10 Floodplain Management at the Local Level: Tulsa, Oklahoma, and Boulder, Colorado

It's obvious that you're the backbone of a movement and that you more than anyone else have answers to the questions I've been pursuing.

—Ann Patton (in a letter to Gilbert White)
Floodplain Manager, City of Tulsa, Oklahoma

To some degree, Gilbert White pursued integrated floodplain management throughout his career, but it became central to him on the national level in the 1960s and, through the Natural Hazards Center, at regional and local levels beginning in the mid-1970s. In many ways, floodplain management is most complex at the local level, where government officials, planners, developers, and individual citizens must deal with the problem of flooding itself on the one hand and the complex organization of institutions, laws, regulations, and potential solutions available on the other. Indeed, the resulting uniqueness of individual local situations raises a fundamental question: Is the goal of integrated floodplain management overly ambitious in a democracy such as the United States?

Throughout his academic career, Gilbert was committed to ensuring that the communities in which he lived practiced wise management of their floodplains. In this regard, Boulder, Colorado, which became the Whites' home in 1970, proved a persistent challenge. In fact, Boulder was not unlike most of the 21,600 U.S. communities founded along rivers and coasts. It seldom experienced heavy flooding, and the mitigation of losses from flooding was not a high priority in community planning. Despite Gilbert's efforts to apply his knowledge and despite Boulder being (by mid-century) Colorado's community most at risk of disastrous flooding, it was an uphill battle throughout the Whites' years in Boulder to mitigate adequately against a flood of even the 100-year magnitude. His own university stubbornly pursued an agenda of development on its property in the city's floodplain. (Some of his friends jokingly attributed Gilbert's longevity to his determination to witness long overdue flooding that would vindicate his unrelenting insistence that Boulder development be restricted in even the 500-year floodplain.)

Not surprisingly, cities at the confluence of two or more rivers or tributaries that experience regular flooding have some of the most dramatic flood histories—and, occasionally, the most exemplary flood mitigation programs. In the United States in the latter half of the twentieth century, one of them was Tulsa, Oklahoma. During the last quarter of the century, White and the Natural Hazards Center helped Tulsans turn around the city's reputation from being the nation's worst to one of its best communities in managing stormwater. From there, Tulsa soon emerged as a leader in integrated management of floodplains. The city developed and carried out management plans, not only for the Arkansas River flowing through Tulsa but also for the river's dozen tributary streams and the resultant thirty microdrainage basins in the metropolitan area.

In the latter part of the twentieth century, a handful of communities, including Tulsa, provided national leadership and helped maintain morale (including Gilbert's) and interest in the nation's progress (albeit slow and difficult) toward the goals embodied in the report of the 1966 Task Force on Federal Flood Control Policy, prepared for President Lyndon Johnson and Congress. No one anticipated the myriad planning, engineering, legal, and funding challenges that the National Flood Insurance Program would entail. Such a program requires persistence and political will among the highest leaders and a resulting commitment to long-term mitigation planning—all this despite the relatively short life of any one administration and the vote-getting popularity of short-term solutions and quick gratification (e.g., disaster relief). Consequently, the movement toward comprehensive floodplain management has involved grassroots efforts opposing both the powerful interests of those wishing to capitalize on the development of floodplains and those not wanting to restrict such development for political reasons. At the same time, integrated management has required coordinated planning, state-of-the-art science and technology, and coordination among communities sharing any river.

Indeed, coordination is perhaps the most difficult requirement, since not only community but also county, state, and national officials, as well as local organizations and businesses, must be involved or at least apprised of developments. The Natural Hazards Center and, subsequently, the Association of State Floodplain Managers, which the center nurtured, have been central in achieving whatever success the nation has realized, either horizontally among jurisdictions or vertically from the local to federal level. This integration is one of Gilbert's strongest legacies, regardless of whether the steadily increasing costs of flooding are ever reversed.

Beyond his focus on human occupancy of floodplains, Gilbert's broader vision as a geographer encompassed wise stewardship of all the ecosystems dependent upon healthy and well-managed floodplains. Although floodplains constitute no more than 10 percent of the land area of the planet, they are generally more biologically diverse than upland areas and can provide habitat for up to 80 percent of a region's wildlife species. Hopefully, White's legacy will also include helping to slow the decline in the earth's diversity of life forms.

