964, as noted above, when the city amended the zoning ordinance to create a new zone (S3) which prohibited virtually all development in designated flood hazard areas. The city staff encountered little opposition when it systematically began applying the new zoning requirements to vacant and residential property in the floodplain; however, when it reached commercial and industrial areas, local businessmen objected to their property being downzoned.

In response to those complaints, Omaha decided not to apply the S3 zone to nonresidential property. The city created a floodway (S4) zone in 1967 after studies by the Corps of Engineers delineated the floodways of creeks in the Papillion Basin and the State of Nebraska had passed legislation to discourage floodway development. Building elevation regulations were added to the Omaha floodplain management program in 1971, when it joined the regular phase of the National Flood Insurance Program. By 1976, Omaha had rezoned most noncommercial floodplain property as S3. Property zoned S3 could be built upon if developers used fill to elevate building sites above the base flood