By 1960, the city finally crafted a comprehensive plan requiring land development on a basin-by-basin basis that acknowledged downstream impacts of upstream development. But even this comprehensive plan was largely ignored, and piecemeal development continued unchecked. In 1968 J. D. Metcalfe, a businessman, arranged for Ian McHarg, an expert on urban open space recreation and parks development, to survey the problem. McHarg observed that Tulsa was irresponsibly building homes in the floodplains while locating parks on high ground. Since the norm in the United States is for 10 percent of a community's land to be devoted to parks and open space, and since at least 10 percent of Tulsa was in floodplains, McHarg advised reversing the uses—turning the floodplain acres into parks and recreation areas and relocating houses to the higher elevations. Nothing came of this recommendation. Because the Disaster Relief Act of 1950 provided assistance to victims of flooding and tornadoes, "officials and agencies say they lost the ability to require and/or provide adequate controls or facilities to prevent flooding problems" (Poertner 1988).

It was to help the city of Tulsa and the thousands of other communities in similar dilemmas that, as discussed earlier, the federal government asked for Gilbert White's assistance in 1966. After the National Flood Insurance Program was enacted in 1968 and Tulsa experienced serious flooding in 1970, the city opted to join the NFIP, and the situation quickly changed. One of the first requirements for participation in the program was a zoning ordinance to reduce floodplain occupancy. The following year the NFIP's first maps were issued, and by 1972 floodplain maps had been adopted for the city's Arkansas River floodplain. With the new regulations and maps, city officials and developers could no longer pretend that the Keystone Dam would protect development on the floodplains below.[1] However, joining the NFIP had not forced Tulsans to reach consensus on the most appropriate local strategies to control floods, and, moreover, there was little public interest in the first place. Indeed, a Tulsa planner's farsighted proposal that repeatedly flooded homes be purchased with $18 million in urban renewal funds was rejected out of hand as too radical by city commissioners.

Then came 1974, the "Year of the Floods" in Tulsa. Flooding occurred in April, May, June, September, and November. Some homeowners along Mingo Creek, which drained one-third of the city and caused two-thirds of the flood damage, evacuated and repaired their homes three times that year. "Victims waded out of the [September] flood, drenched, stormed a city meeting, and demanded action by the city" (R. D. Flanagan 1994).

A community debate ensued. It raged vigorously immediately following floods and cooled predictably between events, but it did not stop. Tulsans for a Better Community (TBC), a group founded by repeatedly flooded homeowners, joined other neighborhood organizations in a Tulsa Homeowners Coalition. Carol Williams, a coalition activist, demanded that the city commissioners comply with

federal standards and stop upstream development until the city had dealt responsibly with the existing problems caused by unbridled development. Following citizen flood hearings organized by Congressman James R. Jones and the consequent creation of a task force on flood control by Oklahoma governor David Boren, Congress authorized a Tulsa study by the Corps of Engineers. The 1974 study came none too soon; later that year heavy rains filled the Keystone Dam reservoir to capacity for the first time in its ten-year history.

The city commissioners were again asked to consider the option of purchasing and removing repeatedly flooded and repeatedly rebuilt homes. On his own initiative, one citizen, Bob Miller, even visited Rapid City, which had undertaken such a relocation project following a disastrous flash flood in 1972. Tulsa city engineers responded by proposing a Mingo Creek floodplain modification project that called for the clearance of thirty-three homes.

Frustrated with political infighting locally and nationally and recognizing the lack of agreement on what local solutions to flooding would make most sense for Tulsans, a reporter for the *Tulsa World* set about educating herself and the community regarding the resources available. Ann Patton's research led her to the Natural Hazards Center and Gilbert White.

Patton attended the center's first annual workshop in July 1975, and two months later she and five other Tulsans attended the National Forum on the Future of the Floodplain in Minnesota, where Gilbert White was a featured speaker. As mentioned in Chapter 9, because he was speaking to a like-minded audience of deeply frustrated practitioners, Gilbert was outspoken regarding the lack of federal leadership in dealing with both federal agency inflexibility and local land development interests that were undermining nonstructural approaches to floodplain management, including the National Flood Insurance Program. The previous year the Water Resources Development Act had recognized the importance of nonstructural solutions with a provision for 80 percent federal funding of such local innovations. However, the Office of Management and Budget (OMB) was holding up the legislated funding. It had been seven years since the Water Resources Council had been mandated to develop a Unified National Program of Floodplain Management in the wake of the report of the 1966 Task Force on Federal Flood Control Policy.[2] The ongoing debate at the national level was raging as well in Tulsa. Was the ultimate goal of floodplain management to maximize reduction of flood losses or to optimize use of floodplains?

White was frustrated, and he decried the WRC's disregard for the legislation of the past six years, which presumably had settled that debate by saying that both questions were of national concern (Patton 1975). His appeal for grassroots citizen

activists to proceed with local mitigation efforts, regardless of the quality and quantity of federal assistance, galvanized the Tulsa delegation.

By the end of that year, Tulsa had allocated $8 million from the city's 2 percent sales tax revenues, federal revenue sharing funds, and community development block grants for several structural mitigation projects. Subsequently, the voters became much bolder, approving early in 1977 a $22 million bond package for emergency street, bridge, and drainage improvements. Flood control became the city's highest priority in submitting applications for federal funding for jobs and public works. Workers paid through the Comprehensive Employment and Training Act (CETA), augmented with local funding, launched a drainage-way maintenance program.

However, Tulsa's developers were similarly well organized, and after no flooding occurred from the end of 1974 through April 1976, two city commissioners who were strongly in favor of floodplain management were replaced by development advocates, fueling what became known as Tulsa's Floodplain War. As providence would have it, two weeks after the new commissioners were sworn in, 10 inches of rain fell in three hours, resulting in Tulsa's first Memorial Day flood, the record flood to that date. Three thousand structures were flooded, and an enraged citizenry confronted the pro-development city commission. They also confronted officials of the federal government, which had failed to fund the section of the flood insurance legislation that would allow damaged homes to be removed or relocated from the floodplain. Carol Williams and other victims of repeated flooding (some had been flooded five times in six years) begged to use their flood insurance checks or Small Business Administration loans to help them relocate and petitioned the city to allow them to remain in temporary housing until the federal government's responsibilities and a solution could be determined. Their petitions fell on deaf ears.[3]

Patton and her colleagues countered by inviting the open space consultant Ian McHarg to be the keynote speaker at a symposium on local flooding held at the University of Tulsa and funded by J. D. Metcalfe. The city's inaction on his recommendation in the 1960s to swap floodplain development with hilltop parks resulted in a scathing denouncement by McHarg: "Mingo Creek [development] should be enshrined in the Smithsonian Institution as a case study in stupidity." Another invitation went to Don Barnett, Rapid City's mayor at the time of its 1972 flood. Ron Flanagan, a local planning consultant who was advising citizen groups at the time, recalled Barnett leaning across the table at a meeting with the city commission and proclaiming, "Sometime, Mayor, you have to bite the pickle. Sometime you've got to really recognize that this house by this crik is a mistake!" (R. D. Flanagan 1994).[4]

Frustrated, Patton again turned to Gilbert White in an interview for the *Tulsa World*. He observed that when a community makes land-use management decisions, citizens line up behind either real estate development or environmental conservation. When this confrontation takes place, technical support available to the

environmentalists plays a critical role in determining the outcome. The battle was being lost where well-intentioned local people lacked requisite technical support. Upon returning home, Patton wrote, "It's obvious that you're the backbone of a movement and that you more than anyone else have answers to the questions I've been pursuing." Gilbert was similarly impressed by Ann and responded, acknowledging the inadequacy of professional efforts to educate the public: "This makes it all the more important that people like you continue to put in understandable and plain speech what some of us try to say much less effectively." The interview and correspondence were the beginning of both a personal friendship and a commitment to Tulsa by the Natural Hazards Center that led to Gilbert's receiving a "Key to the City" from the mayor of Tulsa in the 1980s.

In the end, however, flooding was again the stimulus for significant change. The disastrous Memorial Day flood of 1976 forced the pro-development city commissioners to pass Tulsa's first floodplain building moratorium later that year. But as chance would have it, no significant flooding immediately followed, the pro-development interests strengthened their majority in 1978, and the commission rescinded the moratorium and reduced the floodplain management staff. Further, an earlier stormwater detention ordinance, calling for builders to ensure that new construction not add to surface runoff downstream, was amended to permit payment of a fee in lieu of providing detention. One bright spot in this era of backsliding was the naming of city planner Stan Williams to help head the Federal Emergency Management Agency's federal Interagency Hazard Mitigation Task Force. His assignment was to draft a manual of procedures for identifying needed hazard mitigation following federally designated disasters.[5]

Tulsa made good use of Stan Williams's efforts in 1984, following another Memorial Day flood, which "made the previous record flood on Memorial Day 1976 look like a drizzle" (Patton 1993). The second flood left 14 dead and 288 injured and resulted in $180 million in damage to nearly 7,000 buildings. Nineteen days before, Tulsa had elected Terry Young mayor and J. D. Metcalfe city commissioner. Metcalfe and Young's respect for Ann Patton led to her being appointed director of a hazard mitigation team convened at daybreak following six hours of precipitation that produced 15 inches of rain. Three experts were hired to undertake planning for the team, all veterans of many years of coping with Tulsa's seemingly intractable flood hazards: Charles Hardt, formerly the city's first hydrologist and a consultant with nationally recognized Wright-McLaughlin Water Engineers of Denver; Ron Flanagan, who also had worked with Wright-McLaughlin; and Stan Williams, recently with FEMA. Within seventy-two hours, with volunteer help from the city's engineering community, the team prepared maps showing the extent of flooding. They identified target buyout areas by the following week, eager to have their own recommendations drafted by the time a federal interagency hazard mitigation team came to town to conduct an independent assessment of Tulsa's needs, as required under a presidential disaster declaration.

Patton and her colleagues knew, based on their disheartening past experience, that they had three days at most to alter victims' expectations when they filed claims with the Federal Insurance Administration to rebuild their flooded homes. The federal and local bureaucracies of FEMA and the National Flood Insurance Program were geared to help victims rebuild their homes and lives as rapidly as possible—despite federal regulations requiring local authorities to abide by salvageable guidelines laid down by the NFIP and not to rebuild "substantially damaged" buildings that did not comply with mitigation requirements. Regarding this regulation, Ann Patton said, "We intended to comply with that requirement, even though FEMA was not then enforcing it" (Patton 1993).[6] In the end, the city purchased 306 homes using federal and local funding.[7] Two years later, a large mobile home park was flooded and purchased by the city for $2 million, again in lieu of rebuilding. The park was turned into an open space recreational area instead.

To institutionalize such pre- and postflood planning and response, in 1985 Tulsa created a stormwater management department and charged the department with formulating a master drainage plan for the city. To ensure a dependable source of future funding for acquisition of flooded or flood-prone properties, a city ordinance was adopted that required residents to pay a flat $2.95 per month and businesses to pay proportionally according to their stormwater runoff. This assessment is supplemented by capital funds set aside annually for acquisitions. Further, in 1991 Tulsans approved $600,000 in sales taxes specifically for floodplain acquisition or flood-proofing of endangered structures. In the decade following the 1984 flood, Tulsa invested $200 million in structural, nonstructural, and related flood projects, only $80 million of which were federal funds. By 2004, over 1,000 homes had been purchased for demolition or relocation to higher ground, not one of which has since been flooded. In addition, on average $700,000 is allocated annually from the city utility fee to support small flood mitigation projects based on a citywide master plan that ranks and prioritizes hundreds of projects on the bases of objectives, costs, and benefits.

Enhancement of the surrounding environment is a consideration in every project and proposal. Enhancements include establishing open space for recreation and wildlife (e.g., parks with playing fields that can accommodate stormwater during floods, small fish-stocked lakes for stormwater detention, and wetlands that support migrating birds and small animals); planting trees to retain soil; and constructing trails for biking, walking, and jogging that also permit easy access to and maintenance of mitigation structures.

In 1992 Tulsa received FEMA's Outstanding Public Service Award for its national leadership in floodplain management. That year the city's flood program received the highest ranking in the NFIP's Community Rating System, thus giving Tulsa residents the lowest flood insurance rates in the nation. In 1994 Patton edited a document describing Tulsa's approach to floodplain and stormwater management, *From Rooftop to River,* and dedicated it "to two gifted leaders," Gilbert Fowler

White and Joseph Davis Metcalfe—"one national and one local . . . Both epitomize the many pioneers whose contributions leave the city and the nation immeasurably enriched." Patton retired from Tulsa's public works department in 2004, following thirty years of promoting successfully in one community the range of nonstructural as well as structural adjustments to flooding that Gilbert White had advocated throughout his career.

Boulder, Colorado

In contrast to his work with Tulsa, where his influence was indirect, in Boulder Gilbert White was central to a half-century struggle to determine and reconcile city, county, and university interests regarding the use of the floodplains created by thirteen creeks that drain runoff into the city from the foothills of the Rocky Mountains to the west. Boulder Creek is the largest watercourse in the county, draining 155 square miles. It flooded seriously in 1894, now considered to be the 100-year flood of record. As in Tulsa, foresighted citizens invited a consultant early on (in 1910) to provide advice on how to mitigate Boulder's flood risk. As did McHarg in Tulsa, the renowned landscape architect Frederick Law Olmsted, Jr. (son of the designer of New York's Central Park), recommended keeping the floodway completely free of residential and commercial development. He advocated using the space for parks and other recreational uses, such as the Boulder Creek greenway trail system that travels along the entire length of the creek through the city today. He further pointed out that this probably would be the cheapest way to address the flood problem presented by Boulder Creek. However, Boulder city officials at the time ignored this advice because only minor flooding occurred in subsequent decades.

In the late 1950s, Gilbert White visited Boulder as part of his University of Chicago restudy of the nation's vulnerability to flooding two decades following the Flood Control Act of 1936. On the occasion of Gilbert's ninetieth birthday, Janet Roberts, a Boulder community activist and political leader over several decades, reminisced about that 1950s meeting of the League of Women Voters when Gilbert issued his first public warning regarding the city's extreme vulnerability. Until then she, like most Boulderites, had no idea that Boulder "was the most vulnerable city in Colorado." A few years later, as a member of the Boulder City Planning Board, Roberts again heard Gilbert warn of the potential risks created by indiscriminate building in floodplains. At the time regulations did not require that flood hazards be disclosed in any way in the plats of new subdivisions. "Indeed," she said, "the developers were vehemently opposed to any such adverse public notice" (Roberts 2001). Janet Roberts subsequently ran for city council in 1959. On the same ballot was a question regarding building a new public library. The chosen location was directly in the 100-year floodplain. White, Roberts recalled, objected passionately to the location, but even she was persuaded by city staff that the building had been designed so that the first floor

Boulder flood of 1894 as seen from the top of the flour mill looking westward. Photo courtesy of the University of Colorado at Boulder library archive.

would be above a 100-year flood. The location was not changed. As the years went by, experts modified the floodplain map many times to reflect new information, each time increasing the threat of flooding to the library.

Gilbert returned to Boulder in the 1960s, reiterating Olmsted's counsel a half-century earlier to avoid the suffering and incalculable costs of flooding by respecting the river's "right" to its floodway. White urged zoning to reserve as much of the floodplain as possible for open space and recreation. Boulder had had improbable good luck with no serious flooding in over sixty years.

Still, the city remained complacent until the South Platte River flooded in the Denver Metro area in 1965. Following this event, city staff presented recommendations to the Boulder City Planning Board concerning possible minimization of flood damage potential in Boulder. In 1966 Gilbert White prepared a report for the city titled "Flood Hazard Reduction and Floodplain Regulations in Boulder City and County, Colorado." The report addressed concerns regarding the increasing encroachment of the floodplain, growing issues about life safety and victimization of new property owners, and the need for wise land use regulations to avoid flood losses.

The city did not act on these floodplain recommendations until after Congress established the National Flood Insurance Program in 1968. Boulder residents Ken Wright (of Wright-McLaughlin Water Engineers) and his attorney-wife Ruth knew of and concurred with Gilbert's advice and admonitions. In the late 1960s Wright had sought Gilbert's help in developing the comprehensive *Denver Metro Urban Drainage Manual* (the effort that brought Wright-McLaughlin Water

der County Achievement commendations in 1984 and 1994, as well as a Boulder City Council commendation in 2001.

Gilbert and Ken Wright served on numerous independent review panels, in part to ensure that city and county officials were aware not only of the city's 100-year floodplains but also of the 500-year flood potential to inundate much larger areas of the city. On October 8, 1973, the Boulder Creek Subcommittee of the Corps of Engineers Committee on Environmental Planning (CECEP), on which both Gilbert and Ken were instrumental participants, presented Boulder's City Council with a Boulder Creek nonstructural improvements policy. The recommendations of the subcommittee resulted in a local resolution that set forth policy guidelines relating to flood control activities for Boulder Creek. It included an inventory and evaluation of the existing floodplain, development of criteria for flood-proofing buildings, implementation of floodplain land use management, creation of an early warning system, and preservation of unoccupied areas of the floodplain for parks and recreation. The landmark resolution provided the basis for enhancing Boulder's floodplain management program, only later to be realized.

Gilbert and Ken's work was aided, sadly, in 1976 by a flash flood in the Big Thompson River canyon north of and parallel to Boulder Creek. The disaster, resulting from a peak discharge of over 30,000 cubic feet per second, killed 145 people and caused over $35 million in property damage. Clearly, the conditions causing this 500-year flood could have occurred a few miles to the south and resulted in the inundation of downtown Boulder and university housing. Yet the challenge remained to persuade the city council, and especially developers, that subdivision development some distance from any creek could nonetheless pose an unacceptable risk to future homeowners. Fortunately, with Gilbert's encouragement, the city earlier had mapped the region's 500-year floodplains, even though the NFIP only required 100-year maps.

Near the turn of the twenty-first century, Gilbert and Ken reasserted their community influence in floodplain management by participating on the city council–appointed Independent Review Panel (IRP). The panel's first review involved an assessment of floodplain management and mitigation alternatives for North Boulder's Four Mile Creek drainage basin. During the course of the IRP actions, the Boulder Housing Authority was persuaded to forgo part of a planned affordable housing development and elevate, with fill, the remainder of the project to ensure that all homes would be above Four Mile's 500-year floodplain. Gilbert was especially gratified with this decision. He and Anne were particularly fond of and knowledgeable about Four Mile Creek; its floodway included a bit of property they owned, and a primitive trail down toward Boulder became their favorite during Anne's last years. When a developer queried them about selling their property, they desisted, deciding instead to promote use and improvement of the trail for public

The Anne U. White Trail. From left to right, Mary White, Gilbert, and Boulder Friends Meeting members of "El Grupo": Mary Hey, DeAnne Butterfield, Ann and Wolfgang Thron, and John Huyler

benefit. The year before her death, the county renamed this Four Mile trail the Anne U. White Trail in recognition of Anne's commitment and work in preserving Boulder County's scenic, natural resources and developing a countywide trail system.

A similar trail system applying the earlier established CECEP floodplain policy guidelines incorporated a 5-mile recreational greenway corridor along Boulder Creek. The greenway preserves wetlands and riparian habitat, offers stormwater conveyance and retention, and maintains a highly prized scenic corridor through the middle of the city. On a typical summer day, over 5,000 people travel the corridor's jogging, bicycling, and handicapped-accessible paths, making this Boulder's most used recreational facility. Even trout fishing and whitewater boating are now possible in the heart of Boulder. The Whites' third-story condominium, after they relocated from Sunshine Canyon to the heart of Boulder, overlooks this greenway corridor, which Gilbert traversed daily as he walked to and from his office.[9]

To their credit, university, city, and county officials worked together to create this highly complex corridor that requires the coordinated maintenance of five city departments, the university, and a trail ranger program. For his part, Gilbert steered the city away from a Corps of Engineers proposal in the 1970s to straighten, line with cement and stone, and thus channelize Boulder Creek. Instead, the community

adopted a "noncontainment" policy, which emphasizes purchasing land to create an undeveloped floodway comparatively free of structural controls (Birch 1989).

In another controversial floodplain matter, Gilbert's influence as chair of the IRP led to significant protections in the development of the Boulder Community Foothills Hospital in east Boulder, adjacent to Boulder Creek. Gilbert had opposed the site of the hospital, given its location in the floodplain, but community pressure convinced him to give way to the selection of this site after an extensive review process. In order to meet multiple community objectives, city staff proposed a requirement to elevate the hospital site and protect the structure to 500-year flood levels in line with Gilbert's philosophy. It was the first time the 500-year standard was applied to a critical facility and marked a growing change in the city's approach to floodplain management. Meanwhile, although unsuccessful in preventing construction of the Boulder Library expansion alongside the Boulder Creek floodway, Gilbert did manage to reverse a citizen task force's otherwise unanimous recommendation to the city council that would have added to and expanded the civic center in the downtown floodplain as well. When the task force submitted its report, Gilbert was permitted to attach his minority opinion along with their recommendation. The council noted that opinion, heard Gilbert's arguments, and accepted his recommendation over that of the task force. Ken Wright described Gilbert as "dogged against all odds when convinced he is right" (K. Wright 2000). Over time, Boulder decision makers assumed as a matter of course that any major floodplain issue would require a citizen task force, if not also an independent review panel of experts. Moreover, if the task force's recommendation was not shared by Gilbert, they also learned to expect Gilbert to submit a minority opinion. To his credit, when he chaired such a task force or independent review panel, which he often did, Gilbert invited members to exercise the same prerogative.

Gilbert's greatest challenge over his many years of involvement in Boulder floodplain issues was his own university's inflexibility and disregard for city and county initiatives to limit development in floodplains. Beginning with his 1960s involvement in shaping zoning regulations, he raised the ire of university officials by urging that construction of foreign student housing adjacent to Boulder Creek be abandoned. Despite the consequent 1969 ordinance that included this request, the university did not relent and in fact proceeded to build even more intensively in the floodplain (White 2000–2005).[10] In the face of this intransigence, Gilbert urged the university and city to institute an educational program to warn students of the hazard they faced and to advise them regarding mitigation measures to lessen the risks to their belongings and personal safety. Gilbert's persistence ultimately resulted in a city agreement to appoint an emergency management official responsible for this education process. The resultant booklet of instructions, subsidized by the university, is now published in six languages, and an ambitious program of instruction in flood preparedness is administered annually to university

students. In anticipation of the next "big flood" that will test the adequacy of these measures, Gilbert funded the development of a questionnaire, now on file with the university, to be administered to flood victims following major flooding. The money for the project came from the Volvo Environment Prize, which Gilbert won in 1995. He had similarly donated the 1964 stipend he received from the city for his consultation concerning zoning ordinance to PLAN Boulder.

Starting in 1996, yet another issue in the ongoing controversy among the city, county, and university regarding floodplain use involved Gilbert and the Wrights. The city of Boulder was considering purchase of a 300-acre property of undeveloped land (the "Flatirons property") in the South Boulder Creek floodplain (the city's largest floodplain) that was formerly a gravel mine. In an unanticipated move, the university purchased the land and announced tentative plans to build a south campus in the floodplain. With the announcement the university also promised to protect some 2,500 houses downstream from the site by constructing a diversion levee. Surprisingly, these announcements came before the university had consulted with city or county officials regarding safe, environmentally sound, and comprehensive floodplain management for the South Boulder Creek watershed. Given the size of the property and its obvious potential to become open space, as well as citizen and professional concerns regarding the adequacy of proposed university structural mitigation measures, Gilbert agreed to again chair the IRP to address South Boulder Creek, as appointed by city council.

The mandate of the Flatirons IRP was to review the Phase "A" Mitigation Planning Report prepared by Taggart Engineering Associates as jointly commissioned by the Urban Drainage and Flood Control District, the city, the county, and the university. For this endeavor, Gilbert worked with other IRP members, including Natural Hazards Center codirector Mary Fran Myers and hydrologists and geologists with the Colorado Water Conservation Board and the U.S. Geological Survey. Assisting the panel was Alan Taylor, Boulder's long-term floodplain manager, who had advocated Gilbert's principles for local floodplain management.[11] As a result of the Phase "A" study, Gilbert's vision of truly integrated structural and nonstructural floodplain management was clear in the IRP report submitted to the city council, county commissioners, and the administration of the University of Colorado. In fact, the IRP reports for South Boulder Creek and Four Mile Creek may comprise as succinct a summary of the principles of integrated floodplain management as is available:

1. The benefits and costs of all floodplain functions should be considered in solutions to flood problems including flood conveyance, natural and beneficial functions such as riparian habitat, open space and aesthetics, and recreation.

2. Flood issues should be addressed from the perspective of the entire contributing watershed, and problem solving should be done on an overall basis

for various portions of one large floodplain, recognizing that different reaches may deserve different action. In particular, consideration must be given to the possible effects of upstream land use on stream flows and possible mitigation measures for downstream areas.

3. A full range of floodplain management tools should be used to address flooding problems, and assessing the effectiveness of these tools should be done on individual buildings and reaches for floods of up to 500-year frequency (White et al. 2001).

The IRP report was critical of the Phase "A" report's failure to provide advice on mitigation measures for flooding of lesser or greater severity than the estimated 100-year event, even though half the nation's flood losses by century's end resulted from floods larger than 100-year events. Moreover, the hydrologic analysis was judged lacking on eight counts, requiring in Gilbert's opinion redoing the analysis and, on the basis of the additional data, revising the flood insurance rate maps for the city and county. Finally, a host of recommended interim actions to increase protection of habitat and people in the event of flooding concluded with an admonition to city, county, and university authorities to coordinate and cooperate fully in using

a wide variety of floodplain management tools to deal with flood hazards including: floodplain regulations, zoning, subdivision regulations, building codes, housing codes, sanitary and well codes, disclosures to property buyers, design and location of utility services, land acquisition and open space, redevelopment, permanent evacuation, disaster preparedness, disaster assistance, land treatment, on site detention, tax adjustments and emergency measures (White et al. 2001).

The report closed by reminding readers of the newly elected George W. Bush administration's proposal to reduce federal support for local natural hazard studies and any resulting mitigation projects. Prompt action was prudent. As Mary Fran Myers observed, "Gilbert certainly has become more vocal and willing to push as he has become older!" (Myers 2002). In this instance, all parties that had agreed to negotiate the use of the Flatirons property (including the university) listened carefully to the IRP. The $250,000 needed to redo the hydrology study and implement the interim six-month work plan appended to the IRP report was approved and funded within two months.

Graciously, Gilbert was quick to acknowledge the sacrifices for the university caused by the consequent delay. Redoing the hydrology analysis alone would require considerable time and could result in substantial modification of university plans. As of 2005, the matter remained unresolved but under conciliatory study.

Regents of the university acknowledged Gilbert's contributions on many fronts, including his persistence on behalf of all Boulderites at risk from severe flooding of Boulder's floodplains, by conferral of an honorary degree at commencement exercises in May, 2006.

Notes

1. The planners in Tulsa (and not a few of its citizens) were aware of several major floods just that year. Rapid City, South Dakota, suffered a severe flash flood, as did Buffalo Creek, West Virginia. The latter was due to dam failure. At the same time, the American town most associated with flooding, Johnstown, Pennsylvania, where over 2,000 people lost their lives after a dam collapse in 1889, also incurred flooding, albeit minor, due to a hurricane. (Five years later, Johnstown was devastated by a 500-year flood.) In 1976 the Teton Dam in Idaho also collapsed. Indeed, within two decades of its construction, the Keystone Dam proved inadequate. In 1986 so much impounded storm water had to be released to protect the dam that major flooding occurred in Tulsa.
2. The director of this undertaking, Dr. Keith Muckleston, had resigned just one month prior to the Minnesota conference. At that meeting, Muckleston decried the foot-dragging of the WRC's membership (ten federal agencies, whose consensus was required for any recommendation). Even when sufficient consensus had produced a draft recommendation in 1973 for unified national floodplain management, the Department of Interior representative on the WRC had lobbied successfully behind the scenes with the same OMB to squelch the draft report.
3. The lobbying of Bob Miller and Carol Williams for floodplain acquisition finally bore fruit three years later. By then, the city had hired engineer Charles Hardt as the city's first hydrologist and Stan Williams as a city planner. Commissioner Norma Eagleton asked these two for an acquisition proposal, and they responded with a plan to purchase another thirty houses in the Mingo Creek floodplain that were standing in the way of a proposed detention basin. The proposal carried, bringing the number of dwellings in Tulsa's floodplains relocated or leveled during the 1970s to sixty-three.
4. Flanagan subsequently was hired by the city's engineering department to develop a pilot master drainage plan for one of Tulsa's thirty-three urban drainage basins. With Gilbert White's help, Flanagan contacted a group of national leaders in drainage planning located in Denver, Colorado, headed by Boulder resident Ken Wright—Wright-McLaughlin Water Engineers—who helped him develop a planning process that resulted in a Corps of Engineers Tulsa Urban Study, completed in 1982. The study detailed the extent of the Tulsa flood problems and recommended solutions within each of Tulsa's drainage basins. Flanagan's study was modeled on the highly regarded *Denver Metro Urban Drainage Manual* developed by Ken Wright with White's help in the late 1960s—a document still referred to across the nation.
5. Another bright spot at the national level during this era was OMB's reassignment, from the WRC to FEMA, of responsibility for the Unified Program of Floodplain Management.
6. Victims' responses to the suggestion that the most damaged homes might not be eligible for federal assistance to rebuild, as formerly had been the case, met with mixed reactions. The prospect raised hope among some, especially those who had rebuilt multiple times, but the majority of homeowners, eager to begin rebuilding as soon as possible, felt tremendous anger, mixed with comparably strong grief. Two of the five commissioners opposed any acquisition program, arguing that the proposed buyout

only rewarded people who should have known they were living in a flood zone. Moreover, these commissioners feared unfairly raising hopes if the bailout fell through. "False hopes are better than none," countered one flood victim whose home was flooded to the ceiling—his sixth flood in fourteen years. After bitter commission debate, an acquisition project was approved.

7. This compared with over 90 percent local funding of the total cost of the previous decade's acquisition of sixty-three homes. Tulsa, fortunately, had unallocated capital sales tax funds available in 1984. The city sold revenue bonds (pledging the sales tax toward their repayment) and used the resulting interest to finance the city's share of the flood buyout. FEMA's disaster coordinator was initially opposed to the buyout and blocked use of NFIP funds until Mayor Young promised to provide 50 percent city matching funds for eligible NFIP rebuilding grants. FEMA and the city thus divided the cost of acquisition 50–50 after deducting flood insurance claims. The buyout program also involved federal temporary housing assistance and Small Business Administration involuntary relocation loans.

8. Properties within the floodplain were subject to a 40 percent surcharge, and the boundaries of the 100-year floodplain were redefined to include properties where the depth of floodwater would be 2 feet or greater, water velocities 2 feet per second or greater, and the area that, when inundated, would cause at least a half-foot rise in the water level. To the city's credit, these were more ambitious, stringent requirements than those called for by the federal government when Boulder joined the NFIP in 1978.

9. Because the condominium complex, initiated and planned by the Whites and several close friends, was located in the 100-year floodplain, Gilbert endured countless jibes. He remained unapologetic, explaining that the projected 100-year flood comes up just below the foundation and that even a 500-year flood would not endanger any of the building's elevated condominiums. The building has no basement, and the first floor provides only storage and parking (Human 2002).

10. The Colorado Supreme Court had previously ruled that the university, a state institution, was not bound by local development regulation.

11. Taylor recalled Gilbert once saying that he would slow down only when he finally convinced his own community to adopt the policies he had so long recommended. Taylor remarked, "I don't know what we'll do when he's not here anymore" (Human 2002).